HEALTHY HOUSING™ RENOVATION PLANNER

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Healthy Housing Renovation Planner

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Cette publication est aussi disponible en français sous le titre : *Rénovation de la maison saine,* LNH 2173

The information contained in this publication represents current research results available to CMHC, and has been reviewed by a wide spectrum of experts in the housing industry. Readers are advised to evaluate the information, materials and techniques cautiously for themselves and to consult appropriate professional resources to determine whether information, materials and techniques are suitable in their case. The drawings and texts are intended as general practice guides only. Project and site-specific factors of climate, cost, aesthetics, and so on must be taken into consideration. Any photographs in this book are for illustration purposes only and may not necessarily represent currently accepted standards.

Canadian Cataloguing in Publication Data

Main entry under title:

Healthy housing renovation planner

Issued also in French under title : Rénovation de la maison saine.
ISBN 0-660-17608-4
Cat. No. NH15-271/1998E

1. Dwellings—Remodeling—Environmental aspects.
2. Dwellings—Environmental engineering.
3. Housing and health.
I. Canada Mortgage and Housing Corporation.

TH3401.H42 1998 643'7 C98-980322-8

Printed in Canada
Produced by CMHC

Canada Mortgage and Housing gratefully acknowledges
Natural Resources Canada and the Canadian Wood Council
for the use of their information which has been included in this publication.

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YOUR HOME, YOUR HEALTH AND THE ENVIRONMENT

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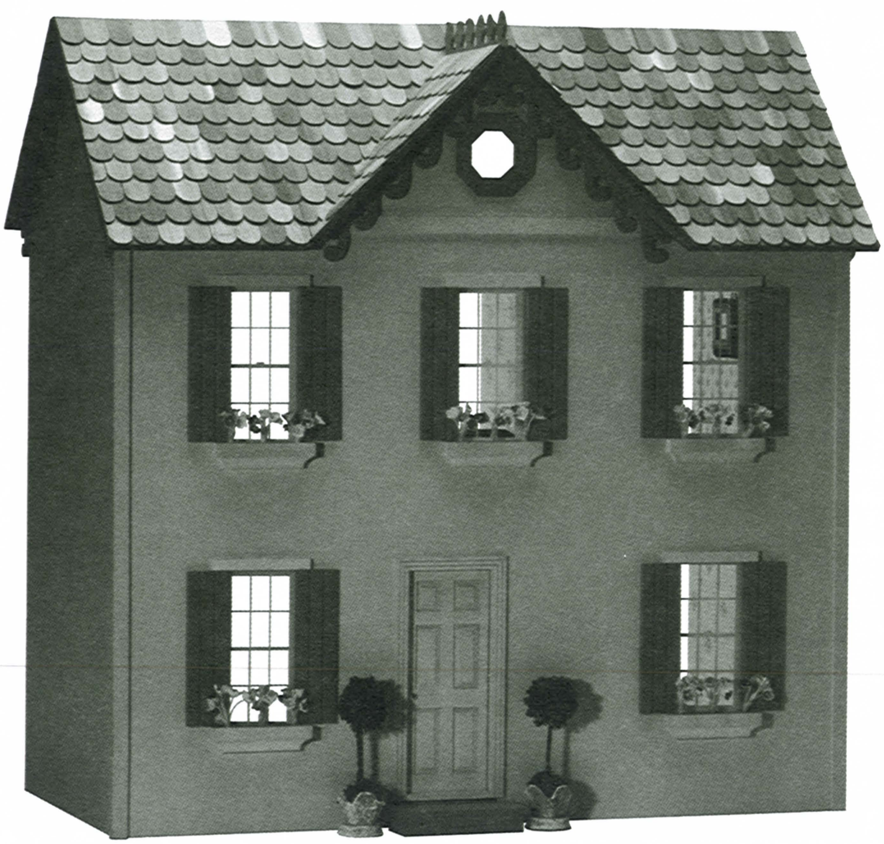


Renovating the Healthy Way

Every year, more than a million Canadians renovate their homes. Changing lifestyles and an aging housing stock have contributed to the growing trend—more money is now spent each year on renovation than on new home construction. With all that renovation activity, it's important that it be done in a way that will do the occupants and the environment the most good—now, and in the future.

Our homes have a major effect on our health, and on the health of the world around us. Everything that goes into our homes has a significant effect on us and on our environment. The decisions we make when we renovate can have effects that will last for decades.

The materials and techniques you use when you renovate can contribute to your family's well-being. Your choices can reduce fuel and energy costs, conserve natural resources, and minimize pollution and waste. Or your decisions could adversely affect your family's health, cause needless use of energy and natural resources and create a source of pollution and waste.

What makes the difference? From a personal point of view, it could be paying special attention to the ways your renovation affects the air quality in your home, or incorporating adaptable living-working space into a modified layout.

From an environmental point of view, it could be as simple as choosing a water-efficient toilet when you renovate your bathroom or putting extra insulation in the walls when you finish your basement.

Whether you're working with a professional renovator or doing the work yourself, you can make the difference by renovating the healthy way. *The Healthy Housing Renovation Planner* will show you how. It provides practical information on renovation products and materials, techniques and technologies and the "Healthy Housing" choices you can make. With a greater understanding of the links between your home, your health and the environment and planning for a healthier future, you will have a a more comfortable and enjoyable living environment for years to come.

Healthy Housing

Through Healthy Housing, Canada Mortgage and Housing Corporation (CMHC) promotes improvements in designs, techniques, technologies, products and materials that will result in the construction and renovation of housing and communities that are:

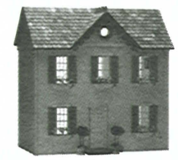
- healthier for occupants
- more energy-efficient
- more resource-efficient
- healthier for the global environment in the long term
- more affordable to create, operate and maintain

Contributing to Occupant Health

Health Canada says indoor air quality is a significant issue. Reducing levels of pollutants in household air to minimize health risks should be a guiding principle in both new and renovated housing.

This can involve choosing building materials with low emissions and techniques that can minimize irritants to the eyes, noses, skin and lungs. This is called "source control," and you'll read more about it in see Chapter Two: Let's Clear the Air! It can also involve supplying better "controlled" ventilation, which can be part of your renovation project (see Chapter Four: Heating, Cooling and Ventilation).

The renovation choices you make contribute to your well-being in other ways. You may



HOW TO USE THE HEALTHY HOUSING RENOVATION PLANNER

The Healthy Housing Renovation Planner is a step-by-step workbook to planning a healthy renovation.

Chapter One explains the links between your home, your health and the environment. It presents the key principles of Healthy Housing—contributing to occupant health, reducing energy consumption, conserving natural resources, minimizing environmental effects and balancing cost and practicality.

Chapter Two discusses the health effects of indoor air quality, with special attention to environmental hypersensitivities. A Home Health Checklist guides you through your home to help you identify sources of air quality problems—and solutions to them.

Chapter Three discusses the importance of up-front planning, walking you through the things you should think about before you begin your project. It describes the "house as a system", how you can renovate according to Healthy Housing principles and how you can get the most for your renovation dollar. Chapter Three will help you determine whether you have the skills and the time to do the job yourself. If you decide to hire a professional, Chapter Three gives you the information you need to choose the renovator who is best for you. The chapter also discusses the critical importance of a written contract, insurance, building codes and by-laws and ways to minimize inconvenience while a project is under way.

The rest of the *Renovation Planner* deals with typical renovations, both large and small. In each chapter, you'll find several steps to help you plan a healthy and affordable project. Each chapter is divided into sections that will help you gather the information you need to make practical choices:

- What Are the Issues?—the key issues involved in the renovation; the reasons you are renovating and the principles to consider
- Taking Stock—inspecting the part of the house you're renovating, noting the key elements, materials, condition and other details
- What Are the Options?—strategies for making changes, and the components and materials available
- Making a Plan—stating what you hope to achieve, making a list of materials and estimating cost

There are charts and checklists throughout the Renovation Planner so you can record your observations and your choices. Project planning worksheets help you assemble all the parts of the puzzle in one place. Lists of publications provide you with additional information on the subjects discussed.

Throughout the Renovation Planner we use the Healthy Housing symbol shown here to point out topics and tips that can make a special difference. This symbol helps you plan the healthy way—for a renovation that will be good for you, good for the environment, and that will make good economic sense.

want to make changes—such as reinforcing walls now so you can add grab bars later or allowing for wheelchair clearance through doors—that will keep your house physically accessible as you grow older. You may wish to renovate for built-in convertibility as your family's needs change—for a home office or a self-contained suite, for example.

Reducing Energy Consumption

Partially due to Canada's climate extremes, we are among the world's heaviest energy users. More than 20 per cent of our energy use goes to building, heating, cooling and operating our homes. That adds up to a big energy bill for you to keep your house supplied with heat, light and power. It also adds up to a huge drain on the country's energy supplies.

Through the R-2000 Program, industry and government have developed technical requirements and a program to support testing and registration of new homes that meet a high standard of energy efficiency and environmental performance. Natural Resources Canada is assisting industry in the ongoing development and operation of the R-2000 Program.

In an older home, you can reduce the amount of energy you use by incorporating energy-efficient materials and techniques in your renovation plan. You can renovate to save energy, increase comfort and improve durability. You can install high levels of insulation, use air and vapour barriers, and seal the cracks where air leaks in and out, while ensuring adequate ventilation. All of this can reduce your energy bill significantly.

Some of the energy consumed by your home is built right into the house. This is called "embodied energy." Researchers estimate that manufacturing, transporting and installing the materials used in building a house can consume as much energy as you would use to operate it for 30 years.

Embodied energy can be reduced by carefully choosing your building materials. Ceramic floor tiles, for example, require less energy to manufacture than carpeting. If you install ceramic tiles in your renovated room instead of carpeting, they'll last longer, and you'll save the energy it would have taken to replace the carpeting several times over.

Conserving Natural Resources

Making your renovation healthier also means wise use of resources. Choosing building materials made from recycled wood, metal or plastic can reduce the amount of natural resources harvested. If you can refurbish or reuse the old sink, bathtub, cabinets, doors or fixtures you remove in the demolition stage, you can spare the natural resources required to make new ones, and stretch your renovation budget further.

Taking care to use "leftover" lumber and other excess materials during the building process can also help reduce resources used—residential construction accounts for approximately 12 per cent of all waste sent to landfill annually.

You can reduce water use significantly by choosing water-saving appliances and fixtures when you renovate. Several types of toilets, dishwashers, washing machines and shower heads on the market use much less water than conventional units. You can also install a cistern to collect water for watering your lawn or garden.

Minimizing the Effect on the Environment

Making renovation choices that will help you reduce energy and natural resource consumption will minimize the effect of your home on the environment. You can also reduce pollutants generated in the operation of your home, and reduce "greenhouse gas" emissions, by improving energy efficiency and reducing fossil fuel consumption. You can install a high-efficiency furnace that gives off fewer combustion gases. You can avoid adding to toxins to our water and land by safely disposing of paints, stains and chemicals, for example.

Balancing Cost and Practicality

Renovating with Healthy Housing in mind makes sense, but only if it's practical and affordable. There are growing numbers of healthy and energy-efficient building products on the market, and in many cases,

WASTE NOT, WANT NOT

Home renovation, like other forms of construction, generates waste. Talk to your renovator about strategies to reduce, reuse or recycle materials. You'll find you can cut down on waste and consumption of resources throughout your renovation project, but it is easier to plan for it at the design stage.

As you clear out the areas that will be renovated, have a garage sale and sell or give away old furniture or appliances instead of just throwing them out. Many materials such as old windows or cabinets may be perfect for use at someone's cottage, for instance. You can have different receptacles for different types of materials, such as wood and packaging, to make it easier to recycle while work is under way.

Almost all the excess materials your renovation produces can be recycled today. However, not all municipalities have facilities for recycling every type of material. If in doubt, ask your municipality what materials its recycling program can handle, or to recommend private recyclers if it does not deal with demolition and construction waste. Here are some suggestions on making better use of building materials.

- Buy kiln-dried lumber and store it in a sheltered place to reduce waste from warpage and shrinkage.
- During demolition, save old lumber that's suitable for reuse in the new construction.
- Use off-cuts for bridging, blocking and other construction details, or cut them up for fireplace kindling. (Do not burn treated lumber.)
- Buy materials in bulk where possible, or ask suppliers to use a minimum of packaging.
- Save and recycle materials such as corrugated cardboard, plastics and drywall through your municipal program or private recyclers in the area.
- Use leftover paint as a primer coat on your next paint job or take it to a paint recycling facility. These are becoming more common in large communities.

A concerted waste-control effort can substantially cut down the amount of energy, resources and money your project consumes. And reducing the amount of waste you send to the dump can also slash your hauling and dumping expenses.

making the health choice doesn't cost more—it may even cost less.

In other cases, there is a trade-off involved and a decision to make. High-efficiency appliances, for example, may cost more than ordinary models, so you have to pay more up front. However, the savings on your utility bills over the next few years may more than make up the difference. If the most energy-efficient appliance is out of your budget range or impractical for you, choose the next-best solution that works for you.

When balancing performance and cost, remember that a healthy renovation choice is not only an investment in your home, but also an investment in your health and in the environment.

Chapter Two

LET'S CLEAR THE AIR!

- *air pollution—an indoor problem*
- *filling out the family health profile*
- *hazardous indoor pollutants*
- *making sure your house is healthy*

A CMHC study shows that one in four Canadian households has someone with allergies or a breathing problem. Indoor air quality is a significant source concern for Canadian homeowners, and concerns has grown in recent years. Health problems such as asthma, allergies and recurring respiratory ailments are becoming commonplace.

Health problems can be caused by a number of things, but for people with breathing problems, air pollution is a major concern. Canadians spend more than 90 per cent of their time indoors. Just as outdoor air pollution can pose health problems, the air we breathe in our homes can pose even greater problems.

Air exchange in older houses may cause pollutants to remain in the home longer. Moldy basements are common in older houses, and aging furnaces can give off pollutants. Some harmful materials, such as lead paints, were used in older houses. In newer homes, tight air sealing keeps the heat in and reduces energy consumption—but without a properly installed and maintained ventilation system pollutants are not exhausted from the house.

When you plan a renovation, you have a real opportunity to change some of the things in your house that may harm your health. At the same time, bringing new materials into your home can actually add pollutants. Before you begin, it's a good idea to think about any existing health problems in your household, changes to the house that could ease the problems and renovation choices that might make existing problems worse, or cause new problems.

Who's at Risk?

The people most vulnerable to indoor pollutants are those whose natural defences are weak or compromised, especially if they spend a lot of time in the home. Those with high sensitivity to household pollutants include:

- infants and young children
- elderly people
- pregnant women
- people with respiratory ailments such as asthma
- people with medical disorders or chronic illness
- people with allergies
- smokers
- people with nutritional deficiencies
- people who are heavy consumers of drugs or alcohol

Many of the most common household pollutants can affect anyone, and some, like carbon monoxide, can even kill you if you're exposed to high concentrations. However, in general, we can divide the population into three groups.

- Normal risk: Average people who have no known sensitivities to chemicals or biological irritants in small amounts and spend much of their time out of the house.
- High risk: People with known sensitivities such as allergies, respiratory ailments or reactions to chemicals and those who are at high risk because they spend a lot of time in the home, such as children, homekeepers, elderly people and those who are ill or infirm.
- Hypersensitive: People who have a high sensitivity to a number of gases and materials, even at very low levels of exposure—these people need to take special measures to keep irritants to a minimum (see Environmental Hypersensitivity).

ENVIRONMENTAL HYPERSENSITIVITY

There's evidence that a growing number of people suffer from environmental hypersensitivity disorder. These people have severe reactions to very small amounts of chemicals and particles commonly found in our air, food and water. Hypersensitivity occurs at all ages, but usually appears in people in their late '20s or older. It is more common in women. Researchers believe the hypersensitivity is triggered by heavy exposure to a particular pollutant at a time when other stresses on the body are high. Common symptoms include extreme fatigue, weakness and difficulty concentrating (a "foggy" feeling), but some sufferers become seriously ill or so disabled that they're forced to quit work or school.

If you or someone in your house is environmentally hypersensitive, you likely already know about household pollutants and have removed them from your house or protected the affected person from them.

Even if you're not in a high-risk group, you may be living with some chronic or nagging condition—a cough, for example, or hay fever—that may be caused or aggravated by a household pollutant. Even if no one in your family seems to be suffering from indoor pollution, there may still be some materials in your house that are affecting your health.

The health profile and house questionnaires at the end of this chapter gives you a better idea of health problems your family might have that could be affected by your home's indoor environment. The profile and questionnaire helps to you pinpoint problems your renovation can target.

The Family Health Profile provides space to list all the members of your family and any chronic health problems or symptoms.

The Air Quality Questionnaire uses a "sniff test" to identify gases, molds and other contaminants: you enter the house after being outside and pay close attention to what you smell.

The Home Health Checklist helps you carry out a full inspection of the house, area by area, looking for signs of contamination, which are often quite visible. Check off the problem areas you find and add any that aren't on the list.

Household Pollutants

Household pollutants can trigger reactions for people with asthma and other chronic respiratory conditions, and may cause or affect other health problems as well. One particular contaminant may cause some symptoms, in other cases, the effects are less direct. Indoor pollutants may make you more susceptible to disease, or may aggravate an existing condition.

Household pollution is a health concern because of its cumulative effect. The average household contains gases and particles from several different sources. While researchers may know what effect a certain chemical might have, less is known about the effects of different chemicals in combination with others, or the effects of long-term exposure. A reaction to one chemical may sensitize you so you'll react to other chemicals of a similar type.

There are more than 60,000 commercial chemicals in use today that were unknown 40 years ago, and many of them end up in our houses. Chemicals are found in soaps and cleaners, and in the composite and synthetic materials commonly used in some furnishings and building materials. Where a kitchen cabinet might once have been built out of solid wood, it's now likely made of particleboard; where wallpaper was once a matter of paper and paste, nowadays it may be made of vinyl, with a factory-applied adhesive backing.

You probably have at least one cabinet filled with paints, solvents, cleaners, glues and hobby materials that contain a variety of chemicals. And there may be pollutants in your home that you don't suspect—fumes from a malfunctioning furnace or gas stove, mold spores and pollens, or radon entering the house through cracks in the basement or from well water.

The pollutants that may be hiding in the nooks and crannies of your house include a variety of chemical and biological irritants. You may have more than one type in your house, and they may be interacting to produce health problems.

Health Canada has identified some pollutants that may be possible hazards in Canadian homes. Renovation gives you an opportunity to get rid of some pollutants, but you may have to deal with other pollutants before beginning renovation. Many of the pollutants described below are highlighted later in the Renovation Planner. For instance, Chapter Eight: The Basement deals with mold problems.

Formaldehyde gas

Urea formaldehyde is the active ingredient in urea formaldehyde foam insulation (UFFI), which was banned in Canada in 1980 after homeowners reported health problems. However, urea formaldehyde, and the more stable phenol formaldehyde resin, are still all around us. They are used as glues or binding agents in scores of products and materials found in almost every home. Formaldehyde gas is pungent and colourless. In high concentrations it can cause symptoms such as eye, nose and throat irritation, a persistent cough and respiratory distress, skin irritation (on contact), nausea, headaches and dizziness.

Sources

- composite wood products, including particleboard, fibreboard and plywood
- furniture, cupboards and cabinets made from composite wood products
- upholstery
- carpeting
- insulation
- paints and finishes
- glues, cleaners, waxes and other common household products

OFF-GASSING

Chemicals from most building materials get into household air through the release of gases, or "off-gassing." This can go on for the life of the material, but is highest during the first few weeks or months after installation.

The speed at which a building material off-gases is directly affected by the surrounding temperature and humidity. A temperature rise to 26°C from 23°C and a humidity increase to 60 per cent from 50 per cent can make some materials off-gas three times more quickly. Gas emissions may be greatest in rooms where sunlight from a window heats up the carpeting and furniture, and where the humidity is high.

Choose furnishings carefully for these rooms. Avoid materials that are known sources of off-gassing, such as urea formaldehyde-based particleboard. Remember that new materials off-gas much more than older ones. Keep relative humidity levels moderate (30 to 55 per cent), not only for off-gassing, but also to prevent mold growth.

What to do

- Choose building materials that don't contain urea formaldehyde, for example, solid wood instead of particleboard.
- If solid wood is not feasible because of cost, use construction-grade (softwood) plywood, which uses more stable phenol formaldehyde glues, rather than finishing-grade plywood (hardwood) made with urea formaldehyde glues.
- Seal all exposed surfaces and edges on materials that are manufactured with high formaldehyde content. You can use plastic laminates or multiple coats of low toxicity, water-based, acrylic sealers designed to reduce emissions from wood, gypsum board and grout, and to reduce the moisture permeability of surfaces.
- Improve the ventilation in your house.

Combustion gases

Appliances that burn fuel, such as furnaces and fireplaces, commonly leak at least small amounts of the gases created during combustion. However, they can emit large amounts when the appliances are not operating properly, or when another appliance or system (a bathroom fan or range hood, for example) draws air from the house and causes normal chimney flow to be reversed, commonly known as "backdrafting." Gases are drawn back down the chimney or exhaust duct and into the house.

The most harmful combustion gases are

- carbon monoxide, which can cause headaches, dizziness, nausea and, in rare cases, death
- nitrogen oxides, which can damage the lungs and increase susceptibility to colds and respiratory illnesses
- sulphur dioxide, which is thought to cause, and certainly aggravate, respiratory and pulmonary problems
- hydrocarbons such as benzene (see What's a VOC? about volatile organic compounds, on **page ??**).

Combustion gases can cause chronic, low-grade ailments that are hard to define, or a general deterioration of health.

Sources

- gas or oil furnaces, boilers, hot water heaters (carbon monoxide)
- gas fireplaces (nitrogen dioxide, sometimes carbon monoxide)
- woodburning fireplaces (carbon monoxide, soot, complex hydrocarbons)
- gas ranges (carbon monoxide, nitrogen dioxide, combustion particles).

What to do

- Ensure that fuel-burning appliances (furnaces, hot water heaters, fireplaces) have access to an ample supply of air. Small enclosed rooms should have a direct air supply from the exterior.
- Install a balanced ventilation system in the house.
- Replace fuel-burning appliances with induced-draft units, sealed units that have their own air supply, or electric appliances.
- Have a qualified service person check for chimney obstructions or a cracked heat exchanger in the furnace.
- Have your furnace maintained regularly by a competent mechanical contractor.
- Install tight-fitting doors on fireplaces or install an efficient fireplace insert.
- Replace older wood stoves with new, cleaner-burning devices.

- Install a quiet range hood, exhausted to the exterior, that is quite close to the cooking surface. This is especially important for gas stoves.
- Install certified carbon monoxide detectors or smoke alarms in rooms with a fuel-burning appliance that uses a chimney.

WHAT'S A VOC?

Many of the hazardous chemicals in modern houses are members of a large family called volatile organic compounds, or VOCs. These include formaldehyde and related chemicals, benzene, xylenes and toluene, alcohols, mineral spirits and fuels such as propane and butane.

Many VOCs are irritants, and can cause severe symptoms if they are absorbed through the skin or the fumes inhaled.

Among the most harmful is benzene, which can cause bone marrow depression or leukemia and depression of the central nervous system. Toluene can produce headaches, nausea, drowsiness and depression of the central nervous system. Xylenes can cause dizziness, coughing, nausea, fatigue and, in extreme cases, kidney and liver damage.

VOCs are commonly found in building materials and furnishings, house paints, heating fuels, solvents, waxes, polishes and many other household products.

Chemicals other than VOCs

Ozone is a strong irritant. It usually comes in from outdoors but can also be generated in the house by electronic air cleaners that are not properly installed or maintained, and by portable devices used as air purifiers. Ozone can cause coughs, chest discomfort and irritation of the nose, throat and trachea.

Bleach releases chlorine, an irritating gas which is harmful to the lungs, and some cleaning products release ammonia.

Sources

- solvents
- paints
- cleaners
- pesticides
- aerosols
- electronic air cleaners and ozonators.

What to do

- Choose non-odorous, non-toxic products, or don't buy them at all.
- Select low-emission building materials and furnishings.
- Store chemicals in sealed containers.
- Take leftover toxic chemicals to local household hazardous waste collection sites.
- Use bleach only when absolutely necessary. Wear respiratory protection and ventilate the area.
- Install exhaust fans, vented to the outside, in work and hobby areas where chemicals are used.
- If you can detect ozone's pungent, sweetish smell, have your mechanical contractor inspect the electronic unit that may be generating it.
- Clean filters regularly.
- Keep ozone-generating devices out of the house.

Molds

These micro-organisms will grow almost anywhere in your house, along with other fungi if there is sufficient moisture present.

They can trigger allergies and respiratory disease, and the toxins they produce can wear down your immune system, leaving you prone to illness. Molds can grow on most surfaces, but they need warm damp conditions. There are many different types of molds: one study showed 16 different kinds in one finished basement.

Problem areas

- basement or crawl space
- kitchen (near or under sinks)
- bathrooms
- in, and under, carpet and rugs on cold floors
- on window frames or below windows
- in, and on, furniture against outside walls
- inside wall cavities where there is dampness or condensation
- in damp or unventilated storage areas
- closets, especially ones adjacent to exterior walls
- around plumbing leaks
- near roof or wall leaks.

What to do

- Fix basement plumbing and leaks.
- Do not store porous, absorbent materials such as cardboard, newspaper or books in the basement. Keep the floors and walls clear.
- In winter, do not turn on the humidifier unless relative humidity falls below 30 per cent.
- Provide better general ventilation, and spot ventilation in damp areas.
- Insulate fresh air ducts and cold water pipes to prevent condensation.
- Use air-vapour barriers to keep wall cavities dry.
- Remove carpets and rugs from cold floors, such as basements.
- Remove obstacles obstructing air flow in damp areas.
- Eliminate piles of newspapers, clothing and other materials in damp areas that can give molds a place to grow.

Moisture

While moisture isn't a pollutant, both high and low humidity in a house can cause health problems. High moisture levels are a good environment for bacteria, viruses, molds, fungi and dust mites, and increases off-gassing.

Low moisture levels can cause high dust levels, and respiratory infections. Humidity levels between 30 and 55 per cent are considered best for the health of the occupants and the health of the house.

Problem areas

- kitchen
- bathroom
- laundry room
- basements and crawl spaces.

What to do

- Repair leaks and cracks in the basement and eliminate all other sources of moisture.
- Use a hygrometer to monitor humidity levels.
- Provide direct ventilation with an outside exhaust for moisture sources such as stoves, showers and clothes dryers.
- Do not hang clothes to dry in the basement unless the area is well

ventilated, with stale air being exhausted to the outdoors.

- Install a balanced, whole-house ventilation system that controls moisture by bringing in drier outside air, where possible.
- Provide an outside area for drying firewood.

To counter low humidity:

- Reduce ventilation or seal air leaks in older houses.
- Use a humidifier if necessary, but clean it often and monitor the humidity level.

Dust and airborne particles

Common household dust can include microscopic particles from fabrics, soil, plants, insulation, human and animal dander, food, dirt, paint, plastic, soot and cigarette smoke. The mix also includes plant pollen and spores from molds and yeast.

The particles themselves can carry harmful chemicals, as well as dust mites (tiny insects that live on the dust itself). Many of these things are biological allergens that can cause reactions ranging from sneezing and running eyes to palpitations, internal pains and loss of muscle control in some people.

Vacuuming hard-surface floors will remove almost 100 per cent of dust. Vacuuming a carpeted floor typically removes 30 to 60 per cent of the dust. However, the act of vacuuming itself stirs up dust. To minimize this, a central vacuum, especially one vented outdoors, or a vacuum with a high-efficiency filter are the best options.

Problem areas

- carpets
- upholstered furniture
- pets
- fireplaces
- smoking
- heating ducts
- doors, windows and air leaks that allow particles to enter from outdoors
- exposed, worn or damaged surfaces on building materials such as particleboard or vinyl- asbestos flooring.

What to do

- Install a central vacuum system vented to the outside.
- Install a ventilation system with a filter for the incoming air.
- Add an effective air filter to your forced-air heating system.
- Remove carpets or other sources of dust and allergens.
- Reduce moisture levels causing mold and mildew problems.
- Caulk and weatherstrip thoroughly to prevent outdoor irritants from getting in.
- Do without pets or build a facility outside the house for them.

FURNACE FILTER

The furnace filter in your forced-air heating system protects your furnace from hair, lint and other large particles. The new breed of "premium" filters protect both people and furnaces. For more information on high-efficiency furnaces, see Chapter Four.

Cigarette smoke

Cigarette smoke is a common and serious indoor air pollutant. It contains about 2,000 chemicals, including more than 50 components known to cause health problems, and 12 carcinogens.

The list of harmful elements includes carbon monoxide, nitrogen oxides, formaldehyde and carbon dioxide. Exposure to second-hand cigarette smoke can cause eye, nose and throat irritation, headaches, nausea, dizziness and loss of appetite. As well, it increases the risk of lung cancer, aggravates asthma and may trigger a number of other illnesses.

Sources

- smoking in the house.

What to do

- Stop smoking in the house—the only really healthy choice.
- Create a separate smoking room, with its own ventilation system and air seals to keep the smoke from spreading through the house.
- Install an effective ventilation system with a supply of outside air and a particulate filter.

Radon

Radon is an invisible, odourless gas produced by the decay of uranium in the soil. Mixed with other soil gases, it leaks into houses through cracks and openings in the basement, and then breaks down into chemically active elements and attaches itself to dust particles, which we breathe in.

The known health risk associated with radon is an increased risk of developing lung cancer. Any area can have radon, although in some regions of the country high radon concentrations are more likely. The only way to determine the level of radon in your house is to have it tested, preferably during the winter.

Points of entry

- floor drains and sumps
- joints where basement walls and floor come together
- cracks in basement walls and floors
- holes in the foundation wall for pipes or wiring
- exposed earth or rock surfaces in the basement
- well water.

What to do

- Install a sub-slab ventilation system.
- Cover exposed earth with a polyethylene air barrier.
- Seal all cracks and joints in the foundation wall and floor slab with caulking or foam.
- Install a self-priming drain or gas trap in floor drains leading to a sump or to drainage tiles.
- Remove radon from well water using activated charcoal filters or aeration units.

Soil gases

In some areas—especially near landfill sites and refineries or gas stations that have had leaks—other gases can migrate through the soil and get into your house.

Gases from landfills can contain volatile organic compounds (see VOCs, **page 12**), such as methane which can cause explosions in high concentrations, water vapour and carbon monoxide or dioxide (see Combustion gases, **page 11**).

Gasoline and heating fuel generate petroleum vapours including benzene,

toluene and xylenes (see VOCs). Soil gases enter the house through the same openings as radon and can be mixed with radon.

Points of entry

- floor drains and sumps
- joints where basement walls and floor come together
- cracks in basement walls and floors
- holes in the foundation wall for pipes or wiring
- exposed earth surfaces in the basement.

What to do

- Have professional testing done if you suspect a soil gas problem and there is a landfill or petrochemical source nearby.
- Install a sub-slab ventilation system.
- Cover exposed earth with a polyethylene air barrier.
- Seal all cracks and joints in the foundation wall and floor slab with caulking or foam.
- Install a self-priming drain or gas trap in floor drains leading to a sump or to drainage tiles.
- Put an effective seal on floor drains and sumps.

Old house problems

While recently built houses can have special air quality problems, older houses have some unique health hazards. These involve asbestos and lead, which can have serious health effects and were used commonly in the house-building industry until a few decades ago. Governments moved to control both substances in the 1970s, although use of lead paint began decreasing after 1950.

Asbestos

Asbestos is a naturally occurring mineral with long, flexible fibres that can lodge in your lungs. Prolonged, high-level exposure to asbestos fibres in industrial settings can cause scarring that can lead to asbestosis (a severe impairment of lung function), or cancer of the lungs or lung cavity. Asbestos may also cause cancer in the digestive tract if fibres are inadvertently swallowed.

It is unlikely that asbestos will pose these health risks in your home. However, it is important that you take proper precautions when renovating, as fibres can re released into the air when materials containing asbestos are cut or uncovered. (see what to do below).

Before government controls were introduced in the 1970s and 1980s, asbestos was commonly used in a number of housing products, so it's more often found in old materials. Asbestos that's sealed or in a solid form is relatively benign; however, fibres can be released into the air when the surface of any of these materials is disturbed or starts to break down.

Sources

- clapboard
- roofing shingles and felt
- exterior siding
- heating duct insulation
- wallboard
- textured and latex paints
- plaster
- vinyl asbestos floor tiles
- appliance wiring
- pipe and boiler coverings
- household items such as ironing board pads
- compounds and cements such as caulk, putty, roof patching, furnace cement, driveway coating.

What to do

- Take precautions when you tear up, remove, cut, scrape or sand any materials you suspect may contain asbestos.
- If the asbestos material is isolated or protected and doesn't pose a threat:
  - Leave it alone.
  - Seal it with paint or (in small areas) duct tape.
  - Cover it with a new surface such as wallboard.
- If it is deteriorating or must be removed, have an experienced contractor do it using precautions to avoid exposure to fibres or spreading them into the house.

Lead

Exposure to lead can cause insomnia, irritability, loss of memory, headaches, anemia, muscle tremors, stomach cramps and, in high doses, kidney and brain damage. It may also impair male fertility and increase complications during pregnancy. Small children and unborn fetuses are most at risk: even low levels over a long period can affect their brain and nervous system development, leading to behavioural problems and learning disabilities. Recurring flu-like symptoms can be a sign of lead poisoning.

Lead was a main ingredient in many house paints before 1950 and is still used in small amounts. Its use is limited by law now, but exterior paints can contain more lead if they are labelled with a warning.

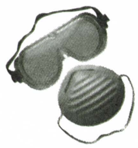
If your house was built before 1950, you almost certainly have some paint with high lead content; if it was built between 1950 and 1980, you likely have some with lower levels. If the house has been repainted, the old paint has been sealed in. If the new paint deteriorates or is improperly stripped, it can create a new hazard. Even dust from lead paint is toxic.

Sources

- old house paint (especially made before 1950)
- plumbing pipes and the service connection into homes (before the 1950s)
- solder used to join water pipes in modern homes
- miscellaneous household items (ceramic pottery, lead crystal, hobby materials).

What to do

- Have old paint lab-tested for high lead content, especially before major renovations.
- Leave paint undisturbed if it is not accessible to children and if it is in good condition.
- Do not create any leaded paint dust when young children or pregnant women are living in the house.
- Replace doors, windows or trim covered with lead paint, or strip and repaint them away from the house.
- If you want the paint removed, have it done by a trained contractor. This work will be dusty. Move the family out of the house during the work and clean up thoroughly before moving back in.
- Have your water tested for lead content. Recommended levels are below 10 parts per billion. If results show high lead levels:
  - Replace old plumbing.
  - Install a point-of-use water purification device in your kitchen for drinking and cooking.



- Secure a better source of lead-free water for drinking and cooking.

CASE HISTORY: HEALTHY HOUSING HELPS

Asthma is a common ailment, but few people suffer from it as badly as Linda, a 49-year-old mother of three from Dartmouth, Nova Scotia. Linda developed the condition at 21, and her health gradually deteriorated until she was barely able to look after her young children. She took a battery of drugs, was hospitalized frequently and spent up to three hours a day on a mist machine to help her breathing. Each year when the pollen began to fly, she says, she was a "basket case."

Looking for a solution, Linda and her husband John decided to buy a new house built as part of a Healthy Housing demonstration project in Dartmouth. Equipped with an electronic air cleaner, a heat recovery ventilator and a central vacuum, and constructed using the healthiest choices in materials, their new house is a "clean" living space. And for Linda, it has been a lifesaver. In her third winter in the house, her drug bills fell from $600 a month to $15. She can control her condition with only a "puffer," and she has said goodbye to the mist machine.

While she still suffers from allergies, Linda says getting off the drugs has made her "feel like a real person" again. But the biggest change is in how she feels from day to day: after years of struggling for air, she now takes breathing for granted. "I'm a firm believer that the difference is the Healthy Housing construction of this house," she says. Her doctor, who sees a lot less of her now, agrees.

Making a Healthy Plan

If you're about to renovate you have a golden opportunity to tackle some of the indoor pollution problems in your home. If you're planning a major job, it may not cost much more to tackle an existing or potential health problem while you're at it—controlling surface water run-off and installing better ventilation for your damp basement, for example. If you have an existing health problem, it could be worth the cost and effort to undertake a renovation project aimed specifically at addressing it.

What you need to do, of course, depends on the house itself. Very new houses still have high levels of material emissions.

Many houses, especially those built in the last 20 years, need a mechanical ventilation system to provide adequate fresh air. If your house is older, you might have a problem with emissions from your old furnace or hot water tank, or molds growing in the basement or wall cavities.

Using the information gained through answering the questionnaires in this chapter, you should be able to identify many of the problems your house has and include solutions for them in your renovation plan.

Generally, there are three main strategies for dealing with a health problem in a house.

Eliminate

The first and best way to deal with a contaminant or source of contaminants is to eliminate it. This could mean replacing your leaky old furnace with a sealed, high-efficiency model. It could mean getting rid of the moisture problem in parts of the house or installing hardwood flooring instead of carpeting. Or it could mean choosing not to use a material in your renovation because it poses a health risk (see A Healthy Renovation, **page** ??).

Separate

If you can't get rid of the offending material, the next best thing is to separate it from the rest of the house. If you're keeping that big wall unit made out of

particleboard, seal all the unfinished surfaces with plastic laminate or multiple coats of acrylic sealer. If you're allergic to outdoor pollutants like pollen, seal the house so outdoor air can't get in and install an effective filter on the air intake for your ventilation system.

You can also try the "oasis" approach: try to isolate one heavily used area—a bedroom or family room, for example—from the rest of the house, with tight air sealing and its own source of ventilation. That way, the affected family members can spend some time every day in an environment that won't bother them.

Ventilate

Any strategy for making your house healthier should include ventilation. Whatever irritants remain in the house will affect you less if they are exhausted to the outside instead of being allowed to build up, and if they are diluted by a constant supply of fresh outside air.

Local ventilation, such as a bathroom fan or an effective fan in your range hood, helps get rid of excess moisture and pollution at the source.

For really effective air exchange, you need a balanced ventilation system, that is, one that brings fresh air in from outside to offset the amount of air you're venting. This also avoids creating negative indoor air pressure and problems like backdrafting and combustion spillage. The ideal is a central or whole-house ventilation system with a heat recovery ventilator (HRV).

A Healthy Renovation

Renovation can go a long way toward making a house healthier. However, if you're not careful, your renovation may cause some health effects you had not foreseen. When you renovate, you create disruption and bring in new materials that can actually make your indoor air quality worse.

A renovation aimed at reducing energy consumption, for example, could actually decrease natural ventilation rates in your house and cause new problems such as too much humidity, stuffiness and lingering odours.

In order to avoid this kind of problem, remember to think of your house as an integrated system, as described in the following chapter. For example, if you install new windows, you'll likely cut your fuel bills and make the house more comfortable by reducing cold drafts. However, this reduced air flow may also cause the humidity levels in the house to rise. This could cause more condensation on your windows, inside the wall cavities and in the attic which, in turn, could cause mold, rotting studs and joists, peeling paint and deteriorating plaster.

Reducing the air flow in your home may also increase concentrations of indoor pollutants. Your fireplace, for example, may have more trouble getting the air it needs to vent properly and begin to smoke. And

HEAT RECOVERY VENTILATORS

A heat recovery ventilator (HRV) is a boxy-looking device, usually installed near the furnace (if you have one), that transfers heat from outgoing exhaust air to warm the incoming fresh air, without mixing them together, as both pass through its heat exchanger coils. The result is warmed fresh air, with reduced heat loss and better humidity control.

since the air flow pattern in the house has changed, certain areas may not get enough fresh air and may become stale.

That doesn't mean you shouldn't get the new windows. You can compensate for these kinds of reactions—by adding some "controlled" mechanical ventilation, for example. But you can plan better, and healthier, if you remember that your house works as a system.

The second important way to control the effects of your renovation is by carefully choosing the materials and components you're bringing into the house. Is that new kitchen cabinet made of particleboard which contains urea formaldehyde? What kind of paint will you be using, and what are its off-gassing qualities? Does that fireplace have sealed doors or an energy-efficient insert to minimize smokiness?

A major renovation is filled with dozens of product choices, big and small. Making those choices with your health in mind can make a major difference in pollution levels, both in the renovated area and in the whole house.

In the chapters dealing with specific projects, the *Renovation Planner* tells you what materials for a particular job could pose health problems. The *Renovation Planner* also shows you ways you can have a healthier end product by the way you install and finish those materials.

A detailed, comprehensive listing of building materials and their chemical composition is available in the CMHC publication, *Building Materials for the Environmentally Hypersensitive,* which can help you make a healthy choice among similar materials.

While You're Working

Think about possible pollution problems that could arise while you or your contractor renovate. For example, most paints become stable after a few days or weeks, but they off-gas significantly in the first few days after they are applied. Adhesives, solvents, finishes, tars and other compounds used for building also release a lot of toxic and irritating chemicals into the air.

To minimize off-gassing, try to supply as much ventilation as you can during the work and for the first few days afterward. One of the most effective ways to exhaust the fumes is to position a fan in the window, blowing out of the room to the outside. Using a small, ducted exhaust fan is preferable to just opening the window because it can guarantee exhaust from a room: put the duct (for example, a dryer duct) out the window and seal the rest of the window opening shut with cardboard and tape. If the weather's too cold, at least leave windows and doors open enough to create an air current through the work area. Using your furnace circulation fan is not a good way to vent fumes because it spreads them through the house.

If you can't avoid using some furnishings or building materials that contain pollutants, try to buy them in advance, and store them in a well-ventilated place for a few weeks to let them off-gas before they're actually installed in the house. This is called "conditioning the product," and the supplier may be willing to do it for you.

There are other hazards produced by renovation work, as well. Power saws, sanders, routers and other power tools can spread dust and chemical pollutants through the house. Minimize that problem at the source by using a local dust collector—for example, a dust bag on a sander—or by using a wet saw to cut stone or tile.

If possible, plan for this type of work to be done outside, or seal off the work area from the rest of the house with a "dust barrier" of polyethylene sheets. As well, make sure those doing the cutting or sanding wear effective dust masks.

It's important to try to keep construction pollution from getting onto other surfaces in the room and the rest of the house. Fine particles of dust cling to walls, carpets and furniture, and so do gases and vapours. Sooner or later they become part of the household dust and end up in your lungs. Cover all furniture in the work area with polyethylene sheeting during the job to decrease this problem.

Use extra care when dealing with areas that are already contaminated. For example, you can expose yourself to serious contamination when cleaning or demolishing moldy areas, or attics that have a buildup of animal feces or other contaminants.

Seek expert advice on the best way to approach the problem, and wear the recommended safety equipment. (For advice on cleaning up molds, see Chapter Eight.) If asbestos or lead is involved, the job is best left to a professional.

At the end of the work day and of the project, clean the work site thoroughly, and use a vacuum with a high-efficiency particulate arresting (HEPA) filter or with an exhaust that can be directed outdoors. Seal leftover containers of paints, solvents and other materials tightly, and store them where they won't become a continuing air quality problem.

Assessing the Results

Since you're renovating the healthy way, you naturally want to see some improvements when you're finished. In some cases—where you've installed a whole-house ventilation system or eliminated a major pollutant, for example—the results may be dramatic. But in other cases, especially where you've renovated one room and left the rest of the house unchanged, improvements may be more difficult to measure.

An improvement in your health may also take time to become visible. And, especially if you have multiple health problems, the improvement might not be obvious. You may simply find that you feel better overall, or have a better tolerance to some foods. There's also the possibility that a secondary problem you hadn't even noticed might emerge once you've cleaned up the more obvious one—an off-gassing problem that was masked by mold odours, for example.

In order to gauge these things, and decide if you need to go on and make more changes, keep an eye on the health of family members and yourself, starting before the renovation begins and continuing for several weeks after the work is complete. Keep a record in a diary or a log book. If you have a significant health problem, make entries every day or two. If you don't, once a week may do. In either case, record both your general health and specific health-related incidents such as sneezing, coughing or feelings of nausea.

If the improvements you made in your renovation have not helped an existing health problem, reassess your approach. Did you miss a major source of irritants? Do a revised house inventory. Has a second contaminant emerged? Or was the

HEPA FILTERS

A high-efficiency particulate arresting (HEPA) filter is a special filter capable of taking very fine particles out of the air. It is often used in industrial vacuums or filter systems to remove irritants.

renovation too small a scale to change the overall air quality enough? Even if you see a modest improvement, the results may show the need to go further and get rid of more indoor pollution, or supply more fresh air.

If you don't have any major existing health problems, you may not notice the effects of the renovation on how you feel. But by using the least harmful materials and avoiding new sources of pollution, you can at least be content that you haven't made your house less healthy for you or the environment.

Family Health Profile

List the members of your household and any chronic or infectious illnesses, allergies, chemical sensitivities or unusual symptoms (i.e., headaches, nagging coughs) they may have.

Air Quality Questionnaire

Before doing the test, close all the windows and doors, and stay outside for at least 15 minutes. This will help clear your senses,

BEFORE UNDERTAKING RENOVATIONS

You may want to seek professional advice before undertaking renovations specifically for suspected indoor air quality problems. Professional residential indoor air quality investigators are being trained across the country. Contact the CMHC office nearest you or the Lung Association for the availability of experts in your area. By seeking professional help you are more likely to identify renovation steps that will solve the problems and avoid introducing new ones.

FAMILY HEALTH PROFILE

Individual	Age	Percentage of time spent in house	Symptoms or illnesses	Source of problem (if known)

make your sense of smell keener and provide a "shock reflex" when you re-enter the house. Then go back into the house and note what you smell in each area. It may help to have more than one member of the family do the test, since people's sense of smell differs. If your answer to some of the questions is "I don't know," don't stop. You may be able to find the answer as you go along.

If you answered "Yes" to any of these questions, your house may have an indoor air quality problem. If you experience symptoms but cannot detect any odour, you may consider asking a friend with a keen sense of smell to give you another opinion. Most people are so used to the smell of their own house that they do not detect odours.

The two sets of questions on page 24 will establish the nature of the contaminants in your house.

If you answered "Yes" to any of these questions, your house may have an indoor air quality problem associated with chemical contaminants.

If you answered "Yes" to any of these questions, your house may have an indoor air quality problem associated with biological contaminants such as molds or bacteria.

Home Health Checklist

Walk through your house, from bottom to top, checking each area for signs of contamination listed below. Check off boxes opposite each item.

AIR QUALITY QUESTIONNAIRE

	Yes	No
Do you notice an odour as you enter the house?		
Do you feel better outdoors than inside your house?		
Do you feel better in other people's homes than your own?		
Are there times when you feel sick inside your house?		
Do you associate specific symptoms with specific odours?		
Are odours worse in certain areas of the house?		
Are odours worse at a particular time of day or year?		
Does anyone in your house smoke?		

NATURE OF CONTAMINANTS		
NEW HOUSES	Yes	No
Does your house have a "new smell" or a chemical odour (similar to that of a new car, new house, new wood, gas, paint, fabric shop, carpet store, etc.)?		
Has a pest control company ever treated your house?		
Has the house been renovated recently?		
Do you have new furniture or furnishings?		

AIR QUALITY QUESTIONNAIRE		
OLD HOUSES	Yes	No
Does your house have an "old smell" (stale, musty or earthy)?		
Does your house have a crawl space or basement?		
Does the crawl space or basement have a dirt floor?		
Do you sense that your basement is unhealthy for you (feelings of dampness, aversion or discomfort, etc.)?		
Does water come into the basement at certain times?		
Is there flooding when it rains or during the spring thaw?		
When you store paper, cardboard boxes or clothing in the basement, does it acquire a smell, or develop mold?		
Do you see mold or mildew anywhere in the house?		

HOME HEALTH CHECKLIST

BASEMENT	Yes	No
Water stains on walls/floor/under windows		
Cracks in walls/floor		
Black (mold) stains on walls/floor/furniture		
Moldy carpet/underpad		
Signs of oil/fuel leaks around furnace		
Petroleum smell from furnace or water heater		
Walls/obstructions cutting off air supply to furnace		
Damaged/crumbling wall surfaces		
Musty piles of clothes/rugs/boxes		
Open floor drains or sumps		
Containers of solvents/paints/glues/chemicals		
Chemical storage area open to room		
Storage of firewood		
Unvented dryer		
Signs of water leaks from plumbing		

HOME HEALTH CHECKLIST

LIVING ROOM/FAMILY ROOM/DEN	Yes	No
Condensation on windows		
Chemical smell from carpet/drapes/furniture		
Moldy smell from carpet/drapes/furniture		
Smoke stains around fireplace/wood stove		
Exposed particleboard surfaces on furniture (i.e., bookshelves)		
Old paint (possible lead content)		
Inadequate lighting (can cause eye strain)		

HOME HEALTH CHECKLIST		
KITCHEN	Yes	No
Condensation on windows		
Water damage or mold on window sills		
Water stains/moldy smell under sink		
Smoke stains around stove/range hood		
Lack of ventilation with outdoor exhaust		
Cleaner/chemical storage area in room		
Exposed particleboard surfaces on cupboards/shelves		
Inadequate lighting		
Old paint (possible lead content)		
Plumbing leaks		

HOME HEALTH CHECKLIST		
BATHROOM	Yes	No
Condensation on windows/walls/toilet		
Water damage or mold on window sills		
Black or red stains (mold, mildew) around tub/sink		
Water stains/moldy smell under vanity		
Black stains on or under carpet		
Damaged/crumbling wall surfaces/peeling paint		
Lack of ventilation with outdoor exhaust		
Inadequate lighting		
Old paint (possible lead content)		

HOME HEALTH CHECKLIST

BEDROOM	Yes	No
Condensation on windows		
Water damage or mold on window sills		
Exposed particleboard surfaces on furniture (i.e., bookshelves)		
Lack of ventilation openings		
Old paint (possible lead content)		
Inadequate lighting		

FOR MORE INFORMATION

These CMHC publications and fact sheets offer more information on the topics in this chapter. The publication order number is shown in brackets.

The Clean Air Guide (#6695)

Indoor Air Quality (#6069)

Moisture and Air: Problems and Remedies (#5968)

About Your House: Fighting Mold (#CE8)

Building Materials for the Environmentally Hypersensitive (#6742)

Radon: A Guide for Canadian Homeowners (# 6989)

Soil Gases and Housing: A Guide for Municipalities (#6728)

About Your House: Combustion Gases in Your Home (#CE2)

About Your House: Asbestos (#CE3)

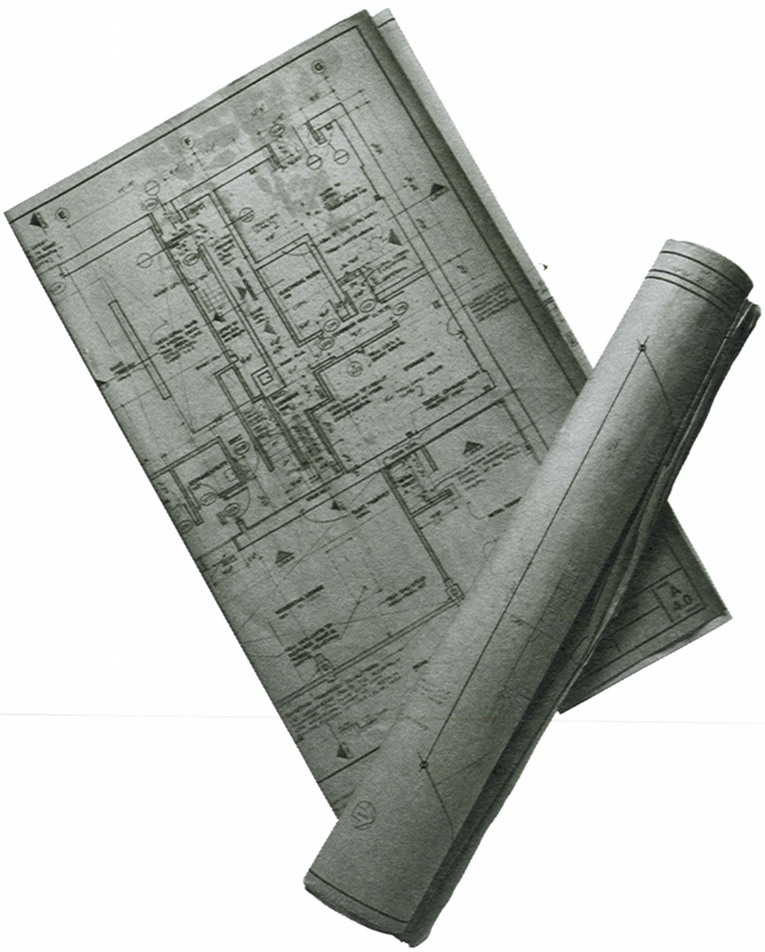
Renovation: Lead in Your Home (#6624)

Avoiding Renovation Hazards (#6560)

Chapter Three

GET IT IN WRITING

- *planning a renovation*
- *the house as a system*
- *why are you renovating?*
- *working with a professional*
- *permits and inspections*



The prospect of renovating your house can be exciting when you think about the final outcome. But there's a lot of work to do before you get to the finished result. A renovation is a complex process, and it shouldn't begin before you've taken the time to do some careful planning.

Planning is critical to the success of your project. There are more variables that most people realize in renovation. CMHC surveys show that most homeowners looking at a substantial renovation may not have an adequate understanding of what is involved until they approach a renovator or designer with their plans. Once they find out, those plans often get a lot less ambitious. In fact, it's common to find out that your plans take much more work than you thought, cost twice as much as you estimated, and take twice as long.

There are many decisions and issues involved in creating a plan that works. You need to look at the present condition and value of your house and at your plans for the future. You must consider the kinds of problems you might have as you renovate. Some houses have design problems, such as a small kitchen or an odd layout that can be corrected by a well-designed renovation. Other houses may have structural problems, such as sagging floor joists or a leaky basement, that must be dealt with before renovation. Of course not all houses have major problems—yours may be sound and ready to renovate.

Then there are the dozens of decisions about materials and working parts. Before you start, you should know what materials and products you want for walls, floors, windows, doors, sinks and tubs, paint and trim. You have to choose each piece of the puzzle and, before you choose, you have to do your homework to know which will serve your purpose best without breaking your budget.

You may also have to make some decisions about the unseen parts of the house, such as the heating, plumbing and electricity that make the whole system work. These may be affected by your renovation, and you need to know that before you start hammering and sawing.

If you're thinking of managing the renovation yourself, you'll require some intensive planning and research to identify all the different jobs that will have to be done and the trades you may need to do them. A bathroom renovation, for example, might start with demolition and then involve some new framing, plumbing, electrical wiring, drywalling, flooring, trimming and painting. There are also inspections to schedule and some clean-up to do.

As well, since the house is actually a system, you should think about how the work you do is likely to affect the rest of the house. These effects can be subtle, such as an altered air flow, or they can be more obvious, such as the need for a supporting beam.

The planning stage is also the time to incorporate Healthy Housing principles into your renovation. These can play a part in your decisions from start to finish, as you choose everything from building materials and appliances to heating and ventilation options, insulation and sealing materials, and healthy working practices.

Having your work done by a professional renovator can take some of the more technical decisions out of your hands. But that doesn't mean you don't have to do some research up front, or that you shouldn't be an informed consumer. The final decisions must still be made by you. The more research you've done, the better you'll understand the implications of your decisions. That will also mean fewer surprises when you get into detailed planning.

THE HOUSE AS A SYSTEM

As you begin looking at your house and its structure, it helps to have a good idea of how a house works. You see a collection of walls, floors, windows and doors where you live, play and work. A house isn't just a collection of building materials. It is also a system made up of subsystems. The changes you make in one part of the house will affect the house as a whole.

The subsystems are the structure, which carries the weight of the building to the foundation; the building envelope, which includes the basement floor slab, the foundation walls, exterior walls, roof, windows and doors; and services such as heating, ventilation, air conditioning, telephones, electricity, water and waste handling.

There are also flows of heat, moisture and air inside the house. They can have a big impact on comfort, the health of inhabitants, efficiency and structural integrity. These flows move according to their own rules.

Heat flows from hot to cold at a speed dictated by surface area, temperature difference and the resistance of the materials it encounters. Moisture, usually in the form of vapour, is mostly carried by air flow caused by pressure differences between areas. Pressure differences between the inside and outside can make air flow through any holes in the envelope—and that causes heat loss.

All these elements work together to make the whole system function in a certain way. And when you make significant changes to the house, they affect the way the system works. For example, building an addition can change the load on the heating, electrical and air conditioning systems. Taking out an interior wall can change air flows, putting new stress on the surrounding ceiling and wall surfaces if it's not done carefully.

You may find it difficult to accurately predict the effects of renovation on the house as a whole. You must be aware that what you do may cause reactions—and be prepared to take measures afterward to restore the balance. A well-informed home inspector or an experienced professional renovator should be able to foresee reactions and plan for them.

Planning a renovation takes some special skills and techniques. You need to know what to expect as the project takes shape and how to choose the resources you'll need to get the job done. Here is a look at the challenges you'll face along the way, and the best ways to meet them.

What Are the Issues?

You have your own reasons for renovating. You may want your house to look better. You may want a modern kitchen or more room for your growing family. Or you may be looking to make your "fixer-upper" more attractive for the resale market.

Before you begin seriously planning a renovation, have a good idea of where you're starting from. That means having a realistic picture of your house and all its strengths and weaknesses. It also means having an idea of how much sense your renovation will make now and in the years to come.

If you've lived in your house for more than a few months, you probably already have a good idea of what needs changing. However, figuring out what to spend your money on may not be that simple. Before you go forward, you need to determine what kind of renovation will be the best fit for your lifestyle, your health, your future plans and your finances.

Think about specific things that require attention or are making life more difficult. For example, you keep your food and dishes in cramped quarters because there's not enough storage space in the kitchen, or the whole family crams into your tiny family room because there's no play space for the kids.

Some problems may be obvious, but there may be others you've never thought of. Does the downstairs really have to be that dark, or would some bigger windows make it more livable? Is the bathroom big enough for your family or do you need another one? Look at the way people move through the house—do you get traffic jams in some areas, while others are rarely used?

Next, consider your family's health. Are chronic health problems affecting you? There may be things in the house that are contributing—for example, if members of your family suffer from allergies, you may have a moisture or mold problem that's aggravating them. (Chapter Two has a questionnaire that can help you pinpoint sources of problems.)

Your house may also have physical problems. Is your aging furnace producing enough heat to keep you warm at a reasonable cost? Does the basement leak? Do you have sagging ceilings or a rotting front porch?

Aside from these concerns, there may be things you want to do to make your house look better or to provide some extra comfort. Improving appearance is one of the leading reasons people renovate, and it can make financial sense because it can make a real difference to resale value.

Taking Stock

Before you get into the nuts and bolts of renovation, take a minute or two to make a few notes about your house and its history. Here are a few questions that can help you get a picture of your house.

- When was the house built?
- Were there previous owners? How many?
- How many square feet is the area of the house?
- How much land does it have around it?
- What kind of construction is it (wood frame, solid brick)?
- How old is your electrical service? Has it been upgraded?
- How old is your plumbing?
- What is the overall condition of the house?
- Has it been renovated before?
- How much did you pay for the house?
- How much is left on the mortgage?

The answers to these questions give you a picture of what you are working with. They may also help you later as you decide what is, and is not, feasible in your renovation project.

However, this represents only a general sketch of your house. As you continue planning, you'll have to take a much more detailed look at your house—particularly the parts you'll be renovating. Be prepared to do some serious investigating—to look under the sink and into the corners and closets as you inspect the structure and working parts of the house. And if you don't already have a good tape measure, it's a good idea to get one since you'll have to measure all the spaces involved in your renovation.

One of the best ways of getting a detailed picture of your house is an inventory. Making an inventory means conducting a walk-through, much like the one in Chapter Two. The difference is that you are looking closely and critically at all the elements of your house, not specifically for potential sources of health problems.

An inventory can help you find out what needs to be renewed and what might present compatibility problems, for example, whether your new appliances will overload your electrical service.

For major projects such as basement, kitchen and bathroom renovations (described in Chapters Eight through Eleven) it's also important to measure the areas involved so you know how much room you have to work with, and how things will fit.

You should measure all the walls, floors, counters, windows, doors and any other pertinent dimensions. Note the dimensions on the assessment worksheets in Chapters Eight through Eleven along with other details.

You can get a better picture by making a schematic drawing. This doesn't have to be a professional rendering. A sketch of the room layout, with all the pieces such as doors, windows and cabinets in place, gives you a good start if you're thinking of moving things. Using your measurements you can turn your sketch into a scale drawing on which you can try out different arrangements. You can use commercial planning kits, which come in book form or as programs for your home computer.

What Are the Options?

Once you have an idea of what you have and what needs to be done, the next step is to look at your options. This involves some research, and it can take some time, especially for a major or complex renovation.

In many cases, there are several different ways of making your renovation a reality. For example, you may have to choose between expanding a room and just using the space more efficiently, or between installing a new furnace and upgrading your old one.

The options section in the rest of the Chapters in the Renovation Planner suggest some basic strategies for dealing with the common renovation situations But every renovation is different, and yours may require something that fits your particular problems or wants.

Reading books and attending seminars given by building supply centres may help you find the right strategy for your house. If you have a serious problem or an unusual situation, you can hire a qualified home inspector who specializes in those areas.

For example, if someone in your home is environmentally hypersensitive, it may be worth hiring a health and environmental expert for a professional assessment of the house and recommendations. If someone in your family uses a wheelchair, an accessibility expert can recommend a plan to make the house more accessible. There are relatively few of these experts in Canada, but related associations, your local CMHC office or the government department responsible for your area of concern may be able to help you find one. Professional renovators may also specialize in areas such as accessibility.

There are other experts, inspectors and consultants available who are knowledgeable about all the different parts of the house, from heating and cooling technicians to home inspectors and structural engineers. In most cases, an inspection or survey by a qualified home inspector costs between $200 and $300. It is money well-spent. These inspectors may be able to help you make a plan that truly solves your problems. On the other hand, they may tell you that because of the existing problems, you'd be better off doing something else.

Your renovation should serve both your short-term and long-term needs. These might include some of the following.

- Raising a growing family: This can make extra living space such as a basement recreation room a priority, or dictate an upgrade to the kitchen or bathroom.
- Reselling in the near future: Kitchens and bathrooms are the biggest lure for home buyers, along with exterior improvements, to give the house more "curb appeal."
- Making a home for your retirement years: This can require some maintenance upgrades, as well as attention to the working systems such as the furnace. In addition, special features such as grab bars in the bathroom and non-slip flooring can help you live more comfortably and safely after retirement.
- Using the house for a home business: An office can often be built in the basement or in some spare space elsewhere in the house.
- Adding a separate living space for relatives or to rent. This requires an apartment with a full set of facilities, including a kitchen and bathroom, heating and ventilation outlets, and most of the other services found in a house.

Some of these may be long-term plans, while others may be short-term ones. However, you can sometimes combine both, having one begin after the other has run its natural course. For example, the children's recreation room you build today may become a den later, or part of a furnished apartment for other members of the family.

While you're renovating the kitchen or bathroom to handle your family's needs, remember that your own needs may change in the coming years. If you're expecting to stay in the house through your retirement years, think about installing features that will make today's renovation practical to use later as you age. You can either install these features now, or just put in the structure so they can be installed later. (Chapters Eight through Eleven contain more information on planning for people with special needs.)

While you're renovating for your own uses today, remember that you could be selling in a few years. Renovate to make your house more attractive, and install good-quality, durable components for which a new owner will pay a good price.

Looking at both your present and future needs can help you plan your renovation to give you the biggest improvement for the money you can afford.

Shopping for Value

In today's market, there are usually several choices for every item that goes into your new room. That can turn into hundreds when you start to combine materials, styles and colours.

RENOVATING FOR SPECIAL NEEDS

For an increasing number of people, renovation planning involves adding features that will make the house more practical and accessible for people with special physical needs. This includes people entering their retirement years, or people who use wheelchairs, for example.

If you're renovating to spend your retirement in the house, you may need to build in a number of features that make it easier to function with limited vision, hearing, strength or mobility. These include things such as:

- contrasting colour schemes for easier identification of wall switches, handles and surfaces
- non-slip floor surfaces
- grab bars in the bathtub-shower area
- a height-adjustable, hand-held shower head
- easy-to-operate door handles and appliance switches
- ample task and overhead lighting
- furniture that's easy to get into and out of—height adjustable, if necessary.

There are a number of other features that can accommodate special physical needs, such as:

- access ramps
- wide hallways and doorways for wheelchair use
- wide doors with low thresholds
- lever handles
- pivot space for wheelchairs in kitchens, bathrooms and bedrooms
- low sinks and work surfaces, with knee space under them
- windows with low sills for seated viewing
- easy-to-reach electrical switches and outlets.

If you don't have special needs today, but anticipate this possibility down the road, you can make the adjustment easier by building in the needed features now. An alternative is to renovate your house with the services 'roughed in' (pre-installed) or structures in place to install those features when they are needed. For example, stacking two closets above one another and reinforcing them makes a space that can serve as an elevator shaft in the future.

This principle of preparing your house to adapt to changing needs is part of a concept called FlexHousing, and it can be the key to your ability to live in your home as you get older or as your needs become more complex. It can also be used to ready the house for other kinds of lifestyle changes—wiring a bedroom for future use as a home office, for example. Either way, it will save you the expense of a second renovation when the time comes.

You've likely already started to think about the kind of flooring or appliances you want in your new room or rooms. It's never too soon to begin your research in earnest. Spend some time at building centres, flooring or window and door dealers, kitchen or bathroom showrooms, and home shows. Read home improvement and decorating magazines. Make a clipping file of things that look suitable. Call CMHC for publications that can help you with your decisions.

It's important to shop critically. Compare different wall materials, floor coverings, cabinets, countertops, mouldings, hardware, mirrors, lighting fixtures, plumbing fixtures, appliances, windows, doors, paints and finishes. Find out about different materials qualities and prices. This will give you options when you decide exactly what you can and cannot afford.

A common mistake many people make is to buy components solely on price when they should be looking for value. Different prices may suggest varying quality and durability, so choose wisely.

For example, countertops are available with three different qualities of plastic laminate surface, each thicker and more resistant to wear than the one below. However, all three will give you good quality in the right setting. In a seldom-used basement bathroom, the thinnest may be adequate, while in a busy kitchen where it will get a lot of use, you'll need the medium or high quality. Buying the cheapest laminate for the kitchen would be no bargain, and buying the most expensive for the bathroom wouldn't be the best use of your money.

A good way to control costs is to put the expensive materials in spots where a little will go a long way. You may be able to use a high-end floor tile in a bathroom or a short hallway, for example, because the area is small. You won't have to buy much of it, and it may be one of the most heavily used locations in the house.

Buying healthy

Next, take a close look at the health, energy and environmental impact of all the components and materials you're considering. Ask a few questions, such as:

- Do they emit polluting chemicals? (see Chapter Two)
- Are they made from threatened resources?
- Do they use a lot of energy in a complicated manufacturing process, when you could buy others that are in a relatively natural state?
- Are they locally produced to cut down on the energy required to transport them?
- Do they have recycled content?
- Can they be recycled or easily disposed of once their useful life has passed?
- Are they easy to keep clean and maintain?
- If you're buying appliances, what are their EnerGuide ratings?
- Are the shower heads and toilets the type that use the least water?

If the answers to these questions aren't apparent, ask the suppliers. Then, make the healthiest choices you can.

Don't forget long-term costs. An appliance or a material with a longer life span may cost more up front, but because you won't have to replace it as often; it will save money, energy and resources in the long run. Also, look at the maintenance factor: a low price or good looks doesn't seem quite as attractive if you have to spend extra hours cleaning or repainting something, year after year. And don't forget the financial and environmental cost of the cleaners and finishes.

ENERGUIDE RATINGS

EnerGuide ratings are found on a sticker posted on new household appliances. These show both the appliance's yearly energy consumption and where it ranks on a scale of similar models. A handy guide to getting the most energy-efficient appliance that meets your needs is available from Natural Resources Canada (see the publications list at the end of this chapter).

Another important question is the effect of your renovation on the market value of the house. After all, your house is likely the biggest investment you'll ever make, and when you do a major renovation, you're adding to that investment. Sooner or later, you're going to want to sell it and get your money back.

Some renovations are better than others for raising the value of your house. Kitchen and bathroom projects are the best bets, returning, on average, about 70 per cent of your money , and possibly more if they really make the house more appealing to buyers. Most other renovations rank considerably below that, and some, such as an in-ground pool, can actually decrease the house's value—many people are put off by the maintenance costs and the potential hazard to children.

The style of your renovation also figures into payback. In real estate, the rule is that neutral colours and tasteful styles sell best. Your renovation doesn't have to be dull, but extreme styles like "Olde English" or "hi-tech" may turn off as many buyers as they attract. For bathrooms and kitchens, clean and modern-looking is best. Remember to include energy and resource efficiency in your projects—it just makes good sense.

Even more important is how your house fits into the local real estate market. Reading the real estate ads will give you an idea of what similar homes are selling for, but if you're about to spend a lot of money, have a real estate agent or an appraiser come in and tell you what the house would be worth in the current market, before and after the renovation.

Next, look at where your house fits into your own neighbourhood. There's a longstanding rule in real estate that it's bad business to upgrade a house past the level of the others on the street. If your house and all the others in your neighbourhood are worth around \$100,000 and you put \$30,000 into a renovation, you probably won't get your money back: few people want to buy a \$130,000 house in a \$100,000 neighbourhood. On the other hand, if your house was originally worth only \$70,000, that \$30,000 may bring it up to the neighbourhood average, and you may get most of your money back.

Finally, you should compare the financial result of renovating with the results of moving. You might do just as well to buy a house that meets your needs and save all the hassle of renovating. And, an extensive renovation can raise your taxes, adding a long-term cost. Don't forget, however, that moving also costs something—real estate commissions, land transfer taxes and moving fees can add up.

Sometimes, the bottom line is where you'll be happiest. If you like your house and the neighbourhood and you don't want to move, it can be worth renovating even if the numbers don't quite add up. Renovating a home can be an investment, but the real objective should be to make life more enjoyable and healthy.

Making a Plan

Once you've seen all the available options, you can get down to choosing the ones you'll use. However, it's vital first to get a focused idea of what you hope to accomplish with the renovation project. That way, you can make the choices that make the most sense to satisfy your renovation goals.

Your goals depend on the needs of your family, the needs of the house, market values and your plans for the future. You know your wishes, but before you commit yourself to a plan, it's a good idea to consult with the whole family. Some members might have concerns or needs you hadn't thought of.

Along with your basic plan, you should make a 'wish list' of all the things you want to have in your renovation. For example, if you're planning a kitchen renovation, you may decide you want a built-in breakfast counter, an island or a new bank of cabinets along an empty stretch of wall. You may also know you want a new stove with a ceramic cooktop, a solid-surface countertop and a double sink from a particular manufacturer.

Your budget may not allow you to buy everything you want right now, so it's best to decide at this point which are your 'core' needs and which are 'nice-to- have' things that you can do without or add later. Items that are important to your health should be a high priority, and so should any features that are going to save you money by reducing heat, water and electricity consumption.

Choosing an Option

In some cases, the choice of how to approach the renovation is clear; in others you may have to compare a number of different options. Which strategy will serve your purpose best? If you're in doubt, having an expert come and look at your house may be wise.

Once you've picked a strategy, you can also pick the materials, appliances and any other components that will go into the project. A sizeable project has dozens of pieces, and each one should be chosen with care. Everything must be functional, and all the pieces must be coordinated so they work together. For example, you may want a bathroom sink big enough so you can wash your hair, but at the same time you should leave a usable amount of space on the vanity top. As well, you'll have to think about colour and texture, and create a decorating scheme using all the elements in the project.

Remember to think about value, health concerns, and energy and resource efficiency as well as price when you make your choices: you want the renovation to be long-lived and healthy in addition to being affordable.

There are other strategic considerations when picking components. If you're going to be in the house for a long time, you can often buy components that are modular or easily adaptable so they can be updated in the future. For example, standard-sized kitchen cabinets can usually be refaced, while fancy or odd-sized ones may be difficult to update without replacing them.

Then there's size. If you're buying a pre-assembled kitchen counter, or a big, moulded bathtub, make sure it's going to fit through your doors before you order it. Otherwise your whole job may shudder to a halt as everyone stands around figuring out how to get the centrepiece of the project into the house. Measure your door and hallway widths. Are there tight corners or narrow stairs to deal with? Take these into account when you're planning your renovation.

Estimating the costs

A major part of the planning process is estimating what it's going to cost. A professional renovator will give you a bid for the entire cost of the project. However, you should have an idea of the costs involved in advance; this is essential if you're going to manage the project yourself.

Asking friends or acquaintances about similar jobs they've had done will give you a rough idea of what things cost. But for a better idea, you can cost the job in much the same way a professional renovator does. Where appropriate, the chapters in this book include a place to compile all the materials that will go into the project. This will give you a basic shopping list of what you'll need, which will help you calculate a price for the project.

If you record the prices of the different materials as you do your research, figuring out the cost should be relatively easy; if not, you'll have to price each item by checking with building centres and other suppliers.

However, that's only half the picture. To come up with a full price for your renovation project, you need to figure in a number of other expenses. These include:

- hired labour, calculated by the hourly rate and the number of hours
- new tools
- equipment rentals, with fuel if needed
- delivery fees
- financing costs (interest)
- plans-drawings
- taxes
- waste haulage and dumping fees
- temporary services
- permit and inspection fees
- legal fees
- construction supplies
- contingencies and waste.

The most difficult cost to pinpoint may be labour. But if you're going to bring in tradespeople or subcontractors, you can approach one or two and get a rough bid on the job, or at least an estimate of how many days they think it will take, and their hourly rate.

Try not to overlook any part of the job, even the small details. There are often costs involved in demolishing the old construction before you begin. If you cannot reuse or recycle existing materials, there may be costs to truck away this waste. And 'insignificant' things such as nails, paint and hardware for doors and cabinets can add up to a significant amount over the course of a project.

Then there are cost overruns. There may be some things that were overlooked and need to be considered. And there will likely be some surprises once you open up a wall or two and get a better look at the old framing and services.

The project planning worksheet at the end of the following chapters can be used to list all the costs of the renovation. However, remember to be liberal in your estimating. For any job, it's wise to add a good allowance for waste and contingencies, If you've done your homework, this shouldn't be more than 10 to 15 per cent of the total project cost.

Finding out the total cost of the project can bring you to a key point in your planning: comparing your costs with your budget. If you've found that your dream renovation is going to cost double what you'd hoped, it's time to sit down and rethink the project to make it more cost effective.

The first way to trim costs is to move down to less expensive components—for example, go with a middle-of-the-line stove instead of the fancy European model you wanted. Or you can leave some parts of the plan until next year, when you have the money. You may also be able to make the job more affordable by simplifying it. The more corners and contours and special features your plan has, the more expensive it's likely to be.

If you have to make hard choices, try to retain the special features that give you the biggest impact for a limited number of dollars. These are the features that will give your renovation a 'personality.' Plus, try to keep the Healthy Housing principles in mind—try not to compromise on the aspects that are important to you.

FINANCING YOUR DREAM

If you can't pay for your renovation with the cash or liquid assets you have to spare, you'll have to finance the job. Before you proceed with your plans, you need to know how much you will be able to borrow. Most banks or other lenders will be happy to help you calculate the amount of loan you qualify for. There are a number of ways to finance a renovation project.

- Credit cards: For small jobs where you can repay the money within a few weeks or months, putting the expenses on a credit card can be the simplest way to operate. However, the interest rate can be high, even with a special low-rate card.
- Line of credit: For amounts of $5,000 or more, a line of credit is a flexible way to borrow renovation funds. You borrow the money only when you need it, and you can get it fast, using special cheques or even a cash machine.
- Personal loan: Terms up to five years are commonly available, and you can choose a fixed or variable interest rate. However, the rate is likely to be higher than for a line of credit, and since you get the money all at once, you're paying interest on all of it.
- Mortgage add-on: Many people finance renovations by adding to their existing mortgage. You can do this only if you have a substantial amount of equity in the house. The interest rate for the new mortgage will be a blend of your old rate and the one you get for the add- on.

For a big job, lenders may provide some interim financing to get things started. The rest of the money will usually be advanced in stages, based on completion of different parts of the project. In order to protect their interests, lenders may send an inspector to make sure the work has been done as described before the funds are released. If you use your house as collateral to get credit, or if you alter your mortgage, you will also have to pay appraisal and legal fees.

If you're using a professional renovator, the law requires that a specified amount of the money—usually 15 per cent or more—be held back at the end of the job in order to satisfy any liens that might be filed by subcontractors or suppliers who haven't been paid by the renovation contractor. This money will be deducted from the final advance and can be held in trust by a lawyer. Legislation varies from province to province but, generally, liens can be filed up to 31 days after the project is completed (check with your municipal building department).

Who'll Do the Work?

One of the basic decisions in a renovation project is who is going to carry out the actual work in your renovation. This has a significant impact on how much you will pay for the job, how long it will take and what kind of job you'll get. There is a range of choices.

- Hire a professional renovator or architectural design firm to design and build the project for you (manage the project, prepare the plans and hire the trades).
- Hire a renovator, and do some of the work yourself.
- Be your own general contractor and hire subcontractors to do the work.
- Do part of the job yourself, hiring subcontractors for some parts.
- Do the whole job yourself.

The option you choose depends on how willing or able you are to get directly involved in your project. For large projects, or those requiring special technical skills, many people opt to hire a professional renovation contractor (see Hiring a renovator, later in this chapter).

Being your own general contractor

Being your own general contractor can save you up to 20 per cent of the cost of a job, according to some estimates. However, this is among the hardest jobs in the project. You have to be the co-ordinator for the whole process, and if it's a sizable one, that can be a daunting job. You have to get everyone and everything to the site when needed, shuffle schedules, deal with emergencies, strikes and changes of plan, and supervise the job while it's going on. Remember also that renovation contractors may have subcontractors they use on a regular basis, and this may get preferential timing and prices. Here's a list of the things you'll have to think about:

- tradespeople
- materials not supplied by tradespeople
- special tools
- permits and inspections
- insurance
- scheduling
- confirming deliveries and tradespeople's attendance
- payment for suppliers and tradespeople
- checking the quality of the work
- clean-up.

You're running the project, so you'll have to draw up a master plan showing what and who is needed, and when. For this, you'll have to research the project thoroughly and understand exactly what is needed for each job. If you hire subcontractors who supply everything for one part of the job, that will make things simpler. But in some cases, you'll have to supply the materials or a special tool, and failing to do this can cause a delay.

Hiring the tradespeople is a critical part of general contracting. Use the same methods as if you were hiring a professional renovator (see Hiring a renovator, this chapter), and if the tradespeople are doing a substantial amount of work, you'll need at least a simple contract that stipulates the work to be done, the materials used, the price, and the start and completion dates. Require them to clean up after work is done each day, and brief them on any special health and conservation features of the project, such as controlling pollution and recycling construction waste.

Being the general contractor and doing all this can be time-consuming, but it can save you money. When you have hired the people you need, pay them in stages, and hold back part of the payment until you're satisfied the job has been done right.

You'll also need to draw up a flow chart showing when every job is supposed to be done, and every inspection due, so the project runs smoothly. For this, many contractors use a Gantt chart (see illustration, **page 43**), a project calendar that uses a bar to represent each job, showing when it's supposed to start and finish. This is critical where one job has to be done before the next one can start; if the first isn't done on time, the next one will be delayed, and so will the whole project. That will result in rescheduling and lots of potential problems.

In order to keep all this straight, it's important that you get a daybook or notebook and write everything down as the renovation progresses. Note every conversation with suppliers and subcontractors, every specification, every date and price. That way, you'll be able to recall quickly what was promised and when, and to come up with key information when it's needed. This can prevent a lot of lost time, and put you in a better position if tradespeople don't live up to their agreements. As well, note all key dates when you have to deal with important details, so nothing gets forgotten. Plus, putting changes to the project in writing—as soon as possible—goes a long way toward getting the job done right the first time.

If you're going to be your own contractor, it may be advisable to hire a professional renovator or architect as a consultant or overseer; for example, you might hire a renovator to help you plan the job and stay around as a consultant. This will add to your costs, but it will give you some expert back-up so you don't get too far off track.

However, if you do have some handyman skills and some organizational skills, you may be able to reduce your costs by doing part of the job yourself. What and how much you do will depend on your time and abilities. But since it's your project, you can put the package together any way you like, as long as you can find contractors and tradespeople who agree to participate. Some contractors will want assurances that you will do your work according to their schedule, similar to any other subcontractor.

A simple way to save some money may be to be one of your own subcontractors, doing one or two jobs under the general contractor's supervision. You may be able to tackle the demolition work yourself, and if you feel competent to do the framing work, or if you've laid flooring before, you can save the cost of a couple of tradespeople. However, there is a downside to this, which includes:

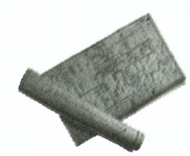
- the cost of buying or renting tools
- the lack of a warranty on the work
- possible problems with the quality of the work
- the possibility that, if any problems show up later, they may be linked to your work
- the time commitment
- the requirement that some work must be done by a qualified person, such as an electrician or plumber.

Doing it yourself

Many homeowners who have handyman skills elect to do the job themselves, especially for smaller-scale projects. Four out of five renovations in Canada are done by the homeowners, with or without help for parts of the job. (Typically, help is used for the more technical parts, such as plumbing and electrical wiring.) This may save you money, and it can be personally rewarding. As well, doing it yourself can

GANTT CHART

Task	Week of	March 5	12	19	26	Apr 2	9	16	23	30	May 7	14	21	28
Selections														
Excavation														
Foundation walls														
Backfill and subfloor														
Wall framing														
Roof framed														
Windows/doors														
Shingling, siding														
Mechanical rough-in														
Insulate, drywall, tape														
Prime, stipple, trim														
Check out,wall tile, paint														
Flooring, cabinets														
Finish mechanical														
Hardwood floor														
Clean and inspect														
Ready to occupy														



GANTT CHART

Task / Week of													

cut down on scheduling and negotiations with tradespeople, and allows you to work at your own pace.

However, if you're considering doing the job yourself, ask yourself first whether you really have the necessary skills. A major project can require a dozen different specialized operations. While some jobs, like painting, are possible to get right on the first attempt, others, such as drywall taping, are tricky. You could find yourself having to call in a professional to save you part way through and paying a premium for short notice. As well, in some places the law requires that certain jobs, such as electrical work and plumbing, be done by certified tradespeople.

A second question is, will the job you end up with be good enough? Doing the work yourself is a good investment only if you produce a truly professional-looking result. A floor with the tiles off line, or badly installed kitchen cabinets, can actually decrease the resale value of the house. It would have been better value to pay a professional.

Financially, doing it yourself can save money. But it's not such a bargain if you're losing a considerable amount of money by taking time off a well-paid job. As well, you may pay more for materials than a professional renovator, and you may have to buy or rent tools you don't have.

And there's your personal time to consider. For a major job, do a good estimate of how long the job will take—then double it to account for delays and mistakes. Are you willing to lose that much 'quality time'?

The most important question, however, may be whether you'll enjoy doing the job. If you're a handyman who makes carpentry your hobby, a renovation can be a satisfying challenge. But if you think only that you'll save money, it can turn into an ordeal, especially if you're underskilled. A one- or two-week job is a feasible project for most handy homeowners; a two-month renovation, however, is best reserved for people who enjoy working with their hands.

Hiring a renovator

For substantial renovation projects, most people opt to have a contractor take charge of the job. If you want top quality in design and detail, you can hire an architect who provides professional design services and often oversees hiring the renovator and executing the work. This, of course, will raise the cost of the project but may save you money in the long run. The most common choice, however, is to hire a renovation contractor.

What kind of renovator you use depends on the job. If you're doing a kitchen or bathroom renovation, you should hire a kitchen or bathroom contractor; if you're doing an overall renovation of the house, you want a general contractor. Choosing people who specialize in the area you're working with pays off, because they have the specific expertise you need, and are familiar with all the materials and the problems that may appear. If you hire people who spend their time doing other things—a 'handyman' who comes at a low price—be cautious and make sure they have a thorough knowledge of the procedures and materials involved, and the right tools. Get references of past work and performance from previous clients.

Choosing a contractor or renovator can be the most crucial decision you make in the whole project, so it's not something you should rush into. It is wise to get at least three bids from renovators to perform the work.

First you need a list of names. The best source is often referrals from friends; they can give you an appraisal of the dependability of the renovators they worked with, the quality of the work and their overall experience. You can also get names from local home builder and renovator associations, or from places such as building supply stores that work with renovators. Or you can talk to homeowners when you see renovation projects under way in your own neighbourhood.

Once you've found a few candidates, meet with them and show them your preliminary plans. They may be able to give you a 'ballpark' estimate right then, but the first meeting is more for getting to know the renovators and their work. Do not sign anything or pay anything at this stage.

You want to find out as much about renovators as you can, so ask a lot of questions, such as:

- How long have they been in business?
- What work are they licensed to perform?
- What kind of work do they specialize in?
- Have they done a similar job before?
- Will they be doing the work with their own crew, or will they subcontract most of the job?
- Do they have the necessary equipment, or will they have to rent it?
- How will they handle a specific problem related to your job—for example, installing kitchen cabinets on your sloping floor?
- How will they deal with the health and energy efficiency aspects of the job?
- Do they have a vacuum with a HEPA (High-Efficiency Particulate Arresting) filter for effective clean-up of fine dust?
- What work schedule do they intend to follow? Does it fit in with yours?
- What kind of warranty do they offer, and what does it cover?
- How many people, and how many trades do they intend to use?
- Have they ever had a problem with a job, and how did they handle it?
- Are there any lawsuits pending against their company?

If renovators seem less than informed about the technical details of the job, or don't want to talk about health and energy efficiency considerations, you may have the wrong person. If they intend to do the whole job alone, you may question whether they have all the required skills. On the other hand, if they are equipped to do a lot of the work, it cuts down on the number of tradespeople needed, reducing costs and delays.

Even if the renovator is capable, it's important that you're also satisfied on a personal level. Things can get very tense in the course of a long project if you can't communicate effectively with the person you've hired. You want someone who will explain what's going on as the project takes shape, discuss any problems in a reasonable way and work with you to make the renovation as good as it can be.

You also want someone who's willing and able to help you refine your plan and save money in the job. If renovators are knowledgeable about the type of work you're doing, they should be able to suggest ways to get what you want without going over your budget.

The best proof of quality, however, is satisfied customers, so the renovators should be able to produce references from three people for whom they have done similar jobs. Don't just accept these at face value. Take the time to phone the people, and visit them if they're willing to let you view the finished job. Their willingness itself is often a sign that they were reasonably satisfied. Ask about their experience with the renovator and the tradespeople, and about the quality of the work. Were there any problems? Did the renovator involve the owners in the project? Did the crew clean up after work each day? Was the work done on a timely basis? Was the work continuous once it started, or were there long stretches when nothing was done? Was there supervision of the workers?

When you've chosen three renovators you might want to work with, ask them to submit bids on the job. In order to do this, you'll need good-quality drawings and a list of specifications. If you haven't used an architect or designer to produce formal drawings, you can hire one of the renovators to do the design work for a fee; this can become part of the overall contract if you hire this person for the job. By paying for this work, you avoid feeling obliged to use the same person further, and you can circulate these drawings to other renovators in the bidding process.

Even with a small project, include a full list of the specifications, consisting of all the materials you'll need, and be as specific as you possibly can: what type of flooring, what kind and brand of doors and windows, what kind of finishes you want. The materials list in the later chapters will help you. Note any special jobs you need done—for example, adding insulation to an exterior wall, installing extra ventilation or putting in a new subfloor. And include your expected time schedule.

For a big job, it can take two to three weeks for the renovators to prepare their bids, which they should submit in person so you can discuss them. Then compare the bids line by line to make sure they are quoting on the same job and using the same materials. Make sure they have included everything you asked for. If you have any doubt as to what's included, phone and find out. The quote should include everything that the renovator will have to do to complete the job; assume that anything not listed is not included in the price. As well, make sure the renovator is committed to your start and completion dates.

In most cases, the renovator will quote you what's referred to as a fixed price for the job. It will include all the materials, labour, equipment and fees involved, plus contingencies, overhead and profit. If it is difficult to estimate just how much the job will cost—in an old house that might need extra work once the demolition begins, for example, you can use the cost-plus method for contracts. Under this method, the renovators are paid the actual costs of the materials and equipment they use, plus labour and profit margin. This leaves the costs open ended, so it's best to specify a limit lest things get out of hand. However, renovation projects often uncover problems that weren't anticipated, so make sure you have built in a contingency budget.

Another option is a design/build contract, in which you retain the renovator to design and carry out the whole project. You can use a fixed price or cost-plus arrangement for this, again with a set limit on the costs.

When choosing a renovator, don't automatically take the lowest bid. It may be unrealistically low, and the renovator may make up the difference by cutting corners or adding unexpected costs later. Look for a fair price. Factor in any differences in what the renovators are offering, and the skills they're bringing to the job. Then add the intangibles—their reputation, their willingness to make suggestions and involve you in the job, the likelihood that they'll stand behind their work. Choose the one you think will give you the best value for your money.

The Contractor Worksheet provided here will help you to compare the renovators or contractors you're considering for your project.

GET IT IN WRITING!

Don't be tempted by a renovator or contractor who offers you a discount if you pay cash, and wants to do the job with no written contract. This type of 'underground economy' transaction can involve many risks and pitfalls that offset any promised savings. For example, contractors who insist on cash may be unlicensed and uninsured; that means your cash advances are unprotected. They could neglect to get the required permits or inspections. And product warranties may not be valid unless the items are installed by a recognized contractor.

As well, an underground renovator could do poor work, which could create health and safety problems. If one of the crew members is improperly trained, or is injured or causes damage to your property or someone else's, your homeowner's insurance policy might not cover you, and you could be held liable.

If something goes wrong or the work proves unsatisfactory, or if the contractor walks off the job without finishing it, a cash deal may leave you with no legal recourse. In fact, it makes it difficult for you to prove the contractor was ever there. And after you have paid the renovator, you may find that materials or labour employed at your site may not have been paid for, and you may be held accountable for the bills. For your own protection, and for your peace of mind, it's best to deal on the open market in a legal and responsible way.

Drawing up a contract

Many people start a renovation project without a written contract, but that's a perilous course to take. Relying on verbal promises without a written description of exactly what work will be done and when, can leave you with no recourse if the job goes awry, or drags on into the next millennium.

Using your drawings and the renovator's bid, you both should be able to draft a contract, or you can use a standard one like the one reproduced in this chapter. It should include:

- the names, addresses and phone numbers of all the parties involved
- tax registration numbers
- a copy of the renovator's business licence, plus membership in a home builders' association
- the drawings and specifications for larger projects, plus a form for orders authorizing changes to the original plan
- a detailed description of the work to be done for smaller projects, with drawings if necessary, including all work that is subcontracted
- the total price of the job, including taxes
- a payment schedule
- the hourly rate charged for labour (for extras)
- firm starting and completion dates, with provisions for reasonable delays and penalties
- copies of documents proving both you and the renovator are insured (see About insurance, following)
- copies of agreements with subcontractors to be used
- the renovator's warranty
- a dispute resolution mechanism
- a termination agreement, specifying what it will cost you to void the contract at different stages.

CONTRACTOR WORKSHEET

Contractor	#1	#2	#3
Address, phone no.			
Proposed work			
Materials			
Extra charges			
Total cost			
References/comments	1		
	2		
	3		
Licence/home builders' association membership			
Insurance			
Guarantee			
Experience in particular field			
Health/environmental awareness			
Reputation, legal history			
Personal factors: compatibility, communication			

You and the renovator will both sign two copies of the contract, one for each of you. You should also direct that the manufacturer's warranties for the components you buy be provided to you when they are received. You may want to have your lawyer review the contract if you are planning a major renovation.

Any changes in the original plan or the contract must be made using a 'change order,' also signed by both you and the renovator. Having the labour rate included in the contract allows you to make sure you are not being overcharged if extra work has to be done.

The payment schedule will usually call for five to 15 per cent of the money to be paid when you sign the contract, and another 20 to 25 per cent when the work begins. The rest will be paid at specified times. For your security, it's better to schedule those payments when a certain amount of the work is done, rather than on specified dates.

Working with your renovator

Once the job is under way, you'll be seeing a lot of your renovator and the crew, and the job will go much better if you co-operate with them. Talk regularly with the renovator so you know what's going on and what might be needed from you—an empty driveway so the delivery van can bring in the new bathtub, for example. But don't call every five minutes; make a list of your questions and save them for a time which you can both arrange to be available for in advance.

If a problem arises during the job, the best course is to bring it up immediately with the renovator—not the tradespeople—and discuss it calmly and reasonably. If the problem escalates and the renovator just isn't responding to the issue, send a registered letter to the renovator with a copy to your lawyer. If that doesn't work, you can try sending a letter to the local home builders' association, your provincial consumer protection department or the department that issues the renovator's licence.

On the other hand, you must be reasonable with the renovator. No job is perfect, so don't overreact if something is wrong. Contractors are busy people, so allow sufficient time for a response. As well, things like bad weather and back-ordered components can delay the job through no fault of the renovator, so leave a little leeway in your schedule for these things.

As a last resort and in cases where things are going so badly that the project seems unworkable, you have the option of cancelling the contract; that's why it's wise to include a termination clause. You'll likely have to pay to get out of the deal, so it's best to agree on the cancellation penalty before you start.

There is also the possibility you might change your mind about what you want done after the project gets under way. Maybe things don't look the way you imagined them, or you see a problem that wasn't apparent on the plans. Whatever the reason, it will likely cost you money to make changes during the job, and a lot of money if you want major changes. All this can be avoided by discussing every aspect of the job with your renovator in the planning stage. However, if it does happen, sit down with the renovator as soon as possible and look for some alternative solutions.

When the job is finished, the renovator will want you to sign a certificate of completion. Don't sign this until you've done a thorough inspection of the job and you're completely satisfied that everything has been done, and done properly. If the renovator has to return later and finish a few details, wait until then to sign the certificate.

Most reputable renovators offer a warranty on their work and should be willing to come back if something goes wrong.

About insurance

If you're hiring someone to do your project, it's important to make sure the renovator has workers' compensation coverage and third-party liability insurance covering all the people on the job and any damage they may cause ($2 million is standard). Don't just take the renovator's word—ask to see a certificate, and check to make sure it's current. Don't accept or assume any liability for the renovator or tradespeople.

As for your liability, your homeowner's insurance policy may cover you during a project done by a renovator. However, if you're acting as your own general contractor and employing tradespeople, your policy won't automatically supply coverage. You'll have to approach your insurance company to add temporary coverage, which will likely involve a small extra premium. Again, make sure any tradespeople you hire have their own insurance.

You should also contact your insurance company if you're going to be moving out of the house during the renovation. Your policy may not cover you for perils such as theft (including building materials), vandalism or glass breakage if you're not considered to be in residence. Since the house will be full of tradespeople every day, and empty at night, you'll be vulnerable to this kind of thing. Your insurer may cover you for a short absence, or sell you some extra coverage, at a price. But in any case, don't leave valuables in the house if you're not going to be there.

If you move out in winter, most insurers require that someone check your house every day to see that the heat is working if you're absent for four days or more. Otherwise, they can refuse to cover water damage from frozen pipes.

Finally, the renovation may increase the value of your house, which means you may have to raise your coverage. Call your insurers and tell them what you're doing and what difference it will make to the house—for example, how many square feet you're adding. They will calculate a new overall value, which may increase your premium. Phone at the start of the job, not at the end, to make sure your new living space will be covered while it's being built.

Building codes and by-laws

If you're doing a job of any size, you'll likely require a building permit or permits, and one or more inspections to make sure the job meets minimum health and safety standards. Permits are often overlooked by less reputable contractors and by homeowners doing a renovation themselves, but they're well worth the relatively small cost and effort involved. In fact, getting the municipal inspectors involved can give you some peace of mind about the project; you'll know that an expert and impartial observer has cast an eye on the job. As well, passing inspection should put you on firm ground in case of future insurance claims.

Permits are intended to make sure your project meets acceptable levels of health and safety, which are usually based on the standards set out in the National Building Code of Canada. Your municipality can set its own standards based on local conditions, so the requirements vary from province to province and from city to city. Generally, however, you'll need a permit if your job involves:

- structural changes to walls, roofs or foundations
- any addition, including a deck, that requires a foundation
- significant changes to the electrical or plumbing systems

- significant demolition of the house structure
- excavation or landscaping that requires new grading.

Not every job requires a building permit. You're unlikely to need one if you're just refinishing the walls and floors, installing new appliances that don't necessitate any rewiring or replacing a window. But if you're making substantial changes to the structure or services of the house, it's always best to ask.

The best time to find out what permits you need is now, when you're in the planning stage. Take your plans to the local building department and find out whether they comply with building regulations, or how to make them comply. Aside from building regulations, there are other municipal standards and zoning by-laws that may come into play. For example, the planned addition might violate the required minimum setback from the lot line, and your additional apartment could require a zoning variance. The building department may even be able to give you advice on the best way to plan the renovation.

It's often possible to get a permit issued within days, or even the same day you apply, if you have well-developed plans. However, once you've narrowed down your time schedule, it can save time to visit the building department, arrange for all the necessary permits and schedule the inspections on the days they'll be needed. If your schedule isn't that precise, you can phone and arrange the inspections when you're ready for them. But try to time this carefully; otherwise, you can end up with tradespeople waiting around for the inspector to show up or the inspector arriving before the job's ready.

Permit fees are generally based on the estimated cost of the project. They're not expensive; permits for a $10,000 job, for example, might not cost much more than $100. And if the inspectors catch some faulty work you didn't notice, that could be a good investment. However, if you're caught renovating without the proper permits, it could cost a lot more in penalties and delays. Many architects and renovators will arrange for required permits as a service to you as part of the project.

Living with a renovation

Many homeowners remember their renovation projects as a very stressful experience—sleeping in the kitchen in a house filled with building materials and demolition dust, dealing with a different problem every day. Because of the very nature of renovation, it's hard to avoid having your life disrupted in one way or another. The whole thing can be a little less traumatic if you know what you're in for and prepare yourself for it.

Surveys show that one of the most stressful parts of renovation for many homeowners is the loss of privacy. Most people consider their home a refuge, and if tradespeople are walking in and out at all hours, it's hard to maintain a personal life. What can you do? One strategy is to try and isolate the renovation from the rest of the house, if possible. Use drop cloths or polyethylene sheets to make a barrier (see Chapter Two) or leave the walls between the renovation and the adjacent rooms intact until the job is nearly done. There will still be some noise and commotion, but you'll have a separate area to live in.

Another good tip is to remove anything you value from the work area, so it won't get damaged. If people are going to be working on one side of the wall, remember to take everything off the other side.

Since your house will be filled with people you don't know, it's also useful to establish some house rules—where they can go and where they can't, and which facilities they're free to use. They'll need access to a washroom, water and electricity, but you may prefer that they use your guest bathroom, for example, instead of the one upstairs. Parking can also be a problem, if there are a lot of tradespeople and deliveries. Establish where people can and can't park, and when.

Another possible problem is the hours the workers keep. They may show up at dawn, or work late into the evening if time is getting tight. This can be disruptive if you have a baby in the house, a young family to feed and send off to school or a job where you work odd hours. Talk to your renovator before the renovation starts; you may be able to adjust the work schedule to fit your lifestyle.

With all the dust from demolition and the potential for emissions from the new materials coming in, the indoor air quality in your house may suffer. Try to minimize the effects by following the advice in Chapter Two. If you have asthma, allergies, chemical sensitivities or some other health problem, it may be wise to move out until the work is done and the dust and chemical levels have begun to subside.

Your neighbours also have to live with your renovation, so it's best to inform them beforehand of what's going on and what annoyances they might have to put up with. You may have to get their permission to bring equipment or components across their property, or even use their driveway. Be as considerate as you can, and assure them that you're covered if there's any damage.

Finally, take comfort in the fact that some day—although it may seem as though that day will never come—the renovation will be over, the workers will go away and you'll be left in peace to enjoy the fruits of their labour, and your own.

FOR MORE INFORMATION

These CMHC publications offer more information on the topics in this chapter. Order numbers are shown in brackets.

Inspection Checklist for Maintenance and Repair (#5731E)

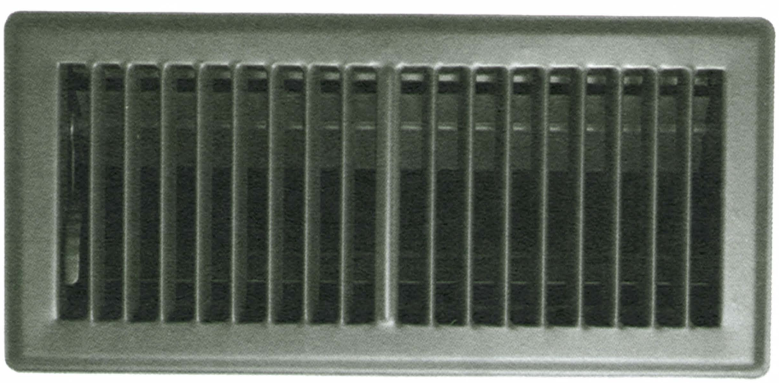
Renovator's Technical Guide (#6993E)

Renovators' Series: Construction and the Environment (#6719E)

Chapter Four

HEATING, COOLING AND VENTILATION

- *a "best way" to a healthy house*
- *what you should know about heating systems*
- *cooling system issues*
- *finding and fixing ventilation problems*

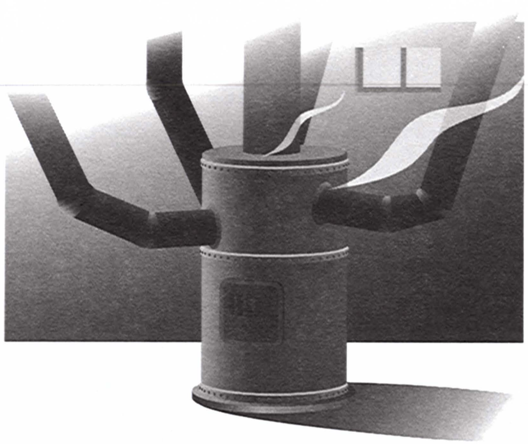


One of the best ways to make your house healthier and less expensive to operate is to upgrade the heating, cooling and ventilation systems.

Whether you're planning to renovate your house for comfort, for energy efficiency (to lower heating costs) or for resale, improving your heating system can be an effective part of the project. It can make the house warmer and more comfortable. It can save money on your fuel bills, especially when combined with extra insulation and air sealing (see Chapter Five). It can ease the demand on our fuel supplies and reduce the amount of pollution your system produces. And, it can make the house more attractive to buyers, who may see an old, creaky heating system as a liability.

Cooling is a different issue. People often consider air conditioning a natural complement for a home heating system. However, in many parts of Canada, the need for cooling is limited, so it pays to think carefully before spending the money to install an expensive air conditioning system.

Your heating bills may also be high because the heating system no longer operates as economically as it once did.



Meanwhile, upgrading the ventilation in your house can make a big difference in how healthy it is to live in. Making the air in the house warmer or cooler doesn't accomplish the whole job if the air isn't changed frequently to keep it fresh and to reduce the amount of pollutants it carries.

Heating, cooling and ventilation systems often use the same distribution system to deliver air to all parts of the house. However, they use different technology, and not every house has all three.

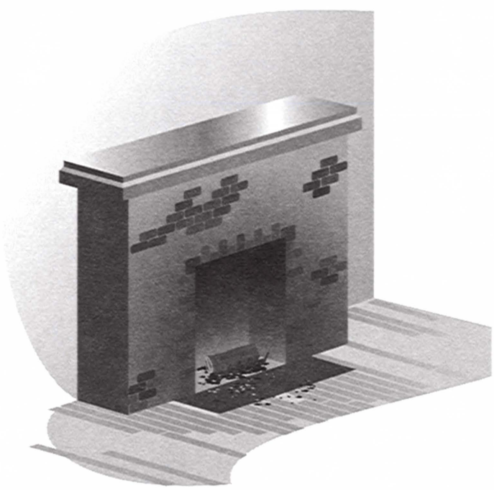
Heating

What Are the Issues?

There are a number of reasons why you might consider upgrading or replacing your heating system.

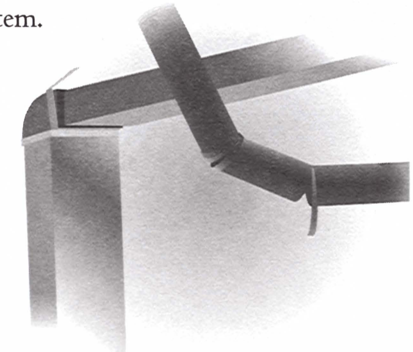
- High heating or maintenance costs: Many heating systems are unreliable or operate inefficiently, because of their age (beyond reasonable service life) and their use of old technology, or because they're not working the way they should. This wastes fuel and raises your heating costs. Your heating bills may also be high because the fuel your system uses is no longer as economical as it once was.
- Comfort: How well your house is heated plays a big part in how comfortable it will be. If it's not delivering enough heat to the whole house, or to particular rooms, you'll feel it throughout the heating season.

- Air quality: Your heating system may be having an effect on your health. As explained in Chapter Two, if they're not operating properly, furnaces and other fuel-burning appliances (especially woodburning fireplaces and stoves) can give off combustion gases such as carbon monoxide and nitrogen oxides, which can have serious effects at high concentrations. (High doses of carbon monoxide can cause death.) As well, your system could be producing fumes from unburned fuel—for example, small amounts of fuel oil sometimes leak from a tank or supply lines. And dirty furnace filters can harbour dust, mold and pollen.

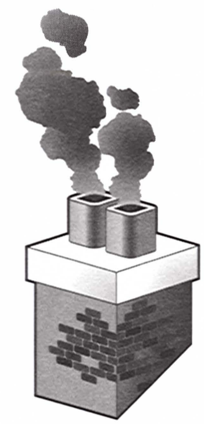


Your distribution system can also create mold problems. If forced-air heating ducts run through unheated spaces in the house, condensation can form; this provides a good breeding ground for mold. Heating ducts can also carry dust, mold spores and other contaminants around the house, contributing to air quality problems.

- Effectiveness: Even if your system generates heat well, it may not deliver it to the house effectively because of a leaky or inefficient distribution system. This creates cold spots and can prompt you to turn up the heat, using more fuel than necessary. It can also cause the furnace to operate improperly, which can make the house less comfortable and increase costs.



- Environmental pollution: Systems that don't burn the fuel cleanly can release high levels of pollutants into the atmosphere. As well, an inefficient heating unit wastes fuel, putting unnecessary demands on our resources.



What You Should Know about Heating Systems

With the exception of baseboard heating, a heating system is composed of the heating unit, the distribution system and the controls.

- The heating unit: This is the furnace or other appliance whose job it is to generate heat.
- The distribution system: This is the network of pipes or ducts, and outlets that delivers the heat throughout the house.
- The controls: These are the devices, such as a thermostat, that make the system turn on when heat is needed and turn off when it's no longer needed.

Different types of systems use different heating units and distribution methods.

Forced-air systems

These systems have a furnace, which can burn oil, gas, propane or wood in a combustion chamber to generate heat; some units use electric heating elements. Some new systems use a fan-coil in combination with a domestic hot water tank. The heat is transferred by a heat exchanger to air that is forced over it by a fan. The warmed air then flows through a plenum and is circulated by a fan, or blower, through a system of ducts that run to registers, or grilles, through the house. Cold air registers in the walls or floors return cooler air to the furnace through return air ducts.

The gases created by the combustion go up a chimney or are vented directly to the outdoors through a side wall vent. A special draft diverter hood on conventional furnaces and hot water tanks helps the gases escape and prevents them from coming back down, or 'backdrafting.' The furnace is wired to a thermostat, which turns it on and off when the indoor temperature falls below or rises above a set level. Some high-efficiency furnaces use a special heat exchanger which extracts more heat from the combustion gases by causing condensation. These are called condensing furnaces, and the combustion gases they produce are cool enough to vent using a plastic side wall vent installed through the basement wall.

Hot water systems

These systems use a boiler or hot water heater to generate heat. The boiler can have a burner which burns oil, gas, propane or wood, or it can use electric elements. The boiler heats water, which is circulated through a series of pipes to convectors or radiators in rooms through the house. The water can be circulated by gravity, or more commonly by a pump. The gases created by the combustion go up the chimney flue or side wall vent. In some cases, a special draft diverter hood on the flue helps the gases escape and prevents backdrafting.

All the radiators can be connected in one continuous loop, but some systems have more than one loop, dividing the house into heating zones whose temperature can be controlled separately. The boiler is wired to a thermostat which turns it on and off when the indoor temperature reaches a level you have set. In some cases, boilers or hot water heaters can be used to provide hot water to a fan coil unit which then delivers heat to the house in the same manner as a forced-air system.

Electric baseboard systems

Baseboard heaters use electricity to generate heat which is transferred directly into the air around them. The heaters are located at the base of the walls in all the rooms in the house. Each room or area usually has its own thermostat so the heaters can be set to make the area comfortable. Many baseboard heaters have built-in thermostats located on the heater itself.

Heat pumps

These pumps have an outdoor unit that extracts heat from the air using refrigerant in a coil. (There are also units that extract heat from the ground or from a body of water such as a well.) The refrigerant evaporates, absorbing the heat, and is then pumped inside to another heat exchange coil, usually in your forced-air furnace's warm air plenum. There it transfers its heat to air which is distributed by the forced-air

BACKDRAFTING

Backdrafting is a problem often caused by "competition" among different fuel-burning appliances for air, or by the operation of exhaust fans and ventilation systems. This competition can cause conditions in which combustion gases are drawn back into the house instead of going up the chimney. Cold weather and certain wind conditions can also cause backdrafting to occur.

blower to the registers throughout the house. Heat pumps are controlled by a thermostat, like other heating systems. In summer, they function as an air conditioner by reversing the process, extracting heat from the indoor air and releasing it outside. They also help dehumidify the house. Ground and water source heat pumps can also be used to heat water.

Woodburning appliances

These include woodburning fireplaces, stoves and furnaces. Wood is burned in a chamber called a fire box, producing heat which is distributed in a number of ways. Traditional fireplaces and woodburning stoves depend on the natural flow of warmed air and radiant heat from the fire, while some modern types use a fan or an improved air flow system for more effective heat circulation. Woodburning furnaces can distribute heat using a conventional forced-air or hot water system. Woodburning appliances vent combustion gases up a chimney, which must be properly installed and certified. They typically require a hearth or floor pad to prevent heat or coals from starting a fire in the house.

Taking Stock

If you have a heating system that's more than a few years old, it's worth taking a good look at it as you assess the house in the early planning stages of your renovation. Start with an inventory of the system.

First, look at your furnace or boiler. On the Heating Assessment Worksheet, jot down the basic information about its type and model; this will help if you need to get advice from a heating contractor. The make and model number should be indicated on a label on the side of the cabinet or inside the front panel. If possible, find out how old the unit is. These appliances have a life span: furnaces normally last 15 to 20 years, while boilers last 20 to 40 years.

If you've been living in the house for a few years, review your heating bills, noting how much fuel you've used and what your heating costs were each year. This can show whether your energy consumption is rising, and provide a basis for comparison if you're considering replacing or upgrading your equipment. Be sure to look only at your fuel consumption, not rental charges or other related expenses. And consider whether one year was considerably colder than another—this can significantly affect energy consumption.

As you inspect the system, also look for problems with your furnace. These are not always easy for a homeowner to identify, and generally require a qualified service person to diagnose and repair. However, you may notice some indications that the furnace isn't working as well as it should. Signs include:

- a change in the sound of the furnace, or strange noises
- the furnace starting and stopping frequently
- a decline in the amount of heat the furnace delivers
- fuel smells
- signs of combustion gases leaking, such as smoke or soot stains around the furnace or chimney flue
- the colour of the flame—with some furnaces, you can look into a flame inspection port: an oil flame should be bright yellow, with no smoke, and a gas flame should be mostly blue.

Next, look at your distribution system. Tour the house, noting how many heat registers and cold air returns there are, or how many radiators or convectors. Also note where they're located; usually they're around the exterior walls, often under windows. Think about how well the rooms are heated. Do

HEATING ASSESSMENT WORKSHEET

Fuel	Type of furnace	Make, model, year of purchase	Type of distribution system	Amount of fuel used last year	Heating cost last year	Weather last year	Amount of fuel used three years ago	Heating cost three years ago	Weather three years ago	Use of fireplace or space heating

some rooms get uncomfortably hot, while others are chronically cold? Are the grilles or radiators blocked by furniture, drapes or carpets? Are they clean? Are the grille dampers open fully? Can air easily enter and leave the room—for example, is there both a supply and return register? If not, is a little space (25 mm, or 1 in.) left under the door to allow air through?

Problems with a distribution system may not be apparent, especially if the basement ceiling is finished and the ducts or pipes are covered. However, these signs may point to problems:

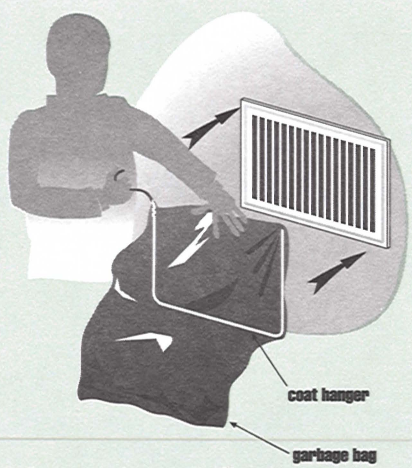
- uneven heat delivery to different parts of the house
- rising fuel consumption for the same degree of comfort
- a system that takes a long time to heat the house.

USING DAMPERS

Dampers are fin-shaped plates built into your heating system's ducts, that can be adjusted to speed or slow the flow of air through the ducts. Duct dampers are usually installed where supply ducts leave the supply air plenum in the basement, and in the heat registers. By adjusting them, you can control the heat delivered to the rooms and help redirect heat from some rooms to others where it is needed.

TESTING YOUR AIR FLOW

You can use a simple test to make sure the air ducts in a forced-air system are open and functioning.

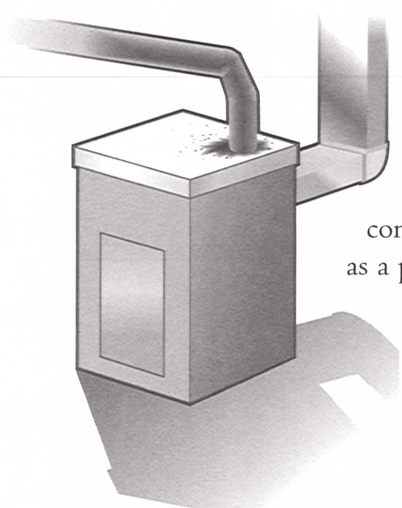


- First, turn on the circulation fan using the thermostat, or turn up the heat to get the furnace going.
- Then, use a tissue to determine whether the grilles are blowing air out (supply grilles) or sucking it in (return air grilles). Another test you can try uses a wire coat hanger and a garbage bag (approximately 66 x 91 cm, or 26 x 36 in.) to measure air flow.
- Bend the wire coat hanger until you have a square shape.
- Then tape the open end of the garbage bag around the wire; the device should look like a big, plastic butterfly net.
- Crush the bag gently to deflate it and hold it tightly to the floor over the supply air grille while the furnace is running. Time it to see how long it takes for the bag to inflate. (It doesn't have to be fully inflated, just up and wrinkly.)
- If the bag inflates in three seconds, the air flow is about 25 litres per second (50 cubic feet per minute). If it inflates in five seconds, the flow is around 15 L/s (30 cu. ft./min.). If it takes 12 to 13 seconds, the flow is around 5 L/s (10 cu. ft./min.).
- A properly functioning supply air duct should deliver 20 to 40 L/s (40 to 80 cu. ft./min.). That means if the bag takes five seconds or more to inflate, your duct may be blocked or the fan may not be delivering enough air.

DISTRIBUTION SYSTEM WORKSHEET

Room	Number of warm air registers/ radiators	Locations	Condition: open or blocked	Number of cold air returns (forced-air systems)	Locations	Room temperature warm/cold

Write the details of your distribution system on the Distribution System Worksheet.



Indoor pollution

If you have any concerns about health problems—or even if you don't—consider your heating system as a possible source of indoor pollution. Check the basement for any combustion odours that could be caused by backdrafting of combustion gases or by fuel leaks. Look for soot stains around any combustion appliance and listen for unusual rumbling sounds when it is operating. Look around the tank and supply line for signs of leakage, if you heat with oil. If you have strong suspicions that fuel is leaking into your house, have your fuel supplier perform a proper inspection.

Having the ducts cleaned can help get rid of accumulated dust and obstructions, and changing the filter frequently on a forced-air system also helps keep down the levels of irritants your furnace can spread through the house. But if you're sensitive to dust and molds, you may need to think about installing a higher-efficiency air filter on your forced-air system. Talk to your contractor about filtration options for your system.

Use an expert eye

As mentioned, assessing a heating system can be difficult for the average homeowner. So, if you think your system may not be performing efficiently, it's best to get an expert opinion before you start making plans. Your fuel company can send a representative to test your system and see if it's working properly and efficiently. Or you can hire an independent heating contractor; these can be found in the Yellow Pages™ under "heating." (See Who'll Do the Work?, this chapter for more information on how to choose a heating contractor.)

What Are the Options?

If you're not getting the kind of efficiency you should from your heating system, there are ways to improve it. These range from low-cost fixes to an invetment in a new system.

If you have your heating system inspected, you may find it isn't delivering heat the way it should because it's in bad repair. The burner may not be operating efficiently, or there may be problems with the distribution system, for example fixing these problems could give you better performance without the cost of replacing the furnace itself.

In other cases, your furnace can be converted into a higher-efficiency appliance by adding a new component such as a more efficient oil-burner head. These upgrades can result in significant fuel savings and might be a more economical solution than a new furnace. The upgrades available vary with each type of heating system.

Finally, if your furnace has deteriorated, or if your heating contractor advises you it just doesn't make economic sense to upgrade it, replacing it with a new, more efficient model may be the best option. This involves a significant investment, but it is possible to figure out whether investing in a new furnace makes sense, financially, using your heating needs, the cost of fuel and the efficiency rating of the new and old furnaces. Explore the possibility of financing the purchase on your monthly fuel bill to reduce the capital outlay.

To find out how big a furnace you need, your heating contractor should calculate the heating load of the house. (Don't depend on the rating of the old furnace—it may not have been properly sized to begin with.) The heating load is an estimate of how much heat your system has to supply to keep your house warm on a typical cold winter day. The calculation is based on a number of factors, including the size of your house, its location, its insulation and airtightness. Your municipality may also have energy efficiency requirements, so you should consult with them when considering this option.

Remember, however, to have the contractor figure in the effects of any renovation project on the house's heating requirements. A major renovation can dramatically change the heating load and your decision on what to do with your heating system. For example, an ambitious insulating or weather sealing job will reduce the heating load, making the expense of a high-efficiency

CARBON MONOXIDE DETECTORS

Combustion gases often contain carbon monoxide which, in high doses, can cause death. To guard against this hazard, homeowners who have fireplaces, gas furnaces or water heaters could install a carbon monoxide detector.

furnace unjustifiable when a properly sized mid-efficiency furnace will do the job. On the other hand, a large addition can increase your heating requirements, and you will need a bigger furnace or a separate heat source for the new living space.

The fuel you save could result in a payback on an upgrade or replacement within a few years. That's not to mention the environmental benefits: you'll be using less of a limited resource, and since modern furnaces tend to burn cleaner, with a new furnace you'll be producing less pollution. As well, if you get a high-efficiency furnace that doesn't need a chimney, it will vent combustion gases more efficiently, and you may be able to close off one major route for heated air to escape your house. (Note: If your water heater uses the same chimney as the furnace, you won't be able to close off the chimney. If the furnace no longer needs a chimney connection, ask your contractor to make sure the flue is not oversized for the hot water tank.)

Installing a new furnace may have extra costs attached, however. You might have to upgrade your chimney or distribution system, or put a hole in the basement wall for a new venting system to exhaust flue gases or supply combustion air. This could add several hundred dollars to the overall cost.

Fixing your system

Before you consider plans to upgrade or replace your heating system, make sure first that it isn't underperforming because it needs adjustment or repair. Like everything

WHAT DO THE NUMBERS MEAN?

When comparing furnaces and other heating appliances, look carefully at the efficiency numbers provided by the manufacturers and make sure the appliances are being compared under the same rating system. Some may cite the steady-state efficiency of their furnace; this represents its performance when it's fully heated up and operating at peak efficiency. However, the unit will not be able to match that performance in ordinary use. Look instead for the seasonal efficiency, or Annual Fuel Utilization Efficiency (AFUE), which represents its performance in a typical heating season. AFUE ratings range from around 60 per cent to over 90 per cent for different heating appliances. The higher the percentage rating, the greater the heating system's efficiency.

The steady-state rating of heat pumps is expressed as a co-efficient of performance (COP) for heating, and an energy efficiency ratio (EER) for cooling. The seasonal performance is expressed as a heating seasonal performance factor (HSPF) for heating, and a seasonal energy efficiency ratio (SEER) for cooling. HSPF ratings range from 5.9 to 8.8, while SEER ratings range from 9 to 16. The higher numbers represent greater efficiency. The COP and EER ratings are commonly used for ground-source or water-source heat pumps, because they extract heat from the ground or a body of water where the temperature is relatively constant. The COP of these units runs from 2.5 to 4.0, while the EER ranges from 10.5 to 20.

When in doubt about the efficiency rating of an appliance, look for the EnerGuide sticker on the manufacturer's literature or on the appliance. Ask your contractor for more information, such as a detailed technical description of the unit.

else, heating systems can deteriorate and go out of tune over time, so they should be inspected once a year by your fuel company service person or a heating contractor. An extra inspection is advisable if you're considering changes.

An inspection can turn up correctable problems with your furnace. In some cases, it may also find problems with your distribution system. There's also the possibility the distribution system was inadequate to begin with.

If you have an expert come to evaluate your heating system, make sure this person does a careful inspection of the distribution system. There may be ways you can significantly increase your heating levels by making some adjustments or repairs, or replacing parts of the system. The charts on fixing various systems outline some of the

FIXING FURNACE PROBLEMS

Problem	Consequences	Solution
Cracked heat exchangers	Can create a serious air pollution problem by allowing combustion gases into the air that is delivered to the house.	Replace the heat exchanger. (If this happens, check the warranty as this is usually covered for an identified period of time.) Sometimes it is more economical to replace the entire furnace.
Backdrafting	Can create serious air pollution problems by releasing combustion gases into the household air.	1. Ensure the venting system (for example, the chimney) is not blocked. 2. Ensure the venting system operates properly. 3. Provide fresh air intakes to supply makeup air for appliances such as fireplaces that exhaust a lot of air from the house. 4. Provide combustion air for the furnace. 5. Ensure no return air grilles are located close to the furnace. (These measures usually need a heating system specialist.)
Loose or worn belts	Can stop fans from operating efficiently, resulting in poor warm air circulation or inefficient combustion.	Adjust or replace.
Burned-out fan motor (forced-air systems)	Stops warm air circulation.	Replace, repair or rebuild.
Circulation pump not working (hot water systems)	Stops delivery of water to radiators.	Repair or replace.
Blocked chimney or vents	Will cause combustion inefficiency and pollution problems by preventing combustion gases from escaping furnace.	Repair.
Dirty oil nozzle	Lowers efficiency of oil burner.	Clean or replace.
Dirty oil filter	Interferes with burner function.	Replace oil filter.
Failed power venting system	Can allow combustion gases to leak into the house.	Repair or replace.
Faulty thermostat/control	Makes furnace operate inefficiently.	Repair or replace.
No heat	During winter months can cause the house and its contents to freeze.	Check that power is on. Adjust or replace thermostat. Repair furnace (faulty high limit is common).

FIXING FORCED-AIR DISTRIBUTION SYSTEMS

Problem/symptom	Solution
Lack of air flow	Ensure supply air grilles are open and not blocked by furniture or drapes. Check ducts and dampers to make sure they are open. Check furnace fan. Clean or replace air filter.
Uneven heating from room to room	Use dampers in ducts or floor registers to "tune" the duct system to restrict air flow to rooms that don't need much heat and to increase air flow to colder rooms.
Loss of air through leaky joints in the ductwork	Seal joints with foil-type duct tape or with a special water-based mastic available at hardware stores.
Heat loss from surface of ducts running through unheated spaces	Wrap exposed ductwork with foil-backed insulation batts or special duct insulation (especially critical where the ducts run through unheated spaces since condensation can occur). Seal seams in insulation with foil-type duct tape.
Loss of air flow because the system has too many right-angled elbows or uses flexible ducting	If possible, improve duct layout in the course of a major renovation project so air flows as directly as possible.
Too few cold air returns, reducing air flow in the system and thus heat delivery	Install extra air returns, especially in bedrooms, in the course of a major renovation. (A specialist should do this since calculations are required to determine the number of returns suitable for your heating systems—you can have too many returns.)

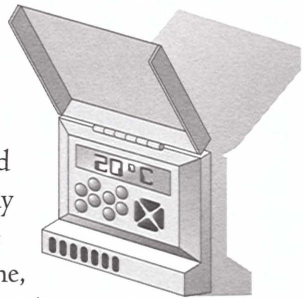
FIXING HOT WATER DISTRIBUTION SYSTEMS

Problem/symptom	Solution
Lack of water flow in radiators	Check for air build-up in radiators by using valves to relieve pressure.
Uneven heat distribution from room to room	"Fine tune" system using the valves in baseboard radiators to adjust the flow of water. If system has more than one loop, adjust the valves that control water flow to different parts of house. Alternatively, install thermostatic radiator valves, which control the flow of hot water through each radiator.
System slow to heat up the house, especially after the thermostat has been set back at night	If system is gravity type, add a circulation pump and replace open expansion tank with a sealed, pressurized tank.

common problems with furnaces, forced-air and hot water systems, and suggested solutions, most of which must be performed by a qualified contractor.

Controlling your losses

One of the most cost-effective ways of saving money and energy on a heating system is by adding a



programmable thermostat. This will turn down the heat automatically when you go to bed or when your family is out of the house for an extended time, and turn it back up when you need it again. You can do this manually, but the programmable thermostat never forgets. It can turn up the heat before you get up in the morning so you will wake to a warm house. As a rule of thumb, for each degree you lower the heat overnight, you will save two per cent on your heating bill. (Note: installing a programmable thermostat may cause a problem in a house that suffers from window condensation since the cooler indoor air can increase the condensation.)

If you are installing a ventilation system that will use the furnace's forced-air system to circulate fresh air, you may have to install a control that allows you to operate the fan independently of the furnace so it can do its job year-round. A switch that allows continuous operation may be provided on your thermostat or on the furnace cabinet. Since this full-time use can increase energy use substantially, look into speed controls.

Upgrading or replacing your system

Oil systems

Oil furnaces or boilers work by spraying fuel oil out of a nozzle into a firebox, or combustion chamber, and igniting it with an electrode or pilot light. There are both forced-air and hot water systems.

OIL SYSTEM UPGRADES

Option	Effect	Seasonal efficiency	Comments
Downsize an old system by installing a smaller oil burner nozzle.	Smaller burner runs more efficiently.	Varies	Some improvement on old-style system (must be verified by a professional heat loss calculation).
Install a flame retention burner.	Burner runs longer and more efficiently.	70%–78%	Significant improvement on old-style system.
Install a flame retention burner with high-static pressure.	Stops air from flowing through the system and up the chimney when furnace is off, resists backdrafting.	74%–82%	Helps reduce pollution levels in house.
Install delayed action solenoid valve.	Prevents the furnace from producing soot and fuel smells at the end of its cycle, increasing efficiency.	Same as existing system	Helps reduce pollution levels in house.
Install electric plenum heater.	Supplies lower-cost heat; oil burner comes on only when needed.	Varies	Saves money only if electricity costs less than oil. Requires adequate electric service.
Convert oil burner to gas burner.	Switches to lower-cost fuel.	63%–68%	Provides opportunity to convert water heater, range, dryer, fireplace to gas. Requires gas lines running to house; gas not available in all areas.
Install oil-fired hot water heater and coil in existing forced-air system.	One burner for two systems—more efficient, and only one vent hole in house. Can be side-wall vented to reduce air leakage.	65%–70%	Supplies heat and hot water at higher efficiency with one appliance. Can reduce floor space requirements.

OIL SYSTEM REPLACEMENT

Option	Advantages	Efficiency	Comments
Mid-efficiency furnace	Use high-static flame-retention burners, low-mass combustion chambers and improved heat exchangers.	83%–89%	Some vented using a pipe through the wall, eliminating need for a chimney.
Condensing oil furnace	Extract more heat by condensing combustion gases.	85%–95%	Some vented using a pipe through the wall, eliminating need for a chimney.

Conventional oil furnaces have a seasonal fuel efficiency of about 60 per cent.

Many people who have older oil furnaces in their houses have already moved to upgrade them since the energy crisis of the 1970s. If you haven't done so, a renovation is a good opportunity to bring your system up to date. You can either upgrade your existing furnace to increase its efficiency, or replace it with a new model that has much better fuel efficiency.

Look at the Oil System Upgrades and Oil System Replacement charts for the main options in upgrading and replacing an oil furnace.

Gas and propane systems

Natural gas furnaces ignite natural gas as it flows out of a burner. Older systems use a pilot light to ignite the fuel, while modern ones have electronic ignition. There are both forced-air and hot water systems. Conventional gas furnaces have a seasonal fuel efficiency of about 60 per cent.

Gas is a popular form of heating in parts of Canada where it is a relatively low-cost fuel. Propane, a liquefied natural gas, is also popular in many parts of the country, especially in rural areas that don't have natural gas lines. In the past few years, new equipment has appeared that allows you to get fuel efficiency similar to natural gas systems. Propane systems require space outside for tanks, and you may have to pay tank rental fees.

Use the Gas System Upgrades and Gas System Replacement charts to investigate the main options.

GAS SYSTEM UPGRADES

Option	Effect	Seasonal efficiency	Comments
Install fan or draft inducer on furnace.	Helps exhaust gases up chimney.	Similar to existing system	May help prevent backdrafting.
Add retrofit condensing furnace to existing ductwork.	Extracts extra heat by condensing combustion gases in stainless steel heat exchanger.	75% or higher	Can produce a worthwhile efficiency gain but compare costs to buying a mid-efficiency furnace. Exhausts using pipe through wall or up existing chimney.

GAS SYSTEM REPLACEMENT

Option	Effect	Seasonal efficiency	Comments
Install mid efficiency gas furnace.	Has no pilot light, uses improved heat exchangers. Controlled exhaust system sends less heat up chimney.	70%–84%	May require installing a chimney liner. Some models can be side-wall vented. Can have condensation problems if efficiency rating reaches top of range.
Install high efficiency condensing furnace.	Extracts extra heat by condensing combustion gases in heat exchanger; some use a "pulse" system to burn fuel in short bursts. Induced draft fan sends combustion gases out a plastic pipe through wall. Can be a "sealed" combustion unit with no chance of backdrafting or fuel leakage into house, therefore, no threat to indoor air quality.	89%–96%	Eliminates chimney and possibility of backdrafting or fuel leakage into house. Condensate must be piped into floor drain.

Electric systems

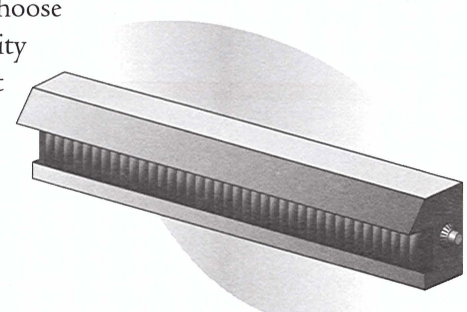
The most common type of electric heating system in many areas uses baseboard heaters, also called resistance heaters. These have an electric element which radiates heat into the room. There are also wall heaters, which work on the same principle, and electric furnaces or boilers, which use an element to heat the air in a plenum or the water in a boiler.

Electric heat systems are considered 100 per cent efficient since they convert all of their energy to heat. However, the facilities that generate the electricity are not as efficient, so this type of heat consumes a significant amount of resources. As well, electricity is a relatively high-cost form of energy in most parts of the country, which can make baseboard heaters and electric forced-air furnaces expensive to operate.

If you have health concerns, electric heat can be a good choice because it doesn't produce combustion gases or require a chimney. But baseboard heaters and plenum heaters can "toast" dust, which is not desirable, so they must be kept clean. As well, if you are considering installing an electric system, remember that it may require you to put a 200-ampere electrical service in your house, which will increase the initial cost.

Since electric heating is already efficient, there's little you can do to increase its efficiency except maintain it—keep the baseboard heaters free of dust, adjust the thermostats and improve the air circulation around the baseboard heaters. Wall-mounted thermostats are better than those mounted directly on the baseboard heaters. So, the best alternative may be replacement. If you have baseboard heaters, this will likely involve installing a whole distribution system as well as a furnace, but the fuel savings can make the expense worthwhile.

Which alternative you choose depends on the availability and the cost of different fuels in your area. The choices include gas, propane, oil or a wood-fired system.



CHANGING FUELS

One of the most common ways to reduce your heating bills is to change to a less costly type of fuel. A number of different fuels are used in different parts of Canada; the main ones are oil, natural gas, propane, electricity and wood. However, your choices may be limited by what's available in your area.

Natural gas is not available everywhere in Canada. As well, some types of furnaces and other heating equipment may not be available in your area. To find out what's available to you, consult a local contractor or your utility company.

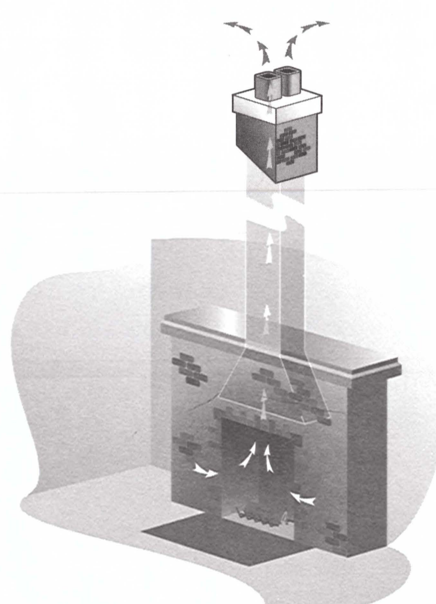
Changing fuels is a major undertaking. It usually requires a new furnace and may require other changes such as the installation of gas lines. In order to decide whether it's worthwhile, you first have to figure out how much you will save with the new fuel. A qualified heating contractor will be able to calculate the yearly cost of heating with different types of fuel so you can compare the savings. However, it's advisable to get more than one quote, since contractors may specialize in one type of fuel system.

Wood

Woodburning appliances come in a variety of shapes and sizes. Woodburning fireplaces are a common sight in Canadian houses; however, for heating purposes, woodburning stoves are better. For those wanting to heat their entire house, there are also woodburning furnaces. Most woodburners use cut firewood as fuel, but there are stoves, furnaces and fireplaces that burn wood pellets which are fed into the firebox using a motorized auger. Be aware that augers require electricity and will not operate during a power outage.

The efficiency of conventional wood-burning fireplaces is very low, from 10 per cent to minus 10 per cent, since they often draw significant amounts of heated air out of the house, both while in use and when idle. Conventional woodburning stoves have seasonal efficiency ratings of 55 to 70 per cent, while woodburning furnaces have ratings of 45 to 55 per cent. High-efficiency fireplaces and woodburning stoves, now commonly available, have made wood a more viable form of heat. However, woodburning furnaces have not been improved as much and are becoming less popular.

If you have a ready and reasonably priced supply of wood, it's possible to use a fireplace or woodburning stove as a heating source. The woodburner should be in the area where your family spends a lot of time, and in an open area where the heat can circulate through the house and up staircases. Whole-house heating may not work well in a house that has many small rooms. Avoid locating the stove or fireplace in the basement, since it is difficult for the heat to rise effectively through the rest of the house. You can help distribute heat using a hot air duct, small wall vents with



fans or your furnace's forced-air system, with the fan set at low speed.

Woodburning appliances, especially fireplaces, also have a health issue attached. Because they exhaust so much air up the chimney, they can depressurize the house and may cause backdrafting (unless your furnace or water heater are sealed-combustion units that don't rely on household air). Open fireplaces and some woodburning stoves may also give off harmful emissions; that pleasant "woody smell" is actually the smell of combustion gases, which include carbon monoxide. If you have woodburning appliances, or if you're installing them, it's important to make sure they have an adequate air supply. Some appliances come with tight-sealing doors and outside combustion air ducts;

WOOD HEAT UPGRADES

Option	Advantages	Seasonal efficiency	Comments
Install fireplace insert in existing fireplace.	May have its own combustion air supply. Circulates room air through a convection chamber around the firebox before returning to room. Advanced combustion models have an insulated firebox with enhanced air flow system and a second, heated air supply to produce a second burn of combustion gases.	50%–70%	Effective way of producing heat and reducing indoor air pressure and backdrafting problems. May require installing stainless steel chimney liner.
Install tight fitting glass doors on fireplace.	Reduces amount of room air drawn into fireplace and lost up chimney.	Some improvement	Check with manufacturer to make sure fireplace can be used with doors closed—not all allow this.

WOOD HEAT REPLACEMENT

Option	Advantages	Seasonal efficiency	Comments
High efficiency wood fireplace	May have its own combustion air supply. Circulates room air through a convection chamber around the firebox before returning to room. Advanced combustion models have an insulated firebox with enhanced air flow system and a second, heated air supply to produce a secondary burn of combustion gases.	50%–70%	Much better than old-style fireplaces. Best models certified as low emission appliances. Can be used for central heating.
High efficiency wood stove	Technology is similar to high-efficiency fireplaces. Two main types: • Radiant stoves radiate heat off surfaces • Convection stoves have air delivery system.	55%–80%	Similar to high efficiency woodburning stoves. Radiant stoves better in open areas, convection better in enclosed rooms.

these can help prevent combustion gas from entering the house.

When selecting any woodburning appliance, make sure it has Underwriters' Laboratories of Canada (ULC) certification. You might also want to check that the appliance is Environmental Protection Agency (EPA) certified. EPA certification ensures that the appliance is clean burning and, as a result, is also highly efficient.

The main options for upgrading and replacing a woodburning system are presented in the Wood Heat Upgrades and Wood Heat Replacement charts.

Other heating options

If you're changing your heating system, consider alternative heating methods. Some of these are more efficient than traditional heating systems and may be available through your local fuel supplier or heating contractor.

Heat pumps

Because of their low operating costs, these are a reasonable alternative in some areas. Heat pumps are very efficient since they need only the electricity to run the compressor and the circulation and evaporator fans. However, since they extract less heat as the outdoor air gets colder, they are not suitable for parts of Canada that have a particularly cold climate. (There are, however, some "bi-valent" units that use gas or propane to heat the outdoor air before it enters the outdoor coil so they can operate in colder weather.) Even where they are practical, it's not economical for air-source heat pumps to handle the entire space heating load, so they're usually teamed up with another heat source.

Stand-alone heat pumps function much like a conventional furnace with a forced-air system. However, they include a supplementary heater (usually electric) to take over when the temperature falls below the "balance" point where the heat pump can't economically supply enough heat.

Another option is a ground-source heat pump, also called an earth energy system. These systems run antifreeze or refrigerant through loops of piping in the ground around your house, and extract heat from the earth. There are also "open" systems that extract heat from water drawn from an underground water source or well. Ground-source heat pumps can be used in colder climates than air-source units and are also very efficient. However, their initial cost is much higher, so they're an option only if you're investing for the long term.

Heat pumps can be used to heat your domestic water as well. All heat pump systems require careful design and installation, and they usually require your house to have a 200-ampere electrical service. Heat pumps can also be used to cool a house during the summer months.

Space heating

Your renovation may create new spaces that need to be heated, but are hard to reach with your heating ducts or hot water pipes. You may also want to warm up some cold areas in the house that are hard to heat. In these cases, the best solution may be a space

SEEING THE BIG PICTURE

Changing your heating system may be only half of your goal. If you want to provide cooling as well, there are other considerations that will influence your decision. For example, the added benefit of cooling could make a heat pump a better value. As well, a forced-air delivery system is necessary to distribute the cooled air for a central air conditioning system, and it must be sized properly to match the output of the air conditioning unit.

SPACE HEATING

Option	Advantages	Seasonal efficiency	Comments
Gas fireplace inserts	Can be used in existing woodburning fireplace.	50%–70%	Should have own source of outside combustion air. Electronic ignition preferred over pilot light. Chimney liner may be required.
Direct-vent gas fireplaces	Hook up to existing gas lines. Use vent pipe through wall to exhaust combustion gases.	60%–70%	Should have own source of outside combustion air. Zero-clearance fireplaces can be installed against existing wall. Electronic ignition preferred over pilot light.
Gas space heaters	Free-standing or wall-mounted models available.	60%–82%	Should have own source of outside combustion air and outside vent to exhaust combustion gases.
Electric baseboard heaters	Inexpensive. Easy to install.	100%	Heavy users of electricity, but small scale use can make sense. Need own electrical circuit.
Electric convection heaters	Can be mounted on or recessed into walls. Floor heaters also available for cold spots such as bay windows.	100%	Heavy users of electricity, but small scale use can make sense. Need own electrical circuit.
High efficiency woodburning fireplaces	Add cozy atmosphere. May be useful as a back-up heat source.	50%–70%	Costly to install. Have own supply of outside combustion air and outside vent to exhaust combustion gases. Best in areas not used continuously; otherwise have to be fired up frequently.
Woodburning stoves	Add cozy atmosphere. High-efficiency models preferred. Useful as a back-up heat source and cooking appliance.	55%–80%	Require special flue pipe and heat pad for safety. High-efficiency models have own supply of outside combustion air and outside vent to exhaust combustion gases. Best in areas used continuously.
Heat pumps	Ductless mini-split systems supply heat for up to three wall mounted air-flow heaters. Can also supply air conditioning.	100%	High initial cost, could be worthwhile for large addition. Low operating costs. Not suitable for all parts of Canada.

heater, which operates independently of your main heating system. These may not be as efficient as the rest of your heating system, but since you'll use only one or two, the extra cost may be acceptable.

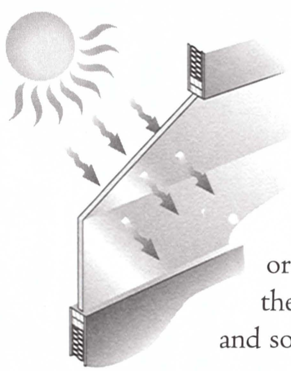
The options for space heaters include gas heaters, electric heaters, woodburning stoves and fireplaces, and heat pumps. (See the Space Heating chart.)

Integrated space heating and domestic hot water heaters

It is possible to meet your space heating and water heating requirements using one integrated unit that supplies all your needs. There are 'combo' systems that employ the water heater as the main source for heating the house. In some systems, the hot water from the tank circulates through a coil in an "air handler," where it heats the air for a forced-air system. Other systems use the water heater to supply heat for a hydronic or radiant floor heating system.

In order to deliver acceptable efficiency, these systems should use a mid- or high-efficiency water heater coupled to a well-matched heat exchange unit and distribution system. That means they should be considered as a replacement for your old heating system, rather than as an upgrade to an existing one. While these systems can be retrofitted to existing equipment, they will not operate efficiently if all the components are not properly matched.

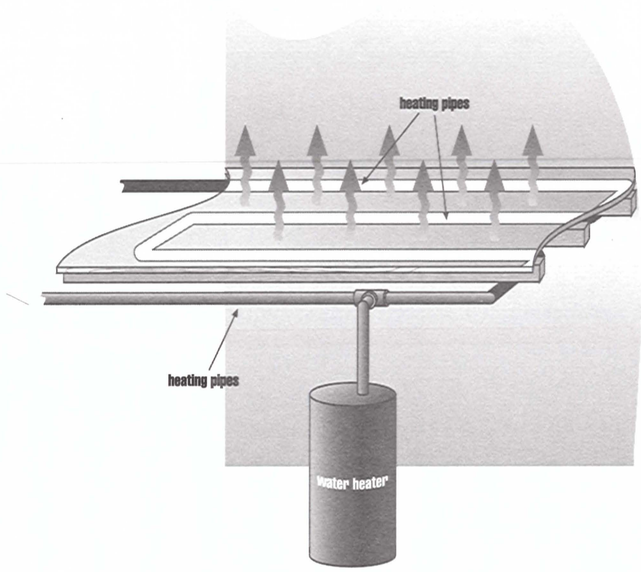
Solar heat



If your house has large walls facing within 30 degrees of south, you can use solar heat to supplement your heating system. This involves making use of, or installing extra, windows that catch the sun's rays during the heating season and some dense materials such as tiles, gypsum drywall or concrete to absorb the heat. These changes can be included as part of a renovation project. (A more extensive description of solar heating strategies is included in Chapter Six.)

Radiant heating

This produces heat by running warm water through a series of pipes under the floor. Some systems embed the pipes in concrete floors, but they can also be installed directly underneath a wooden subfloor. These systems are efficient and comfortable, since the heat comes up from the floor; however, they can be expensive. A radiant system could be an alternative if you have a source of warm water for space heating, if you're installing new flooring or if you need to get heat to a difficult location.



Making a Plan

Once you have an idea of your needs, you can choose the course of action that makes the most sense in terms of cost, energy conservation and lifestyle. The first step is to define what you want to accomplish with the changes you make.

On the Heating Goals Worksheet, write down your goals for your heating system improvements under the headings provided. For example, under the Heating costs heading, you might want to decrease your heating costs substantially; under the Comfort heading, you might want to supply more heat to some cold bedrooms; under the Air quality heading, you might want to make your house a "cleaner" environment by getting rid of any combustion gases, cleaning the air and adding ventilation.

Choosing an Option

Once you know your goals, you can try to make the best choice among the options presented here. Which course you choose depends on a number of factors including:

- whether your system is in need of repair
- the fuel efficiency of your system
- maintenance costs
- your system's capacity to be upgraded
- the available alternatives in your area
- health problems in the household that may be related to your system or potentially resolved by the use of another system.

Aside from these considerations, look at how long you intend to live in the house. If you're going to stay where you are for a long time, and perhaps retire there, investment in an expensive high-efficiency furnace will be repaid in fuel efficiency and comfort. But if you're thinking of reselling within a few years, an upgrade of your existing

HEATING GOALS

	Goals	Priority (high/low)
Heating costs		
Comfort		
Air quality (health)		
Efficiency		
Pollution		

HEATING OPTIONS WORKSHEET

	Details	Advantages	Disadvantages	Health Considerations
Fixing system				
Option 1				
Option 2				
Option 3				
Upgrading system				
Option 1				
Option 2				
Option 3				
Replacing system				
Option 1				
Option 2				
Option 3				

HEATING SYSTEM COST COMPARISON WORKSHEET

Existing system	Yearly operating cost	Yearly maintenance cost	Total yearly cost
Repair	Details	Initial cost	Estimated yearly cost
Upgrade	Details	Initial cost	Estimated yearly cost (including maintenance)
Option 1			
Option 2			
Replacement	Details	Initial cost	Estimated yearly cost (including maintenance)
Option 1			
Option 2			
Option 3			
Summary			

furnace or a mid-efficiency furnace might be a better choice. (See What do the numbers mean?, page 68)

Use the Heating Options and Heating System Cost Comparison worksheets to list and compare the most likely options for your heating system.

Counting the costs

To figure out which option makes sense financially, you should have some idea of how much it is going to cost to make the changes initially and how much the system will cost to run each year. In addition to the initial outlay, ask potential suppliers to provide an estimate of the annual operating expenses of the systems they are proposing. This estimate should take into consideration the energy content of the fuel used, the cost of the fuel, the heating load of your house and the seasonal efficiency of the appliance you're considering. The calculation should look like this:

$$\frac{\text{Energy cost per unit}}{\text{Energy content of fuel}} \times \frac{\text{Heating load}}{\text{Seasonal efficiency}}$$

$$\times\ 100{,}000 = \text{Annual heating cost}$$

Pay particular attention to the estimated heating load—if this figure varies widely from one contractor to the next, find out why. Use your own heating costs from the Heating Assessment Worksheet in the Taking Stock section to compare the heating costs with different furnaces or other heating equipment as you gather estimates from different contractors.

Once you've found out the yearly savings in operating costs, divide it into the initial cost

HEATING EQUIPMENT WORKSHEET

Appliance chosen (model, serial no. if applicable)	Other materials	Cost per unit	Total cost	Supplier (address, phone no.)	Date purchased/ comments

of the improvements to see how many years it will take you to recoup your investment. For example, if a new furnace will cost you $2,000, and you calculate that your heating costs will be $400 a year less, it will take you five years to get a payback. In addition, if keeping your existing system would have involved repairs, you can also deduct those saved repair costs from the $2,000.

When assessing the initial cost of heating equipment, make sure you're being quoted the installed price: extra work such as installing a chimney liner, supplying a new fuel source or changing the distribution system will raise the installation costs.

When you've made your final choice, record it on the Heating Equipment Worksheet. When you've made your purchases, update the list so you'll have a record for future reference. Also attach all receipts and other project documents to the page so they'll be handy if you need to look at them.

Who'll Do the Work?

Any work on a heating system should be done by a trained heating contractor. These can be found under "heating" in the Yellow Pages™; your fuel supplier should also be able to refer you to a qualified firm. If you're buying new equipment, the company you buy the equipment from may install it as part of the deal.

Follow the guidelines in Chapter Three to choose your contractor. Check the contractor's references for proper certification and licensing, and look for membership in industry associations such as the Heating, Refrigerating and Air Conditioning Institute (HRAI) of Canada. Check equipment warranties

MAINTAINING YOUR HEATING SYSTEM

While you can do your part in helping keep your heating system working properly—changing the furnace filter, for example—your system should be checked and maintained periodically to keep it working efficiently. Many heating contractors and fuel suppliers offer service contracts that include routine maintenance and emergency visits if something goes wrong. However, the needs of different types of furnaces vary. New heating equipment should need only regular maintenance, so price may be the biggest factor when considering a service contract. Older systems are more prone to problems, which can make a service contract more worthwhile.

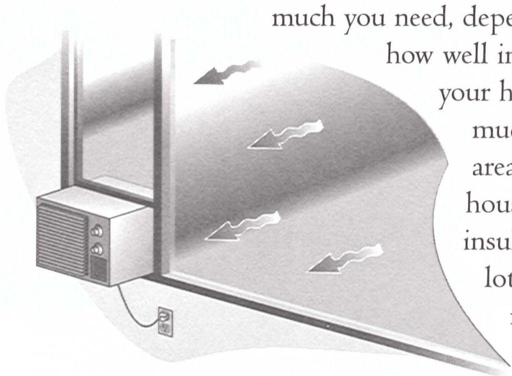
and installation-related warranties. And ask about ongoing service/maintenance plans and costs.

Cooling

What Are the Issues?

Air conditioners are a personal issue. Some people consider them a necessity, while others are content and comfortable without them. The main factors are listed here.

- Comfort: In the warmest parts of the year, air conditioning can make a house a more comfortable place to live. How necessary it is depends on the house itself (some heat up more than others) and your own tolerance of warm temperatures and humidity.
- Efficiency: Whether you need air conditioning, and how much you need, depends on how well insulated and sealed your house is and how much window glass area it has. A tight house with good insulation but with a lot of glass will trap more heat than a loose, poorly insulated one.



- Energy consumption: Cooling the house consumes a significant amount of electricity over the course of a summer. This puts an extra load on natural resources and adds to the yearly cost of operating the house.

What You Should Know about Air Conditioners

Air conditioning systems cool the house during hot weather using refrigerant. The refrigerant circulates through condenser coils, usually located in an outdoor unit, and releases its heat to the outside air, becoming cool. It then flows through tubes to an evaporator coil inside the house. Indoor air is circulated over the evaporator coil, becomes cooled and is delivered to the room or the house. This process also takes humidity out of the household air that flows past the evaporator coil.

Central air conditioning systems provide cooling for the whole house, usually using your furnace's forced-air system to distribute the air. Room air conditioners are self-contained units that cool only one or two rooms. There are also "ductless" systems that combine the features of the two types.

Taking Stock

Before you decide on an air conditioning system, look carefully at your house's needs. Does it heat up during most of the summer, or just when the weather is hottest? How many weeks of hot weather do you get in your area? Are you using your existing resources, such as awnings, shades, fans and trees to control the solar heat problem?

At the same time, check your electrical service. If you're considering central air conditioning, a typical 100-ampere service may not be able to handle the extra load. A contractor or electrician will be able to tell you whether you need a higher-rated service; in some cases, an extra panel can be added to your circuit box, at an additional cost, to accommodate the unit.

What Are the Options?

It can pay to consider the alternatives before you invest in air conditioning. In many cases, you can make your house comfortable in summer without the expense and energy consumption of an air conditioning system.

There are a number of strategies you can use to reduce the heat accumulation in your house during hot weather.

- Block the sun: If you're building an addition or doing outdoor renovations, consider bringing your roof overhang out far enough to shade your windows fully in summer. Alternatively, put trellises, awnings or shade panels above south-, east- and west-facing windows. If they are installed in the proper position, they won't block the rays of the sun in winter, when the sun is lower in the sky.
- Install window shades: Just adding effective shades or shutters that will cover the whole window in hot weather can keep a lot of radiant heat out of the house. If your windows need replacement, you can buy new units with adjustable shades built into

...consider bringing your roof overhang out far enough to fully shade your window in summer.

them or with low-emissivity (low-E) coatings (see Glazing Choices chart in Chapter Six).

- Use landscaping: Try to use the shade of deciduous trees. They can shade a window in summer when the leaves are out, but still allow the sun to reach it in winter when they're bare.
- Install energy-efficient windows: Windows with tight air seals and special solar control coatings that block some of the sun's rays can help protect you from heat as well as cold.
- Insulate and air seal your house: Upgrading your insulation levels and reducing air leakage can help reduce indoor temperatures in summer, as long as you don't have a lot of heat entering through the windows (see Chapter Five for details).
- Install fans: Ceiling fans can help make the house more comfortable in hot weather.

Choosing an air conditioner

If you decide you need air conditioning, there are three main types of systems to consider.

Central air conditioning

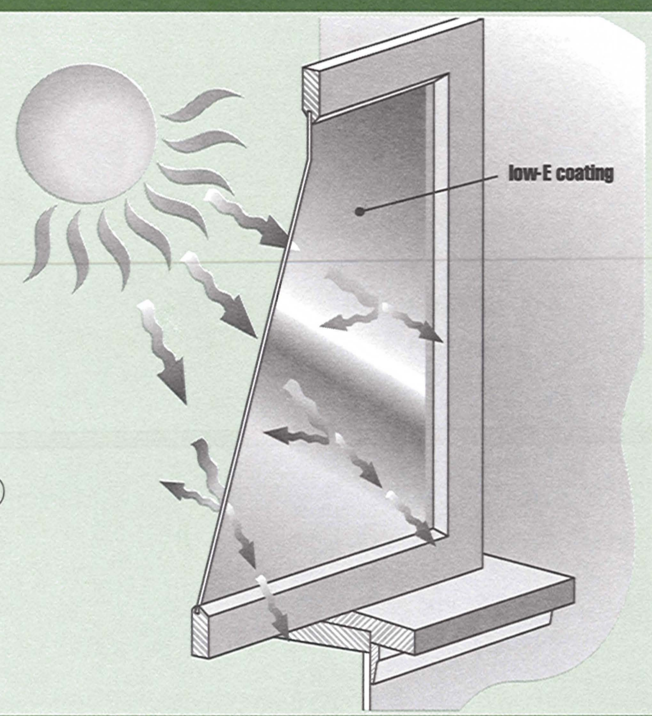
Most central systems are called "split" systems because they have two parts. A compressor unit located outside the house sends cooled refrigerant inside through copper tubes to the evaporator coil, which is usually located in your furnace's forced-air duct. The furnace's circulation fan delivers the cooled air to the house.

Putting in a central air conditioning system involves a significant cost. However, once it's installed, a central system operates much more efficiently than small, window-mounted units. This is partly because it uses a higher-capacity electric circuit.

You'll need a suitable outdoor location to install the compressor unit. Since it will create some noise, it should be away from windows, both yours and your neighbours'.

HOW HEAT COMES IN

One of the ways heat enters the house during the summer is through the windows. This happens as direct sunlight passes through the windows and is absorbed by the materials inside the house—a process called "passive solar gain." As well, radiant heat from warm objects and surfaces outside can enter the house through the window glass which is a poor insulator. Both these forms of heat can be reduced by shading the windows, or by using glass with low-E coatings, which reflect heat energy while letting visible light through. (For more on passive solar gain, shading and low-E glass, see Chapter Six.)



Putting it between two closely spaced houses can magnify the sound. The condenser should be in a shaded area, and the area around it should be kept clear to allow good air flow, important for the unit's performance. As well, it must be relatively close to the furnace or blower inside, since the copper tubing should not be run long distances.

If you live in an area where installing a heat pump makes sense as a form of heating, you can get central air conditioning as an added benefit, since a heat pump uses the same technology as an air conditioner and can be used for both purposes. However, a heat pump involves a bigger investment. If you already have a gas or oil furnace, this may not be economically viable.

If you have an existing central air conditioning unit, it may be oversized for your house. An oversized unit won't operate efficiently, and it won't dehumidify the house adequately (see Comparing air conditioners, page 87). Some units were incorrectly sized for the house when they were installed, and some become oversized when homeowners reduce the house's air conditioning load with better insulation or air sealing. There's little you can do to correct this situation except use the system sparingly or replace it if it's getting old.

Ductless split systems

These "intermediate" systems can provide a cooling solution for houses that don't have forced-air ducts. They use an outdoor condenser unit, like a central air conditioner, but deliver the cooled refrigerant to wall-mounted or ceiling-mounted room units, which circulate the cooled air using a fan.

You can get ductless split systems with up to three wall units that can be located in different rooms, and some systems allow you to attach limited ducts to run cool air from a wall unit to a second room nearby. Another strategy is to use wall vents with small circulation fans to move the cooled air around the house, although this option can be more expensive since you have to install the wiring and repair the wall finishes after installing the fan.

Window air conditioners

These self-contained units have all the working parts in one module. They perform less efficiently than central units and are the least energy-efficient choice since they run on regular household circuits. As well, they can be noisy, allow air or water to leak in, and are a security risk. However, if you need to cool only the living room or a bedroom, or if a larger system is not feasible, they can do the job with less cost and overall energy consumption.

Window units still need to be sized to match the room where you're installing them; the manufacturer's literature should indicate how many square metres or feet the unit will cool. And they should be removed in winter, or at least tightly covered, to prevent heat loss.

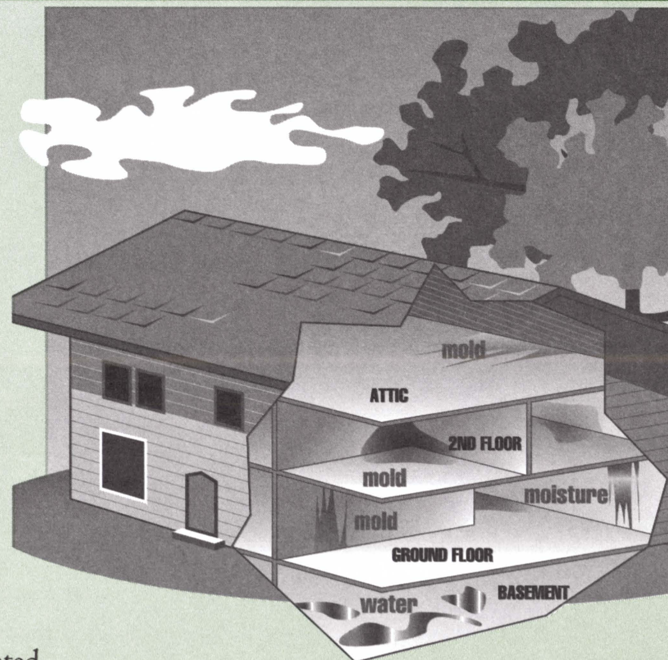
Making a Plan

The most important decisions when you're considering air conditioning are how much you need it and how much you're willing to spend. The options run from no air conditioning through room air conditioners to a central system. Take a minute to look at your own need for air conditioning. Remember, your existing heating system will also influence this decision to a great degree.

On the Air Conditioning Worksheet provided, define your needs in relation to the issues outlined above. Under the Comfort heading, assess your need for cooling to make the house livable during the summer; under Efficiency, look at how

TRACKING HUMIDITY

One of the reasons homeowners use an air conditioner is to reduce the humidity in the house during hot, humid weather. Generally, humidity above 50 per cent makes the house uncomfortable and encourages the growth of molds, microbes and dust mites. You can monitor the relative humidity in your house using a hygrometer, which can be bought at hardware stores, department stores, building supply stores and electronics stores. There are two types: mechanical hygrometers, which cost less and are reasonably accurate once calibrated (adjusted to a standard setting), and electronic hygrometers, which are more expensive and are usually accurate in the mid-to-high humidity ranges. Either will do the job, but remember that a hygrometer should be calibrated before use and should not be set on or near any source of direct heat.



Generally, humidity above 50 percent makes the house uncomfortable and encourages the growth of molds, microbes and dust mites.

efficient your house is at keeping the heat out and whether you can improve it.

Choosing an Option

Once you've assessed your needs, there are several options you can choose. If you've decided that your cooling needs are low, you can consider alternatives to make your house more comfortable. If you have only one or two rooms that overheat, room air conditioners might do the job for much less initial cost than central air conditioning. In that case, you'll spend a little more for electricity per unit, but less overall.

If your house has a real problem with heat gain and you can't solve it with window shades and landscaping, it may be worth getting a central air system. Have an air conditioning contractor, technician or consultant come and look at your house; they can be found in the Yellow Pages™ under "heating" or "air conditioning."

The contractor should do a heat gain calculation on your house to determine how much cooling it needs. This is calculated much like a heating load analysis, figuring in the type of house, size of the

AIR CONDITIONING GOALS WORKSHEET

Issue	Goal	Priority (high/low)
Comfort		
Efficiency		
Energy consumption		

AIR CONDITIONING OPTIONS WORKSHEET					
	Details	**Effectiveness**	**Comments**	**Estimated initial cost**	**Estimated operating cost**
Option 1					
Option 2					
Option 3					
Option 4					

rooms, the number and orientation of windows. It can tell you how big a heat problem your house has and help determine the size of air conditioning unit you need.

Installing a central air conditioning system is usually practical only if you have a forced-air heating system with ducts for carry the cooled air throughout the house. Otherwise, you'll have to install ducts for all the rooms you want to cool, which may not be feasible unless you're already ripping out the walls for a renovation project. In some cases, ducts can be run through the basement or a crawl space.

Use the Air Conditioning Options Worksheet to weigh the options.

Comparing air conditioners

When considering an air conditioner, look first at its efficiency, as expressed by its seasonal energy efficiency ratio (SEER) rating. The higher the number, the less electricity it will consume; however, the price is likely to be higher as well. Try to look at several models and ask for the manufacturer's literature on the models you're considering.

It's also critical that air conditioners be sized properly, especially central air systems. Your unit must be big enough to do the job but, since an oversized system won't operate efficiently, any extra efficiency you pay for will be wasted. Generally, it is better to undersize than oversize an air conditioner since the lower-capacity unit will actually control humidity better; it runs longer each cycle and reduces both the temperature and the humidity. As well, the air conditioner must be matched to your furnace's air flow capacity. If the air conditioning capacity is too large for the furnace air flow, the air conditioning coils in the forced-air system could freeze up.

Another issue to consider is the noise of the unit. The sound level of air conditioners is usually measured in bels. A unit with a rating around seven bels will be relatively quiet; one around nine will be noisy. This can be a significant factor, especially in a neighbourhood where the houses are close together.

Also, check which type of refrigerant the unit uses. In the past, most refrigerators, freezers and air conditioners used chlorofluorocarbons (CFCs) as the heat transfer fluid. When CFCs are leaked into

the atmosphere, they deplete the earth's ozone layer resulting in increased ultraviolet exposure; this has serious effects on human health. New appliances use other, more environmentally friendly, refrigerants.

Who'll Do the Work?

Installing a central air conditioner or a ductless split system is a job for professionals. In most cases, you'll buy the system from an air conditioning contractor who will also do the installation. You will need an electrician to run the power supply to the air conditioning unit and to upgrade your electrical service, if that's necessary. The electrical work will require a permit from your local utility.

Follow the guidelines in Chapter Three for choosing a contractor. Look for industry credentials. The contractor should be registered with the provincial authority responsible for heating and air conditioning and, preferably, affiliated with industry associations. Contractors certified by organizations such as the Heating, Refrigerating and Air Conditioning Institute of Canada (HRAI) or the Heating, Ventilation, Cooling Industry of British Columbia (HVCBC) have access to training in residential applications.

Because of the importance of sizing the unit, make sure the contractor does a proper heat gain analysis of your house. If this is not done, the contractor may be just guessing, and the unit you buy may be the wrong size.

You'll likely be able to install a room air conditioner yourself. These come with a window-mounting kit that makes it a fairly simple job; it's also possible to mount them in the wall by cutting a hole and installing wooden framing around the opening. In either case, care must be taken to seal the opening around the air conditioner to prevent air and water from leaking through the cracks.

Counting the costs

The initial cost of the air conditioning system includes both the price of the unit and installation. As with other projects, get quotes from three different contractors for the same or equivalent systems, fully installed. Remember, however, that an air conditioner has two costs: the initial cost and the yearly cost of operating it. This can make an efficient unit more economical over a number of years, although you'll pay more money at the start. It is important to consider how much you will operate your air conditioner during the summer.

The formula below will allow you to estimate the yearly operating cost of a central air conditioning unit you're

WHAT DO THE NUMBERS MEAN?

Air conditioners are sized according to their cooling capacity, which is stated either in tons or in British thermal units (BTUs) per hour. One ton of cooling equals 12,000 BTUs per hour; this should cool an area of roughly 46 m^2 (500 sq. ft.), although different houses have different needs. Central air conditioners range from one to five tons. Some manufacturers also state the air flow of their units for comparison purposes. How much cooling capacity you need is best calculated by a qualified air conditioning contractor.

The performance of air conditioners is rated by their SEER, which measures their efficiency in typical operating conditions. A SEER rating of 10 is considered a benchmark by the industry; however, ratings go up as high as 17. The EnerGuide label on the manufacturer's literature or on the appliance will tell you the SEER of the unit you're considering.

considering. In order to use it you'll need to know:

- the size (in BTUs) and SEER of the unit (from the manufacturer's literature)
- the cooling load for your area, in hours per cooling season (get this from Environment Canada or your air conditioning contractor)
- the cost per kilowatt hour (kWh) of electricity in your area.

Calculating for two different units will tell you how much less it will cost each year to use the one with the higher efficiency rating. By comparing this to the price difference between the two, you can calculate the number of years it will take to make up the difference.

$$\frac{\text{Capacity (BTUs)}}{\text{SEER}} \times \frac{\text{Cooling load (hours)}}{1{,}000} \times \text{Electricity rate (per kWh)}$$

$= \text{yearly cost} \times 1.25 = \text{total cost}$

Note: The total operating cost includes the electricity needed to run the fan motor in the air handler or furnace, which circulates the air through the house. This adds 25 per cent to the annual cost.

AIR CONDITIONER WORKSHEET

	Size of unit (BTUs) / SEER rating	X	Cooling load (hours) / 1,000	X	Electricity cost (per kWh)	=	Operating cost	Plus 25%	=	Total yearly cost
Option 1										
Option 2										
Option 3										

AIR CONDITIONING EQUIPMENT WORKSHEET

Appliance chosen (model, serial no. if applicable)	Other materials	Cost per unit	Cost	Date purchased	Supplier (address, phone no.)	Comments

For a house in an area with a cooling load of 375 hours, for example, the annual cost of a 24,000-BTU air conditioning system with a SEER of 10 and an electricity rate of \$0.07 per kWh would be calculated as follows:

$$\frac{24{,}000}{10} \times \frac{375}{1{,}000} \times \$.07 = \$63 + 25\% = \$78.75$$

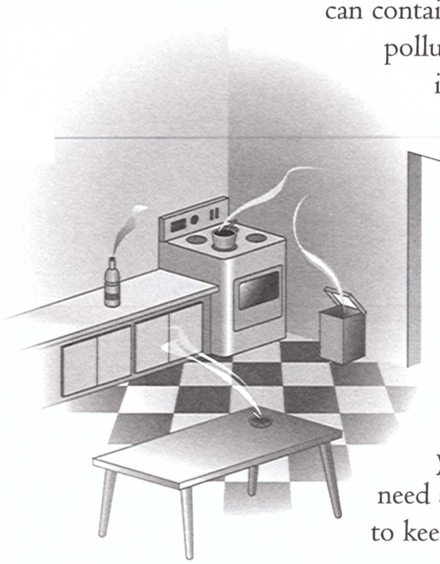
Remember this is only an estimate. Actual costs will depend on your thermostat setting, how much you use it and on such other considerations as the use of drapes, and keeping windows and doors closed.

Use the Air Conditioner Worksheet to compare the operating costs of the units you're considering. Once you have made your purchase, you can enter the particulars in the Air Conditioning Equipment Worksheet for future reference. Also attach all receipts and other project documents to the page so they'll be handy if you need to look at them.

Ventilation

What's the Issue?

- Health: As described in Chapter Two, household air can contain high levels of pollutants and irritants, including dust, combustion gases, cigarette smoke, pet dander and chemicals such as formaldehyde. As well, high moisture levels can cause problems with condensation and mold. These can have serious health results on you and your family, so houses need some effective ventilation to keep the indoor air healthy.



If you're considering upgrading your heating system, think about improving the air quality in the house at the same time. This can be a logical add-on since you can connect ventilation equipment to the furnace's forced-air system while you're having the new heating equipment installed and tuned. If, on the other hand, you're renovating to make your house a healthier place to live, adding some effective ventilation can be a most worthwhile project.

Upgrading your ventilation system can be especially important if you're going to be air sealing your house in the course of a renovation. Since a house is a system, renovations such as installing well-sealed windows (see Chapter Six) or doing extensive caulking and weather sealing (see Chapter Five) can reduce the air flows in the house. This can cause a moisture or indoor pollution problem since you are filling cracks that used to allow air to flow in and out.

What You Should Know about Ventilation Systems

Ventilation systems are used to expel stale and polluted air from the house, bring fresh air in to keep the house healthy, and control odours and humidity levels. There are different ways of supplying ventilation.

- Natural ventilation: Houses built before the early 1980s often have no controlled ventilation system. These houses rely on windows and the natural air flow through the cracks in the building envelope to maintain air quality. However, even though the house might be drafty, it may not have a reliable source of fresh air, since natural ventilation depends on factors such as the outside temperature and the wind to cause air flow. Since you can't control natural ventilation, there is no way to ensure that you get fresh air where it is needed and to turn it off when it's not.

- Exhaust-only ventilation: The next step up is a house with some planned ventilation in the form of bathroom and kitchen exhaust fans. This may be sufficient if the house has a lot of air leaks which continually replace the exhausted air. However, the tighter the house is, the more it needs a planned supply of fresh air to balance the exhausted air. The more you can control both the exhaust and the air intake, the more effective the system can be. Furthermore, if like most people, you don't operate your kitchen fan continuously, you're effectively relying on natural ventilation when these systems aren't on.
- Balanced ventilation: In order to be truly effective, a ventilation system should have both ventilation fans to remove moist and polluted air, and fresh air intakes to replace the air being vented. This can be accomplished using kitchen and bathroom exhaust fans in combination with a fresh air intake joined to your forced-air furnace's air circulation system. This type of system should be balanced by a professional so the amount of air being brought into the house is the same as the amount being exhausted, to avoid changing the air pressure in the house. You also have to be careful with the installation. If it's done incorrectly, it could cause corrosion of the heat exchanger. It also requires your furnace's circulation fan to operate much of the time.
- Central ventilation system: This exhausts air through a central outlet and brings it in through planned intakes. Recently built houses, or those that have been made more energy efficient, may have a central ventilation system which may use a heat recovery ventilator (HRV). If it's operating correctly, an HRV should supply adequate air flow as well as recover heat from the indoor air before exhausting it to the outside. Generally, central systems are carefully sized for your house. Adding significant new space may require adding new sources of ventilation.

Heat recovery ventilators

A heat recovery ventilator (HRV) is a boxy-looking device, installed near the furnace (if you have one), that transfers heat from outgoing exhaust air to warm incoming fresh air. The HRV is usually connected to the air ducts of a forced-air heating system. It receives air from the system's return ducts and exhausts it through an outside exhaust vent; at the same time, it brings in fresh air through an intake vent and routes it to the heating system's supply air ducts. The incoming air absorbs heat from the exhaust air as it passes through the HRV's heat exchanger surfaces. The result is warmed fresh air, with reduced heat loss and better humidity control. If you don't have a forced-air heating system, installing an HRV involves adding a system of ducts to carry the air through the house.

Taking Stock

The first step in deciding whether you need more ventilation is to look for any indication of health or air quality problems in your house. If you filled out the Air Quality Questionnaire in Chapter Two, you should already have an idea of whether you have a problem. However, the Ventilation Problem Worksheet lists some of the common signs and allows you to take a look at your house's air quality.

Leave the house for a few minutes to clear your sense of smell; then take a tour of the house, from bottom to top. Mark down any

VENTILATION PROBLEM WORKSHEET

Sign of ventilation problems	Yes/No	Location	Details
Odours lingering in the house more than an hour after they are generated			
Family members suffer from health symptoms such as allergies or recurrent respiratory illnesses		N/A	
Condensation on windows and walls throughout house			
Mold or moisture stains on walls, floors or window frames (inside)			
Signs of appliance backdrafting (soot stains around chimney or flue, combustion odours)			
Moldy, earthy or chemical smells when you enter the house or basement			
Air does not clear after showers			

of the listed indications you see or smell, plus any others that are apparent.

The next step is to assess your present ventilation system. Take an inventory of the ventilation equipment in your house, noting what ventilation equipment you have: exhaust fans, intake fans or a full central ventilation system that includes both. Also note the location of the exhaust fans and intakes. Mark the information on the Ventilation Assessment Worksheet.

VENTILATION ASSESSMENT WORKSHEET

Devices	Yes/No	Locations	Working effectively? yes/no	Noisy? yes/no
Exhaust fans	(Number)			
Intake fans	(Number)			
Central ventilation system				
HRV				

Your ventilation system may be adequate for your house, or it may not. Remember, however, that even if you don't have any apparent problems, you should review the system following your renovation work which may tighten the house enough to make extra ventilation necessary.

Is your ventilation system working?

You now know how many exhaust vents and air intakes your house has. However, what you may not know is how well they are performing. One way of telling is by the results: do exhaust fans keep the area free of steam and odours as they're supposed to? You can test this by using the plastic bag test, as described in the Heating section of this chapter. Here you fill the bag with air, and then time it to see how long it takes to empty. A good bathroom fan should exhaust 20 to 40 L/s (40 to 80 cu. ft./min.).

There are a number of reasons exhaust fans don't perform well. In some cases, the fans themselves aren't powerful enough to do the job. One study of range hoods installed across the country found that only one out of 20 actually exhausted the amount of air for which the fan was rated. As well, the exhaust hood or grille on the outside of the wall may be giving too much resistance because its screening is clogged, its damper is stuck or because its design is poor.

There are two main types of exhaust fans: axial flow or propeller fans, and centrifugal or squirrel cage fans. While propeller fans are less expensive, they generate a weaker flow of air, which can easily be slowed by resistance in the ducts. Squirrel cage fans are more expensive, but they perform better under most conditions. This makes them a good choice as replacements for old fans, as well as for new installations.

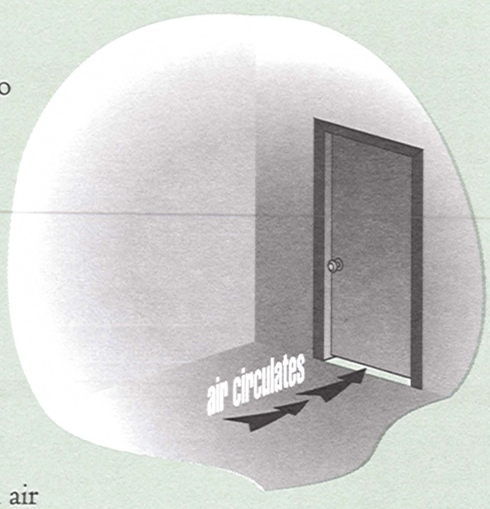
The ducts used to carry the exhaust air outside are also crucial to the performance of the system. If they are too long, or if they have too many elbows or bends, they can drastically reduce the flow of air. Another common problem is the use of flexible ducts: the resistance from their ribbed surfaces can cut the air flow by half.

What Are the Options?

There are many different ways of supplying ventilation to a house, some of which may be difficult to incorporate into a renovation project. However, the practical solutions can be organized into a small number of options, as shown in the Ventilation Options chart. Each option represents a step up in effectiveness from the one below, ending in a full ventilation system with a heat recovery ventilator.

When you're choosing an option, consider the noise factor as well. If the fan you choose is noisy, you're less likely to turn it on or leave it on, and it will have less benefit. This factor can be minimized by buying a model with a low noise rating. Quieter fans are generally also more effective and energy efficient. Bathroom

LETTING THE AIR FLOW



For a central exhaust system to work at its best, the interior doors in the house should have a gap of at least 25 mm (1 in.) under them to allow air circulation. The same rule applies to forced air ventilation systems with a central air return.

VENTILATION OPTIONS

Option	Method	Comments	Cost
Fix existing system.	Replace old exhaust fans with high-quality fans and control devices such as humidistats. Replace ducting that restricts air flow.	May be sufficient for "loose" house.	Low
Upgrade existing system.	Install new and more effective exhaust fans—use low-noise, centrifugal fans. Bathrooms and kitchen are most effective locations to deal with pollutants and moisture generated there.	Can make significant difference. Gets rid of moisture and pollutants at source. Will not necessarily provide fresh air as required or desired.	Low
Add exhaust and central fresh air intake.	Install extra exhaust fans in rooms where needed. Install fresh-air duct and join to furnace's forced-air distribution system.	Circulates fresh air throughout the house. Furnace fan must run continuously, raising your electricity consumption.	Moderate, but high operating cost.
Add heat recovery system.	Install heat recovery ventilator (HRV). Join to forced-air heating system, or install separate ducts through house.	Best system in cold climates. Supplies fresh air while recovering heat from exhaust air.	High, especially if new ducts must be installed.

fans are now available that are extremely quiet and consume little energy; these have a higher price than noisier fans, but the extra expense can be worth it. Another way to minimize noise is to put a very short length of flexible duct between the fan housing and its rigid duct in order to absorb some of the vibrations. (This is the only place you should use this type of duct.)

VENTILATION GOALS WORKSHEET

Goal	Priority (high/low)

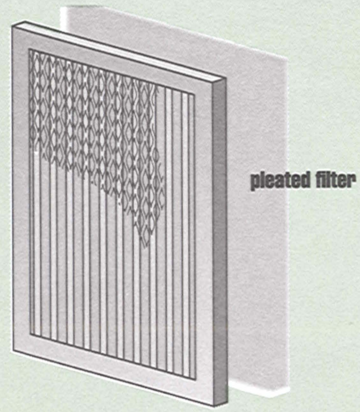
Manufacturers measure the noise level of fans in sones; the higher the sone rating, the higher the noise level. For a kitchen range hood, sone ratings below 6.0 are considered quiet, but ratings of 3.5 or below are desirable. For a bathroom fan, a unit with a level of 2.0 sones or less is recommended.

Making a Plan

How you improve your ventilation system depends on your needs, your health and your budget. Before deciding on a plan of action, review the factors mentioned above. Is your ventilation adequate, or do you have air quality problems such as stale air and excess moisture? Can you identify leaky areas in your house, or does it seem airtight? (Check for drafts around windows and doors.) Will your renovation mean that you'll need better ventilation?

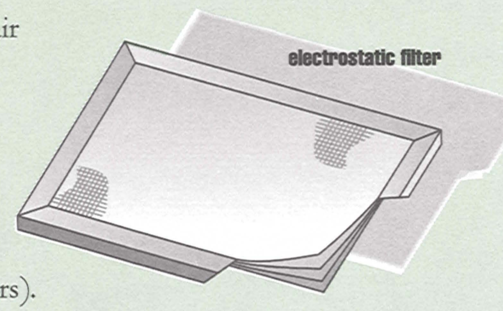
Use the Ventilation Goals Worksheet to list your needs for extra ventilation, and your goals for this ventilation project.

A WORD ABOUT FILTERS



One problem associated with forced-air heating and ventilation systems is the load of dust, mold spores and other irritants often carried in the air circulating around your house. This load can be reduced by using filters.

Most filters on forced-air heating systems are designed to remove only the larger particles from your household air. They are designed to protect the furnace, not your health. However, you can cut down the number of particles in the air by installing a more effective filter on your air distribution system. There are medium-efficiency cotton or synthetic filters, electronic filters that use a high-voltage screen to polarize dust particles and electrostatic filters that extract dust particles by ionizing them or giving them an electric charge.



For an even bigger improvement, there are also high-efficiency air cleaners that use several filters, or a complex air flow system, to remove a high percentage of particles. The most effective is the high-efficiency particulate arresting (HEPA) filter, which can remove 99.9 per cent of the dust from the air. And there are filters that use activated charcoal or a combination of chemicals to take some of the chemical pollutants out of the air (regular air filters are incapable of capturing chemical vapours).

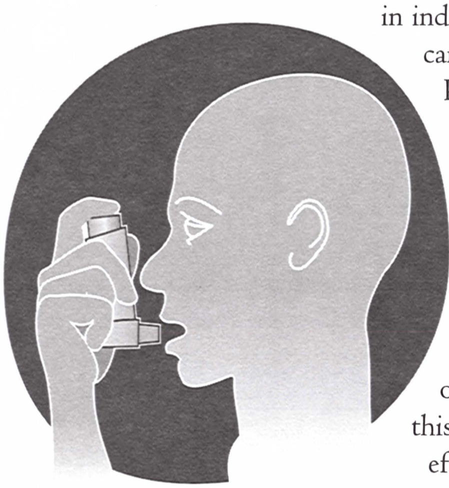
If you have a forced-air heating system, you may be able to replace your old filter with a thicker, medium-efficiency filter without doing any real modifications. However, many of these filters and systems are installed by cutting a slot in the duct system at or near the furnace. This must be done by a professional installer. Fresh air intakes should also include a filter to prevent more dust, pollen, insects and other outdoor contaminants from coming into the house.

Higher-efficiency filters can be worthwhile, but they often put extra demands on your forced-air system. They can slow down the air flow, in some cases enough to make your furnace overheat. This problem makes it difficult to use a HEPA filter in home heating systems. To counter this, your installer may have to modify your system; in some cases, the furnace's air flow can be increased. Even with these modifications, higher-efficiency filters must be cleaned regularly to avoid problems. Electronic air cleaners can produce ozone if they are not cleaned regularly.

Using a more efficient air filter can add very little to your costs if your heating system is configured so it can be installed easily. The more complicated, high-efficiency systems involve a significant cost and professional installation. However, this can be worthwhile if you have health concerns in your household and the indoor air quality is affecting your well-being. In any case, filters require regular maintenance. Replaceable filters should usually be changed every four to six weeks when your furnace is operating or as recommended by the manufacturer. Washable filters also should be cleaned as needed, which means frequently.

VENTILATION OPTIONS WORKSHEET

	Method	Advantages	Disadvantages	Cost	Health considerations
Option 1					
Option 2					
Option 3					



If you're unsure about what needs to be done, or if someone in your household has a particular health problem, it may be wise to call in a consultant or contractor who specializes in indoor air quality. These can be found in the Yellow Pages™ under "air quality," or through your local CMHC office. An indoor air quality expert can help identify the problems in the house and recommend the best way of getting rid of them; this can make the job more effective and could help control the cost.

Choosing an Option

Once you've decided what your needs are, use the Ventilation Options Worksheet to find a strategy for adding ventilation to your house. Whether you choose a simple, low-cost solution or a more extensive, higher-cost system will depend on whether you have an air quality problem and how big your budget is.

Equipment

The technologies used for ventilation range from simple exhaust fans to HRVs and electronic filters. Almost all types can be bought from building supply centres or from heating and air conditioning contractors who do ventilation work.

When shopping for fans, look at their design (squirrel cage is best) and compare their capacities. Some fans are rated by the area they're capable of ventilating, while others have an air flow rating on the package. A low-capacity bathroom unit might have an air flow of 25 L/s (50 cu. ft./min.), while a high-capacity kitchen range hood might be rated for 150 L/s (300 cu. ft./min.). Make sure the fan is rated to ventilate the room you're installing it in. Also, remember to look for fans with low noise ratings. They may cost more initially, but are worth it in the long run. And keep in mind the rules regarding duct installations to keep the air flowing freely (see Making Your Fan Effective).

HRVs are usually sold and installed by heating and air conditioning contractors. Try to look at more than one type before buying. HRVs are available with plate heat exchangers or rotary wheels. Those with plates only recover heat and can dry out a house, whereas those with rotary wheels not only recover heat but also recover moisture.

Use the Ventilation Equipment Worksheet to enumerate the fans and other materials you'll need for the work you decide on.

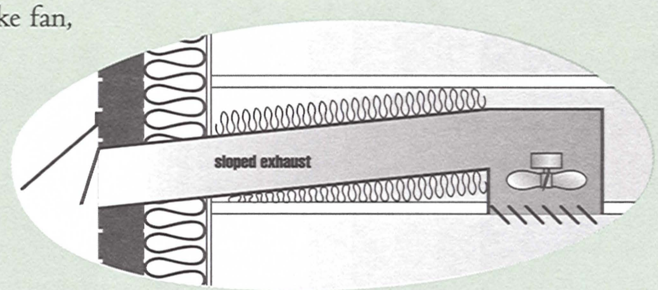
VENTILATION EQUIPMENT WORKSHEET

Appliance chosen (model, serial no. if applicable)	Other materials	Cost per unit	Cost	Date purchased	Supplier (address, phone no.)	Comments

When you've made your purchases, update the list so you'll have a record for future reference. Also attach all receipts and other project documents to the page so they'll be handy if you need to look at them.

MAKING YOUR FAN EFFECTIVE

If you're planning to install a new exhaust or intake fan, follow these design principles:



- Locate the outdoor opening close to the fan so the duct run will be short.
- Use smooth-sided sheet-metal ducts, in as straight a run as possible.
- Don't use flexible ducts, except as a short, vibration-absorbing connection to the fan.
- Tape or seal joints to prevent air leakage.
- Wrap ducts in insulation if they carry warm air through unheated spaces (such as an attic or crawl space) or cold air through heated spaces, with an air/vapour barrier on the "warm side" to prevent condensation. The air/vapour barrier should be sealed to the house's air/vapour barrier. Insulated sleeves for ducts are readily available at building supply and hardware stores.
- Slope the duct downward to the exterior wall to prevent water condensate from dripping back inside.
- Never exhaust indoor air into a crawl space, basement or garage.
- Locate fresh air intakes away from sources of pollution, e.g., exhaust vents, cars, garages and compost areas.
- Use the type of exterior exhaust or supply hood recommended by the manufacturer. Exhaust hoods should have a damper to prevent air from moving back down the duct and a corrosion-resistant rodent/bird screen with a maximum grille size of 8 mm (1/4 in.). Remember to check grilles annually to ensure they are free of any obstructions.

Who'll Do the Work?

Replacing exhaust and intake fans is a job many homeowners can do. (Remember, however, that the wiring for a new fan will require a permit.) For more complicated jobs such as adding a fresh air supply to your furnace's forced-air system or installing an HRV, you'll need a professional contractor.

Some heating and cooling contractors do ventilation work, or you can look for a contractor who specializes in ventilation or indoor air quality. Use the guidelines set out in Chapter Three for hiring a contractor. Make sure you hire someone who has experience in ventilation work and is familiar with indoor air quality concerns and the ventilation equipment planned to be installed. Certification by organizations such as the HRAI or HVCBC is also desirable.

Counting the costs

Many ventilation strategies can be combined with larger projects without raising the cost excessively. The costs generally go up as the system gets more complex and includes equipment such as an HRV. However, an HRV can be an important addition for all houses, especially where someone in the family has a respiratory problem. As well, it saves heat and energy as it operates, making it more cost effective, especially in parts of the country where outdoor temperatures can be extremely cold.

All ventilation systems have a cost since they exhaust heat from the house or consume energy to operate the fan and heat the fresh air supply. But the benefits to your health and well- being usually make the expense worthwhile. It is important to consider ventilation requirements as part of your planning process so you will not have to add it afterward, which could cost significantly more.

FOR MORE INFORMATION

These publications offer more information on the topics in this chapter. The order numbers of the CMHC publications are shown in brackets.

Tap the Sun, CMHC (NHA 2000E)

About Your House: Measuring the Humidity in Your Home, CMHC fact sheet (CE 1)

Keeping the Heat In, Natural Resources Canada

Heating with Gas, Natural Resources Canada

Heating With Oil, Natural Resources Canada

Heating with Electricity, Natural Resources Canada

Heating and Cooling with a Heat Pump, Natural Resources Canada

A Guide to Residential Wood Heating, Natural Resources Canada and CMHC

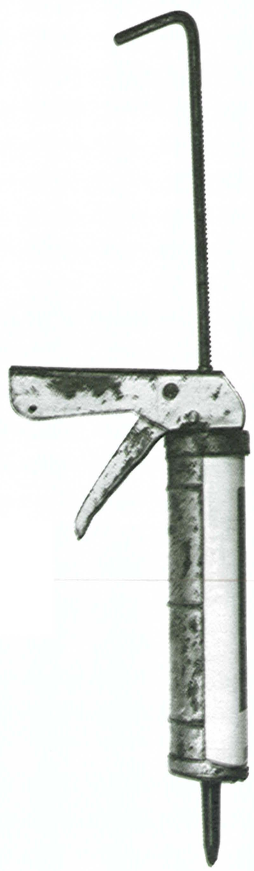
Comparing Heating Costs, Natural Resources Canada

Healthy Housing Mechanicals, Fact Sheet 7, (PE0225)

Chapter Five

INSULATION AND SEALING

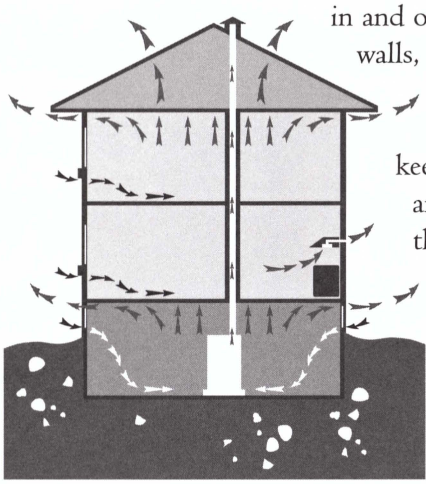
- *main insulation and sealing issues*
- *insulation assessment*
- *understanding insulation values*
- *sealing your house*



In the Canadian climate, protection from the cold (and to some extent, the summer heat) is a basic part of house construction. The main means of protecting yourself from the cold and heat are with insulation and air sealing. If you're doing a renovation that involves any building or remodelling of exterior walls, this protection will also be a basic part of your renovation plan. In many cases, insulation levels and air sealing will require upgrading. If your renovation project includes an addition, it's important to make sure you do an adequate job at the time.

What Are the Issues?

- Energy efficiency: The more your house allows heat to flow in and out through the walls, roof and basement, the more energy you're going to use every year to keep it warm in the winter and, in some cases, cool in the summer.



  Cutting down heat losses and gains decreases that consumption. That not only results in an immediate drop in your fuel bills but also eases pressure on our natural resources and reduces the amount of pollution your heating system produces.

- Comfort: A house with inadequate insulation or a lot of air leaks can be uncomfortable in cold or hot weather. Some houses are chronically cold in winter, while others have "cold spots" because of a badly insulated wall or a number of cracks that let cold air blow in.

- Protecting the structure: Insulation and sealing are parts of a larger system that also stops moisture from getting inside the walls and roof structure, and prevents damage such as wood rot that can weaken the house.

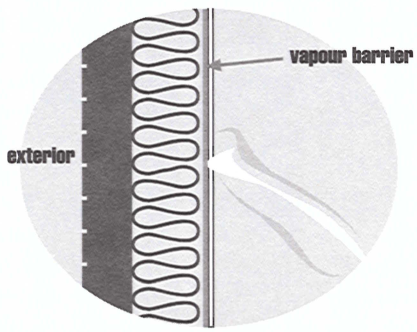
What You Should Know about Insulation and Sealing

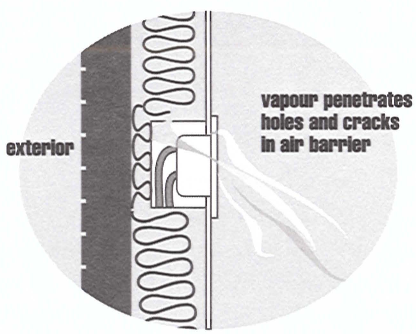
One of the main ways heat and cold travel in and out of your house is by conduction through the walls and other building surfaces. Insulation is simply a material that cuts down this movement through it, in most cases because of air spaces inside that stop heat transfer. Insulation is built into most external walls, attics and other exterior surfaces in Canadian houses.

Air leaking in and out provides a second way for heat and cold to get through the building envelope. Wherever two building surfaces come together, there is a potential crack or gap for air to leak through. A sealant is needed to fill the opening. Materials used for this include caulking, plastic foams and special gaskets.

Most Canadians know that external walls and attics should be insulated. But just putting insulation into a new wall is not enough to protect you from the cold. In order to have an adequate barrier between the inside and the outside, you have to create a continuous, protective "envelope" around the house.

This envelope includes an adequate layer of insulation to keep the cold out—it can be placed between, or to the inside or outside of the framing of the external walls. It also includes an effective air barrier to seal all the cracks and holes in the house structure so outside air can't leak in, and inside air can't leak out. And it includes a continuous vapour barrier on the inside to keep interior moisture from moving into the building structure.





AIR AND VAPOUR BARRIERS

An air barrier is a system of components meant to stop air flowing into a wall, floor or roof structure. A vapour retarder or vapour barrier is a material that slows down vapour as it tries to move through a wall, floor or roof structure. In some cases, one layer of components—for example, polyethylene sheeting, when placed on the warm side of the insulation, overlapped at the seams and sealed with acoustical caulking—can be used as an air/vapour barrier system, doing both jobs.

How you go about creating this layer of protection depends on the kind of renovation you're doing. If you're building or rebuilding exterior walls, you'll need to look at both the insulation they require and the best way to seal the new structure. If you're remodelling existing rooms without building new walls, your plan will concentrate on whether the rooms need extra insulation or sealing, and how to provide it.

A third alternative is to consider upgrading the insulation and air sealing in the house as a renovation project in itself. This makes sense if the house is cold and uncomfortable, or if it's costing too much to heat and cool it every year. It can also make sense as part of an energy-smart renovation that includes upgrading your furnace (see Chapter Four).

However, an extensive air sealing job can be a better investment than upgrading your insulation since it can create a faster return on your time and money. And since many of the cold spots in the house result from air leaking through the building structure, sealing them makes an immediate difference that you will notice.

Insulation

If you're doing some new construction, insulation will come into the planning at an early stage. The type and amount of insulation you use goes hand in hand with the way the walls are built. You must decide on the kind and quantity of insulation you'll need, as you decide on the type of construction you'll be doing.

For example, your wall structures must be capable of holding enough insulation to offer an adequate level of protection. That means building them deep enough to accept the insulation batts or other type of insulation. If there's a problem—if space is important, for instance, and you have to use a compact wall structure—you'll have to choose another method to supply adequate levels of insulation.

If you're remodelling without building new walls, you may still be able to plan an insulation upgrade into the renovation. For instance, if you are removing the drywall or plaster from existing exterior walls, it will give you the opportunity to add insulation from the interior. There are other ways of upgrading insulation in old walls, such as by adding it over the existing interior or exterior wall finish (see Strategies, this chapter).

However, upgrading insulation in finished walls or other more difficult-to-reach parts of the house can involve significant cost and labour. Unless your house has a real deficiency that is making it uncomfortable or very expensive to heat, these costs may not be worthwhile.

Taking Stock

Before deciding how to insulate, and where, you should find out how much insulation your house already has. During the last 20 years, many homeowners have insulated their attics and, perhaps, upgraded the insulation in some other parts of the house. Since this may have been done by a previous owner, it's best to inspect the insulation of the house before you start.

Where should you look? Generally, any part of the building envelope that separates an unheated space from a heated space should be insulated. Depending on the design of your house and your renovation, this can be just about any surface—walls, floors or ceilings.

In some areas, it's easy to find out how much insulation you have. In an unfinished attic, a visual check should allow you to identify the kind of insulation filling the spaces between the floor joists and to measure its thickness.

In other areas, it can be much harder. Finished walls usually give no indication of what's inside. One way of finding out is to turn off the power to the circuit and remove an electrical outlet plate. Then shine a flashlight into the cavity around the outlet box.

In some houses built before the 1970s, there may be no insulation in the walls at all. This is often the case if you have solid brick, concrete block or wood walls. In newer houses, there will be some, but it may not be enough to satisfy today's standards for the part of Canada you live in. And it may have deteriorated or settled over the years.

Where the insulation is accessible, check to see how thick it is, and if it's evenly distributed and continuous; any gaps can create an avenue for heat transfer. Also, check for water damage or compacting that reduces the effectiveness of the insulation.

Look, as well, for signs of structural damage caused by condensation or water leaks. Where you can see the studs or joists, check for blackening of the wood or obvious water marks. Blackened wood is a sign of wood rot, which means the members must be replaced. Any water leaks that caused the rot or damage should be fixed before you go any further.

Where possible, take a look at heating ducts and hot water pipes. If they are not wrapped, you are likely losing heat—especially if they run through unheated areas where condensation could also be a problem.

If your heating bills are very high or you have mold spots on your walls, you may want to hire someone who uses an infrared camera plus a blower door fan to find areas that have missing insulation or serious air leaks. Since this is an expensive test, it is recommended for serious problems only.

Make a record of the kind of insulation you have in your house and, if possible, how much, on the Insulation Assessment Worksheet. Then compare it with the levels recommended in different parts of Canada to see if upgrading is necessary and practical. (Contact your municipal building department for the recommended level in your area.) If you can see the type and thickness of the insulation, you should

INSULATION ASSESSMENT WORKSHEET

Area	Insulation yes/no	Type	Thickness	Insulation value	Condition
External walls					
Walls adjacent to heated or unheated garages					
Basement walls					
Ceilings below unheated attics or roofs					
Floors over unheated crawl spaces or garages					
Heating ducts					
Hot water pipes					

UNDERSTANDING INSULATION VALUES

As with most other types of building products, insulation comes in many forms. However, the performance of all types of insulation can be measured and compared using Resistance System International (RSI) ratings or R ratings, their imperial equivalents. These ratings measure how well the insulation blocks heat transfer and allow you to gauge what insulation level you're installing in a building structure. Insulation batts or boards are sold with a given RSI value, and there are recommended RSI levels for different house structures. Insulation levels may be cited in RSI or R values, or both.

Converting R to RSI

RSI Values	R Values
0.7	4
1	5.7
2.1	12
2.2	13
3.5	20
4.9	28
6.1	35
7	40
8.8	50
10.6	60

Conversion calculator

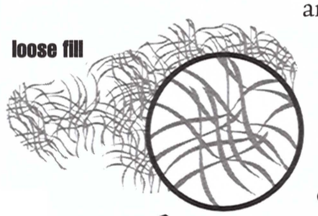
R value X 0.1761 = RSI value

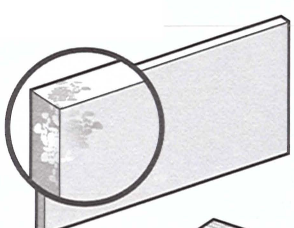
R per inch X 0.00693 = RSI per millimetre be able to estimate its insulation value using the Common Types of Insulation chart, in the What Are the Options? section below.

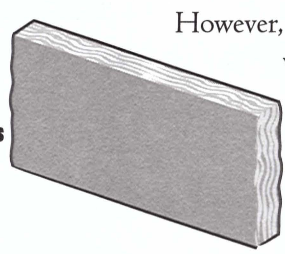
How much insulation do you need?

The level of insulation you need in a specific part of the house depends on two things.

- Your location: Different parts of Canada have drastically different climates. Houses in Edmonton, for example, need more insulation than those in Ottawa, and houses in Ottawa need more than those in Vancouver. Contact your municipal building department to determine the level of insulation recommended for your area.
- Your own strategy: You may be content to install the recommended insulation levels. However, if you want a more efficient house, it may be possible to add extra insulation value while you're renovating without too much extra work or cost. The payback period can be difficult to calculate, since you may be dealing with only part of the house's outer shell, and some of the improvement may come from better air sealing (see Sealing Your House, this chapter). However, extra insulation will pay you back in extra comfort as well as in energy savings.







What Are the Options?

How and where you insulate depends largely on the kind of structural work you're doing. However, it may be worth widening your approach to add insulation to parts of the house that are below standard.

The main options are these.

- Insulate the new walls and roof structures to recommended RSI values or above.
- Add insulation to the existing walls after removing old drywall or plaster, or siding.
- Add insulation to areas, such as the attic, that are below standard and can be insulated without major demolition or rebuilding.
- Do a general insulation upgrade of the house—usually advisable only if the house is seriously below standards.

Materials

Since different types of insulation are made of different materials manufactured in different forms, their RSI ratings can't be measured simply by how thick they are. Rigid and semi-rigid insulation, for example, have much more insulation value per centimetre or per inch than loose or batt forms.

Your choice of insulation should take in both the RSI value and other characteristics that make it suitable for the renovation project you're doing. For example, when insulating the outside of a basement wall, you need a water-resistant insulation, such as semi-rigid fibreglass or rigid extruded polystyrene. For a wall cavity, you may need insulation that can be fitted around the pipes and wires, such as fibreglass batts.

There is a type of insulation for every job. But finding the right one for your project can be complicated. You can make your choice simpler by first deciding what form of insulation will best suit your application and then choosing among the different materials available in that category. Here are the four main forms insulation comes in.

Batts or blankets

This is the most familiar type of insulation for most do-it-yourselfers, and it's fairly versatile. Batts or blankets are generally used to fill the spaces between wall studs, between joists in the attic or over unheated spaces. They can also be laid over a horizontal surface, such as a drop ceiling, or wrapped around other surfaces such as ducts.

Insulation batts come in standard 381 mm (15 in.) and 584 mm (23 in.) widths to compress slightly for a snug fit (called a "friction fit") between the studs and joists in normal construction. You can buy pre-cut batts or rolls, in different thicknesses with different RSI values. Batts can be faced with foil or paper, but this alone does not form an effective air/vapour barrier. Blankets come in the same standard widths, but are sold in long continuous rolls.

Batt and blanket insulation is usually less expensive than rigid board insulation, and it's easy to work with. However, it has a relatively low insulation value for its thickness, so it's used where there is enough space to install a thick enough batt to get the insulation value you need.

Rigid insulation

This is best suited to places where space is at a premium, but where you want a moderate or high level of insulation. Rigid insulation is often used on the exterior of walls, both above and below ground level, on roofs under the roof finish, as an extra layer of insulation over stud walls and in finished basements where it can be installed right against the exterior walls.

Rigid board insulation comes in standard panels 610 mm or 1.219 m (2 or 4 ft.) wide and 2.44 m or 2.74 m (8 or 9 ft.) high, and in several thicknesses. It delivers much more insulation value for its thickness than batt or blanket insulation. However, it is generally more expensive. Different types of rigid insulation materials have different insulation values, and the panels are available in different thicknesses.

The rigid panels can be fastened directly to a wall using adhesives, nails or screws, and you can buy special systems with nailing strips that fit into grooves in the panels. However, rigid boards are not suitable for walls with uneven surfaces, and they can be difficult to cut around contours and obstacles. With enough care and patience, rigid insulation boards can be cut and installed between studs but any remaining gaps must be sealed or the insulation won't perform to full efficiency. Normally these products are applied over existing insulated cavities to boost the R value.

Polystyrene and polyurethane boards are flammable, so they must be covered with a fire-resistant finish such as 13-mm (1/2-in.) drywall; fire code requirements may vary in different parts of Canada. It's possible to buy panels with a fire-retardant finish already in place, or with decorative or moisture-resistant coverings.

Loose-fill insulation

This is loose insulation material that can be poured or blown into the spaces you want to insulate. Loose fill is most often used in two applications: attic floors, where it fills in the spaces between uncovered joists, or wall cavities, where it settles into the openings between the studs and can fit around obstructions such as wiring and piping. It can be blown into finished wall cavities through holes or blown into open cavities, such as when plaster has been removed. It's also good for filling odd spaces or topping up existing insulation.

Loose-fill insulation comes in bags and can be poured in place without much difficulty. However, it generally has a slightly higher RSI value when it's blown in by a professional contractor using special equipment that can control its density.

Foamed-in-place insulation

Foam insulation is less common than other types. However, the foam materials used today are considered safe, are produced to a high standard and can be useful in some applications where other types of insulation are hard to install. Their emissions can irritate those who are sensitive to chemical irritants.

Foam is installed by professional contractors, who spray it onto open surfaces using special equipment. Because most types expand to many times their volume, they are not used for enclosed spaces such as wall cavities.

INSULATION AND AIR FLOW

Some types of insulation, such as loose-fill cellulose, can retard the flow of air as well as heat. This can help air seal areas where they're applied. As well, some rigid board insulation can act as an air/vapour barrier where one is needed if the joints between the boards are sealed.

Vapour and air/vapour barrier systems

Once you've installed insulation, the next concern is to make sure it stays dry. If water vapour gets into the wall, ceiling or floor structure, it can meet the cool outer layers and condense. This can damage the insulation, cause rotting studs and create mold problems which can make people sick.

Water vapour can move by one of two mechanisms—vapour pressure and air leakage. Vapour pressure can be retarded by the placement of a vapour barrier. Air leakage can be stopped by an air barrier (see Air barrier, this chapter). It is quite common to have one barrier to perform both of these functions, i.e., an air/vapour barrier. An air/vapour barrier stops moisture from leaking into the building envelope as described above, protecting the structure, and it stops warm air from leaking out of the house.

The vapour or air/vapour barrier system is installed on the warm side of the insulation—usually over the wall studs on the inside surface of the wall under the drywall—to stop the air before it gets inside the wall structure. However, in some cases it can be buried inside the wall or building structure, for example, if extra insulation is added to the inside of the wall. This can cause condensation problems unless you make sure there is at least twice as much insulation value outside the vapour or air/vapour barrier as there is inside it; and this increases to three times as much in very cold climates or in houses that have a high humidity level.

There are different types of materials that can be used as air/vapour barrier systems.

Polyethylene sheeting

The standard air/vapour barrier system in stud wall construction is sheets of polyethylene plastic, usually the 0.15 mm (6 mil) thickness. These are usually stapled to the studs or other wall surface, overlapped at the edges and bonded together using acoustical sealant, to make a continuous air/vapour barrier.

Insulation

Extruded polystyrene, polyurethane and polyisocyanurate rigid insulation can act as an air/vapour barrier system if the joints between the boards are sealed properly (usually with special tape).

Wall finishes

In older houses, the wall finishes themselves sometimes act as an adequate air/vapour barrier, but only if the joints are well sealed. The most effective finishes include coats of

COMMON TYPES OF INSULATION

Category	Type of insulation	Composition	Insulation value	Common uses	Health concerns	Installation precautions	Comments
BATTS	Fibreglass	Made of glass fibres felted together into batts or blankets.	0.022 RSI/mm 3.2 R/in.	Walls, attics, floors over unheated spaces.	Sharp fibres can cause itching skin and irritation, permanent eye injury, irritation of the respiratory system and, possibly, lung injury if inhaled.	A mask, eye protection, gloves, a cap and a thick long-sleeved shirt should be worn.	Won't rot or burn, but binders and facings will.
	Mineral wool	Made of metal slag or volcanic rock spun into fibres.	0.023 RSI/mm 3.3 R/in.	Walls, attics, floors over unheated spaces.	Dust and fibres can irritate the skin, eyes and respiratory system, and possibly injure the lungs.	A mask, eye protection, gloves, a cap and a thick long-sleeved shirt should be worn.	Won't rot or burn, but binders and facings will. Denser than fibreglass, better soundproofing properties. High recycled content.
RIGID AND SEMI-RIGID BOARD	Expanded polystyrene (beadboard)	Made of expanded polystyrene beads bonded into a solid material. Low- and high-density boards available.	0.026–0.028 RSI/mm 3.7–4 R/in.	Interior walls and ceilings, exterior sheathing, under siding. High-density can be used for exterior foundation walls and under basement slabs.	Can release gases if cut using the hot wire method, produces hazardous dust when cut with a saw. Can also release some of its component gases over time.	Respirators and eye protectors should be worn when cutting and extra ventilation should be provided.	Low-density boards less moisture-resistant than other types of board insulation.
	Extruded polystyrene	Made by mixing polystyrene with a solvent and pressurized gas.	0.033–0.035 RSI/mm 4.7–5 R/in.	Interior walls and ceilings, exterior sheathing, foundation walls, roof decks, basement walls and floors.	Can release gases if cut using the hot wire method, produces hazardous dust when cut with a saw. Can also release some of its component gases over time.	Respirators and eye protectors should be worn and extra ventilation should be provided when cutting.	Moisture-resistant, good for wet applications.
	Polyurethane	Closed-cell board containing bubbles filled with refrigerant gas.	0.04–0.05 RSI/mm 5.8–7.2 R/in.	Interior walls and ceilings, exterior sheathing, foundation walls, roof decks, basement walls and floors.	Produces hazardous dust when cut with a saw. Releases refrigerant gas over time.	Respirators and eye protectors should be worn and extra ventilation should be provided when cutting.	Often faced with foil on both sides. Release of gas lowers insulation value.
	Fibreglass	Made from the same glass fibres used in batts.	0.029–0.031 RSI/mm 4.2–4.4 R/in.	Exterior sheathing, exterior foundation walls.	Sharp fibres can cause itching skin, and irritation, permanent eye injury, irritation of the respiratory system and possibly lung injury if inhaled.	A mask, eye protection, gloves, a cap and a thick long-sleeved shirt should be worn.	Semi-rigid, doesn't have same strength as rigid boards. Comes in two types: one for use below grade, one for above grade.

COMMON TYPES OF INSULATION

Category	Type of insulation	Composition	Insulation value	Common uses	Health Ccncerns	Installation precautions	Comments
LOOSE FILL	Cellulose	Made from shredded recycled newspaper.	0.024–0.025 RSI/mm 3.4–3.6 R/in.	Blown or poured dry in attics, can be wet sprayed into wall cavities.	Releases irritating dust when poured or blown. The dust contains the fire retardants borax and boric acid, which are poisonous if ingested or absorbed through a cut or bruise. The dust may also be toxic if inhaled.	A mask, eye protection, gloves, a cap and a thick long-sleeved shirt should be worn.	Insulation value can vary with application; blown has higher value than poured. For maximum insulation value, should be installed by an experienced contractor.
	Glass fibre	Same material used for fibreglass batts, chopped to pour into small spaces.	0.020–0.021 RSI/mm 2.9–3 R/in.	Blown or poured into attics or wall cavities.	Sharp fibres can cause itching skin and irritation, permanent eye injury, irritation of the respiratory system and, possibly, lung injury if inhaled. Contains binders and processed oils.	A mask, eye protection, gloves, a cap and a thick long-sleeved shirt should be worn.	Insulation value can vary with application; poured can have higher value than blown. For maximum insulation value, should be installed by an experienced contractor.
	Mineral wool	Same material as for batts, made in loose form	0.021–0.022 RSI/mm 3.0–3.2 R/in.	Blown or poured into attics or wall cavities	Has a larger particle size than loose fibreglass, so may not be as irritating. Usually treated with mineral oil to reduce dust.	A mask, eye protection, gloves, a cap, and a long-sleeved shirt or blouse should be worn.	Insulation value can vary with application; blown has higher value than poured. For maximum insulation value, should be installed by an experienced contractor.
	Vermiculite	Made of particles of volcanic rock, expanded by heating.	0.016–0.017 RSI/mm 2.3–2.5 R/in.	Poured into attic floors or wall cavities.	Releases silicate dust when handled. Asphalt-coated vermiculite can release volatile gases.	A mask should be worn.	Untreated vermiculite absorbs moisture, can lose insulation value in damp conditions. Asphalt-treated variety available for damp areas.
FOAM	Polyurethane	Made using refrigerant gases, much like polyurethane board insulation.	0.042 RSI/mm 6 R/in.	Crawl space walls and garage ceilings under occupied rooms. Can be used on inaccessible or uneven masonry walls.	May release refrigerant gas as it cures, and over time.	Must be installed by professionals using proper masks and safety equipment. Blowing agents may be harmful to the environment.	Not approved for enclosed structures. Must be covered with fire retardant material when installed indoors. Produced to standard CAN/CGSB 51.23.
	Polyicynene	Low-density foam made from modified urethane.	0.025 RSI/mm 3.6 R/in.	Crawl space walls and garage ceilings under occupied rooms. Can be used on inaccessible or uneven masonry walls.	(No information available at time of printing.)	Must be installed by professionals using proper masks and safety equipment. Blowing agents may be harmful to the environment.	Not approved for enclosed structures. Must be covered with fire retardant material when installed indoors. Less expensive than polyurethane.

oil-based primer paint or varnish, and vinyl wallpaper. Together with the caulking of all cracks, this can produce an effective air/vapour barrier system. However, new applications of oil-based paint and vinyl wallpaper raise health concerns because of their off-gassing.

The important thing is that the barrier be as free from gaps and holes as possible. This is not hard to accomplish with polyethylene sheets; however, they must be joined to window and door frames, and sealed around any pipes, wires or electrical outlets. Special plastic boxes are sold to air seal outlets and attach them to the vapour barrier.

If you're working with existing walls in an older house, the finish materials probably form the major part of the existing air/vapour barrier system, along with caulking. If you're going to tear out the wall surface, you can install a polyethylene barrier. If not, air sealing the house with caulking will tighten the barrier to acceptable levels if all obvious cracks and openings are sealed. Note: Great care should be taken to seal electrical boxes and behind baseboards.

Air barriers

As well as a vapour barrier, external walls should have an air barrier to keep outside air from blowing into the walls through cracks in and around the siding and filtering through the insulation. If you're building new walls, you can supply an air barrier using either of two methods.

Insulation

Some types of rigid insulation boards, such as extruded polystyrene, polyurethane and polyisocyanurate are dense enough to act as an air barrier if used as sheathing (the panels that cover the outside of wood-frame walls, under the siding or other finish material). Glass fibre sheathing boards have a backing of spunbonded polyolefin which allows them to function as an air barrier. Insulation boards must be sealed together with sheathing tape to make a continuous barrier.

Sheet materials

The most common air barrier in modern housing is spunbonded polyolefin, often called house wrap. This is a polyethylene "paper" that comes in large sheets which can be wrapped right around the walls you're building, to form a continuous cover. Olefin retards air flow, but allows moisture to flow out of the building envelope. In older houses, tar- or asphalt-impregnated building paper was usually fastened over the sheathing. In hot weather, the tar bonded the layers together, making the system airtight.

Sound barriers

In some places, you may want to add some insulation as a sound barrier—between the main living space and a separate apartment or rec room, for example. Both insulation batts and rigid insulation can be used for this purpose, as long as they're installed tightly, with no open spaces between the batts or boards. And remember that to make a really effective sound barrier, you have to fill all the cracks and openings between the living spaces with caulking, weatherstripping or other sealers. Sound can travel through any opening you leave unfilled. Drain pipes, especially plastic ones, can also present a sound problem. They should be wrapped with insulation to muffle the noise of water running through them.

Making a Plan

Using the information in the Insulation Assessment Worksheet and the Common Types of Insulation chart, you should be ready to form a strategy for insulating your house or any new living space you're about to build.

Start by defining your goals. On the Insulation Goals Worksheet, write down what you want to accomplish with this insulation project. If you're building new space with exterior walls and a roof structure, the goal is to install a specified amount of insulation in them. If you're working with existing structures, it defines your overall strategy. For example, under the Energy efficiency heading, you might want to cut your heating bills by insulating unheated walls; under the Comfort heading, you might want to make a cold room less cold in winter.

INSULATION GOALS WORKSHEET

	Priority (high/low)
Energy efficiency	
Comfort	
Protection	

Choosing an Option

Now you can focus on identifying the insulation jobs that need to be done and the strategies you'll use. If you're building new space, this is an inventory of the new exterior surfaces. If you're renovating existing space, it includes walls, ceilings or floors that will be worked on in the course of the job. Or, it may include areas of the house that you've decided to insulate to correct deficiencies or comfort problems.

Using the Insulation Options Worksheet and the sample strategies provided, select an appropriate type of insulation for each of the jobs you're planning. At the same time, you can decide what levels of insulation to put in. You may choose to install higher levels than those recommended for your region for the extra comfort and energy savings if it is not too difficult or expensive.

Consider your house's particular needs. If you have a cold north wall that is exposed to prevailing winds, it could be worthwhile installing extra insulation there. If space is a problem, installing rigid board insulation on the outside of the walls may be the most practical way of getting high insulation levels.

Your future plans should also be considered. The longer you're planning to stay in the house, the more sense it makes to add high levels of insulation.

Once you know the size of the areas you'll be insulating, you can use the Insulation Materials Worksheet to estimate how much insulation you'll need for the job. This helps get the material's cost, which is a basic step whether you're doing the job yourself or taking it to a renovator or other contractor. Once you've made your purchases, you can update the worksheet with the details for your permanent records.

For batt insulation, use the information on the package to determine how many square metres or feet a package will cover. For board-type insulation, you can usually measure the length of the wall space and divide by the width of the boards, usually 0.6 m or 1.2 m (2 or 4 ft.).

Working healthy

When choosing insulation, think about using a type that has limited health impact, especially if anyone in your household is sensitive to chemical pollutants. The health concerns of the different types are listed in the Common Types of Insulation chart. If the insulation you choose has significant health hazards, think about having a contractor install it; otherwise, plan to use the proper safety clothing and equipment.

There are other steps you can take to protect the people installing insulation and everyone else living in the house. While the work is in progress, take care to keep loose

USING YOUR LEFTOVERS

Don't throw out any insulation that's left over after your insulating job is done. Extra batt insulation can be added to your attic, while pieces of rigid board insulation can sometimes be placed in interior walls to act as soundproofing—just take care to place the rigid boards so they don't interfere with future rewiring and plumbing.

INSULATION OPTIONS WORKSHEET

	Option 1	**Option 2**	**Option 3**
AREA 1			
Type of insulation			
Installation method			
Air/vapour barrier system			
AREA 2			
Type of insulation			
Installation method			
Air/vapour barrier system			
AREA 3			
Type of insulation			
Installation method			
Air/vapour barrier system			

INSULATION MATERIALS WORKSHEET

	Area 1	Area 2	Area 3
Type of insulation			
Brand			
RSI/R value			
Air/vapour barrier system			
Sq. metres/feet to be insulated			
No. of packages/boards needed			
Cost per unit			
Total cost			
Date purchased			
Supplier (address, phone no.)			
Extra materials			
Comments			

or batt insulation well sealed so the fibres can't be spread around. As with any type of dusty or polluting work, use polyethylene sheets to make a dust barrier between the work area and the rest of the house.

Provide extra exhaust ventilation in the work area, and vacuum the work site at the end of the day—an outside-vented central vacuum or one with a HEPA (high-efficiency particulate arresting) filter is recommended. As well, vacuum any clothes you wear while installing fibrous insulation and wash them separately to avoid spreading the fibres.

To avoid long-term health effects, make sure you cover all insulation with an airtight finish material; for plastic insulation boards this must also be fire-retardant. Most insulation has some built-in hazards,

HEPA FILTERS

A high-efficiency particulate arresting (HEPA) filter is a special filter capable of taking very fine particles out of the air. It is often used in industrial vacuums or filter systems to remove irritants.

and it shouldn't be left exposed or in direct contact with the rest of the house. If you are particularly sensitive to irritants you can reduce exposure by insulating exterior walls from the outside.

Who'll Do the Work?

Installing insulation is a job most homeowners can attempt on their own. If you're framing new construction yourself, it makes dollar sense to install the insulation as well; however, this exposes you to the insulation and its possible built-in health hazards.

Having your renovator or an outside contractor do the work minimizes your exposure to the insulation and can ensure that you get a professional job. However, it also adds labour costs to the total. While general-purpose contractors can do simple insulation jobs, there are also many contractors who specialize in the field and are expert in its installation. Use the guidelines set out in Chapter Three for choosing a contractor. For an extensive insulation job, be sure the one you choose has good references (check them out) and has been in business for more than a few months.

Counting the costs

The cost of the insulation job involves the insulation, the related building materials (such as lumber, fasteners, wind and air/vapour barriers) and labour, if you're having the job done professionally.

When choosing insulation, shop carefully to see the price differences in the different types of insulation and the differences in the total cost. You can save money by using common batt insulation; however, if your space is tight, the rigid insulation might be worth any extra money, since the higher insulation level will pay for itself over time.

Remember to figure in all the expenses. These include:

- studs, to make a framework for installing extra batt insulation
- special nailing strips or fasteners to attach rigid insulation boards
- special tape to seal rigid or semi-rigid insulation sheathing
- polyethylene vapour barrier
- house wrap, for exterior insulation
- safety equipment, if you do the work yourself.

THERMAL BRIDGING

One way heat and cold are transferred between the inside and outside wall surfaces is by moving through solid materials, such as the studs in the walls. Called "thermal bridging," this can cause cold spots and condensation on the inside wall surfaces. When installing insulation, there are strategies to avoid thermal bridging by minimizing contact between structural parts of the wall. For example, you can install rigid insulation with the nailing strips on top of the insulation boards instead of between them. That way, the strips don't touch the surface behind the insulation. Or, you can install a second layer of batt insulation over the first, supported by wooden studs nailed horizontally across the vertical studs. This minimizes thermal bridging by covering most of the stud surface with insulation.

Strategies

Here are some strategies for insulating different parts of the house.

Basement: Interior

- Stud walls: Install batt insulation in wood or metal stud frames set against exterior walls, after installing interior dampproofing (see Chapter Eight). A space can be left between the stud frames and the exterior wall, and extra batts installed in the gap. This allows for higher RSI levels and helps avoid thermal bridging.

- Rigid insulation: Fasten rigid panels of expanded or extruded polystyrene to the foundation walls with wood or metal nailing strips, after installing interior dampproofing. Extra layers can be added for higher insulation levels. However, this is possible only with level, poured concrete or concrete block walls.

Basement: Exterior

- Rigid or semi-rigid insulation: Install glass fibre, extruded polystyrene, polyurethane or polyisocyanurate panels over dampproof coating on outside of foundation wall. This requires excavation around the foundation, and a protective covering above grade. This solution may be necessary for leaky foundation walls or brick or rubble walls with an uneven inside surface.

Crawl spaces

- Batt or rigid insulation: Install insulation batts between floor joists above the crawl space or board insulation below the floor joists. Or have foam insulation sprayed onto walls and ceiling of the space. The crawl space will be unheated.
- Rigid insulation: Excavate and insulate outside the wall with extruded polystyrene, polyurethane, polyisocyanurate or glass fibre panels. The crawl space will be heated by heat from the house above. It is vital that a moisture barrier be installed on top of the soil which is sealed and anchored so it does not balloon up during storms. Uncovered soil can lead to serious mold problems in the crawl space and inside the house.

Attic

- Topping up: Add extra batts or loose fill insulation over top of existing insulation to bring it up to the desired RSI value. Cover the tops of the joists to stop thermal bridging. Install a retainer to keep insulation 50 mm (2 in.) away from chimneys, if there is not one already in place.
- Finishing a room: Use batts to insulate walls around the space to be finished. Install batts between the rafters before finishing ceiling, leaving space above for ventilation; this may require reinforcing the rafters.
- Roofs (houses that have little or no attic space): Blow loose-fill insulation into the roof space, leaving room above the insulation for ventilation to avoid moisture build-up. Baffles (small dams of plastic or cardboard) are usually needed between the soffit area at the edges of the roof and the attic space to keep the insulation from blocking soffit vents. Or, install rigid insulation on the ceiling of the room below. To avoid

SOFFITS AND SOFFIT VENTS

A soffit is the area that forms the underside of the overhang at the edge of a roof. Small vents called soffit vents are usually installed in the soffit to allow air to circulate into, and out of, the attic or roof space.

condensation, thoroughly seal all holes where pipes or other services enter the roof space from the house. Insulate the outside walls surrounding roof spaces with batt insulation.

New walls

- Stud walls: Install batt insulation in stud frames built deep enough to accommodate the required insulation levels.
- Double stud walls: Build two stud walls with a gap in between. This provides three layers of insulation batts—two in the stud walls and one in between them—and also minimizes thermal bridging.
- Inside/outside: Install batt insulation in stud frames, as usual; add rigid or semi-rigid insulation as sheathing on exterior of wall.

Old walls

- Rebuild: Extend stud frames to allow thicker batt insulation or build new frames of deeper studs. For extra insulation, build two stud walls with a gap in between for three layers of batts.
- Batts and rigid insulation: Where space is limited, nail rigid or semi-rigid insulation to stud frames over batt insulation.
- Extra wall: Build a new stud wall over the existing interior wall, install extra insulation and finish.
- Blown-in insulation: Have a contractor blow loose-fill insulation into uninsulated stud walls through holes drilled in interior wall finish or exterior sheathing. Holes must be filled and the wall may have to be refinished. It may be possible to blow insulation into the wall cavity from the attic or basement.
- Insulate from outside: Install rigid board insulation over the exterior siding, then add new siding. Batt insulation can be installed by building frames onto exterior walls. May require a new air barrier over the existing siding, but it should not be a vapour barrier; use a house-wrap product, not polyethylene. Window and door frames may need to be extended.

Solid walls (brick, concrete block, log, wood plank)

- Extra wall: Build a new stud wall inside the existing solid wall, install batt insulation.
- Insulate from outside: Install rigid board insulation over the exterior siding, then add new siding. Batt insulation can be installed by building frames onto exterior walls.

Note: Some rigid insulations can act as a vapour barrier i.e., have low water vapour permeance. When using these materials ensure an adequate interior vapour barrier and amount of outboard insulation is used to prevent condensation problems from occurring.

Sealing Your House

Aside from adequate insulation, the best way to prevent your house from losing heat is to stop air leakage. This is partly accomplished by installing a good air/vapour barrier. However, for a really effective job, you have to fill all the small cracks and holes in the building envelope.

In most cases, the air flows in different directions in different parts of the house and under different wind and weather conditions. Because of a process called the "stack effect," warmer indoor air tends to leak out the cracks in the top floors, while colder outdoor air leaks into the cracks in the lower floors during the heating season. This loss of warm air wastes the expensive fuel you've used to heat your house. The

THE STACK EFFECT

The stack effect is the tendency during the heating season for warm air to rise up through the wall cavities and any other cracks or passages to the top floors of the house. This typically causes low pressure in the lower parts of the house, which draws in outside air, and high pressure at the top of the house, which forces air out.

incoming cold air causes you to turn up the furnace thermostat setting, and since it's dryer than inside air, it tends to make the house dry in winter. The opposite effect occurs during the cooling season, bringing hot air down from the attic and increasing air conditioning costs.

The most common way to stop these leaks is with caulking. If you're gutting and remodelling existing rooms, you have an opportunity to seal all the cracks and openings that have been making them cold and drafty. Building new walls, meanwhile, gives you an opportunity to do a proper, thorough sealing job to make them air-tight from the start.

If you're not doing structural work, you can still cut your energy bills and make your house a lot less drafty by caulking the key spots that tend to cause air leaks in most houses.

Caulking and sealing are especially important in houses that don't have a polyethylene air/vapour barrier system, since they likely have a lot of places where air can filter through. But even if you're building a new wall, with an airtight barrier, there will be cracks that need sealing—where the windows and doors meet the building structure around them, for example.

Caulking plays much the same role as the air/vapour barrier. It helps to stop air leaks and works to prevent moisture from getting into the building structure, where it can hit the cool outer surfaces and condense. Moisture in walls can cause structural deterioration and mold problems, which can make you sick.

Generally, the warm, moist air leaking out of the house is more of a problem than the air leaking in from the outside, since the inside air carries moisture into the wall or roof cavity. Therefore, it's usually more effective to seal the house from the inside. However, it's also important to seal the cracks on the outside to prevent rain and melt water from getting into the building structure and causing damage, and to prevent wind from blowing into the insulation, making it less effective. Outside caulking should be done with care, since you should not seal openings that are intended to let moisture escape from the building envelope (see under Outdoors, below).

Taking Stock

Most houses have a host of places where the cold outside air whistles in, and the warm inside air leaks out. Every house is different, so the first step in assessing your need for sealing is to find out where the leaks are in your house.

There are several ways of finding the air leaks, ranging from simple to high-tech. The simplest is to take a stick of incense or a small piece of plastic wrap on a coat hanger and go around the house on a windy day. Put it next to any joints where walls meet floors, window and door frames, or any other transitions where cracks can occur, and see if it shows any air movement. In the basement or attic, also test any penetrations in the wall, for example, around the chimney, water pipes or electrical conduits.

This works best if the air pressure in the house is different from the pressure outside. One way of creating a pressure zone in the house is to open the windows on the lee side of the house (the side away from the wind). This forces air in through any cracks and out the open windows. On a cold, still day, you can try opening the upper windows while keeping the basement windows shut, or vice versa.

Professional air sealing contractors use a special blower door—a door insert with a fan in it—to create a negative air pressure in the house, then look for air movement with a special smoke pencil.

As you test your house, you're looking for any cracks that can let air leak into or out of the exterior walls or ceilings. But you're also looking for cracks that can let air flow into interior walls and ceilings, where it can rise through the building structure and end up in the attic.

Indoors

The most problematic spots inside the house are:

- the frames around doors and windows, which often are not insulated or sealed in houses built before the 1970s
- the baseboards, which often cover gaps leading into the wall cavities
- the holes where plumbing pipes and electrical wires come through the outside walls or through the basement ceiling
- the "header"—the spot where the floor joists and first-floor wall structure sit on the foundation wall in the basement
- the gaps in the attic floor around the chimney, plumbing vent stack and lighting fixtures
- all electrical boxes, since in many houses the inside walls are connected to the attic.

As well, you may need to fill some cracks around wet areas such as sinks and bathtubs, where water can leak inside the wall cavity.

Outdoors

There are also places that need attention on the outside. Here, the main focus is not air but water leaking into the building structure. This can cause wet insulation, rotting wood and mold inside the walls.

If you're going to air seal the inside of the house, you should also take a few minutes to go outside and check for cracks and holes that could be allowing rain and ice to penetrate the walls. The most common trouble spots are:

- the cracks where the wall meets window and door frames
- the holes where plumbing pipes and wires enter the walls
- the cracks where vent outlets or other installations penetrate the siding or wall surface.

Not all holes in the outside walls need to be caulked. The normal cracks in siding must be left open, and so must the "weep holes" in sealed windows—small holes built into the bottom of the window frame to let

VENT STACKS

The plumbing vent stack is the upward extension of the drain pipe (called a soil or waste stack) that is connected to your plumbing fixtures. It vents air up through the roof, allowing a free flow of water in the system.

moisture get out. Look only for spots where the outside wall has been breached, where different building materials come together or where seams have pulled apart.

While sealing can be done in most types of weather, some caulking won't adhere or flow well in cold weather. Check the caulking tube for the temperature range at which it can be used.

The Air Leakage Worksheet covers the most common places for air and water leakage in houses. Use it to do a sealing audit of your house. If you're building new walls, use it to plan where sealing must be done.

What Are the Options?

Generally, there are three main options.

- If you're building new living space, or rebuilding old walls, air seal those structures as you build them.
- Use the renovation as an opportunity to do a more extensive sealing job to make the house more comfortable overall.
- Do a whole-house air sealing job.

Since the cost of the caulking is modest, a whole-house sealing project can make sense financially. In some cases, you can have

AIR LEAKAGE WORKSHEET (ATTIC AND UPPER FLOOR)

Area	Sealant in place yes/no	Type and condition	Visible gaps yes/no	Details
ATTIC				
Chimney				
Plumbing stack				
Ventilation ducts				
Light fixtures in floor				
Top of interior and exterior walls				
Attic hatch				
UPPER FLOOR				
Window frames				
Door frames				
Baseboards				
Bathroom fans				
Plumbing penetrations				
Bathtub and sink joints				
Electrical outlets and fixtures				

AIR LEAKAGE WORKSHEET (MAIN FLOOR AND BASEMENT)				
Area	**Sealant in place yes/no**	**Type and condition**	**Visible gaps yes/no**	**Details**
MAIN FLOOR				
Window frames				
Door frames				
Baseboards				
Fireplace				
Kitchen fan				
Plumbing penetrations				
Wiring penetrations				
Electrical outlets and fixtures				
BASEMENT				
Window frames				
Door frames				
Cracks in foundation wall				
Header				
Plumbing penetrations				
Wiring penetrations				
Fuel intake penetrations				
Dryer vent				
Furnace air intake				
Floor drain				

payback in as little as a year (see Counting the costs, at the end of this chapter).

Materials

The complicating factor in air sealing is that the cracks and gaps in your house occur in a number of different materials. That means you may not be able to use the same sealant to fill them all. Some sealants work better on particular materials and under different conditions. Thus, it's important to match the caulking to the job you need to do.

AIR LEAKAGE WORKSHEET (OUTSIDE)				
Area	**Sealant in place yes/no**	**Type and condition**	**Visible gaps yes/no**	**Details**
OUTSIDE				
Window frames and sills				
Window frames and sills				
Window frames and sills				
Door frames				
Door frames				
Door frames				
Plumbing penetrations				
Wiring penetrations				
Kitchen fan				
Dryer vent				
Foundation joint				
Damage to wall surface				

Here are the variables to consider when choosing a caulking or sealant.

- Flexibility: Some materials—metal, plastic and wood, for example—expand and contract more than others; that means cracks will widen and shrink, requiring a caulking that can stretch to compensate.
- Adhesiveness: Some caulking sticks better than others, and some sticks better to specific surfaces. This can be important where the joint moves a lot or is subject to wear.
- Durability: Caulking doesn't last forever and will have to be replaced sooner or later. But, especially for a location that's exposed or difficult to reach, the longer it lasts, the better.
- Paintability: Some caulking can be painted over to match your decor, and some can't. For an exposed surface, choose paintable caulking. Failing that, some caulking comes in colours; you should be able to find one that matches your decor. A third option is to choose a clear caulking that won't be seen.

The Types of Sealants chart lists the caulking and other materials most commonly used for residential sealing.

CAULKING AND SEALANTS

The words "caulk" or "caulking" are generally used to describe the tubes of sealing material sold in the hardware store. However, some of them are more properly called sealants; these are more capable of stretching and compressing than the older-style caulking, and are better for joints that will expand and contract. Some, such as silicone, are called elastomeric sealants, which indicates they're highly stretchable.

Specialty caulking

Other caulking is especially formulated for particular jobs. This includes glazing caulking which can be used in place of putty for sealing window glass, and duct caulking which is used to seal the joints in metal or plastic ducts. For caulking around chimneys, light fixtures or other hot surfaces, choose a silicone or other sealant rated for high temperatures. The temperature range should be listed on the tube.

WHICH FORM OF CAULKING?

Most caulking comes in 300-mL (millilitre) (10-oz.) tubes for applying with a caulking gun. For some jobs, however, it's more convenient to use the rope type of caulking, which comes in long strips that can be laid in place by hand. For small jobs, caulking is also available in handy squeezable tubes.

Sealants and your health

Caulking and sealants are made using a variety of binders and chemical additives in order to make them flexible and durable. These chemicals are released while the caulking cures or hardens to its permanent state, and they can be strong irritants. Some have strong odours, and some can have health effects.

Generally, you can minimize the health effects of caulking by buying a material that has low emissions, such as acrylic latex. Caulking that cleans up with water is better than that which needs mineral spirits or other solvents. Before you decide which caulking to choose for an extensive job, check its health effects using the Types of Sealants chart. Don't use outdoor caulking for indoor jobs, since the emissions tend to be high. Products to avoid include chlorosulphonated and neoprene rubber caulking, and polysulphide caulking.

Provide extra ventilation while the caulking job is being done and afterward while the caulk is curing. This can take several days

TYPES OF SEALANTS

Sealant	Flexibility	Adhesion	Durability	Clean up	Paintable	Comments	Health hazards
Acrylic latex	Good to excellent	Most indoor and outdoor surfaces	5–20 years	Water	Yes	Can be used as all-purpose caulking indoors and outdoors.	Lower solvent content than other caulkings, may emit some solvent and resin fumes.
Siliconized acrylic latex	Excellent	Most indoor and outdoor surfaces	20 years or more	Water	Yes	Can be used as all-purpose caulking indoors and outdoors.	Lower solvent content than other caulkings, may emit some solvent and resin fumes.
Silicone	Excellent	Most indoor and outdoor surfaces	More than 20 years	Solvents, scraper	No (most types)	Good for interior and exterior joints that have significant movement. Can be difficult to apply in cold conditions. Requires a primer for surfaces such as wood and steel.	Releases acetic acid and solvent odours as it cures. Look for "neutral-cure" varieties.
Bathtub	Excellent	Smooth surfaces such as tile and plastic	More than 20 years	Solvents, scraper	No	Usually silicone, can be made of other materials. Excellent for areas that get wet regularly.	Can release acetic acid and solvent odours as it cures. Contains fungicides that may irritate some people.
Acoustical	Good	Polyethylene air vapour barrier, metal, concrete, drywall	More than 20 years	Mineral spirits	No	Doesn't harden, must be covered.	Releases volatile solvent fumes, can be an irritant if not well sealed inside building structure.
Butyl rubber	Medium	Most outdoor surfaces	5-15 years	Mineral spirits	Yes	Can be difficult to apply. Useful for sealing joints between masonry and other materials.	Releases noxious solvent odours. Should not be used indoors.
Polyurethane	Excellent	All outdoor surfaces	15 years	Mineral spirits	Yes	Good for most outdoor surfaces, especially joints that will experience significant wear.	Odours from solvents and plasticizers can be an irritant or affect nervous system.
Acrylic (solvent, not latex formulations)	Medium	All outdoor surfaces	10-20 years	Mineral spirits	Yes	Good for general outdoor caulking.	Fumes can be a strong irritant. Shouldn't be used indoors.

TYPES OF SEALANTS (OTHER MATERIALS)

Sealant	Flexibility	Adhesion	Durability	Clean up	Paintable	Comments	Health hazards
OTHER MATERIALS							
Polyurethane foam	Excellent	Most surfaces	20 years	Razor blade	Yes	Comes in aerosol cans. Good for sealing gaps over 3 mm (1/8 in.). Expands to 2 1/2 times its size, can overfill cavities.	Flammable, requires fire retardant covering.
Foam backer rod	Good (compresses in place)	Most surfaces	20 years	N/A	N/A	Foam rods or ropes, usually made of polyethylene or polyurethane. Fit into large cracks, can support caulking bead. Usually covered.	Few emissions.
Foam gaskets	Good	Can be caulked in place	20 years	N/A	N/A	Come pre-formed for sealing electric outlets and lighting fixtures.	Few emissions.
Neoprene gaskets	Good	Most surfaces	20 years	N/A	N/A	Rubber gasket. Good for sealing large joints that will have significant movement, such as the opening where the vent stack penetrates the attic floor.	Some rubber odour, should be used away from living spaces.

with some types of caulking; check the tube for this information.

Making a Plan

Armed with your Air Leakage Worksheet showing all the gaps that need sealing and a list of the materials needed to caulk them, you should be able to devise a strategy to seal your house or the parts of it that you're renovating.

Before you start, however, use the Sealing Goals Worksheet to define exactly what you hope to achieve through your sealing job. For example, under the Energy efficiency heading, you might want to cut your heat consumption dramatically by doing a whole-house sealing job; under the Comfort heading, you might just want to seal the areas you're remodelling and get rid of some annoying drafts.

SEALING GOALS WORKSHEET

	Priority (high/low)
Energy efficiency	
Comfort	
Protection	

Choosing Options

Now you can begin to choose what strategy and what materials to use for all the different parts of the project.

If you're just sealing the areas you're going to renovate, use the Air Leakage Worksheet to identify all the areas that should be caulked and sealed in that area. If you're doing a full-house job, break it down area by area and job by job. At the same time, you can use the choices in What Are the Options to choose the types of caulking and other sealants suited to the jobs at hand.

If you're planning a whole-house job, the best strategy is to start at the top of the house, usually the attic. That's because the air flowing out of the house at the top tends to draw air in at the bottom. Even if you don't finish the entire project, you can slow the air flow downstairs by sealing upstairs. You will also slow or stop attic moisture damage.

Use the Sealing Options Worksheet to plan the materials you'll use for the jobs you have to do. Then use the Sealing Materials Worksheet to estimate how much caulking you're likely to need for the overall job. Using a standard 3-mm (1/8-in.) strip or "bead," a 300-mL tube of caulking should seal approximately 14 m (48-ft.) of 3-mm wide cracks. (For cracks more than 6 mm, or 1/4 in., use polyurethane foam instead of caulking.)

Measuring the surfaces involved and dividing by 14 m should give you a rough idea of how many tubes you'll need for a 3-mm (1/8-in.) bead. Multiply this by the price of the caulking for a material's price. Then add the price of any extra materials, such as gaskets. Once you've made your final purchases, you can update the worksheet with the details for your permanent records. You can also attach all receipts and other documents to the chart for future reference.

Who'll Do the Work?

If your renovation includes new walls, doors or windows, air sealing must be part of the work. This could be carried out by you or a professional renovator or tradesperson. In any case, the important thing is to identify what should be done to make the new construction airtight and to make sure it's done right.

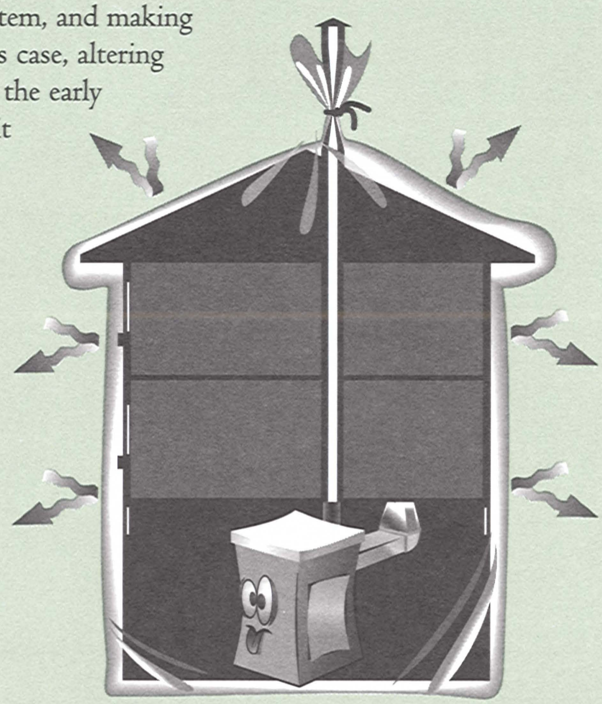
SEALING OPTIONS WORKSHEET

	Option 1	Option 2	Option 3
AREA 1			
Area to be sealed			
Type of caulking/ other materials			
AREA 2			
Area to be sealed			
Type of caulking/ other materials			
AREA 3			
Area to be sealed			
Type of caulking/ other materials			

SEALING MATERIALS WORKSHEET

Area of house	1	2	3
Type of caulking/ other materials			
Brand			
Estimated length of area (metres/feet)			
Divide by 14 metres (48 feet)			
No. of tubes/units needed			
Cost per tube/unit			
Total cost			
Date purchased			
Supplier (address, phone no.)			
Comments			

BEWARE OF NEW PROBLEMS



As you seal your house, remember that a house is a system, and making changes to that system can cause repercussions—in this case, altering the air flows in the house. A typical house built before the early 1970s has so many air leaks that it's difficult to make it truly airtight, even with an ambitious sealing job. However, if your house is already fairly tight, it's possible to cause air quality problems by filling all the cracks. This is more likely if you have a professional job done.

Common signs of a house that's become too airtight include:

- fog or condensation forming on the inside of windows
- odours lingering in the house an hour after they're generated
- fireplaces beginning to smoke
- a stuffy feeling in the house
- signs of mold.

The solution is to add some controlled ventilation using exhaust fans or fresh air intakes at strategic spots in the house. Even with the new ventilation, which all people and houses need to stay healthy, your energy consumption will be lower. (Chapter One has a full discussion of the house as a system. See Chapter Two for more on air quality issues and Chapter Four for a discussion of ventilation systems.)

Whether you're building new construction or renovating existing structures, it is possible to do the job yourself. However, first think about how extensive a job you want to do and how competent you are to do an effective job. Caulking is not difficult, but it is a labour-intensive project, and a tricky one, since there are so many places in the house that may need sealing, and some of them may not be obvious.

To get a really thorough, airtight job, it can be worthwhile hiring a contractor who specializes in air sealing. These can be found in the Yellow Pages™. Use the guidelines set out in Chapter Three for hiring a contractor, making sure the contractor you choose has the necessary training and experience in home insulation and sealing, and three previous jobs you can view before hiring anyone. Always talk to the people provided as references before you sign a contract.

Counting the costs

The price of caulking can vary greatly. Generally, the more specialized the sealant, the higher the price is likely to be. You can save money by buying a general-purpose caulking instead of high-tech sealants for simple applications, such as caulking around window and door frames from inside. But don't short-change yourself by buying cheap caulking that won't do the job. The total cost of caulking for a renovation is not large, but the potential cost of air and water leakage can be huge.

Figuring out the payback period for a sealing job that is not part of a building project can be difficult. It depends on the amount of existing air leakage, the price of fuel in your area, and the cost of the sealing job. In a house built before the early 1970s, air leakage can account for 25 to 40 per cent of the annual heat loss. If the house is heated with natural gas, sealing all those leaks could save $150 to $250 a year.

If you are able to do the work yourself, those kinds of savings can produce a payback within a year. If you are undertaking an extensive sealing project, the payback period may be longer. Hiring a contractor to perform a professional full-house sealing job can cost from $500 to $2,000.

FOR MORE INFORMATION

The publications below offer more information on the topics in this chapter. The publication number for the CMHC publication is shown in brackets.

Building Materials for the Environmentally Hypersensitive, CMHC (NHA 6742)

Keeping the Heat In,
Natural Resources Canada

Chapter Six

WINDOWS AND DOORS

- *they do make a difference!*
- *what you should know about windows*
- *what you should know about doors*

Adding or replacing windows and doors is one of the most popular renovations to upgrade the exterior look and performance of a house. It's also a common part of a number of larger renovation projects.

Windows and doors can make a big difference to the look of your house, which is one reason many people upgrade them. However, they're also major functional elements in the house. The right types, located in the right places, can make life better and easier for you and your family.

Windows supply light where it's needed, improve the look of a room, furnish ventilation during the non-heating season and add solar heat. They open up the room to an outside view that can be a big plus in a renovation project. Doors can also play a big part in your lifestyle. Adding a door can save steps, change the traffic patterns in the house and even change your lifestyle if it makes an outside patio or deck more accessible.

However, inefficient windows and doors can rob you of a lot of energy—they can lose up to 25 per cent of your house's heat over the course of a heating season. That means it's worth thinking carefully about them when you're renovating with an eye to saving energy and reducing your heating bills.

With these things in mind, it pays to spend some time learning the basics of windows and doors, and planning how and where you'll use them in your renovation project. They're the "moving parts" in your house structure, and you'll be living with them for a long time.

Windows

What Are the Issues?

- Appearance: Windows have a major impact on the overall look of the house. They are often the biggest architectural detail in the exterior face of the house. Installing good-quality windows can significantly improve the appearance of your house and its "curb appeal," if you're renovating to resell.
- Energy efficiency: Windows have a big effect on how comfortable your house is and how much it costs you to heat it. They are major openings in the building envelope through which heat can escape and cold air can get in. This heat transfer can occur in two ways: by transmission through the glass and window structure, and by air leakage around the frame. In summer, the same deficiencies will also make the house hotter and increase your cooling needs.

  Windows can also act as heat collectors during the cold season by allowing the sun's heat to come in. This effect can be maximized by locating windows to catch the strongest sunlight. In fact, it can be used as an alternative heat system through a strategy called passive solar heating (see The Solar Heating Option, this chapter).
- Security: Windows can be an easy way for intruders to get into the house. This can be a problem if one or more of your windows can't be seen easily from the street. If you're installing a new window, you may want to reconsider its location; if you are replacing an existing one, you might think about other safety measures such as better locks or extra lights.
- Privacy: Privacy can be a consideration when you're considering adding or improving windows. They shouldn't be located where they will look straight into a neighbour's bedroom window or patio, or allow people to look into private areas of your house.

- Light: One of a window's main functions is to bring natural light into the house. This is a major factor when deciding where to put a new window, since it can make a room brighter and more appealing. It can also help save energy; the more natural light you let in, the less you may have to turn on the lights during the day.

What You Should Know about Windows

The parts of a window

To assess your old windows, or buy new ones, it's important first to understand how a window is built. These are the basic parts of a window.

- The glass: Also called the glazing, this is the heart of the window. It can be an uninterrupted sheet of glass, or several panes divided by mullions, or grilles; increasingly, the grilles are simply decorative pieces that subdivide one large pane of glass. Windows can have single, double or triple panes of glass for insulation purposes (see the Glazing Choices chart).
- The sash: This is the moving part that holds the glass; it can be made of wood, vinyl, metal or fibreglass and should make a tight seal with the glass.
- The frame: The horizontal and vertical members that surround the sash and on which it is hung comprise the frame. Frames are usually made of the same materials as the sash.
- The casing: This consists of the mouldings that surround the window and cover the frame.
- Spacer bars: These are the strips of material between the panes of glass of multiple-paned windows. They keep the correct spacing between the panes of glass. Spacer bars used to be made of aluminum, but are now often made of less conductive materials.

Special features

- Glass enhancements: Since glass makes up most of the area of a window, it's a major element in its performance. Unfortunately, glass is a very bad insulator; a single pane of window glass has an insulation rating of RSI 0.16 (R0.9), compared with a recommended RSI 3.5 (R20) for an average wall. To increase the insulation value somewhat, manufacturers use a number of different strategies. These features may be standard on window units you buy or they may be offered as options. They are summarized in the Glazing Choices chart.

LEAD AND OLD WINDOWS

If your house was built in the early 1950s or before, there's a good possibility the original paint around your windows and doors had a high lead content. When you strip, sand or disassemble them, you can raise dangerous fumes or dust that can damage the nervous system. If you think your windows have old lead paint, try a home test or have a sample lab-tested to see if your suspicions are true. If they are, use extreme care in working with the contaminated windows. Disturb the paint as little as possible.

The best policy is to remove and safely dispose of casings and other components that have lead paint; however, if you're keeping them, repaint them to make sure the lead is completely sealed. If you're intent on refinishing them, the best option is to strip and repaint the pieces away from the house. Avoid sanding the surface, which releases lead dust, or peeling it using a heat gun, which releases lead fumes. Use a chemical stripper and wear the required respirator, coveralls, goggles and gloves. Better yet, have a professional do the job. (See Chapter Seven for more information on dealing with lead paint.)

RSI

The ability of materials to insulate or block the transfer of heat is measured by RSI (Resistance System International) ratings, or R values, their imperial counterpart. The higher the rating, the higher the insulation value.

Weatherstripping

The air sealing used in windows plays an important role in their energy efficiency. If the window leaks air around the sash, it loses most or all of the benefit you gained by buying double glazing and low-E coatings. The best seal is achieved using compression strips that are squeezed when the window shuts against them. These are used in windows that swing shut and include tubular gaskets or closed-cell rubber or foam strips. Casement windows sometimes use magnetic weatherstripping; however, it can become ineffective in very cold weather.

For double-hung windows, compression strips can be used at the bottom and V-shaped tension strips for the sides and the gap between the two sashes. Brush-type stripping is often used in sliding windows but it's less effective. If you buy a window with this type of stripping, look for a thick brush with an embedded plastic fin as an extra air block.

GLAZING CHOICES

Feature	Construction	Effects	Comments
Single glaze	One pane of glass.	Poor insulator, may cause icing/condensation problems.	Standard in older windows. Doesn't meet standards for modern use.
Double glaze	Two panes of glass separated by insulating air space.	Better insulation value than single glaze.	Minimum requirement for modern windows. Good general choice for locations not exposed to extreme temperatures.
Triple glaze	Three panes of glass with air spaces between. Some have film of polyester with a low-E coating (see below) suspended between two panes of glass.	Better insulation value than double glaze.	More expensive than double glaze, makes window heavier. Good choice in extremely cold locations such as northern exposures.
Gas-filled	Space between panes filled with inert gas that conducts less heat than air. Two gases used: argon and krypton.	Better insulation value than air-filled units.	Krypton gas is more expensive, but allows a smaller space between the panes so unit is not as bulky.
Low-emissivity (low-E) coatings	A very thin layer of metal oxide or a film applied to the glass surface.	Allows the sun's short-wave rays to pass through, but blocks radiant heat from escaping house. Reduces both heat loss in winter and radiant heat gain in summer. Blocks ultraviolet light that fades furnishings.	A double-glazed window with a low-E coating can have the same energy rating as a triple-paned window and will cost less. Special solar control coatings available for areas that overheat.

GLASS AND SAFETY

For safety and security, it's sometimes advisable to use stronger and more shatter-resistant glass. Large windows often use plate glass, which is thicker than ordinary window glass. For windows where safety is a concern, there is tempered safety glass that crumbles into small pieces rather than breaking into sharp shards. For windows that are especially vulnerable to intruders you can use acrylic or a tougher plastic called polycarbonate that resist breaking under force. However, they scratch more easily than glass.

Hardware

Depending on its style, a window may have hinges, latches, cranks or levers to make it operate. These should be sturdy and operate smoothly and easily. All members of the family should be able to reach them and operate them, even those who may have reduced grip strength or dexterity. As well, windows should have secure locks that can't be easily breached by intruders.

Common crescent-shaped locks are standard equipment on many double-hung windows. Locks that operate using a key are better for security purposes; however, these shouldn't be used for bedrooms since they could prevent someone from escaping in case of fire. If you install keyed locks, they should all use the same key and all members of the family should be able to operate them. Locks should be solidly built and it's best if they can also lock the window in a slightly opened position for ventilation.

Thermal breaks

One way heat and cold can migrate through a window is by conduction through the frame. This is especially pronounced with aluminum windows and can cause condensation, and even frost, to form on the inside of the frame in cold weather. To prevent this conduction, aluminum windows should have a thermal break built in. This is a piece of non-conductive material that prevents the outside of the frame from touching the inside so heat and cold can't conduct readily.

Window materials

Wooden windows were once the only choice for builders and renovators. However, window frames and sashes can now be made of several different materials, each with its own properties. In fact, frame construction has become the defining factor when you go to shop for windows.

The material determines the window's strength, durability and ease of maintenance. It also has an effect on the window's energy efficiency: different materials block heat transfer better than others and construction features can make a frame a better or worse conductor. Remember, too, that the bigger the frame and sash, the less window area you have. That can mean less heat loss, but it also means less light and less solar gain.

Window styles

Aside from the variation in materials and construction, there is also variation in styles of windows to suit a number of purposes and housing styles. Some work better in a specific situation. For example, awning windows are often used because they are easy to operate from the sill and, even when

WINDOW MATERIALS

Frame material	Construction	Comments	Insulation performance
Aluminum	Made of solid aluminum. Should incorporate a thermal break—a void filled with rigid foam, plastic or wood to stop heat being transferred from the inside to the outside.	Can cause condensation problems without an effective thermal break built in. Strong, resists warping. Resists weather damage. Requires no painting.	Average; can be cold without effective thermal break.
Wood	Made of solid wood.	Traditional material. Requires regular painting and maintenance to prevent moisture damage. Can be less expensive than other materials.	Good.
Clad wood	Wood with protective skin, usually aluminum, vinyl, or high-tech micro vinyl to keep out moisture.	Doesn't have to be painted. Offers better protection from moisture; problems can occur if moisture gets between cladding and wood.	Good.
Vinyl	Made of solid vinyl or with a core of another material, usually metal or wood. May have a core of foam insulation.	Resists weather damage. Wood core preferable to metal because it is a better insulator.	Good to excellent; best with insulated core.
Fibreglass	Made of glass fibres moulded into rigid material. May have a core of foam insulation.	Very strong, resists warping. Resists weather damage. Needs little maintenance, although surface is paintable. Can be more expensive than other types.	Excellent; best with insulated core.

open, can provide some protection from the elements. However, some types of windows perform significantly better than others in terms of energy efficiency.

These are the basic styles of windows.

Fixed

This is the term for windows that don't open. These are the most airtight models because, with no moving parts, they can be sealed tightly all the way around. Fixed windows are the most basic models; however, you can also get fixed architectural units (with arched tops or a half-moon shape, for example) that add style and appeal to the house, and large units that can be assembled to make bay or bow windows or a greenhouse room. Fixed windows can't be used for ventilation or for a fire exit, which can rule them out in some situations. However, they're good for security purposes.

Casement

These units swing open and shut like a door, which makes them easy to operate. Since casement windows use a compression seal between the window and the frame they are relatively airtight.

Awning and hopper

Awning windows swing up from the bottom; if they open out, they can keep out the rain. Hopper windows swing open from the top. Both are easy to operate in places where the window will be at the top of a wall—a basement or kitchen, for example.

They are fairly efficient because a compression seal can be used.

Single- and double-hung

These are the traditional windows, with two offset sashes that slide vertically. Single-hung units have only one sash that slides (usually the bottom); double-hung windows have two moving sashes. Both are more difficult to seal than casement, awning or hopper windows, so they're not as energy efficient. However, they're the best match for some types of architecture. Many houses still have old, single-glazed models that should be upgraded or replaced.

Horizontal sliders

Often the least expensive type of window, these are used by many builders in basements, bathrooms and kitchens. However, they are the least efficient type of window because it's difficult to make an effective seal between the sliding surfaces. Other styles are usually worth the extra money.

Extra features

Some windows feature "tilt and turn" action, allowing them to swing from the side or pivot from the middle. Others pivot from both the top and the side. This allows you to clean the outside of the window from inside the house and can be a valuable feature if a window is in a location where it's difficult to get at from the outside. It also makes it much easier to clean in winter. If you choose a pivoting window make sure it has an effective weather seal.

Special styles

Skylights and roof windows

These roof-mounted units are useful for parts of the house that get little light. In fact, a skylight can illuminate an area 20 times its own size. Skylights are usually located out of reach and can be fixed or operable. Some fixed units have a ventilation flap. Roof windows are usually within reach, can be operated manually and often pivot for easy cleaning.

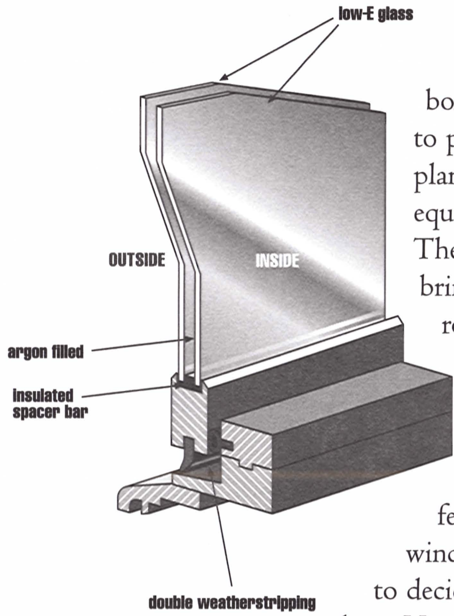
While skylights can provide more light than a conventional window, they can also lose much more heat and can present problems with overheating and condensation. Look for high-efficiency glazing and some kind of heat-reduction barrier such as a protective coating, blinds or shades. Installation is critical with these units to prevent leaks and water damage. Plastic skylights are often domed and may come tinted to prevent overheating.

Light tubes

A relatively new alternative to skylights is light tubes. These pipes can be run up through the ceiling to the roof in areas where a skylight isn't feasible. Their reflective inside surfaces deliver a lot of light; for example, a 330 mm (13 in.) diameter tube can light an 18-m^2 (200-ft.) room. Good units lose almost no heat in winter and generate almost no heat in summer.

Bay/bow windows

Bay windows are usually made up of a central panel with a smaller window on either side. A bay window can bring in extra light and add more space to a cramped room; a window seat is often built inside the bay. A bow window has a shallower profile and is often made up of a number of equal-sized window units. These units can be bought ready to install, or may be assembled on site. However, they can be somewhat more difficult to install and may be less energy efficient than the equivalent straight window.



Greenhouse

Greenhouse windows are box-shaped units designed to provide a sunny place for plants, and often come equipped with plant shelves. They are also a good way to bring more light into the room.

Rating windows

With all the energy-saving features of windows, it can be difficult to decide which unit performs best. However, there are rating systems that make the decision easier by assigning a number of different values to window units sold in Canada.

The most important of these is the Energy Rating or ER number. This measures a window's overall energy performance, including its ability to capture the sun's heat, prevent heat loss through the frame and glass and prevent air leakage. The ER number is expressed as a plus or a minus; this reflects whether the window shows a net heat gain or heat loss over a heating season.

A window with an ER of zero is "neutral," gaining as much heat as it loses; one with a minus rating loses heat over the season, and one with a plus rating produces a heat gain. Super-high-efficiency fixed windows can have ratings up to plus 15. However, a typical double-glazed window may have a rating of minus 19, and some units can have ratings down to minus 40.

The Energy Rating is found on the Canadian Window and Door Manufacturers Association (CWDMA) certification label. The label should be on new window units. This label also guarantees compliance with Canadian Standards Association (CSA) standards and has three more ratings: airtightness (rated A1 to A3), water tightness (B1 to B3 or higher) and wind resistance (C1 to C3). The higher the number, the better the unit's performance.

Window units should also pass the standards of the Insulating Glass Manufacturers Association of Canada (IGMAC) for quality and edge-seal tightness. If they do, there will be an IGMAC label on the spacer or etched on the glass.

Looking at the combinations

The Window Performance chart shows the thermal performance in RSI and R values, and the energy ratings (ER) of a typical casement window with a low conductivity edge seal for different types of frames, glazing and other features.

Taking Stock

The first step toward deciding on a window strategy is to assess what you have and what you need. This assessment is required whether you're remodelling some rooms or renewing your windows as a separate project.

To get an idea of how well your windows are doing their job, do an inspection tour of your house. Look at each room to see how it's used and what could be improved. Are the windows big enough to bring in enough light, or is the room darker than it should be? Could you get a better view with new windows? Are the windows drafty?

Then take a close look at the windows themselves. Are they in good shape, or are they hard to operate or showing signs of deterioration? Are they the old single-glazed variety or are they double glazed? You can tell this by holding a light up to the window and counting how many reflections you see.

Here's a list of things to look for as you inspect your windows, using the Windows Assessment Worksheet.

- dark rooms with a "closed-in" feeling
- cold areas near the windows
- signs of rot on wooden window sashes, frames or sills, which indicate a condensation problem
- condensation, frost or fog on the surface of the glass in cold weather, which can mean the window surface is too cold for the moisture conditions in your house
- condensation, frost or fog between the panes (in double-glazed or triple-glazed units, indicates the seal has failed and the unit must be replaced)
- air leaks—drafts near a window often mean you're letting in a lot of air through cracks around the glass, sash or frame (pinpoint the problem by holding a candle near the closed window on a windy day to see if it flickers)
- difficulty operating a single- or double-hung window—sticky action can be due to moisture absorption, deterioration or a badly fitted unit.

For renovations that involve building new space, look at your plans to see how many windows you're likely to need and where they'll fit best in the new design. The plan itself may dictate where windows are needed, but you can also think about how different areas will be used, and where the light and the view will be most appreciated.

What Are the Options?

If your renovation is confined to remodelling the interior of one room or several, you won't have the luxury of putting windows where you want them as you would with new construction. However, you can still make worthwhile improvements and have windows that are better to live with.

If you noted significant problems with your windows in your house assessment, there are two main ways of correcting them: you can either upgrade the existing windows or replace them with new, tighter, more efficient units. If, on the other hand, you need more windows, the option is to add one or more.

Upgrading your windows

If you don't have serious problems—extensive wood rot, for example, or windows that have deteriorated and don't work properly—upgrading can be the least-expensive way to get better service out of

WINDOWS ASSESSMENT WORKSHEET

Room	Window	Exposure	Type of window	Observable problems

WINDOW UPGRADES

Upgrade	Types of windows	What's involved	Materials	Comments
Renew weatherstripping	All	Replace existing weatherstripping with same type. If window has none, install suitable type.	Casement-type windows: compression strips (tubular gaskets, rubber or foam strips), spring-loaded "bumper" strips, magnetic strips. Double-hung windows: compression strips at the bottom, V-shaped tension strips for sides and between sashes.	Can reduce air leakage around sash.
Seal window frames	All	Remove the window casing and fill any gaps around the frame.	Polyurethane foam or closed-cell foam backer rod, caulking.	Can reduce air leakage through cracks around frame.
Add storm windows	Double-hung, awning, hopper	Add storm window on outside or inside of the window.	Permanent storms with built-in screens, temporary storms (can be taken down in the spring) or removable interior storms that mount on the inside of the window frame.	Can reduce air leakage. Storms don't produce tight air seal, so effectiveness is limited.
Reglaze window	Double-hung	Take window apart, install new double-glazed sashes in old window frame.	Replacement glazing kit, available from some window dealers.	Increases efficiency of sash and glazing. Leaves you with existing frame which could be leaky.

the windows you have. It's much less expensive than buying new windows. You won't get the same kind of energy efficiency unless the windows were modern, efficient units to start with. If the upgrade is a "band-aid" solution that doesn't effectively cure the problem, you will still have a long-term energy loss.

Most windows can be fixed or upgraded if they suffer from air leakage problems. The Window Upgrades chart lists the most common upgrade options, starting with simple and inexpensive cures and moving up to more expensive fixes.

Replacing windows

Choosing new windows will be the key decision if you're building new exterior walls. However, you may also choose to put in new windows if the existing ones fail the inspection you did earlier.

Generally, you may need to replace existing windows if they:

- show serious deterioration such as wood rot
- have serious condensation problems that can't be corrected
- have single-paned glass and create a cold spot in a room.

You may also want to replace windows to make the house more attractive. New windows can be a reasonably priced way to give rooms a brighter look, both from the inside and the outside. If you don't want to cut new holes in the wall, it's usually possible to enlarge an existing window opening and install a new, bigger unit that lets in more light and improves the view.

If you're considering this, remember that it's easier to enlarge an existing opening downward than to widen it, since you won't need to alter the support structure above

WINDOW PERFORMANCE

Energy features	Aluminum frame with thermal break			Wood or vinyl frame			Fibreglass frame		
	RSI	R	ER	RSI	R	ER	RSI	R	ER
Double glaze clear with air fill	0.28	1.59	-40.6	0.36	2.04	-24.9	0.42	2.38	-19.0
Double glaze low-E with air fill	0.35	1.99	-32.7	0.47	2.67	-17.1	0.55	3.12	-11.5
Double glaze low-E with argon fill	0.37	2.10	-29.0	0.51	2.90	-13.3	0.61	3.46	-8.0
Triple glaze clear with air fill	0.35	1.99	-32.7	0.50	2.84	-11.8	0.56	3.18	-10.8
Triple glaze low-E with air fill	0.39	2.21	-27.9	0.60	3.41	-9.5	0.68	3.86	-6.2
Triple glaze low-E with argon fill	0.41	2.33	-25.2	0.65	3.69	-6.8	0.75	4.25	-5.4

Source: Based on "Thermal performance of a typical window with different configurations," from *Canadian Wood-Frame House Construction*, CMHC.

the window. This can also make the window easier to see out of when you are sitting down.

Adding extra windows

In some cases, there just aren't enough windows in a particular part of the house. The result is an area that's dark even on a bright day. In other cases, you might have the opportunity to create a lovely view by adding a window in a kitchen or den. Or, you may want to take advantage of available sunlight to help heat the house (see The Solar Heating Option, this chapter).

This is slightly more complicated than enlarging an existing window opening. However, it's feasible in most cases as long as the work is done properly. The job involves cutting an opening in the wall and building a wood frame inside it to accommodate the new window. In some cases, the structure above must be temporarily supported with a steel lintel (a long plate shaped to fit the wall structure) while the work is being done.

New construction

If you're building an addition, you can start in the planning stage to choose the best type of windows and the best locations for them. If you're uncertain how to plan the job, there are some ground rules for modern housing that may help.

How many windows do you need?

For living and dining rooms, the rule of thumb is that there should be one square metre (10.76 sq. ft.) of window space for every 10 m^2 (107 sq. ft.) of floor space. For bedrooms, dens and family rooms, the minimum desirable space is five per cent. Rooms where the window is used for ventilation should have an unobstructed opening window area of at least 0.28 m^2 (3 sq. ft.). For bathrooms, the window should be at least 0.09 m^2 (1 sq. ft.) in size. However, these are minimum values—to get more light you may want to increase the size.

The final decision depends on what you're planning to use the room for, how much light you need and the atmosphere you want to create. Since windows are an energy component, think about how they'll affect the comfort and temperature of the rooms they're in (see Exposure concerns, next).

Exposure concerns

In the Canadian climate, it makes sense to install fewer and smaller windows in the north walls of your house, since that's where you have the biggest heat loss during the winter. However, by installing high-efficiency windows—for example, triple-glazed windows with two low-E coatings—you can put the normal amount of window space on the north side without sacrificing heat.

Western exposures, and to some extent eastern exposures, pose a more difficult problem. Windows that face west and east can cause overheating in summer when the sun is low in the sky. Installing windows that have heat-blocking coatings, or using shades or blinds, can help minimize the problem. In fact, some window units come with built-in shades. However, the best rule is still to limit the number and size of the windows on these sides.

When windows face south, however, you have an opportunity to cut your energy use and your heating bills by using the sun to help heat your house. This is called passive solar heating, and almost any window that faces south will deliver some extra heat. However, you must plan carefully to maximize this effect as a heating strategy (see The Solar Heating Option).

Windows and fire safety

In residential houses, windows are part of the fire safety system. Fire codes require opening windows on each floor to act as escape routes. These are usually in the bedrooms and must open to the outside without any special hardware or special knowledge.

Fire escape or egress windows must have an unobstructed opening that's at least 0.35 m (3.8 sq. ft.) big and at least 381 mm (15 in.) wide in every direction; a window that's 457 by 762 mm (18 by 30 in.) would satisfy this requirement. As well, they should be no more than 7 m (23 ft.) above ground level, and no more than 1,000 mm (39 in.) above the floor; built-in furniture may be used as a step up to windows placed high in the wall, such as in basements.

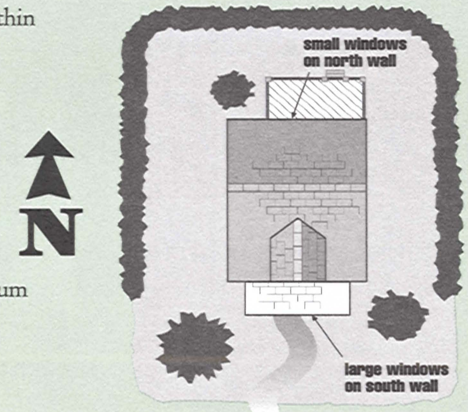
Check your local fire codes if you're unsure whether the windows in your renovation satisfy requirements.

How to choose a new window

Since windows are a major item in a renovation budget, and a significant choice for homeowners renovating their houses, the retail market offers an array of choices. You can choose among different styles, materials and manufacturers, and each choice carries a different price tag.

The type of window you choose depends on the rooms you're remodelling and the style of your house. If you're adding one or two new windows, you should try to match the type and style of the existing windows. If you're replacing all or most of the windows in the house, you can choose whichever style suits your house and your lifestyle. Refer to the styles described earlier in the chapter.

THE SOLAR HEATING OPTION



Passive solar heating involves installing extra window space in any wall that faces within 30 degrees of due south in order to collect the maximum amount of solar heat during the winter months. (You can determine the orientation of your walls using a compass.) However, devising a passive solar heating strategy requires other calculations involving your house and the materials in it.

In its simplest form, getting extra solar heat is a matter of installing more or bigger windows on the south-facing walls of the house. But without proper planning, this can cause serious overheating in the house, so it's necessary to know the maximum amount of window space you can use. This varies from six per cent of the house's total floor space to more than 10 per cent, depending on a number of factors.

The ability of your house to tolerate solar heat during the heating season without overheating depends first on its energy efficiency. The less well-insulated and air sealed your house is, the more solar heat it can tolerate, since a lot of the heat will leak out. However, the more heat is generated inside the house by lights, appliances and people, the greater the chance of overheating when solar heat is added.

The best way to maximize your south-facing windows without causing overheating is to supply some "thermal mass," dense materials that can soak up the heat during the day and release it into the air at night. This can be something as simple as extra-thick sheets of drywall or double drywall installed on the walls and ceilings in the room. It can also be hardwood floors, tiles or vinyl flooring with a concrete underlay, or a stone hearth. Concrete used as a wall material also makes an excellent heat absorber.

These surfaces absorb twice as much solar heat if the sunlight falls directly on them rather than being reflected. However, the heat is absorbed throughout the room, and even in other parts of the house. You can distribute the solar heat throughout the house more efficiently using wall-mounted ventilation fans.

While solar heat is valuable during the heating season, it can cause overheating and raise your air conditioning bills during the summer. To avoid this, it's necessary to provide some kind of shading over the windows. If you are building or rebuilding the roof over the windows, this is a matter of extending the overhang enough to provide extra shade. If not, the best strategy is to install exterior shades above the windows. These can be awnings or specially built panels attached to the wall. If you make them movable, you can adjust them at different times to fine-tune the effect. You can also use louvres installed on the outside of the window itself.

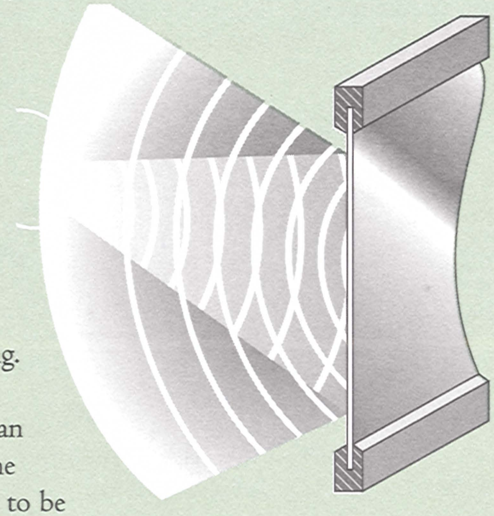
The size and position of the overhang or awnings is crucial to make this strategy work. They must be big enough to shade the window during the summer months. They must also be positioned the right distance above the window so they block the sunlight during the summer when the sun is higher in the sky, but let it in during the winter months when it's low in the sky.

In addition, the recommended size of the overhang changes with the amount of south-facing window area (glazing) in your house, measured as a percentage of your floor area. For example, if you have a conventional house with between five per cent and six per cent south glazing, a 0.6-m (2-ft.) overhang is adequate to prevent overheating. If you have between six and seven per cent, a 0.9-m (3-ft.) overhang is needed, and if you have seven per cent you'll need a 1.2-m (4-ft.) overhang. This is based on a Toronto home with no added thermal mass and "average" heat gains from indoor living, and assumes a 0.3-m (1-ft.) distance from the top of the window to the underside of the overhang. Check with your contractor concerning the recommended overhang for your situation.

A different approach to solar heating is to build a solarium or greenhouse room with floor-to-ceiling windows. This will collect large amounts of solar heat, which can be distributed through the house using circulation fans. These are often built by companies that specialize in these systems. Again, using concrete or other types of thermal mass will help level out the heat gain in the room. However, a shading system will also be needed.

You can find a full explanation of passive solar heating techniques in the CMHC publication *Tap the Sun*.

SOUND DECISIONS



Aside from keeping out the weather, one of the benefits windows and doors provide is to keep out sound. This can make a major difference if you live close to a busy street or some other noisy location; over time, exposure to constant noise can cause fatigue and frayed nerves.

The windows you buy can help cut down the noise levels in your house. When buying windows, extra glazing gives you extra sound protection: double glazing stops more sound than single glazing, and triple glazing stops more than double glazing. Gas between the sealed panes also helps stop sound; krypton performs better than argon. For a serious noise problem, you can also get windows with thicker glass—4 or 5 mm rather than the usual 3 mm. However, these can be hard to find and may have to be custom made. Generally, high ratings on the Canadian Window and Door Manufacturers Association (CWDMA) certification label indicate good sound barrier characteristics.

Fixed windows give the best protection. But if you buy operable windows, look for heavy-duty, tightly sealing weatherstripping to help stop sound from leaking through.

Whether you spend a lot of money for fancy architectural windows or stick to basic units, it pays to make sure you're buying good-quality windows. A window has a life span of 20 to 30 years, and a high-quality model should work properly and keep the weather out better than a cheaper, low-quality unit.

Also, think about durability and maintenance. Good detailing and design are more effective than caulking when it comes to keeping out the cold and the rain. And the longer the window lasts, the longer before you, or some future owners, have to replace it. That saves money, resources and energy.

The best way to get a good idea of how different windows stack up is by going to a building centre or a dealer who stocks different kinds of windows. Be aware that different manufacturers specialize in different materials—vinyl or fibreglass, for example—so try to look at as many types as you can.

As you look at the different window units, look for these points.

- ✔ Material: Note what the window frame is made of. What are its strength and energy efficiency characteristics?
- ✔ Construction: The windows should have solid, sturdy-looking construction. Look for well-sealed corner seams, with no visible cracks and tight sealing around the glass.
- ✔ Design: Look for features such as a prominent, angled drip cap (a metal flange at the top of the window that

deflects rain from running down onto it) and small "weep holes" in the outer frame which let condensation escape if it occurs inside the window structure.

- ✔ Finish: Look for a finish that's durable as well as good-looking. Ask if it will have to be repainted or cleaned regularly. Does it come in more than one colour? Are the colours suitable for your house?
- ✔ Energy efficiency: Ask for literature citing the window's Energy Rating. Look for double or triple glazing, argon or krypton gas fill, and low-E coatings. Also check the insulating characteristics of the sash and frame, the type of weather sealing and spacer used, and the airtightness of the construction.
- ✔ Size: What sizes does the window come in? Can you have it custom made if you want an odd size?
- ✔ Ease of operation: Open and close the window, to make sure the sashes and hardware move smoothly.
- ✔ Ease of cleaning: Will it be easy to clean from the inside? If the window will be in a hard-to-reach spot, double casement windows or tilt-and-turn windows can be a big help.
- ✔ Security: Check what kind of lock or locks the window has. If it's going to be in a hazardous spot, does it have tempered glass?
- ✔ Light: A large glass area in relation to the frame will allow the window to admit a lot of light.
- ✔ Guarantee: Check the manufacturer's guarantee. Some offer a 5- to 10-year warranty against failure of the air seal in sealed units, plus a warranty for the hardware.

Some of these items may not be apparent. However, the dealer, or the manufacturer's literature, should have details of the window's construction and features. The window should also carry a seal with its energy ratings, as explained above. The Window Performance chart gives you an idea of how different configurations of frame material, glass, gas fills and coatings affect energy efficiency. If a contractor is buying the windows on your behalf, ask to see the manufacturer's literature.

Making a Plan

Upgrading or replacing windows can be a confusing prospect because of the variety of options. However, it may be easier if you first define what your needs are. On the Window Goals Worksheet, write down what you hope to accomplish with the project, under the different headings provided. Under Appearance, for example, you might want to add some big, new windows to improve the look of the house; under Efficiency/comfort, you might want to cure a cold, drafty window that's causing you to turn up the heat. Under Maintenance, you might want to upgrade or replace a window that has deteriorated.

As well, include any different styles or details you'd like to have, such as a bay or bow window or a skylight. Rank your wishes on whether they're a high priority—something you really need—or low priority—something you'd like but could live without.

Choosing an Option

Once you've established what you want to achieve, you can look at the options to see what fits your plan and your budget. You should first decide what strategy works for you, for example, whether to upgrade or replace a window.

Use the Window Options Worksheet to decide what strategy is best for your job.

WINDOW GOALS WORKSHEET

	Priority (high/low)
Appearance	
Efficiency/comfort	
Maintenance	
Security	
Privacy	
Light	

Choosing windows

If you're going to be installing new windows, you'll be looking at everything from style to function to energy efficiency. It's also important to choose units whose appearance suits the room and the situation.

Most people renovate at least partly for looks, and expensive, high-quality units such as architectural windows with arched tops can be the centrepiece of your renovation. But if you're installing big windows, make sure they fit both the look and the scale of the house and the other existing windows. A major difference in style or size can look odd.

Use the sections above to review the types of windows available. Then use the Window Choices Worksheet to assess the units you're considering and choose the one best suited to the job. When you've made your purchases, update the worksheet so you'll have a record for future reference. Also attach all receipts and other project documents to the page so they'll be handy if you need to look at them.

Locating new windows

As you draw the plans for your new space, visualize where the windows will do the most good—shedding light on a breakfast table, for example, or providing a view onto your treed backyard. In some cases, a strategically located window can let

WINDOW OPTIONS WORKSHEET

Option	Method/materials	Advantages	Disadvantages	Cost
Upgrade old windows	1.			
	2.			
	3.			
Replace old windows				
Add new windows				

WINDOW CHOICES WORKSHEET

	Style	Features	ER	Price	Date purchased	Supplier (address, phone no.)	Comments
Unit 1							
Unit 2							
Unit 3							

you view a part of the property you want to keep an eye on, such as a pool or playground.

Who'll Do the Work?

There are several ways of buying and installing new windows. You may have them supplied and installed by your renovator, buy them separately and have your renovator or an outside contractor install them, or buy them and put them in yourself.

Proper window installation is critical. If you're going to install the window yourself, make certain you have the necessary carpentry skills. A bad job can crack the window, or put it under too much stress, which can flex the frame and compromise its performance. A badly installed window may be hard to open and close.

If you choose to have a contractor install the windows, follow the rules outlined in Chapter Three for hiring a contractor. In this case, look carefully at both the contractor's and the window manufacturer's guarantee, and make sure the contractor is committed to sealing thoroughly around the window (see Installation notes, below). Also, make sure the renovator gets any building permits needed.

Counting the costs

The cost of a window project, or the window portion of a larger project, can run from modest to expensive, depending on whether you upgrade or replace, how many windows are involved and what kind of windows you choose to buy.

CHANGING THE SYSTEM

As you plan your strategy for changing the windows in your house, remember that a house is a system. That means the changes you make may have consequences, such as altered air and heat flow through the house. Installing tighter windows can raise the moisture level inside the house, and reduce the overall air flow. This can cause moisture problems, mold and rot, as well as lower the air quality in the house. Adding too many south-facing windows can heat up one part of the house, changing the heat and air flows. If you're using a renovator, discuss these issues before the work begins. If not, be aware that you may have to make adjustments after the renovation is done—for example, adding extra exhaust fans and/or fresh air intakes to lower the moisture level and raise the air quality. See Chapter One for a discussion of the house as a system.

If you're adding or replacing a number of windows, you can save money by buying top-of-the-line units for locations that will be seen from the street, and plain ones for places that won't. However, don't sacrifice performance for price; you can find moderately priced windows that still deliver good quality and energy efficiency.

Installation notes

Window units require a specific rough opening—the framed opening in the wall structure that leaves enough room for the unit to be installed and levelled. This must be included in your construction plans. Using or enlarging the depth of an existing window opening is an easy way to fit in a new window. In this case, make sure the wall structure is sound and will support the window. You may have to replace some studs, and possibly reroute services that are built into the wall.

It's best to have the windows delivered and installed after all the framing and roofing work is done, so they won't get damaged on the work site. If they must be delivered sooner, arrange a safe storage space for them.

The windows must be installed plumb and level, and the frame should be sealed to the existing air/vapour barrier. To prevent air leaks, the gap around the frame must also be filled with insulation or polyurethane foam. The foam provides a better air seal; however, it must be injected carefully to avoid overfilling the cavity and distorting the window frame. There should also be a drip cap over the window on the outside wall, and a brick mould—a piece of moulding that covers the gap between the frame and the adjacent wall. If you caulk the window, use a low-emission latex caulking. Be careful not to use an exterior paint on the inside of the window since these can have higher emissions.

PLUMB AND LEVEL

In carpentry, "plumb" means a surface goes straight up and down without leaning to either side; "level" means it goes from side to side without deviating up or down.

If you have extra-thick walls (with extra layers of insulation, for example), you may have to choose whether to mount the windows close to the inside or outside wall surface. They are commonly mounted close to the inside to give them some protection from the weather.

Doors

Doors are rarely the focus of a renovation project. However, they can play a significant part in renovations that include adding new walls or altering old ones. And they can make a big difference in the final result—how the renovation looks, how functional it is and how energy efficient it makes your house.

What Are the Issues?

- Appearance: Entrance doors are key visual elements in the exterior of your house. So, putting in a new exterior door can make a big difference to the house's appearance and, possibly, its saleability. Interior doors also add a visual note to your decor, even though you may not be aware of it from day to day.
- Energy efficiency: Doors waste less energy than windows, simply because there are fewer of them in the house. However, they can lose a significant

amount of heat, even when they're closed. This can happen in two different ways: by air leaking around the door frame, and by heat and cold making their way through the door material itself. Installing energy-efficient doors will repay you with extra comfort and lower heating and cooling bills.

- Security: Doors function to let people in, but they're also there to keep unwanted people out. Some doors do this better than others, depending on their construction and locking systems. This is a major factor in choosing a door, or evaluating the doors you have.
- Access: The major function of an exterior door is to provide an entrance and an exit for the house. If you're doing a major renovation, you may have to decide where to put new exterior and interior doors to provide access to the areas where it's most needed, inside or out. As well, consider using a door that's at least 864 mm (34 in.) wide to provide adequate access and manoeuvring room. And consider door swing direction: if the door swings into a small room—a bathroom or closet, for example—it may severely limit usability of the space.

What You Should Know about Doors

The parts of a door

- The door jamb: This is the construction of boards that surrounds the door and supports it. The board that makes up the bottom of the jamb assembly is the sill. The narrow board that the door closes against is called the stop.
- The threshold: This is the flat or raised surface at the base of the door. Raised thresholds include the sill, and may protrude past the outer wall surface. Thresholds can be made of wood or metal.
- Hinges: These support the weight of the door and allow it to swing and latch properly. Heavy exterior doors usually have three hinges, while lighter, hollow-core interior doors have two. Extra large or heavy doors can require larger hinges, or an extra hinge. Ball bearing hinges can provide more strength and better action in these situations.

WHEELCHAIR ACCESS

For improved wheelchair access through existing doors, there are "swing-clear" hinges that let the door swing back out of the way. When installing new doors, select 864-mm (34-in.) wide doors for adequate access.

- The lockset: This consists of the knob or lever and trim, the latch assembly, the latch or bolt that slides forward into the door, and the strike plate—the flat metal plate that receives the bolt. For opening systems, the two main choices are knobs and levers. Levers make the house more accessible for people with disabilities. This hardware can come with the door, or you can buy the door pre-drilled and add the style you want later.
- Lock blocks: These are solid pieces of wood built into the door structure where the lock is installed, in order to provide a strong structure for the latch assembly and lock. A 305-mm (12-in.) lock block is common.

Special features

- Glass door panels: Also called "lights," these are a popular feature of exterior doors. They provide light and an outside view, although you can get frosted glass if you prefer privacy. Door lights can come plain, or be divided into smaller panes with mullions or grilles. The grilles can be mounted on the interior or exterior, or in between the panes.

  Because of glass's poor insulating qualities, double glazing is standard in door panes. Some units also offer low-E coatings. Door lights should have an Energy Rating, as with other types of windows. Large glass panels should be made of tempered glass for safety.

  Side lights are vertical glass panels installed beside the door. They make an ordinary entrance door look bigger and more elegant, and bring extra light into the entranceway. Like the door panes, they should be double glazed, and if they are more than 508 mm (20 in.) wide, they should be made of tempered glass.
- Transoms: These are window units installed above the door. They come in many styles, make the door look bigger and bring more light into the house. They must be double glazed and should have a good ER.
- The peephole: A small viewer with a lens lets you see who's outside if your entrance door doesn't have a glass panel or sidelights. Peepholes are installed by drilling a hole through the door. When deciding on mounting height, consider the shorter members of the family, children and those who may use wheelchairs. You can mount the peephole lower or use two peepholes at two levels.
- Weather sealing: This is essential to stop air leaks between the door and the jamb. Many pre-hung metal doors use magnetic strips for weather sealing around the edges. Other types include compression seals that the door pushes up against, such as tubular vinyl strips and foam gaskets with a tough skin. Brush-type strips are used between sliding surfaces. Flexible door sweeps cover the crack between the bottom of the door and the threshold. There are also special thresholds with a vinyl bulb that can be adjusted upward to meet the bottom of the door, and door "shoes" that fit on the bottom of the door. Mail slots should also be weatherstripped.

Door construction

There are four basic kinds of door construction: solid core, hollow core, panel and sliding.

Solid-core doors

These have an outer wooden frame, surrounding a core of solid wood, composite wood, rigid insulation or fire-retardant material. The outer skin is commonly made of wood, veneer, hardboard or metal. This type of construction makes a door heavy but strong, and helps it resist warping due to big differences in indoor and outdoor temperatures. Solid core doors are most often used as exterior doors and can accept glass panels.

Hollow-core doors

These have the same basic construction as solid-core doors, but the centre is filled with hollow baffles or grilles. This makes the doors lighter, and suitable for use as interior doors where security isn't a concern.

LOCKS

Locks are the most critical piece of hardware for exterior doors. The standard for residential doors used to be the spring-latch or cylinder lock—the familiar key-in-knob style. However, these are not very secure because they use a bevelled latch that can be pushed back using a credit card. Some locks use a piece of metal called a "dead-latch plunger" to prevent this, but that doesn't stop the locks from being broken with a hammer or torn out with a pipe wrench. Spring-latch locks are inexpensive, but don't provide real security.

The standard choice today is a deadbolt lock, which uses a longer, hardened bolt that can't be forced open. The National Building Code calls for a bolt with a 25-mm (1-in.) throw—the distance it moves forward into the door frame—and a cylinder with at least five pins to secure the lock to the door so it can't be torn off. This information should be included in the manufacturer's literature. Double doors should have bolts at both the top and bottom that engage at least 15 mm (5/8 in.).

A variation on the basic deadbolt is the mortise lock, which combines the features of the spring-latch and deadbolt locks. A second is the vertical deadbolt, which has two bolts that grip the eyeholes or sockets in a special latch plate. These can provide excellent protection.

For fire safety, deadbolts in external doors must be operable from inside without keys, special devices or special knowledge. This rules out the use of double-cylinder deadbolts, which are opened using a key from both sides.

Sliding doors present a particular security problem. The standard locks they come with can be slipped or broken without much effort, and some can be lifted out of their tracks from the outside with a pry bar. To make them more secure, you can buy auxiliary locks with a slide or deadbolt of hardened steel—these are mounted on the frame or track. As with other deadbolts, these locks must be easily operated from inside.

To prevent the panels from being forced, consider installing a heavy-duty safety bar, which attaches the edge of one panel to the opposite jamb. You can also install special "jimmy plates," which fill the space above the panels so they can't be lifted. Both of these can be home made; you can use a stout board or hockey stick as a safety bar and sink screws into the top track in place of jimmy plates.

Better-quality locksets are likely to work better longer, and to offer better protection. For security purposes you can get strike plates that wrap around the edge of the door frame, or strike boxes that allow you to drive screws deep into the frame around the door. When selecting door operating hardware and locks, consider location and ease of operation by all family members as described in the section on windows.

Panel doors

These are built using a wooden frame consisting of stiles (the vertical members) and rails (the horizontal members). Panels of wood or glass are set into the frame, creating an attractive contoured surface that suits traditional architecture. Some solid- and hollow-core doors are moulded or embossed to look like panel doors.

Sliding doors

These have two or more panels that slide on a track. Some units have one moving panel, some have two or more. The most common type is the sliding glass patio door, which is essentially a big horizontal sliding window. Their energy efficiency can be low; check the Energy Rating, as you would with a window.

Aside from the basic construction types, there are different styles of doors to choose from, such as French and bifold doors. Because of the energy efficiency issue and the variety of demands, different styles are chosen for exterior and interior use.

The Door Choices charts show the choices available for interior and exterior doors.

Taking Stock

Whether and where you need new doors may already be apparent. However, if you're still forming your renovation plan, you can get a better idea of what needs to be done by doing a critical inventory of your entrance doors, and the doors in the area you'll be renovating.

Take a good look at the doors involved, their appearance, function and energy efficiency. Some of the common problems to look for follow.

- Worn or missing weather sealing: Modern doors come with factory-installed weatherstripping. However, it may have shifted or deteriorated. If the door is old, it may never have had effective weather seals.
- Ill-fitting frames: If your door shows large gaps between the door and the surrounding jambs, it may never have been installed properly.
- Warped doors: This can also cause gaps between the door and the jamb.
- Misaligned strike plates: If the door has sagged over the years, the latch may not meet the strike plate on the jamb exactly the way it should. This can make the door fail to catch and stay slightly open, letting in a lot of air.

DOOR CHOICES: INTERIOR

Type of door	Construction	Comments
Flush	Flat, hollow or solid core.	Solid core can offer better soundproofing.
Moulded	Hollow- or solid-core door with a moulded or embossed surface that looks like a panelled door.	Fancier appearance, may cost more than flush door.
Panelled	Wooden doors made in traditional panelled style. Can take door panes.	Traditional, elegant look, especially if you use a natural finish. May be more expensive than moulded door. Louvred panels available for extra ventilation.
Sliding	Two or more panels that slide on a track. Wood panel or mirrored available.	Often used for wide openings such as closets. Mirrored sliders serve as door and wall mirror, can make room look bigger and brighter. Doesn't allow entire space to be opened at once.
Bifold	Folding doors slide on track. Hollow-core, panelled, mirrored or louvred units available.	Good for closets and other places where swinging door would be inconvenient. Made to fit common door openings.

DOOR CHOICES: EXTERIOR

Type of door	Construction	Comments	Energy efficiency
Solid wood	Flat, flush or wood panel.	Traditional standard for entrance doors. Match traditional architecture. Must be painted.	Not good insulators.
Metal	Can be flush or panelled. Usually come pre-hung in a metal frame, which provides a good security barrier.	Needs a good thermal break to prevent heat conduction. Can warp if there is a big temperature difference between the two sides.	Good insulators. Insulation values up to R15 (RSI 2.6) with core of rigid polyurethane insulation.
Fibreglass	Much the same construction as metal doors, but has a fibreglass skin that is sometimes textured to look like wood.	Low-maintenance finish. However, skin can also be painted or stained. Tends to be expensive.	Similar to metal doors.
Sliding patio	Glass panels slide on a track. Frames can be made of clad wood, vinyl or metal. 2, 3 or 4 panels common.	Needs special locks for security. Should use tempered glass to prevent injury. Screens available for summer ventilation.	Can be inefficient, creating heat loss in winter and overheating in summer.
French	Hinged doors installed in pairs.	Elegant looking, sometimes used as a more energy-efficient alternative to patio door.	Good: doors with centre post can use compression-type seals like a casement window.
Garden	Looks like sliding patio door, but hinged like French doors. Has up to 4 panels.	Sliding screens available.	Good: uses compression-type weatherstripping.
Storm	Glassed doors with pneumatic closing device.	Adds some protection from the weather. Can cause main door to blister or warp in hot, sunny locations.	Poor: don't add significant insulation value or form tight seal.
Screen	Mostly wooden doors with built-in screens. Fancy designs available.	Nice for summer living. Check for strong hinges and a sturdy closing mechanism, since these often get rough use.	No insulation value, provide ventilation.

- Unsealed frames: If there is air leaking in around the door, it may be coming through the structure around the frame. This can be a major source of air leakage.
- Inadequate locks: Your door may have an old slip-latch lock that can be easily breached with a credit card or a pry bar. It may also have become worn and fail to work properly.

Aside from looking at the doors you have, your inventory may also involve looking at places where you don't have doors, but may need them. Look at the traffic patterns in the house to see if you're well served by the doors you have. Then experiment by adding new doors to your renovation drawings of the rooms involved, deleting doors that are unnecessary, or moving the existing ones to improve access to key rooms. Sometimes you can improve the room layout if you move a door that has been cutting a wall in half.

These considerations are especially important if you're working on the design for new rooms. You'll need to look carefully at your drawings of the new space and the whole floor plan to decide how many new doors are needed, and where they should be. Write down your findings on the Door Assessment Worksheet.

DOOR ASSESSMENT WORKSHEET

Location	Type	Condition	Comments

What Are the Options?

Having looked at your existing doors and your needs for access, you should have a good idea of your needs. For new construction, the main options involve what kind of doors to buy, how many to install and where to locate them. For existing rooms, however, there are four major options.

- Upgrade the doors you have.
- Replace or remove the old door or doors.
- Reverse the swing direction into or out of the room or move the door hinges to the opposite side so the door swings the opposite way.
- Install extra doors where you didn't have them.

Upgrades

Doors are prone to a number of faults, as outlined above. In most cases, fixing an older door is a lot cheaper than buying a new one, and it saves the consumption of a lot of materials and energy. In many cases, you can make a door more functional and (in the case of exterior doors) more energy efficient with a little work.

The Door Upgrades chart lists the possible upgrades to cure door problems.

Replacement

In some cases, the best option is to buy a new door. This strategy has several advantages. A new exterior door will give your house a fresh new look. It should also have some modern features such as an insulated core, high-quality weatherstripping and, perhaps, a high-security metal frame. A new interior door can also improve your decor, especially if the old one was looking tired. And it may operate better and offer advantages such as better soundproofing.

DOOR UPGRADES

Problem	Upgrade	Materials	Comments
Worn or missing weathersealing	Install good-quality new weatherstripping.	Tubular gaskets, rubber or foam compression strips, spring-loaded or "bumper" strips, door sweeps, thresholds with vinyl bulbs.	Can reduce air leakage around door.
Ill-fitting jambs	Use wooden shims (thin pieces of wood) to raise jambs so they fit the door properly. Add weatherstripping.	Wooden shims, weatherstripping.	Can reduce air leakage around door.
Warped door	Lay wooden door flat for a few days so gravity can straighten it; works on small warps. Install third hinge to pull door into line.	Hinge.	Works in some cases. Can make door work better and reduce air leakage.
Misaligned strike plate	Reinforce hinges so door hangs in right position; reposition strike plate slightly and re-cut opening in the frame.	None.	Can make door work better and reduce air leakage.
Unsealed frame	Remove door casings and seal gaps around the frame.	Polyurethane foam, caulking, foam backer rod. (Take care not to warp the frame with expanding foam.)	Can reduce air leakage around frame.
Worn or inadequate lockset	Replace lockset with new one that provides better security.	Lockset with deadbolt lock. Wrap-around strike plate or strike box (optional).	Makes door more resistant to intruders.

Generally, you need to replace your door if it:

- is badly warped and can't be fixed
- is broken or damaged
- fits badly and (for exterior doors) can't be made airtight.

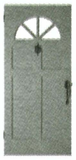
However, you may also want to replace an exterior door to improve the house's appearance, or to put in a unit with a door pane or sidelight that will bring more light into the entranceway. And you may want to replace an interior door to give the room a new look.

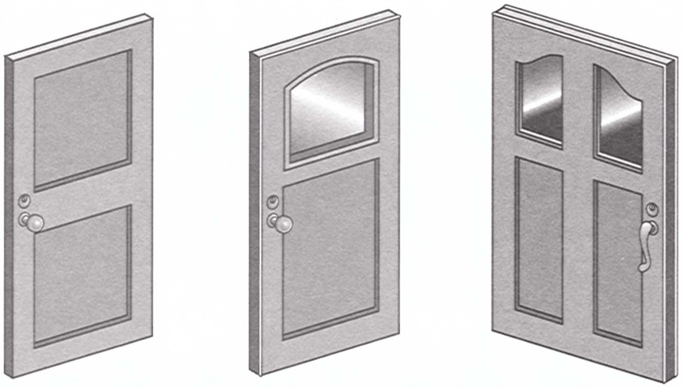
Installing new doors

This is much like installing a window, only with a higher opening. It involves cutting a hole in the exterior wall, building a frame for the door, and installing the new door in it. In some cases, you will have to support the wall structure above with a steel lintel until the new framing is in place.

How to choose a new door

If your old door isn't salvageable, or if new doors are needed, you have a wide choice among the variety of doors on the market. Most people make their decisions based on style and price. However, think as well about the quality of the door you're buying. Like windows, doors have a long life span, so you'll live with your decision for a long time. A better-quality door will likely serve you longer, saving the cost of replacing it. For an exterior door, think also about its energy and security features.





Try to look at a number of doors at building centres and door and window dealers. Here are some points to look for.

Exterior doors

- ✔ Materials: Make sure you know what material the door is made of; check the Door Choices chart for information about its properties.
- ✔ Quality: Look for sturdy construction and smooth action. If hardware is included, what type and quality is it?
- ✔ Style: The door should match the style of your house and of any other visible doors.
- ✔ Energy efficiency: Check what kind of weatherstripping the door has, and whether it has a core of insulation. What is its R value? (The manufacturer's literature should give this information.)
- ✔ Maintenance: Is the finish low maintenance, or will it have to be repainted periodically? This can cost you a lot of time and paint over the years, upkeep that would be avoided with a no-maintenance finish.
- ✔ Convenience: Find out if the door comes pre-hung, with the hardware included, or if you have to order this separately.

Interior doors

- ✔ Materials: Make sure you know what material the door is made of; check the Door Choices chart for information about its properties.
- ✔ Quality: Look for solid construction and smooth action. If hardware is included, what type and quality is it?
- ✔ Style: The door should match your decor. Can you stain or paint it easily to get the look you want?
- ✔ Maintenance: The finish should resist marking and be easy to clean.
- ✔ Convenience: Does the door come pre-drilled? Is hardware included, or will you have to order this separately? Can the door be easily trimmed to fit your door opening?
- ✔ Function: How sturdy is the door? Will it offer a good barrier to noise?

Making a Plan

Deciding how to improve your doors can be a simple matter or a complex one, depending on how big your renovation is. To make the decision easier, use the Door Goals Worksheet to define what you want to accomplish with the project.

Use the different headings to identify your goals: for example, under the Energy efficiency heading, you might want to remedy a chronically drafty door that chills the kitchen or family room; under Access, you might want to add a side door that allows you to come in from a new patio. Include any features you'd like and rank your wishes as high priority—things you must have—and low priority—things you want but could live without.

Once you've identified your goals, you can focus on how to go about fulfilling them. The sections above should give you enough information to know what the options are in your situation. On the Door Options Worksheet, list the ones you're considering, with their advantages and disadvantages.

When you've decided on your strategy, you can look seriously at making a choice among the door units you're considering. Using the criteria mentioned in the Options section, narrow the choice to two or three units, and compare them using the Door Choices Worksheet. When you've made your purchases, update the worksheet so you'll have a record for future reference. Also attach all receipts and other project documents to the page so they'll be handy if you need to look at them.

Locating new doors

If you're laying out a new room, a big part of your plan involves where the doors should be to provide the best access to the room without disrupting the overall design. Doors can swing either to the right or to the left, so decide which will best allow the door to swing out of the way.

An interior door should work with the traffic pattern in the house, leading people naturally between rooms without a lot of extra steps. But it shouldn't waste wall space. A door in the middle of a wall will cut it in half, leaving two areas of less usable space instead of one long wall suitable for cupboards or hanging decorations.

An exterior door, meanwhile, should lead into the house in a convenient spot that doesn't add a lot of extra steps outdoors.

DOOR GOALS WORKSHEET

Goals	Priority (high/low)
Appearance	
Efficiency/comfort	
Security	
Access	
Maintenance	

DOOR OPTIONS WORKSHEET

Option	Method/materials	Advantages	Disadvantages	Cost
Upgrade old doors	1.			
	2.			
	3.			
Replace old doors				
Add new doors				

DOOR CHOICES WORKSHEET

	Style	Materials/features	Energy efficiency	Price	Date purchased	Supplier (address, phone no.)	Comments
Unit 1							
Unit 2							
Unit 3							

It should also be located so the new entrance doesn't disrupt traffic patterns inside. If you're adding a new exterior door, there should be enough free space inside for people to take off overcoats and boots without creating a permanent mess.

Think, as well, about drafts. A new door leading into a kitchen or first-floor hallway can send regular drafts of cold air into the living areas of the house during winter. This can make the house less comfortable and increase your heating bills. If you're putting in a new exterior door, think about adding a mud room or air-lock vestibule—a small entrance hall with a second set of doors that can stop the cold air while the outer door is open. This also gives you a place for coats and other outdoor gear.

You can minimize drafts, however, by considering the wind and weather before you decide where to put the new door. If you can avoid it, don't put a door where it faces the prevailing wind; an extra opening in a north wall, for example, can be a big potential heat loss, especially if you're installing patio doors. If it's unavoidable, try using a wooden screen or some shrubs to create a windbreak for the door, or locate it in a sheltered spot.

CHANGING THE SYSTEM

Since a house is a system, remember that making changes to the doors can change the air flows inside the house. Adding new doors may increase the amount of fresh air coming into parts of the house, especially if they're opened frequently. This can make the heating system work harder. Meanwhile, tightening the existing doors can decrease the overall air flows, which can raise the need for extra exhaust fans or fresh air intakes. Your renovator should be able to discuss these issues with you before the project begins. Chapter One contains a full discussion of the house as a system.

Who'll Do the Work?

As with windows, you can have new doors supplied and installed by your renovator, buy them separately and have your renovator or an outside contractor install them, or buy them and put them in yourself.

Most door repairs can be done by a handyman with some carpentry skills, and installing pre-hung replacement doors in an existing frame may also be within your reach. However, the installation must be done right or the door won't work properly (see Installation notes, below). Don't attempt the job unless you have the necessary skills.

Installing a door in a new location is more complicated since it involves cutting a new hole and building a door frame, with double members above the door (a "header") and extra studs on either side ("jack studs") to bear the weight of the structure above. For this, you'll need a professional. If your renovator isn't installing the doors, you can hire a carpenter. Carpenters can be found in the Yellow Pages™, but friends may be able to refer you to someone trustworthy. In some cases, the dealer who sold you the door may do installations.

Follow the guidelines in Chapter Three for hiring a tradesperson. Get three quotes, and make sure the person you hire is qualified and experienced.

Counting the costs

Doors are usually not a major expenditure, as renovations go. Your investment will vary depending on the materials, the quality and the style you buy. As with windows, it can pay to spend more money on a good-looking front entrance door with a sidelight and spend less on buying plain but good-quality units for a side or back door.

However, it's still false economy to buy a unit that doesn't have good energy efficiency or adequate security in order to save money. Yearly heating losses or a break-in can cost much more than you'll save.

Installation notes

Doors require a specific rough opening in the wall, which must be reinforced with extra "jack" studs on both sides and a "header" to carry the weight of the wall above. In exterior doors, extra shims (thin pieces of wood) and a wooden block should be added to the wall structure at lock height, to stop intruders from forcing the frame apart.

Installing pre-hung doors is not complicated. However, they must be shimmed properly to make them plumb and level, or the door may swing open or shut by itself. In an exterior door, the frame should then be sealed to the air barrier to avoid air leaks. The spaces between the door frame and the rough opening should also be filled with batt insulation and a sealant, or with polyurethane foam.

Main entrance doors usually open inward, with a storm door on the outside. If you have built your exterior wall extra deep to include more insulation, main doors must be installed flush with the inside surface. You will also have to use extra-wide jambs and an extra-wide sill, which may have to be specially made. Sills should be sloped slightly toward the outside to let rain water run off instead of collecting.

To avoid warping, wood doors should be stored flat before installation and, once installed, left in the closed position until they're painted or finished. All unpainted edges should be covered with a primer-sealer to prevent them from absorbing moisture. Most doors come primed or prefinished, but finishes such as lacquer are not an effective moisture sealant. You should paint or seal the door as soon as possible.

FOR MORE INFORMATION

The following publications offer more information on windows and doors. The publication number for the CMHC publications is shown in brackets.

Canadian Wood-Frame House Construction, CMHC (NHA 5031)

Tap the Sun, CMHC (NHA 2000E)

Consumer's Guide to Buying Energy-Efficient Windows and Doors,
Natural Resources Canada

Chapter Seven

PAINTS AND FINISHES

- *visual impact—and health impact*
- *taking stock*
- *working healthy*

Painting and wallpapering can be a stand-alone project or the last job in a bigger renovation. However, while choosing and applying the wall finish may not be a major structural job, don't treat it merely as an afterthought; these final touches can significantly affect how you feel about your house, and they can make or break a larger renovation project.

Whether you're renovating or just changing some of the furniture, you've likely spent a lot of time choosing the right styles and materials for all the different elements involved. But the paint, stain or paper that covers the space may be the largest component you're going to see once the job is done, and it will make the biggest visual impact. Depending on the materials you use, it can also have an impact on your health. So, it's never too early to start thinking about finishes.

If you're doing a major project and hiring a professional renovator, painting and finishing will likely be included in the contract. But, because this is one aspect of the project that depends heavily on your personal taste, it's important to have a good idea of the colours, textures and materials you want to use before you take your plan to a renovator or a designer.

What Are the Issues?

- Appearance: The colours, textures and patterns you choose must complement any renovation you're planning, as well as the rest of the house. You have to plan the colour scheme and the textures you'll use at the same time as you're choosing appliances, floor coverings and the other components that go into a renovation. That way, your renovation will be a co-ordinated unit rather than a collection of elements simply thrown together.

This is a project that can test your creativity. There are a lot of different wallcoverings on the market that can give rooms a unique look. Sometimes, you can even make the renovation look bigger or more expensive than it really is.

- Protection: Paints and other finishes serve to protect building surfaces as well as to improve their appearance. This is especially important with outside surfaces that are vulnerable to heat, cold, rain and snow. However, indoor surfaces also need protection from moisture, stains, and wear and tear.

- Materials: Getting a good finish means matching the right materials with the right job; this is especially critical if you're going to be painting or papering yourself. You also have to make sure the finish is applied properly. A bad paint job can crack or blister, and waste lots of time and effort. You may find yourself repainting a lot sooner than you expected, or having a dispute with the painter you hired. If you're refinishing old walls and ceilings there can also be some repairs involved.

- Health: Finishing has its own health concerns. Paints and other finishes are a major source of emissions during a renovation job. Especially if you're sensitive to irritants, you'll want to minimize those emissions by choosing the least polluting type of finish. As well, the repairs that may be necessary before the application of the final finish can raise irritants. And there are some special problems, such as lead contamination from old paint.

Taking Stock

The first step in planning your finishing job is to take an inventory of the surfaces that are going to need finishing. These come in a variety of shapes and sizes in most jobs, but they can be divided into two main categories: new surfaces and old ones.

New surfaces include both new construction and old walls or other surfaces that you're going to gut and refinish. Your floor plan will lay out how many new walls, ceilings, and window and door frames will have to be finished, so it shouldn't be difficult to identify what needs to be done. However, you also need to choose a finish for every job, so it's necessary to make a list of each type of surface so you can match it with the right paint, wallpaper or other finish.

Finishing new surfaces can be labour-intensive since the materials are new and can be porous. New wood, for example, often absorbs large quantities of paint. Surfaces like wood and drywall usually require a first coat—a primer coat—before the finish coats can be applied.

Finishing old surfaces can be simple, or it can be problematic. Leaving the old walls and ceilings as they were and painting or papering over them is the least expensive way to renovate and still get a new look. However, old surfaces and old paint or wallpaper can deteriorate over the years and may need some repairs before they're refinished. So, it pays to look at those old walls before you start choosing what paint to use.

Are the walls sound? Just covering them over won't fix real problems with the plaster or drywall, although wallpaper and some paints may hide them somewhat. If there is any water damage, or there are cracks or uneven surfaces, these should be patched before the new finish is applied. In some cases, the best way to repair a badly damaged wall surface is to put new drywall over it and start afresh.

A second consideration is the kind of finish that is already on your walls and ceilings. Old paint can usually be painted or papered over with no problem, but some types need preparation. For example, glossy paints need to be sanded for the new paint or paper to stick. And there can be more serious problems, such as deteriorated paint surfaces, which can spoil a new paint job.

Paint is subject to a large variety of problems. These include:

- cracking and scaling, caused by a low quality or badly applied paint—surface must be scraped or stripped before repainting

- peeling, caused by moisture under the paint or unsuitable surface—surface must be scraped or stripped before repainting
- blistering, caused by painting over a damp surface—surface must be sanded or scraped before repainting, and dampness problem must be cured
- "alligatoring," a checkerboard cracking of exterior surfaces due to excessive paint layers—surface must be scraped or stripped before repainting
- chalking, a white powder caused by paint breakdown—surface must be washed with detergent before painting
- mold, which appears as dark spots on the paint—surface must be washed with chlorine bleach solution before repainting. Since mold is a sign of a moisture problem, no painting should be undertaken until the problem is solved.

Wallpaper is also prone to peeling, blistering and mildew as time goes by. The only solution here is to peel off the old wallpaper and replace it.

The best way to appraise all these factors is to do an inventory of the surfaces in the area you're planning to decorate or renovate, deciding how many will have to be painted. By actually measuring the surfaces, you'll also get an idea of how big a job you're facing. You can use these measurements later in calculating how much paint or other finish you'll have to buy. If you're building new walls, use your scale drawings to assess the surfaces and their sizes.

Use the Finishing Assessment Worksheet to get an inventory of the new or existing surfaces you'll have to refinish. For each surface, mark down the size, its condition and any repairs or preparation it will need. Also mark down any window or door frames and trim that will have to be finished.

For an indoor renovation, the surfaces include walls, ceilings, doors, window frames, cabinets and trim, including baseboards. For an exterior job, the surfaces include siding, doors, window frames, soffits, porches and railings.

In some cases, wallpaper may have to be stripped before you refinish a wall or ceiling. This is usually not a major job, but it can be time-consuming and messy, and must be included as one of the steps in your renovation plan. At the same time, be prepared for what you find under a coat or two of wallpaper; it may have been used to cover a bad wall surface.

FINISHING ASSESSMENT WORKSHEET

Room	Surface	Size	Existing finish	Condition	Repairs/preparation need

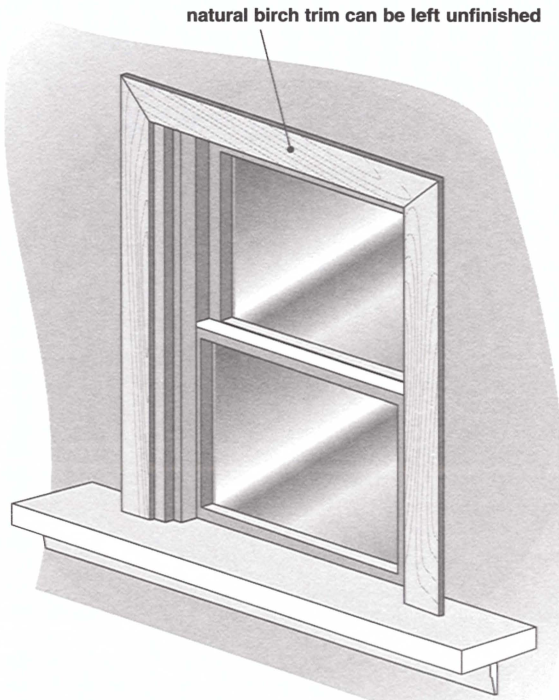
What Are the Options?

Strategies

The strategy for finishing your renovation or sprucing up part of your house may be as simple as painting the walls and trim. However, once you're committed to a refinishing job, it can make sense to broaden the project and include some other rooms that need a new look. In some cases, this may be helpful in making adjacent rooms harmonize with the colours you're using in the renovation project.

The second major choice is the type of finish to use for different areas.

- Paint: The most common choice, is versatile and relatively easy to apply, and you can achieve a wide variety of effects through the choice of paints and techniques.
- Wallpaper: An attractive alternative to paint, it allows you to use textures and patterns that would be difficult to achieve with paint, and can be useful for less-than-perfect walls.
- Wood finish: The look of natural wood can be an attractive accent. However, to protect the wood and achieve the desired colour, most people use some type of finish on the wood.
- No finish: A healthy option is to use wall materials that can be left unfinished. Good-looking trim or panelling made of hardwood or birch can be left bare for a clean surface that gives off few chemical emissions. (Some softwoods, such as pine and spruce, do give off volatile chemical vapours.) Unpainted plaster has a clean look and very low emissions. These options save you the cost and labour of applying a finish. However, they can be harder to keep clean.



Using colour

Creating a colour scheme is an important job, since it will determine the overall look of the finished work. Walls can be painted over later, but the initial colour scheme is important because it will influence your choice of other components and materials, such as flooring, which can't be changed so easily.

There are two main approaches when it comes to colours. One is to make all the walls the same colour to create a continuity throughout the house. The other is to finish different rooms different colours in order to set them off from one another. Traditionally, kitchens are finished in bright colours, living rooms, dining rooms and bedrooms in more muted tones, and bathrooms in light, clean-looking colours.

These aren't hard and fast rules, however, and you can get unusual effects by using non-traditional colours. But remember, you'll have to live with the results, and strong colours can be hard to cover. Remember also that for resale, neutral or muted tones are the most acceptable.

The size and shape of the rooms is another consideration when you're choosing colours. Small rooms can be made to look larger by using light colours, and large rooms can be brought down to more human proportions by using darker tones. You can also add interest and change a room's visual proportions by combining colours. Examples include:

- painting one wall a different colour from the rest
- finishing one wall with wallpaper or wood panelling
- painting or papering a contrasting border around the edge of the room
- finishing the ceiling in a different colour or pattern from the walls
- painting doors and windows a contrasting colour from the walls around them.

The combination of colours can play a big part in how each colour looks. For example, it's not recommended to use two intense colours together, since they tend to "fight" each other, creating an unsettled feeling. Your paint and wallpaper dealer can give you chips and samples to use when putting together the colours for your job.

If you have a hard time visualizing just how different colours and patterns will look in the space you're finishing, try using graph paper to make some scale drawings of the rooms involved, then approximate the colours with water paints or coloured pencils. This can also be done using a home planning software kit on your home computer. Remember to co-ordinate the colours in adjacent rooms so the transition isn't jarring as you walk through the door.

Also, be aware that colours may not look exactly the same after they're applied and all the furnishings are in the room, since lighting and reflection play a big part in how colours are seen. Paint colours can also look different depending on the colour of the underlying surface, how many coats you apply and the type of the paint you use.

Textures and techniques

Along with colour comes the issue of texture. Every surface has a texture, even a plain interior wall covered with flat paint. But there are many other textures you can use to give walls and ceilings extra interest and a feeling that matches both the room's purpose and your decor.

Aside from using paints that have different looks and surfaces, there are many ways of adding extra texture to walls and ceilings. For a wall that needs some extra interest, you can create a spattered or shaded effect using a glaze and special brushes or sponges (see Tools, this chapter). For a room with a rustic or Mediterranean feeling, for example, you can choose a textured paint for a stucco effect. All these add a visual note that changes the feeling of the room, and some can even cover minor defects in the wall surface.

A second alternative is wallpaper. You can use it just to give a different look to one or all the walls. Or you can opt for a paper with a textured finish, or use a fabric wallcovering to provide extra texture. Then there's the option of covering one or more walls with wood panelling; this can be used on the ceiling, as well.

Paint

Paint is the primary choice for most home decorating jobs, and it's usually the simplest way to cover a large surface. However, that doesn't mean it's a simple material; there are different types of paints, with significantly different characteristics. Before you do a paint job, you should know some basic facts about the paint you're working with. The kind of paint you choose depends on the look and texture you want, and the type of material you're covering. As well, some paints can have an effect on your health, so you need to make a healthy choice.

What You Should Know about Paint

In order to do a number of different jobs, paints are made using different formulas that vary their performance.

Generally, all paints contain four basic elements:

- pigments, which contain the colour
- a binder, which forms a skin on the painted surface
- a thinner, either water or a solvent, in which these ingredients are dissolved or suspended (the thinner evaporates once the paint is applied to a surface)
- additives, which include such things as thickeners and fungicides for mildew.

There are two main types of paint, depending on the thinners and binders used.

Water-based or latex

These paints use water as a thinner. They are often called latex paints, but they don't use real latex, or rubber, as a binder any more. Synthetic latexes are used, most commonly acrylic and polyvinyl acetate (PVA), which are sometimes combined in the same paint. Paints with a high acrylic content tend to have a tougher skin, and can be used in place of oil-based or alkyd paints (see below). Water-based paints are available in most sheens, and are often favoured for indoor use because they have fewer emissions than oil-based paints. However, they are not as washable nor as durable as alkyd paints.

Oil-based or alkyd

Despite the name, few paints actually contain oil today. Most "oil paints" actually contain polyester resins called alkyds in a solvent thinner, so this type of paint is usually called an alkyd paint. In general, alkyd paints are best for surfaces that will get hard wear, such as doorways and exterior surfaces. They can achieve a higher gloss than latex. However, they have health effects that make them a less healthy choice than latex (see the Types of Paint chart).

Specialty paints

There are also a number of paints made with special attributes for special jobs. These can be either latex or alkyd paints.

- Ceiling paint: It has a special formula designed to dry quickly without dripping and is available in a bright white to hide irregularities. It can be tinted.
- Kitchen and bath: This comes in semi-gloss or high-gloss, is moisture-resistant and has an additive to resist mildew growth.
- Melamine paint: An enamel formulated for use on cabinets, doors and other surfaces where a hard, scrubbable surface is needed, this type is good for kitchens and bathrooms.
- Masonry paint: This is formulated for use on concrete floors or basement walls and offers some resistance to moisture.
- Acoustic paint: Meant for painting acoustical ceiling tiles, this paint doesn't clog the pores and diminish acoustic qualities.

- Floor enamel: A tough, hard-wearing latex or urethane-based paint, this is meant for wood or concrete floors.
- Glaze: These glossy, transparent latex or oil-based coatings are often used for special effects. They can be tinted with special "universal colours" and applied over an alkyd base, then worked to develop a pattern.
- Spray paints: Enamel paints, in small cans useful for details and small jobs are also available in special marbled or speckled finishes.

Sheen

Aside from the basic types, the other main difference between paints is the "sheen," or light-reflecting characteristics of the paint. A high sheen is glossy-looking, while a low sheen has a soft or muted look. The amount of sheen usually depends on how much pigment a paint has, relative to the amount of binder. The more pigment, the less sheen. The following are the sheens commonly found in both latex and alkyd paints.

VOCs

Volatile organic compounds, or VOCs, are a large family of hazardous chemicals found in finishes and other common household materials. VOCs include formaldehyde and related chemicals, benzene, xylenes and toluene, alcohols and mineral spirits. Their effects range from coughing and dizziness to serious conditions such as depression of the central nervous system.

TYPES OF PAINT

	Composition	Glosses	Washability	Durability	Best uses	Advantages	Disadvantages	Health concerns
Latex	Water-based, acrylic or PVA resins	Flat, eggshell, semi-gloss, high-gloss, enamel	Fair to good	Fair to good	Interior walls, ceilings, woodwork. Exterior walls, woodwork.	Easy to apply, dries in 3 to 4 hours. "Breathable" surface resists moisture damage. Easy clean-up with water.	Not as washable as alkyd paints. Interior latex not as durable as alkyd paints.	Better choice than alkyd paints, but still has some emissions. Low-emission brands are healthiest choice.
Alkyd	Solvent-based, polyester resins	Flat, eggshell, semi-gloss, high-gloss, enamel	Good	Good	Exterior siding, woodwork. Interior walls and woodwork.	Good weather resistance. Good adhesion on deteriorated surfaces or multiple coats of paint. Flows well for a smooth, level finish. Can achieve a higher gloss finish than latex.	Dries slowly, in 12 to 48 hours. Cleans up with mineral spirits.	Releases irritating emissions. Not recommended for most interior uses.

CHOOSING HEALTHY PAINTS

Because they are applied wet, and because they cover such a large area, paints can create a significant health problem during a renovation project. The problem is mainly caused by alkyd or solvent-based paints. They give off a number of volatile organic compounds (VOCs) as the solvent evaporates after painting. These can be a strong irritant; as well, they add to the general air pollution. Once the paint has completely dried and formed a tough skin, the emission levels drop. However, some paints can emit low levels of odours for a long time.

In most cases, the solution is to use water-based or latex paints. Since they use water as a thinner or base, there are no solvents to evaporate. Some latex paints do give off strong odours as they dry, but since the drying time is less than for alkyd paints, the problem is less pronounced.

Increasingly, manufacturers are selling "healthy" paints formulated to contain little or no VOCs or other irritants. These include both water-based and alkyd paints. But, low-emission alkyd paints may contain some irritating chemicals. These "healthy" paints so far come only in lighter shades although new darker colours will soon be commonly available. Many paints also carry the EcoLogo™ emblem of three intertwined doves that signifies they meet Environment Canada standards for reduced levels of VOCs and other irritants, as well as reduced environmental pollution.

Traditional low-emission paints such as milk paint, casein paint and mineral paint are also still available from specialty dealers. These paints can contain some irritants—some people are sensitive to milk—but, generally, the levels are much lower than for conventional paints. However, they may not wash well and may need repainting more often. Mineral paint is best for masonry and similar surfaces.

For situations that need the tough, water-repellant finish usually associated with alkyd paints, 100 per cent acrylic low-emission paints are a healthy choice. If you are going to use alkyd paints, try to confine their use to exterior jobs and small-scale applications such as wood trim.

Wood stains, sealers and varnishes also contain solvents and chemicals that cause health concerns. However, most are now available in water-based versions which have fewer harmful emissions.

RATING PAINTS

Healthiest	Low-emission latex paint, milk paint, mineral paint Ordinary latex
Least healthy	Low-emission alkyd Ordinary alkyd

- Flat: It has a soft, non-reflective surface suitable for general use and tends to hide imperfections in the wall surface as well as touch-up marks. It is the least washable surface.
- Eggshell: Also called satin or pearl, its surface has a little more sheen than flat paint and is a little more washable. It's good for areas where some marking is expected.
- Semi-gloss: With a higher sheen than eggshell and a more durable surface, this is good for areas such as kitchens, bathrooms and children's rooms, where regular washing is expected. It shows imperfections in the wall and touch-up marks more than flat paints.
- High-gloss: This paint has a shiny surface that's very washable. It's good for kitchens, bathrooms and playrooms where regular washing is expected.
- Enamel: This provides a high quality, dense coat with a very high gloss. It is good for trim, railings and outdoor furniture where a durable, glossy finish is desired. It can be alkyd or latex. Some types of high quality wall paints are often also called enamel.

BUYING PAINT

Many manufacturers make higher and lower quality lines of paint, so just choosing a brand is not enough to get the best paint; specify the premium line if that's your choice. Buying a manufacturer's "professional" line of paints may not assure high quality—the designation often just means they're made for fast application. As well, avoid mixing a primer or undercoat from one manufacturer with a finish paint from another; you'll get a better finish and fewer problems by sticking to one brand. Buy the paint all at once, making sure it's all from the same batch, so the colour is uniform. And remember to order a litre or two extra for later touch-ups.

Hiding qualities

One important quality of a paint is how well it covers the surface underneath, whether it's a new material or a previous coat of paint. This is called its "hiding power," and varies from paint to paint. If you're painting a hard-to-cover surface—often a dark or strong colour—look for a paint with good hiding qualities. Special high-hiding paints are available. If the can doesn't indicate a paint's hiding power, check the manufacturer's literature or ask the dealer.

Primers and sealers

For some paint jobs, especially where you're covering new material or a hard-to-cover painted surface, you'll need to use a coat of primer or sealer before the finish coat goes on. The terms are often used interchangeably. In fact, some products are called a primer/sealer. However, a sealer is a finish meant to seal in stains or emissions in the material underneath, while a primer is a special paint that prepares the surface so the finish paint adheres better, covers with fewer coats and makes a more uniform paint job.

With painted surfaces, a primer is advisable if you're trying to cover a strong colour that would take three coats of finish paint. In applications like this, primers can be tinted the same colour as the finish paint for better hiding qualities. Today's primers are generally all-purpose—a latex primer can be used under alkyd paints, and vice versa.

The following are the main types of primers and sealers.

Interior

- Latex: Good for drywall, plaster and masonry surfaces, this type can be used under latex or alkyd paints.
- Alkyd: Good for wood, masonry and previously painted surfaces, it can also be used under latex or alkyd paints.
- Wood sealer: This type is specially formulated for treating new wood, including plywood, where stains from the wood might bleed through the finish coat.

Exterior

- Latex: For use on wood surfaces or previously painted surfaces such as siding, it can be used under latex or alkyd paints.
- Alkyd: This may adhere better to wood and previously painted surfaces than latex primers. It can be used under latex or alkyd paints.
- Masonry block filler: As its name suggests, it fills the gaps and seals the surface of concrete blocks and prevents the alkali in the concrete from deteriorating the finishing paint.
- Metal primer: This is used for sealing bare metal surfaces and can be either latex or alkyd.

The Paint Options charts list some recommended choices of primers and finish coats for a number of different interior and exterior paint jobs.

Special paint finishes

As mentioned, there are more options than just applying an even coat of paint to the wall or ceiling. By using your imagination and a few extra tools, you can use a special finish to add texture and interest to the rooms you're renovating.

These are some of the options.

- Sponging: Use a natural sponge to apply a "cloud" pattern of water-based paint over a contrasting undercoat or "base coat." More than one colour can be sponged on for a more dramatic effect.
- Washing: Apply two thinned coats of latex paint in random patterns over a white latex base coat, for a soft, subtle look.
- Spattering: Use a brush to apply a spray of latex paint to a light latex base coat for a speckled, textured look. A second coat of a different colour can be used if desired.
- Texturing: Apply textured paint to the walls, then work with a brush or roll them with a special roller for a stucco finish. This can hide irregularities in a wall.
- Lines: Use a contrasting colour to paint broad lines around the edges of the walls. This can make a large wall look smaller, or bring down a ceiling that looks too high.
- Stippling: Apply a coat of wet glaze to an alkyd or eggshell latex base coat, then texture the surface with a stippling brush for a slightly rough finish.
- Dragging: Apply a coat of wet glaze to a base coat, then drag a brush through it to make a pattern of soft lines. This method is best used on woodwork.
- Stencilling: Use ready-made or homemade stencils to paint patterns or borders on the walls in a contrasting colour.

INTERIOR PAINT OPTIONS

Surface	Primer coat	Finish coat	Healthy choice
Unpainted drywall	Latex	Latex, alkyd, 2 coats	Low-emission latex primer Low-emission latex paint 2 coats
Painted drywall	Latex, alkyd if necessary	Latex, alkyd, 1–2 coats	Low-emission latex primer if necessary Low-emission latex paint 1-2 coats
Unpainted plaster	Latex, alkyd	Latex, alkyd, 2 coats	Low-emission latex primer Low-emission latex paint 2 coats
Painted plaster	Latex, alkyd if necessary	Latex, alkyd, 1–2 coats	Low-emission latex primer if necessary Low-emission latex paint 1-2 coats
Unpainted wood	Alkyd, latex primer/sealer	Latex, alkyd, 2 coats	Low-emission latex sealer Low-emission latex paint 2 coats
Painted wood	Latex, alkyd if necessary	Latex, alkyd, 1–2 coats	Low-emission latex primer if necessary Low-emission acrylic latex paint, 1-2 coats
Acoustic tile	Not necessary	Acoustic paint, 2 coats	Low-emission latex paint, flat, 2 coats
Unpainted concrete	Block filler (concrete blocks only)	Masonry paint, masonry floor paint, 2 coats	Low-emission latex wall paint, 2 coats Low-emission latex floor paint 2 coats
Painted concrete	Latex, alkyd if necessary	Latex, alkyd, 1–2 coats	Low-emission latex primer Low-emission latex paint 2 coats

EXTERIOR PAINT OPTIONS

Surface	Primer coat	Finish coat	Healthy choice
Unpainted wood	Alkyd, latex primer/sealer	Acrylic latex, alkyd	Low-emission wood sealer Low-emission exterior acrylic latex paint, 2 coats
Painted wood	Latex, alkyd if necessary	Acrylic latex, alkyd, 1–2 coats	Low-emission exterior latex primer if necessary Low-emission exterior acrylic latex paint, 1-2 coats
Unpainted concrete	Block filler	Acrylic latex, alkyd, 2 coats	Low-emission exterior acrylic latex paint, 2 coats
Painted concrete	Latex, alkyd primer if necessary	Acrylic latex, alkyd, 1–2 coats	Low-emission exterior acrylic latex paint, 1-2 coats
Painted aluminum	Latex, alkyd primer if necessary	Acrylic latex, alkyd, 1–2 coats	Low-emission exterior acrylic latex paint, 2 coats
Painted steel	Alkyd spot primer if necessary (rust)	Acrylic latex, alkyd	Alkyd spot primer, if necessary (rust) Low-emission exterior acrylic latex paint, 2 coats

PAINTING TOOLS

If you're going to do the painting yourself, you'll need the right tools for the job. These are main choices for applying paint.

- Brushes: Nylon or polyester bristle brushes can be used for any type of paint and are less expensive than natural bristles. Latex paints should not be applied with natural-bristle brushes. Special brushes are sold for wood finishes. Brushes 51 to 102 mm (2 to 4 in.) wide are suitable for most jobs; for large areas, a 152-mm (6-in.) brush may be preferred, and for fine jobs, a 25-mm (1-in.) brush. Consider buying special brushes with angular edges for painting window frames, moulding and other narrow surfaces.
- Rollers: They can speed up large jobs and provide a more even finish. The length of the pile or nap on the covering (the part that applies the paint) varies; 6 to 13 mm (1/4 to 1/2 in.) is standard; longer naps are better for rough or textured surfaces. There are also smaller rollers for painting corners and trim. You'll need an extension handle to paint ceilings.
- Pads: Flat pads with a foam painting surface are handy for edges and other areas that are hard to do neatly with a brush. These come in several sizes.
- Power painters: These use hand or electric pumps to deliver paint to a roller under pressure. They can speed up a paint job, but add to the cost, and can waste paint.
- Paint sprayers: These speed up the job, and produce an even finish if used properly. However, they spread paint and fumes through the air, increasing health hazards. There are two types: air sprayers, which use compressed air to atomize paint, and airless sprayers, which use high pressure to create a spray. Airless sprayers may use less paint, but can be dangerous because of the high pressures used.

Wood Finishes

For some situations, such as wood floors and decks, you need a finish that protects the wood but doesn't cover its natural grain the way paint does. There are many products for this purpose.

What You Should Know about Wood Finishes

The traditional transparent finishes for wood are varnish and shellac, but most people now use synthetic finishes that are easier to apply and have fewer emissions. Most wood finishes still require several coats, however, which can make using them a time-consuming and labour-intensive process. Even one-step finishes that combine a stain and a finish may require more than one coat.

Like paints, wood finishes are available in a wide variety of shades, to match different types of wood and different decors. And some finishes, such as varnish and urethane, are available in matte, satin or gloss sheens.

These are the main types of wood finishes:

- stains, which colour the wood and bring out the grain
- sealers, which seal in sap and moisture, and prime the surface of open-grained woods such as oak, ash and mahogany so they absorb stain evenly
- varnishes, which add a hard, glossy coat on the surface of the wood
- urethanes, which are similar to varnishes but have a hard finish.

TYPES OF WOOD FINISH

	Advantages	Best uses
Clear stain	Reveals natural colour and grain of wood.	Panelling, trim, natural wood siding and floor surfaces.
Semi transparent stain	Colours wood but doesn't hide the grain. Penetrates the surface. Some contain water repellants.	Panelling, trim, natural wood siding and floor surfaces.
Solid stain	Contains pigment that obscures the wood grain. Not completely penetrating. Good protection against the sun. Can peel on horizontal surfaces. Oil- or water based.	Exterior siding, trim.
Sealer	Seals in sap and other emissions. Creates a natural look, emphasizes grain. Can be used before stain for even staining, or after, for protection.	Softwoods such as pine, other porous woods. Open-grained woods such as oak, ash, mahogany.
Alkyd varnish	Hard, durable finish. Matte and glossy finishes.	Floors, panelling, trim, door and window frames.
Urethane	Smooth, durable finish, not as hard as varnish. Easy to apply.	Floors, panelling, trim, door and window frames.
One-step finish	Urethane base. Stains and finishes in one step. Has hard, smooth, durable finish.	Floors, panelling, trim, door and window frames.

The charts, Types of Wood Finishes, and Wood Finish Options, show the main qualities of the major types of wood finishes, and the options for use in different applications.

Wood finishes and your health

Some wood finishes contain solvents, oils or other materials that can be strong irritants while they're being applied and while they dry. However, today, almost all wood finishes are available in water-based versions that are much less hazardous and produce a good finish. Water-based sealers may tend to raise the grain of the wood. However, these are available and are preferable to oil-based sealers.

Wood finishes, especially solvent-based ones, can also pose a fire hazard. Check the can for warnings, and keep cigarettes or open flames well away from the work site. And, take care when cleaning and storing the brushes and rags used; disposal should be done only at designated sites for hazardous waste.

Wallpaper

Aside from using a special paint technique, the best way to add some visual interest to a room (or several rooms) is with wallpaper. Wallpaper may be a useful choice:

- to add an accent to a dark or static-looking room
- to give a room a richer, showier look
- to make walls look higher, using a paper with vertical lines
- to cover a patched or unattractive wall surface
- to establish continuity from room to room.

Wallpaper can be applied over most surfaces. However, shiny surfaces should be sanded first, and all surfaces should be cleaned of any grease. New drywall should be sealed first with a latex sealer, to stop the moisture in the wallpaper paste from sinking into the surface. This adds an extra step, and some extra cost, to the job.

WOOD FINISH OPTIONS

Application	Option 1	Option 2	Option 3	Healthy choice
INTERIOR				
Trim, panelling	Clear finish (urethane).	Stain plus clear finish or one-step urethane.	Sealer plus stain plus clear finish.	Use water-based finishes, or no finish.
Floors	Clear finish (urethane).	Stain plus clear finish or one-step urethane.	Sealer plus stain plus clear finish.	Use water-based finishes.
EXTERIOR				
Trim, siding, door and window frames	Clear, semi-transparent or solid stain.			Use water-based finishes, or no finish.
Decks	Semi-transparent deck stain.			Use water-based finishes, or no finish.

Textured papers can be used to hide a poor or uneven wall surface. But there's a limit to how much wallpaper can hide; serious problems such as holes and large cracks may still show through, so a seriously damaged wall should be repaired before papering.

Wallpaper is often not recommended for new construction, since in the first few years the structure can settle and nails can pop. These problems are easier to fix with a painted surface than with a papered one.

What You Should Know about Wallpaper

Most of the wallpapers on the market today are pre-pasted vinyl papers, and either strippable or dry-strippable.

- Pre-pasted papers have a paste already applied to the backing, and can be simply wet in a tray and applied to the wall.
- Strippable papers leave the paper backing on the wall when the vinyl top coat is stripped off. This can then be removed with water or steam.
- Dry-strippable papers come off completely, leaving only some paste that can be washed off.

Most wallpaper is now sold in double rolls; in some cases you can buy single or triple rolls, depending on your needs. Patterns that repeat every 406 mm (16 in.) or less are easier to match from strip to strip and produce less waste than larger patterns. Random patterns such as dots or stripes minimize waste.

The most common types of wallpaper are shown in the Types of Wallpaper chart.

Patterns and textures

Standard papers come in an almost inexhaustible variety of patterns, from floral and rustic prints to geometric designs and patterns that simulate sponged or marbled paint finishes. Patterns are a matter of taste, but remember that a big pattern needs a big

TYPES OF WALLPAPER

	Composition	Attributes	Uses	Health concerns
Paper	Printed paper, with no coatings.	Difficult to wash without damaging finish. Now a small part of the market; available as inexpensive or high-priced specialty papers.	General use, not ideal for hard-use areas such as kitchens and playrooms.	Best choice. However, gluten-based pastes can harbour mold.
Vinyl coated	Paper backing covered with thin layer of vinyl.	Washable, not scrubbable. Available in variety of patterns and textures.	General use.	Healthier choice than solid vinyl. Gluten-based pastes can harbour mold.
Solid vinyl	Vinyl with no paper backing.	Durable and scrubbable. Available in variety of patterns and textures.	Suited to kitchens, bathrooms, playrooms.	Stronger vinyl odour than vinyl-coated. Gluten-based pastes can harbour mold.
Lining paper	Plain paper.	Used as underlay.	Good for covering rough, uneven or slightly damaged surfaces before other wallpaper is applied. Useful under shiny papers.	Gluten-based pastes can harbour mold.

wall, or it can be overpowering. Wallpapers also come in different textures, that make a difference to the feeling of the room and the reflected light levels.

The main textures in which commercial wallpapers are produced include the following.

- Flat: It has a matte texture much like flat wall paint but a softer look than satin finish. It's good for hiding wall imperfections.
- Satin: This has a slightly higher shine than flat and shows more wall imperfections. It adds more light to a room.
- In-register: In this type, the surface is engraved to heighten pattern details and create a more interesting texture.
- Embossed: Raised patterns on surface add texture. Some have look of mouldings or plaster and can be painted. It is good for hiding poor or irregular wall surfaces.

Special papers

If you want something special, and are prepared to pay extra, there are a number of choices beyond basic paper and vinyl papers. Specialty papers go in and out of style as the years go by, so be prepared to change them in a few years.

- Metallic: Foil and other metallic papers add a formal look; reflective surfaces can add light to a dark room or hallway but show faults in a wall surface.
- Flocks: Raised designs are applied to surface with a velveteen finish. They add a rich, traditional look.
- Fabrics: This type is made of fabrics such as burlap and grass cloth and add texture and a natural look.

Borders

These narrow strips of paper are a popular way to add a visual note without the work or expense of a full papering job. Used around the top of the walls, they can serve to make the ceiling look lower and add definition to a room; used at lower heights, they can make a transition between two wallcoverings or surfaces.

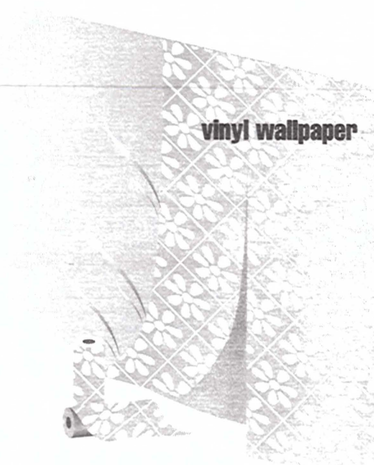
Wallpaper and your health

Plain paper wallpaper has few health effects. However, vinyl wallpaper gives off some irritating emissions because of the chemicals in the vinyl; vinyl-coated paper releases fewer emissions than solid vinyl. The gluten-based pastes used to stick wallpaper to the wall can also provide a home for molds if moisture gets behind the paper. Avoid putting wallpaper on surfaces that may have a moisture problem.

Dealing with old wallpaper

If you have old wallpaper on the walls, it can be removed with chemical strippers or with special steamers that can be rented. However, vinyl papers must be scraped or scored in order to let the chemical or steam get through to the paste. Special tools are sold for this purpose.

You can sometimes apply new wallpaper over old wallpaper, or over the backing of a strippable paper. This will work only if the old paper is adhering firmly to the wall, and can be risky. Painting over old wallpaper is not recommended, since the paint can seal the paper to the wall and you may never be able to remove it.



Making a Plan

Once you've assessed the areas you need to finish and looked at the options, you can begin to make an overall plan for the job. If you're planning an extensive paint job, it may help to define what you'd like to accomplish with the project first. Use the Finishing Goals Worksheet to help. Under the Appearance heading, for example, you might want to brighten the kitchen, living room and dining room. Under the Protection heading, you might want to protect the wood siding and window and door frames. It may also help to indicate whether each goal is a high or low priority, in case you have to make tough decisions.

If you're painting new walls or ceilings, or old ones that have been resurfaced, your goals will likely be clear. However, it may help to put your overall scheme down in writing before you start.

Choosing Options

After you've defined what you want to accomplish, you can start planning how your specific jobs can be done. Use the Finishing Options Worksheet to list all the jobs you have to do, and choose the best strategies and materials for doing them. The information in the What Are the Options? section at the beginning of this chapter can help you choose the right paint or other finish for each job.

A paint job may include a coat of primer, plus coats of finish paint; two coats are best for new surfaces, but one coat is usually sufficient for painted surfaces, unless they have a strong colour and will be hard to cover.

At the same time, include any repairs and preparation that must be done to make the surfaces ready for finishing. This can include patching walls, removing old wallpaper, or scraping or sanding the old paint finish. As well, all surfaces must be clean, so existing walls and ceilings must be wiped or washed.

The next step is to compile a comprehensive and specific materials list that you can use to plan the job, whether you're going to do it yourself or give it to your renovator or a painting contractor. In either case, you need to know the quantity, quality, brand, sheen and colours of each paint or wood finish you're using, and the number and brand of the wallpapers.

Remember that you'll also need tools to do the different jobs. If you're doing the work yourself, these will be extra expenses; if you're hiring a professional, they'll be part of the price bid. The list should look like one of the following, depending on the finish you choose.

Painting and finishing will require:

- brushes
- rollers
- paint trays
- drop cloths
- masking tape
- sandpaper
- solvents (for clean-up with alkyd paints)
- ladders/scaffolding

FINISHING GOALS WORKSHEET

	Priority (high/low)
Appearance	
Protection	
Health	

- masks, if using high-emission paint
- rags
- gloves
- protective clothing and hat.

Wallpapering needs:

- water tray
- scissors
- straight edge
- tape measure
- smoothing brushes or sponges
- utility or trimming knife
- seam roller
- plumb line (a weighted string for establishing vertical lines)
- ladders/scaffolding
- floor covering for spills.

Use the Finishing Materials Worksheet at the end of this chapter to identify the different strategies, finishes and equipment you'll use for the job. By finding out the prices of the finishes and other equipment, you can also use it to figure out the rough cost of the materials needed for the project. When you've made your purchases, update the worksheet so you'll have a record for future reference. Attach all receipts and other project documents to the page so

FINISHING OPTIONS WORKSHEET

	Option 1	Option 2	Option 3
AREA 1			
Surface			
Repairs/preparation			
Primer			
Finish (no. of coats)			
AREA 2			
Surface			
Repairs/preparation			
Primer			
Finish (no. of coats)			
AREA 3			
Surface			
Repairs/preparation			
Primer			
Finish (no. of coats)			

they'll be handy if you need to look at them.

Estimating

To figure out how much paint or wallpaper you need for a room, start by measuring the length of each wall surface to be finished. Add the length of all the walls and multiply by the height for the number of square metres or feet. For a room that's 4 m long, 3 m wide and 3 metres high, the calculation would look like this:

$4+4+3+3 = 14 \times 3 = 42\ m^2$

For paint, divide this number by the number of square metres or feet your paint will cover. This figure can vary depending on the paint and how porous the surfaces are, but a rule of thumb is that a 3.78 L (1 U.S. gallon) can of paint will cover about 37 m^2, or 400 sq. ft. if you've done your measurements in imperial units. Your dealer can help you do a final estimate. Finally, multiply by the number of coats you'll need to use.

For wallpaper, the calculation is more complicated. The width of wallpaper rolls differs. However, a double roll of 508-mm (20-in.) wide wallpaper measures about 5 m^2 or 55 sq. ft. After trimming and matching patterns, you'll get about 4.6 m^2 or 50 sq. ft. of usable paper from a double roll. A double roll of 686-mm (27-in.) paper covers about 6.7 m^2 (72 sq. ft.), or 5.6 m^2 (60 sq. ft.) after trimming.

You can get a rough estimate of your needs by dividing the total area of the room by this figure. But how many rolls you will need depends on the shape of the room, how many doors and windows you have, and how hard it will be to match the pattern of the wallpaper. As a rule, you can deduct one roll for each door and window. However, get your dealer to help you with the final calculation.

Who'll Do the Work?

Painting and papering are jobs most people are familiar with, so this is an area of the project you can likely do yourself and save some labour costs. It's not quite as simple as it looks, however, so before you take on a big job, make sure you have the necessary skills. A sloppy or patchy job can make the whole renovation look bad. There are some areas—a high stairwell, for example—that are hard for an amateur to paint or paper properly.

As well, make sure you know what materials are needed for the job at hand. Leaving out the primer coat where one is needed can spoil the look of the finished job, and using the wrong paint or finish can cause the surface to peel or crack. The information in this chapter can help you plan the job, but problems do arise that may need special solutions. Be prepared to ask your paint dealer if you're not sure what finish to use.

If you decide to hire a painting and decorating contractor, use the guidelines in Chapter Three for hiring contractors. Painters are easy to find, but as with most trades, the quality of their work can vary greatly. Make sure the contractor you choose is committed to doing all necessary preliminary work—patching and sanding wall surfaces, caulking or filling all cracks in the surface and around doors and windows, masking adjacent surfaces, and covering everything with drop cloths—before the painting begins. And make sure the painter will clean up afterward.

If you specify a low-emission paint in your materials list, make sure the painter or contractor is committed to using that product or equivalent. The ideal choice is a painter who has experience with a wide range of materials and a good knowledge of the health issues involved with painting and decorating.

Working healthy

The best way to minimize the effects of fumes during a painting job is to buy low-emission paints and finishes. However, if you're using paints or finishes with appreciable odours, supply as much ventilation as you can. Keep fumes from circulating through the house by closing off the area being painted and exhausting the air from the room with a fan blowing out of a window. Covering furniture before painting helps prevent it from absorbing paint fumes. Seal heating ducts in the room, and cover and seal hardwood, carpets or other flooring that could trap paint dust.

A second concern involves the hazards created when removing old paint. Scraping and sanding can raise dust that will spread around the house and get into people's lungs. Chemical strippers, meanwhile, contain chemicals such as methylene chloride that can be very hazardous, and heat strippers release the volatile chemicals in the original paint. If painted surfaces must be repaired or removed, supply lots of ventilation and wear an appropriate mask to protect you from dust or gases. As well, try to isolate the room to prevent the spread of odours and dust.

The storage and disposal of paints is also a health issue. Most paints give off some chemicals in a liquid state, so they should be kept sealed tightly and stored away from the living areas of your house when they're not in use and after the job is completed. An outside storage shed is preferred, but an indoor cabinet can be acceptable if it has a vent to the outside.

If possible, use leftover paint as a primer for another job, or give it to a neighbour. If you are going to discard it, take it to your local household hazardous waste dump. Never pour it down the drain; this pollutes the local water system.

Counting the costs

The Finishing Materials Worksheet should allow you to calculate the approximate cost of materials for the job. However, the biggest cost in a painting or papering job is likely to be the labour. That means you'll save significantly by doing the work yourself, if you're up to the job.

Generally, it's not worth trying to save money by buying low quality paint. Unless you're doing a very big job, the overall price difference between high quality and low quality paint is not large, and using good paint can save you having to redo the job too soon. That's a saving of time, money and resources. The higher quality paint will also give you a better, more even coat that's less likely to sag or crack.

It is possible to save money on wallpaper, since the price can vary greatly depending on the material and design. Using an expensive paper can add significantly to the cost of the job; if that's your choice and money is tight, try using it on one wall, or in a spot where you can get the most benefit using a moderate amount of paper.

DEALING WITH LEAD PAINT

Perhaps the biggest hazard when stripping or sanding walls is exposing old coats of lead paint that can raise dangerous fumes or dust that can damage the nervous system. Almost all surfaces originally painted before 1950 and most painted before 1976 have some lead. If you are doing extensive work (either renovations or sanding), or if children or pregnant women are present in the house, have the paint tested in a laboratory to find out how much lead it contains. If there are high levels of lead, susceptible people such as young children should not be in the house during the dusty work and should return only after a thorough cleaning.

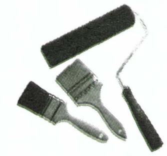
Use extreme care in working with surfaces that have lead paint. If the surface is in good condition and not accessible to children, choose a strategy that disturbs it as little as possible. Avoid sanding the surface, which releases lead dust, or peeling it using a heat gun, which releases lead fumes. Safe options include painting over it, or covering it with another wall surface such as drywall or panelling.

The best method of removing small areas of paint is to use a chemical stripper. But take care to provide lots of ventilation, as described in the section above (Working healthy). Wear coveralls, goggles, gloves and a respirator. Seal the area with a plastic dust barrier over doorways and vents. Cover all furnishings and floor surfaces with plastic sheeting and clean up thoroughly after the work is done. Before proceeding, consult the CMHC publication *Lead in Your Home* (see end of chapter list). If major repair or preparation work must be done, you may want to have the job done by a professional contractor. See Chapter Two for more information on lead paint and ventilation methods.

FOR MORE INFORMATION

The publication below offers more information on dealing with lead paint. The order number is shown in brackets.

Lead in Your Home, CMHC (NHA 6942)



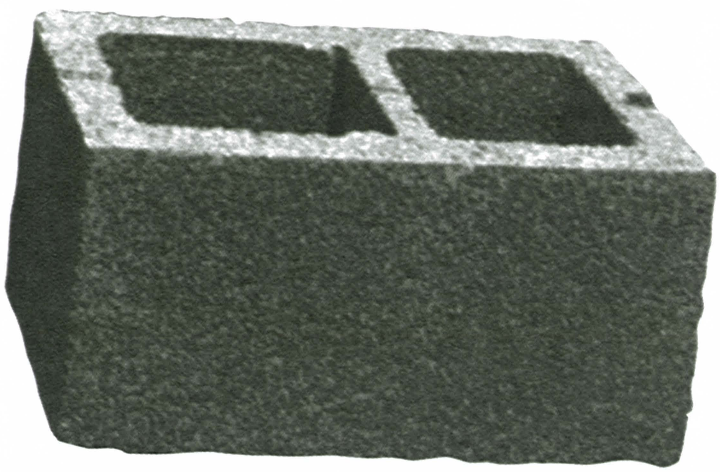
FINISHING MATERIALS WORKSHEET

Room or area	Finish	Colour/ pattern	Sheen	Brand/ quality	Quantity	Price	Total	Supplier (address, phone no.)	Date purchased	Tools/ extras	Comments

Chapter Eight

THE BASEMENT

- *easy, cost-efficient additional space*
- *what you should know about basements*
- *planning a habitable, healthy basement*
- *putting it all together*



Remodelling your basement is one of the easiest and most cost-efficient ways of adding new living space to your house. However, it 's a project that can take many forms.

Traditionally, most basement renovation projects were recreation rooms. But more and more, people are using their basements for other purposes, such as self-contained "granny flats," rental suites or home offices. Each of these uses has its own demands, and the plans for a separate flat will look very different from those for a simple recreation room. Still, all these projects involve the same basic jobs: adding floors, ceilings, walls and services to your bare basement.

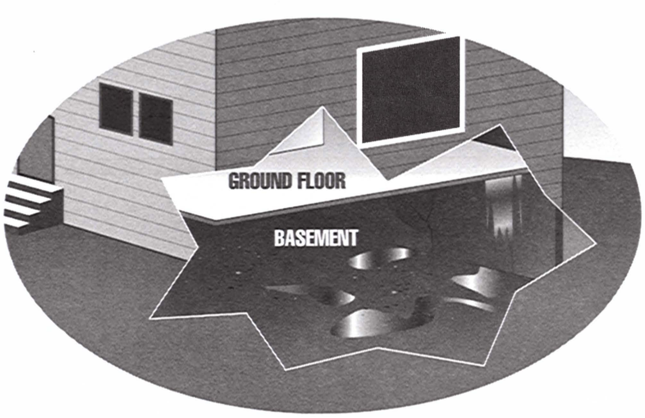
What Are the Issues?

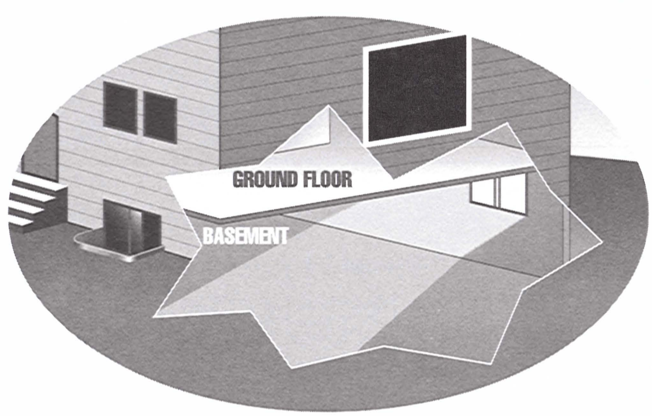
- Livability: Basements make good living spaces, but they can also be damp, unhealthy and uncomfortable. Ensuring that the space is clean, dry and healthy is a major part of the project, and something that must be done before anything else.
- Design: When you finish a basement, you're creating a new space that can take many different forms. What you use it for, and how practical it is for that use, are issues that should be given serious thought before you begin.
- Services: In order to be comfortable and suit your purposes, the new space will need services such as plumbing, heating and electricity. These must be hooked up from the existing services without putting an undue strain on them, or new service capacity must be added.

What You Should Know about Basements

The basement provides both a foundation for your house and an extra living space.

- The basement walls: Also called foundation walls, these are usually made of poured concrete or concrete block. In some houses, they are made of brick, stone (sometimes called rubble) or preserved wood. In wood-frame houses, the framed walls sit on top of the foundation wall. Services such as water and the electric power supply often enter the house through the basement walls.
- Footings: These are the wide bases foundation walls sit on. To keep water from building up around the wall and seeping through to the inside, the footings should be surrounded, on the exterior, by perforated drain pipes (called tiles) that carry water away from the house. Older houses sometimes lack this protection.
- The floor: Inside, most basements have a poured concrete floor, also





called a slab. Some older or rural houses may have a dirt floor, which can be the source of dampness and health problems.

There are several variations on the standard basement. Some houses have only a crawl space under the house, and others are built directly on a concrete slab on the earth. This is called slab construction, or slab-on-grade.

A Two-Part Project

There are two distinct phases in a basement project. The first involves ensuring the basement itself is ready to be finished. As mentioned, basements may pose serious health problems that can make finishing them a difficult and even hazardous job. Before you start building, you must make your basement a healthy and practical place to live.

The second phase involves designing and building the new living space in the basement. This can be a major project, or a modest one, since there are so many uses for a basement space. However, once the space itself is dry and habitable, much of the work is similar to construction in other parts of the house.

Making Your Basement Habitable

Because they're below ground, often made largely of concrete and equipped with major fuel burning appliances, basements are prone to a number of problems that can be bad for your health. It's absolutely necessary to identify these problems and fix them before you renovate. If you fail to do so, you might seal in some serious problems, and you won't be able to get at them later to fix them. You might also create even worse problems—water damage and mold inside newly finished walls, for example.

Recognizing these potential problems is especially important if you're building a basement apartment where people will spend much of their time. But it's just as important if you're finishing a recreation room, since your family will be using it for extended periods. In either case, you don't want to expose people to concentrated doses of irritants that can trigger allergies and chronic illnesses (see Chapter Two).

Problems can exist whether your basement is unfinished or whether it has been previously finished and is due for remodelling. In some cases, old wall surfaces can hide a host of problems that occurred because a damp basement was finished without being fixed.

Taking Stock

The first step in getting your basement into livable condition is to take a good look at it. If you've lived in the house for any length of time, or if you've carried out the health inspection included in Chapter Two, you may already have some idea of any problems that exist. However, it may still be worthwhile taking a close second look, searching for structural problems as well as obvious health hazards.

Moisture

Moisture is the most common problem in basements. The soil around the walls can be full of moisture, and in some cases, water finds its way through. This can happen when the basement wall has a crack or a leak, but it can also happen when the water is able to migrate through the wall itself, causing a humidity problem. A third moisture problem can occur in summer, when warm, moist air from outside comes into the basement, contacting the cool walls and forming condensation.

If you see evidence of a moisture problem, the important thing is to pinpoint the cause. It could be obvious—a crack in the foundation wall, for example. But it could be more subtle. If the dampness you see is due to water migration, the wall is porous and must be sealed. If it's caused by condensation, the problem may be fixed by making the wall warmer or the air in the basement dryer.

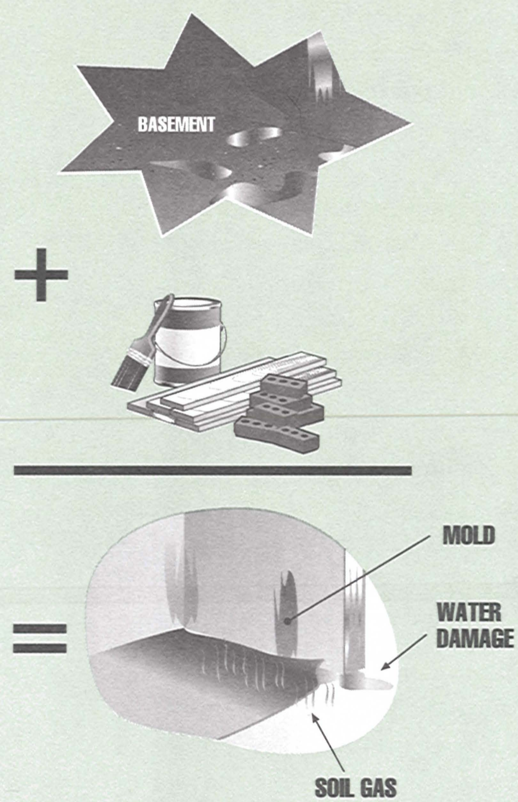
To find out, try this test: attach a square of polyethylene film to a dry section of wall, with caulking, and leave it for a day or two. If water develops on the underside of the sheet, it's migrating through the wall. If it develops on the top, it's condensation.

(This test is not conclusive, but can usually reveal a problem if it exists.)

Moisture can also be a problem in new houses. Before finishing the basement in a new house, it's best to wait at least a year to find out about any moisture problems and to let the new materials dry out.

DON'T BUILD IN A WET BASEMENT

If you cannot afford to fix a basement moisture problem properly, do not finish the space. Moisture will break down the finishing materials, the basement will smell and health problems may occur.



Combustion gases

If you have a fuel burning appliance in the basement—an oil or gas burning furnace or water heater, or a wood burning furnace, fireplace or stove—there's a chance it's leaking some of the gases created during combustion. These can include carbon monoxide, nitrogen oxides and hydrocarbons, all of which can have serious health effects. This leakage is often the result of a negative pressure in the house, that is, the air pressure in the house is lower than the air pressure outside. This can cause the appliances to backdraft and spill these gases back into the house instead of sending them up the chimney (see Chapter Two for more information on combustion gases and backdrafting).

Before you start your project, have your local utility or an authorized contractor test your furnace or other fuel burner for backdrafting, poor performance (which can also cause leaking of combustion gases), chimney problems or leaks in the oil tank or supply lines. If you have a forced-air system, the contractor or servicer should also check the heating ducts to ensure they are adequate for the basement renovation being planned.

Soil gases and radon

These gases can be a serious problem in many areas of Canada. All houses have some infiltration of gases from the soil, and if there are leaking fuel tanks or landfill sites nearby, soil gases can be a health hazard. Soil gases such as petroleum vapours and methane can cause chronic illnesses and even explosions. If you suspect that soil gases coming into your basement contain high levels of methane or other pollutants, contact municipal authorities to determine who can fix this problem.

Radon comes from uranium deposits in the soil and is cited as a factor in increased levels of lung cancer. Test for radon using a home test kit: these are available from some retail stores, mail-order services or through the Yellow Pages™ under "air quality services." Test over a three-month period in late fall or winter. If a home test confirms radon is present, you'll have to try to stop these gases from entering the basement.

Many indoor moisture problems are caused by moisture released from the soil and soil gases. Sealing the flow of soil gas is always important.

Asbestos

Especially in houses built before the 1980s, there may have been some asbestos used in the basement. This material, which can cause asbestosis and lung cancer, was sometimes used as a coating for ducts, pipes and furnace boilers. It is usually a gray, fibrous material. If you see an area of material that looks like asbestos, have it checked by a qualified contractor who specializes in this area before you disturb it in any way.

Structural problems

There is also a chance that problems have developed with the walls or floors of your basement over the years. Common problems include major cracks in the foundation wall or in the floor, deteriorated windows and wood rot in the ceiling joists. Cracks in the walls or floor may play a big part in a moisture or leakage problem. A dirt floor is also cause for concern because of its inherent moisture problem.

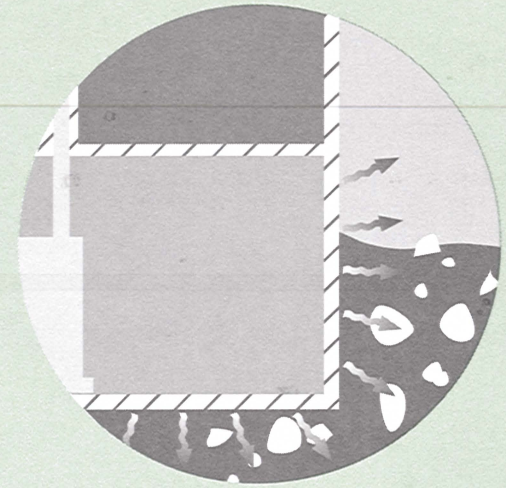
Lack of insulation

Most unfinished basements have no insulation in the walls. This can make them cold, and it increases the heating costs for the whole house. Installing insulation is a necessity if you're going to finish the basement, but it's also advisable if you're just going to make it livable. You can do this from the outside if you're excavating around the foundation or from the inside if you're not. At the same time, a polyethylene moisture barrier should be installed to keep the new insulation and wall materials dry.

The best way to find out if you have any of these problems is to make a complete tour of the basement, looking at the walls, floor and other structural features. Pull all the

THE VALUE OF INSULATION

The basement is often the last area homeowners think of insulating, but it's actually one of the biggest heat leaks in the house. Studies show that basements can account for 30 per cent or more of a house's heat loss. Part of the problem is that concrete is a poor insulator: just to deliver RSI 1.75 (R10) insulation value, the equivalent of a moderate insulation batt, a concrete wall would have to be 1,219 mm (48 in.) thick.



piled-up materials away from the walls so you can see into the corners. Look for problems such as:

- wet or damp spots on the walls or floor
- black, white or green stains from mold
- white stains or efflorescence where water is migrating through the wall
- flaking or crumbling (spalling) of the wall surface
- dark stains on finished walls
- blistering or lifting of paint or wall surfaces
- signs of rot or mushroom-like growth around the ends of ceiling joists and other wood
- warping or cupping of wooden wall or floor finishes.

As well, use your sense of smell to detect problems. An earthy or musty smell may indicate mold is present; a burnt or petroleum-like smell might indicate a problem with combustion gases or fuel leaks.

EFFLORESCENCE

Efflorescence is a white crystalline deposit on masonry walls caused by minerals carried to the surface by water.

BASEMENT PROBLEM WORKSHEET

Room measurements	Length	Irregularities	Width	Irregularities	Ceiling height	Irregularities

Feature	Type/size	Age and condition	Comments
Walls			
Floors			
Windows			
Entrance			
Storage space			
Electrical supply			
Plumbing			
Other			
Design problems	**Particulars**	**Effects**	**Comments**
Space			
Headroom			
Obstacles			
Other			

Use the Basement Problem Worksheet to list any problems you find in your basement. It may help to make a scale drawing of the basement to pinpoint problem areas.

What Are the Options?

If your Basement Problem Worksheet is blank, you can go straight to the planning stages for your basement renovation, described in the second part of this chapter: Finishing the Basement. However, if your inspection shows some problems, it's necessary to deal with them now before you go any further.

Some basement problems can be fixed fairly simply. However, if they are severe and difficult to correct, the repairs may be expensive. This might make you reconsider your renovation project, but it's better to choose an alternative plan than to create a long-standing health hazard.

Small problems

Some minor dampness problems may be possible to fix using relatively simple and inexpensive methods.

- Cracks in walls and floors can be repaired with mortar or a special hydraulic cement.
- Minor dampness can be reduced by covering the interior walls up to ground level with a cement-based dampproofing coating or water-based epoxy paint. (Ensure that this remedy does produce a dry basement over the next year before applying insulation and drywall.)
- Some water problems can be solved by:
  - extending your downpipes (the vertical pipes that run down from your eavestroughs) so they discharge farther from the house
  - adding splash blocks, flat receptacles that deflect the water away from the house at the bottom of the downpipe
  - sloping (also called grading) the ground around the house so water runs away from the basement walls instead of toward it.

More information on finding and fixing moisture problems is contained in the CMHC publication *Investigating, Diagnosing & Treating Your Damp Basement.* (See the list of suggested reading material at the end of this chapter.)

Getting professional help

If these cures don't solve the problem, or if you can't find the cause, it is worth seeking the advice of a professional contractor or consultant. Possible problems include:

- clogged, damaged or non-existent drains around the footings
- a high water table
- badly draining soil around the foundation
- badly draining window wells.

If the problem is serious, it may require significant repairs and you will probably have to hire a contractor to do them.

Exterior repairs

Some problems may require you to make the repair from the outside. To do this, you'll likely have to excavate around the house, which involves a lot of work or the services of a professional with a backhoe to do the digging. This can add significant time and costs to your project. As well, if you have a rubble or brick foundation, the earth may be supporting the basement walls. Do not excavate around them without getting professional advice and, preferably, professional help; it could cause the wall to cave in.

Once the basement walls have been exposed, footing drainage tiles should be installed or brought up to standard. Any cracks or other damage to the wall should be repaired, and the wall should be covered with a dampproofing coating in order to seal water out. This can be a plaster or cement mortar (called parging) or an asphalt preparation although a plastic or rubber waterproofing membrane or a surface-bonding material is preferable.

Exterior insulation

If you're repairing the walls from the outside, it's a natural choice also to insulate the basement from the outside (see Chapter Five for a description). In fact, foundation walls made of brick or rubble should be insulated this way. This leaves more room inside and has an extra benefit: it makes the concrete wall warmer, so it becomes a part of the house's thermal mass, retaining heat and helping keep the house warm.

Rigid or semi-rigid insulation panels are used for this purpose: the choices include glass fibre, polystyrene or polyurethane. (Make sure the materials you choose are rated for below-grade use.) Glass fibre boards which are made for below-grade use, direct the water downward to the drainage tiles and relieve water pressure on the wall. However, they can be used only where there is a functioning drain tile and should be installed to their full depth with no horizontal seams. Extruded polystyrene is more stable and can be reused if it's ever removed. Panels at least 51 mm (2 in.) thick should be used.

The insulation panels are installed over the dampproofing coating, and a corrugated or dimpled drainage mat can be put over the insulation to drain water away. If you have siding that can be lifted or removed temporarily, it's also a good idea to have the insulation extended upward so that it covers the "header"—the spot where the floor structure sits atop the foundation wall. This can stop a lot of air leakage, and make the house more comfortable for very little extra cost.

STORAGE IN THE BASEMENT

Even if you don't have problems with your basement walls, get rid of any piles of clothing, newspapers, books, rugs or other materials in the basement that can give molds a place to grow. Materials such as old carpets and papers that look or smell moldy should be thrown out. Store other materials outside, or build storage racks or cabinets for them, allowing ventilation space to avoid moisture build up. Paints, solvents and other chemicals are also best kept outdoors.

You'll need to protect the top of the insulation from rain and snow. This is done with flashings—flat sheets of metal or other material that cover the top edge to prevent water penetration. And you'll need to protect the exposed parts of the insulation panels from damage with an outer coating of parging, pressure-treated plywood or pieces of siding that match your house siding.

If you choose not to add insulation outside, it's still wise to protect the wall from water pressure by adding a drainage mat before the trench around the foundation is filled in.

Cleaning up mold

Curing any dampness problems in the basement should prevent future mold problems from developing. However, you must also eliminate any existing mold before you think about finishing the walls or floor. This must be done carefully, so you can kill the mold without exposing yourself to contamination.

For moldy surfaces, the best technique is to wet the surface with undiluted chlorine bleach, reapplying in order to keep it wet for 15 minutes. Then wash the surface with a solution of one part bleach, four parts water and a small amount of non-ammonia dishwashing detergent. This cleanser will remove any debris left and retard future growth of molds. Finally, rinse the surface well and then dry it quickly.

Cleaning moldy areas may raise a cloud of spores that can seriously harm your health. To protect yourself, wear rubber gloves and a respirator. There are three suitable types, depending on how severe the contamination is. For mild problems, a comfort mask may be adequate; for more serious jobs, a half-face dust-mist respirator may be needed; for severe problems, use a full-face respirator or have a professional cleaner do the job.

If the mold is growing in carpets, replace them. If they are valuable, you can have them dry-cleaned by a specialist although this is expensive and may cause them to shrink. For mild problems, a thorough cleaning with an outdoor-vented vacuum or one with a HEPA filter may be effective, or dry steam cleaning if the carpet can be completely dried within a few hours. Beware of anti-fungal treatments, which can be as harmful as the mold.

Upholstered furniture should be discarded if it is very moldy. If mold damage isn't obvious, vacuum the furniture then brush in a large amount of baking soda and scrub it in. Leave for three or four days, then vacuum thoroughly again.

HEPA FILTERS

A high-efficiency particulate arresting (HEPA) filter is a special filter capable of taking very fine particles out of the air. It is often used in industrial vacuums or filter systems to remove irritants.

Combustion gases

There are two effective ways of remedying combustion gas problems. One is to do away with conditions that generate negative pressure in the house. Large exhaust fans and open masonry fireplaces are examples of devices that cause this. Stopping the use of these devices or replacing them with appliances that have lower exhaust rates will reduce the amount of time the basement is excessively depressurized.

A house with a lot of air leaks can also cause low air pressure in the basement, since air leaking out of the top floors can draw air up from the basement, a phenomenon called the "stack effect." If you have this problem, air sealing the house can also help to reduce it.

If there are problems with your chimney or fuel system, have them fixed, and insulate and seal the heating ducts to prevent heat loss. Then have the system rechecked before renovating and using the new space. If it's time to move up to a better system, you can replace your furnace and hot water heater with new high-efficiency, sealed units that have their own air supply and don't need a chimney.

Soil gases and radon

The most basic strategy to stop soil gases and radon is to seal all the possible air leaks in the basement: any cracks or seams in the floor or walls, and openings where plumbing pipes and electrical wires enter the basement. Polyurethane caulking or foam are good materials for this. Then seal the floor and walls with a complete air/vapour barrier system—a first step if you're going to finish them (see Wall finishes, this chapter). Install a self-priming drain or gas trap to stop air from coming up through your floor drain or sump, since these gases can travel through dried-out floor traps.

SUMP

A sump is a tank sunk into the basement floor that collects water from basement leaks or an underground drain. It has a pump that ejects the water to the main drain lines or to a ditch.

These repairs can be done with little or no professional help. However, if they don't remedy the problem sufficiently, you'll have to get a contractor who specializes in this field and uses more sophisticated measures, such as vents that exhaust the gases from under the floor slab.

Asbestos

If you have some asbestos on surfaces in your basement, the first consideration is whether it's stable or loose. If it's sealed with a coating, or if it's in a solid form, it poses little danger as long as you don't disturb it. The safest tactic is to cover it with a continuous covering, such as drywall, or give it a thorough coat of paint. However, if the material is beginning to disintegrate or if fibres are loose (friable), it should be removed by professionals. To find contractors who specialize in asbestos abatement and removal, look in the Yellow Pages™ under "asbestos."

Above all, don't demolish, cut or sand any surface that has asbestos in it, and be sure to wear a proper face mask when you do any work with it.

Making a Plan

Now that you know the problems with your basement and the options for dealing with them, you can make a plan to bring it up to livable standards. This must be done before you can finish the basement or move ahead with any type of remodelling project.

This point can be a watershed in the planning of your project. A basement that has serious water problems can be expensive to fix, and once you've made the repairs, you may not have enough money to complete the renovation you planned. In that case, it may make sense just to bring the basement up to standard for now, so it doesn't pose a health threat to your family. You may then put off finishing the space until later, or choose an alternative. In extreme cases, for example, where it will be difficult to keep the basement dry enough, it may just be impractical to put in a finished basement.

The first step is to use your Basement Problem Worksheet to identify what has to be done. Then with the information in the What Are the Options section, identify the repairs that will correct the problems. As mentioned, in some cases you can fix a wet basement by taking steps to keep water away from the foundation. If possible, try these solutions before considering more serious repairs.

Use the Basement Repair Worksheet to list the jobs that need doing and the possible solutions. If there is more than one option, write down the advantages, disadvantages and estimated costs of each.

Who'll Do the Work?

In some cases, you can fix an unhealthy basement yourself, even excavating around the foundation and sealing the foundation wall. This can save a lot of money. However, identifying and fixing a leaky basement can be complicated. If the diagnosis or the repair is beyond your skills, you'll need professional help. This type of work is best done by waterproofing contractors, who can be found in the Yellow Pages™.

As with other jobs, get bids from three different contractors. Listen carefully to their diagnosis of the problem and their approach to fixing it; this may differ from one contractor to another. Then compare the bids, following the guidelines in Chapter Three.

Counting the costs

The cost of a basement repair can run from a few dollars to thousands, depending on what has to be done. Costs can include materials, a contractor or consultant, labour and rental of digging equipment. If you're hiring a contractor to make the necessary repairs, get a quote on an overall price for

BASEMENT REPAIR WORKSHEET

Problem	Option	Advantages	Disadvantages	Health effects	Estimated cost

the job. If you're doing the job yourself, use the Repair Cost Worksheet to estimate the costs.

Finishing the Basement

Now that you're confident your basement is habitable and healthy, you can think about the new space you want to create there. Basements can be used for a wide range of purposes, so you have to consider carefully exactly what kind of room or rooms you need.

Your needs may be obvious—a recreation room or a separate apartment for members of your family. But remember that it's possible to make one space serve more than one purpose. If the new space is designed properly, different people can use it for different activities, perhaps even at the same time. For example, your recreation room can also serve as an exercise room or a hobby room with the necessary extra features. As well, think about designing your space so that it can be used for other purposes in the future, for example, your recreation room could be converted into an office.

Each project has its own requirements. Here is a list of common basement renovations and some of the features you may want to plan into them.

Recreation room

- adjustable lighting for different uses
- adequate seating space for at least six to eight people
- separate areas to pursue two different activities at the same time
- durable, easy-to-clean flooring
- a built-in entertainment centre
- a built-in bar, snack counter or galley kitchen
- an extra bathroom
- soundproofing
- built-in storage
- an intercom for communicating with the rest of the house.

Live-in apartment

- a separate outside entrance
- separate living room, bedrooms
- an upgraded basement staircase
- more or larger windows, if possible
- bright overall lighting, especially in the living room and kitchen areas

REPAIR COST WORKSHEET

Repair	Materials	Quantity	Total	Tools/rentals	Labour	Total

- a full or galley kitchen, with adequate ventilation, electrical and plumbing services
- a full-sized or compact bathroom, with adequate ventilation, electrical and plumbing services
- good-quality, durable flooring
- built-in cupboards, storage space or a storage room
- soundproofing and fireproofing.

Home office

- an outside entrance for customers
- room for a desk, computer station, fax machine and extra seating for visitors or helpers
- good general lighting and task lighting over work areas
- extra telephone lines
- built-in storage for files and papers
- an intercom to communicate with the rest of the house.

Workshop

- a built-in workbench
- room for a table saw and other large tools
- extra electrical outlets (possibly ceiling mounted) near power tools
- built-in wall racks for tools and equipment
- a direct outside entrance to bring in shop materials
- adequate space to work with large sheets of wood
- extra ventilation to outside
- bright lighting, with built-in lights over workbenches
- an inlet for an outside-vented central vacuum system
- durable flooring which is easy to clean.

Exercise room

- an attached shower, whirlpool tub or sauna
- hard-wearing, non-slip floors
- good general lighting
- extra ventilation
- a television or stereo system
- mirror walls
- soundproofing.

Taking Stock

In many cases, renovating a basement is an exercise in working with what you're given. You may not have the whole area, because some space is needed for things like the furnace and the laundry room. As well, there may be obstacles that keep you from putting things where you want to.

Dimensions

The first consideration is how big an area you have to work with. On a sheet of graph paper, make a scale drawing of your basement, marking off the area you can use for the finished space. Measure the length and height of the walls, noting any irregular areas and objects you'll have to work around.

If you're trying to fit a number of rooms into a limited space, you may have problems meeting code requirements. There are minimum standards for the width of hallways, the size of doors and other details of living space. For example, the National Building Code of Canada specifies that hallways should be at least 864 mm (34 in.) wide, or 710 mm (28 in.) for hallways that lead only to bathrooms and bedrooms or have acceptable exits. To ensure access for people with disabilities, or for ease in moving furniture, use a minimum width of 914 mm (36 in.) for hallways and 864 mm (34 in.) for doors.

Another major design problem with some basements is lack of headroom. This can be caused by the original construction, or by ducts or pipes that hang down into the head space. Either way, it must be dealt with in order to build a living space. For living rooms, dining rooms or kitchens, the National Building Code of Canada requires a minimum ceiling height of 2.3 m (7 ft., 6 in.) in 75 per cent of the floor space, and 2.1 m (6 ft., 10 in.) at any other point. Bedroom ceilings must be 2.3 m high over 50 per cent of the space, while bathrooms and hallways must be at least 2.1 m high.

Building codes may differ from province to province and municipality to municipality. Your basement must conform to the local standards, so it's best to find out what they are as you start your planning.

Structure

Even if your inspection indicates your basement is sound, it's a good idea to have an inventory of the basic structures you're dealing with. These include the wall and floor materials—do you have poured concrete walls, concrete block or rubble? It also includes their condition—are the walls even, does the floor slant? These can become factors as the work progresses.

A basement project can become a lot more difficult to plan if there are obstacles standing in your way. The cheapest way to deal with these is to be creative and incorporate them into your plan. However, in some cases it makes sense to have them moved.

Common basement obstacles include:

- steel support posts
- furnaces
- laundry tubs
- plumbing pipes "roughed-in" (installed but not connected) for bathrooms
- plumbing locations.

Another major concern with basements is lack of light. A basic factor is how many windows you have, and where they're situated. The size is also a factor—in most basements, they're small.

As well, there's the entrance to your basement space. Most basements come with a standard set of wooden steps as their only access from the rest of the house. These may be narrow and steep, which makes them unsafe and impractical for heavy use. As well, they may not be in the best spot for your purposes, especially if you're building a separate apartment. The stairs may have to be relocated. Assess your entrance for its appearance, safety and practicality. Straight-run stairs are safer than stairs that wind; also, stairs that are 914 mm (36 in.) wide provide the best access, and large landings improve safety.

Storage space

If your renovation is extensive, you'll likely be incorporating space that was formerly used for storage. Unless you build a shed or other storage facility outside, you'll have to replace that lost space in the basement. Your new space will also generate its own needs for storage, especially if someone is to be living there.

Services

Electricity

Before you begin work, make sure your existing electrical service will handle the new load you'll be putting on it. Check to see what kind of electrical service you have; this is measured in amperes, and your home's rating should be marked on the circuit box or fuse box. Houses built since the 1970s usually have at least a 100-ampere service, although some houses built more than 20 years ago still have a 60-ampere service—these will likely need upgrading.

If you're adding several rooms downstairs, with a lot of new appliances such as a stove and electric baseboard heaters, you'll be drawing a lot of extra power and using a lot of circuits. You may need a higher rated service, especially if your house is already straining the existing service. If your lights flicker or dim sometimes, or if you blow a lot of fuses or trip circuit breakers frequently, you probably need more capacity. The best way to determine what you require is to get an appraisal from an electrician.

Plumbing

If new plumbing is needed, look at the existing services in your basement. In most cases, the existing hot and cold water lines and the large main drain pipe (also called a soil stack) will be uncovered and accessible. If they aren't, you'll have to make them accessible to complete the necessary connections.

The job will be much easier if plumbing hookups have already been roughed in by the builder. All the plumbing connections will be easier, however, if you design your renovation so the fixtures are close to the existing services.

Again, if you're unsure as to how your new fixtures can be hooked up to the existing services, call a plumber to get some expert advice. This can save you money in the long run and may be part of the job if you're having the work done professionally.

Heating

You'll need a source of heat for your new basement, so first take a look at your heating system. Are there heat registers or

BASEMENT ASSESSMENT WORKSHEET

Observable problem	Location	Possible cause	Comment

other heat sources already in place in the basement? If not, consider how feasible it will be to add new outlets from the existing system to heat the renovated area. In some cases this is relatively easy. In others, you may have to add one or more "spot heaters."

Now that you know what the major elements are, use the Basement Assessment Worksheet on the previous page to take a look at what you have to work with in your basement.

What Are the Options?

Your options as you approach a basement renovation fall into two main categories: design, which involves how you're going to fit all the elements into a space that works as an integrated living place, and the elements themselves, which must be chosen carefully so the new space looks and functions the way it should.

Design options

With many basements, you start your designing with basically an empty space. That gives you a free hand to design the room or rooms you want. How you do it depends on how simple or complex a renovation you're planning. However, there are some basic principles that can help make the project work.

As you make your drawings, try as much as possible to devise large, open spaces that create an airy feeling to combat the dark, closed-in atmosphere a basement can have. Cutting a basement into a number of small spaces tends to make it seem closed-in. If you have to do this, you can maintain a more open feeling by using doorways or space dividers that don't reach up to the ceiling.

Another way to keep the basement feeling open is to make it bright. Provide ample lighting and try to include a window in each room. To really open up the basement, it's possible to create "lookouts." For example, cutting an opening in the basement ceiling around the staircase to create a skylight into the room above can completely change the feeling of your basement. This requires reinforcing the edges of the opening and building a railing or short partition wall around it upstairs. It also requires an extra investment, but the additonal light and improved atmosphere can make it worthwhile.

If you have a space problem, consider simplifying your plan to include fewer and larger rooms. You can use movable panels and screens to subdivide the space, if desired. Then reduce your scale: avoid big fixtures and big furniture that make the room look smaller. Using built-in shelves, cabinets, desks, beds or other functional pieces helps conserve space.

One of the cheapest ways to create an open feeling is through decorating. For example, light colours make a basement look both cheerier and larger, and mirror walls or doors create the illusion of a larger space.

Dealing with problems

Headroom

If your headspace is tight, the easiest solution is to choose a compact floor structure: you may have to install your flooring directly over the concrete and a polyethylene moisture barrier. Also, use a ceiling finish such as drywall that attaches flush to the joists and doesn't steal any headspace. Then decorate the space using vertical lines to make the walls seem taller.

If you have heating ducts or water pipes that hang down below the ceiling joists, you can often have them moved up into the spaces between the joists. If this isn't feasible, build boxes around them and turn them into bulkheads or imitation beams. It may be possible to reroute a duct or pipe that really disrupts your building scheme.

If your basement ceiling is just too low, you may decide to lower the floor to get enough headroom. This is a big job, and will significantly add time and cost to the project. It involves breaking up the concrete floor slab and digging out the whole basement, stopping short of the existing footings so they won't be disturbed. Then a short foundation wall and footing must be laid inside the old one, and a new floor slab poured. You can put rigid insulation and a moisture barrier under the new slab to make the floor warmer and prevent dampness.

Since there's usually no way to get machines into the basement, much of this work may be done manually. Because of the structural dangers, however, it's best to have a professional contractor perform this work.

A new problem arises when you lower the basement floor: your new floor may be below the existing drains, so you'll have to install new ones for any plumbing fixtures you place in the basement, and connect them to the main drain lines. Again, this will add more time and expense.

Obstacles

If a steel post creates an obstacle in the middle of the basement, try to incorporate it into a dividing wall, or a storage or wall unit. Alternatively, you can build a box around it and live with it.

A bigger obstacle is the furnace, which is often big and bulky, and connected centrally to a network of ducts or pipes that seem to hold it permanently in place. However, if your furnace is old and inefficient, it may be worth replacing it with a new, more efficient one. New units can be more compact, and you may be able to have the new one installed in a more convenient place.

If you aren't replacing your furnace, it may still be possible to have it moved; this requires changing the hookups to the fuel lines and the distribution system, which must be done by a qualified technician. If that's not an option, think about closing off the furnace from the rest of the basement with a wall or two. This will get rid of the eyesore, and help maintain air quality in the basement. However, make sure you furnish it with a supply of outside air for combustion.

The laundry tubs can also get in the way of your new plan, but these can also be moved as long as they can be connected to the main drain. A floor drain can be a bigger problem: it should not be covered up, in case of floods or water leaks, so you may have to work around it.

Entrances

If you're going to be using the basement for more than casual relaxation, you may want at least to upgrade the stairs. The simplest method is to resurface them with hardwood flooring or some other non-slip material that matches the flooring in the new basement rooms.

If the stairs are narrow and steep, you may want to replace them with wider stairs that rise more gently. This makes the entrance both safer and more attractive. A set of stairs that turns or curves into the room is an attractive variation that can also help traffic flow if the space is tight; remember, however, that straight stairs are safest, and wide stairs provide the best access. At the same time, plan some improved lighting around the staircase. A handrail is also required for safety.

In many houses, a side or back door already provides direct access to the basement stairs. If there is no such access, you may have to put one in to comply with building code requirements for fire exit if you're building a new apartment or other facility such as an office. Adding a new outside exit involves digging a well adjacent to the basement wall, and installing a retaining wall, a concrete floor and a new set of stairs, usually poured concrete. A hole must then be cut in the basement wall, and the door installed. This is not a major job, but it requires a lot of work, and professional advice, especially since you're making a significant opening in the foundation wall. It's also important to provide adequate drainage for the entrance well and to connect it to the existing drainage system.

If you don't need an outside entrance but want more convenient access to the basement, a simpler alternative is to add a new set of stairs that open into a different part of the house. You can take out the old stairs or use them as a second entrance to the basement.

Replacing storage space

As you design your new space, look for ways to incorporate storage into the room or rooms. The areas under built-in tables, beds and bars can be turned into shelved storage closets, and so can odd spaces—under the stairs, for example. Or, you can design a full wall unit that includes a spot for a television and stereo as well as lots of storage. Consider turning a cut-off corner into a walk-in storage closet, or building a separate storage room.

Services

Electricity

If you've determined that you have sufficient electrical capacity, you can start to plan your electrical circuits. However, if there are no open circuits in your circuit box to carry the extra load, or if the service is already overstrained, you may have to hire an electrician to upgrade your service or at least add a sub-panel to supply the power to the new fixtures. This is likely needed if your renovation involves more than a simple recreation room, especially if there's a kitchen included. While you're upgrading, think about installing enough extra capacity for future renovations or other major appliances you might want to add. (Note: If you're planning a basement apartment, the electrical panel should be accessible to the people living in it.)

Once you have enough capacity, there are general guidelines to help you plan your circuits. The rule of thumb is there should be an outlet every 3.6 m (12 ft.) around the walls. However, this doesn't always meet the actual needs of your living space. The important thing is to locate outlets in spots where they'll be needed: near an entertainment centre, a desk, a bar, or a work or hobby bench, for example.

An ordinary 15-ampere, 120-volt circuit can have a total of 12 outlets and lighting fixtures, so if your plan has 16 outlets and lights, you'll need two of these. If you're putting in a kitchen, you'll need a number of extra circuits. There should be one outlet for every 0.9 m (3 ft.) of counter space, and these should be split-duplex receptacles—outlets that are connected so both halves have their own circuit. Appliances, such as a refrigerator, dishwasher or built-in microwave, need their own separate circuits, and an electric stove requires a special dedicated 120/240-volt circuit.

Avoid putting all the lights on one circuit, so the basement won't go totally dark if you blow a fuse or trip a circuit breaker. Remember, also, that potentially wet areas, such as bathrooms, require ground-fault circuit interrupters.

Supplying electricity to your basement space can be relatively straightforward, since the circuit box is often in the basement. However, even if you do the work yourself, it requires a permit and

GROUND-FAULT CIRCUIT INTERRUPTERS

A ground-fault circuit interrupter (GFCI) is a special outlet that cuts the power immediately if a short circuit occurs, preventing the user from getting a shock.

an electrical inspection. In some municipalities you may not be allowed to do your own electrical work.

Plumbing

The plumbing requirements for a basement renovation range from non-existent to complex. A simple recreation room may not require any new plumbing, but a basement apartment with a new bathroom and kitchen will need a full range of plumbing services.

Running hot and cold water lines to new sinks and toilets is usually straightforward. These are taken from the supply pipes using copper or flexible plastic pipe, which is run through the new wall studs. In most cases, joining new fixtures to the main drain pipe is possible as long as the fixture is located above the main drain; you can run a new pipe through the floor to meet it. If there are existing fixtures in the basement that are connected to the drains, chances are you'll be able to make your connections without a problem.

Remember, that each fixture must also be vented, that is, it must be joined to a pipe that allows air to escape from the system up through the roof. This is usually accomplished by running a vent pipe to join an existing drain stack. However, if that's not feasible, you may have to run a new vent pipe, or stack, up to the roof; this can sometimes be done by running it up through closets, which are stacked on top of one another in some houses.

Installing new fixtures can be a problem if the main drain is not below the level of the fixtures. In that case, you can build pedestals to raise the fixtures so your new connections will run downhill to join the drain. If that's not possible, for example, if you're connecting to an outlet that drains into a septic tank, the best option may be to use a special system that processes the waste water and pumps it from your fixtures up into the drains. A third option is to install a biological toilet system which doesn't require a connection to the sewers; however, these require regular maintenance to prevent odours and remove waste solids.

If you're finishing the floors, remember to avoid covering floor drains and sumps. These are meant to deal with water spills, and if there is a flood and you've blocked them in, there's a chance your insurance company may not cover you.

You can install almost any kind of plumbing fixture in a basement, but if space is tight, using compact fixtures can help you fit a bathroom into a small space. A corner shower, a pedestal sink and a compact, round-fronted toilet can make a bathroom viable in a tight corner of the basement. Although it's not ideal, a full bathroom can be built in a space as small as 1.5 m (5 ft.) by 2.1 m (6 ft., 10 in.).

Heating

Heating a basement is usually not difficult since the space is all on one level and is generally not extensive. For a one-room renovation, one heating duct or a spot heater should supply enough heat. For an apartment or other project that creates several rooms, you'll have to design a small

CONTROLLING YOUR WATER USE

Since building extra living space with a bathroom and kitchen may increase your total water usage, make sure you choose fixtures that use the least amount of water. Water-efficient toilets, taps and shower heads that use half the water of conventional models, or less, are now commonly available. (For more information, see chapters Nine and Ten.)

system with several outlets or use wall vents to circulate heat through the rooms.

Most heating systems have enough extra capacity to supply heat to some extra space. If you have a forced-air system, it should be possible to simply run one or two side ducts from the existing ducts that run through the basement and install registers in the new walls. It's also possible to run an extra pipe off an existing hydronic (hot water) system and install radiators in the new space; this requires your system to have a circulating pump. In both cases, check with your fuel company or a heating contractor to make sure this won't cause a problem. You may have to rebalance the heating system.

If you don't have a forced-air heating system, the best option for heating one or two rooms is often space heaters (see the Space Heating Options chart).

Ventilation

If you're adding a new basement kitchen or a bathroom, you'll have to equip each with an outside-vented exhaust fan to get rid of the moisture and odours they generate.

If you're heating the basement with your forced-air system, it should supply enough air flow to balance the exhaust. If you have a heat recovery ventilator (HRV), this can also be used to ventilate the basement. However, if you don't have this kind of air flow, you'll have to supply some ventilation. You can do this by running a 102-mm (4-in.) air duct with a small fan up the wall to pull warm, dry air from the floor above.

Ideally, the intake should be located high in the wall upstairs to take in the warm air that collects there, and the air register should be low in the basement wall so the warm air will rise through the room. Adding one or two vents shouldn't affect the upstairs air flow significantly.

As you plan your basement renovation, think about the possible future uses of the space, as well as the ones you have in mind today. For example, if you're building a recreation room, think about having the wiring and plumbing roughed in for a future washroom, kitchen or full apartment. As well, think about making the space accessible for people with disabilities (see Planning an Accessible Basement). Many basements are renovated more than once, and it will save time and money in the future if the basic elements are already in place.

Picking the pieces

Walls

Once you've solved any moisture problems with your basement walls, you'll be able to decide what kind of wall structure, insulation and finishes you'll use. Your choice of a wall structure for the external walls will depend largely on whether you are insulating from the inside or the outside, what kind of insulation you use and what levels of insulation you add to the wall. (See Chapter Five for more information on types of insulation and recommended levels.) Interior, or partition walls, are usually built in the conventional manner, using frames of 38 x 89 mm (2 x 4 in.) wooden or steel studs.

If adding insulation to the outside of the foundation wall was not part of your initial work to prepare the basement, then insulation becomes an integral part of building your interior walls. There are two main choices.

Framed walls

Where space is not at a premium, many homeowners choose to build standard stud walls against the basement walls. These allow you to use common insulation batts. Before building the wall, however, an interior dampproofing barrier must be applied to the foundation wall from ground level (also called "grade") down to the floor or slab.

AIR AND VAPOUR BARRIERS

An air barrier is a system of components meant to stop air flowing into a wall, floor or roof structure. A vapour retarder or vapour barrier is a material that slows down vapour as it tries to move through a wall, floor or roof structure. In some cases, one layer of components, for example, polyethylene sheeting when placed on the warm side of the insulation, overlapped at the seams and sealed with acoustical caulking, can be used as an air/vapour barrier system, doing both jobs. It is usually attached to the inside surface of the interior walls, before the finish material goes on.

Although there are no requirements, existing guidelines call for a minimum of RSI 2.2 (R13) insulation level in basement walls that are more than 50 per cent below ground. This can be achieved with insulation batts in 38 x 89 mm (2 x 4 in.) walls. However, if space will allow, consider putting in a double layer of insulation. This involves building wall frames of 38 x 64 mm (2 x 3 in.) lumber and erecting them 89 mm (3 1/2 in.) away from the basement walls. RSI 1.4 (R8) insulation batts can then be put between the wall studs, with RSI 2.1 (R12) batts laid behind them in horizontal layers, for a total insulation value of RSI 3.5 (R20). As well as increasing the insulation value, this also cuts out "thermal bridging," the transfer of heat that occurs where the studs come in contact with the outside walls.

To stop the moist air from getting into the wall, an air/vapour barrier system usually consisting of a sheet of polyethylene must be fastened to the inside surface of the new wall and joined to the air barrier extending from the outside wall above. Electric outlets must be joined to the air/vapour barrier, either by wrapping them with a piece of polyethylene or by installing them in an airtight plastic box. As well, insulation and a vapour barrier must be put in the spaces between the joists where they meet the outside wall. Ensure that the air barrier is continuous: there should be no way for air to pass into the insulation at the bottom or top of the wall. All openings should be sealed with plastic sheeting, wood or drywall.

RSI

The ability of materials such as insulation to insulate or block the transfer of heat is measured by RSI (Resistance System International) ratings, or R values, their imperial counterpart. The higher the rating, the higher the insulation value.

Compact walls

If space is tight, you can use a compact wall structure that allows the finish to be installed on the exterior walls without stud frames. There are two different methods.

- If you've added insulation on the exterior of the foundation, you don't likely need more insulation inside. If your basement walls are smooth, with no major holes or uneven spots, you can nail wooden or metal strapping directly to the wall and attach your finish materials to that. For uneven walls, including walls made of rubble or brick, however, you'll still need to build stud walls to make an even surface.
- If you haven't insulated outside, but space is too tight to use stud frames, you can install rigid board insulation right up against the inside of the walls and attach your wall finish to it. Again, this is advisable only where you have a sound, even wall so your finished wall surface ends up flat. That means it's usually limited to poured concrete or concrete block walls. Rigid insulation can be more expensive than using batts, and it must be covered with a fire-resistant material such as drywall. As well, it provides no stud wall to run wires and piping through. If necessary, wiring can be run on top of the wall using special surface channels.

The insulation is usually installed by attaching wooden nailing strips to the wall and fitting the panels between them. There are also systems in which nailing strips fit into grooves on the surface of the panels and systems that come with a fire-retardant finish. However, in most cases, drywall or panelling is attached to the nailing strips providing the necessary fire-retardant cover.

Since this system uses no moisture barrier against the wall, all cracks and penetrations in the wall must be well sealed, and so must all the joints in the finish wallcovering. The spaces between the joists must also be insulated.

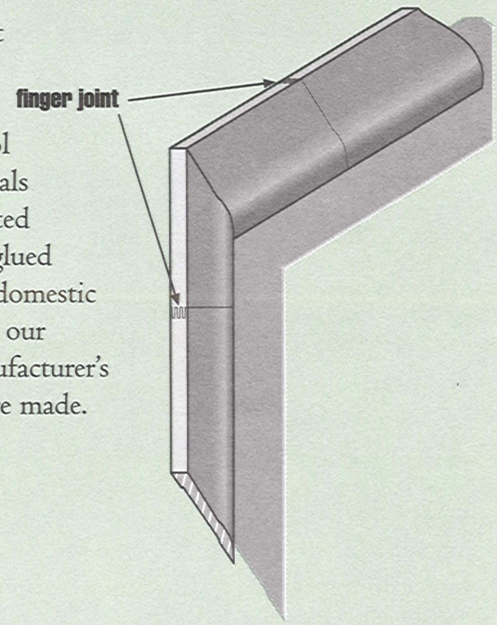
Wall finishes

With the walls framed and insulated, you need to decide what finish material you're going to use on them. This can set a tone for the look of your room or rooms. All the choices are fairly straightforward and not difficult to install.

Whichever finish you decide on, remember to include some access panels for things like shut-off valves, plumbing clean outs, the electrical meter and your circuit box.

RESOURCEFUL BUILDING CHOICES

One way to reduce the environmental impact of your renovation is to choose building materials that use resources more efficiently. For example, fibreglass batt and mineral wool insulation, drywall and some flooring materials contain recycled materials. Using finger-jointed lumber (made of a number of short pieces glued together) and trim made from fast-growing domestic species such as birch reduces the pressure on our forests. Ask your supplier, or check the manufacturer's literature to see how the materials you use are made.



These can be made easily using drywall or panelling, but should be easy to remove if there's an emergency.

There are three main options for wall surfaces.

- Drywall: The basic choice, drywall can be cut to conform to irregularities in walls. Paint, wallpaper and mouldings can be used for a variety of finishes. It's economical, but the joints must be finished with tape and drywall compound. It's a relatively healthy choice.
- Wood panelling: Solid wood panelling is easy to install and can be used for an entire wall or as an accent. Different grades and woods have different looks and prices; light woods make rooms bright, dark woods lend a rich look. Finishing requires sanding, which creates irritating dust. Use water-based finishes to avoid solvent emissions.
- Composite wood panelling: This is made of plywood or hardboard, with a wood-grained finish; it varies in thickness. It's less expensive than real wood, and easier to install but it doesn't have the same look. Generally, it's a healthy choice, although some finishes may give off volatile chemicals.

Ceilings

Choosing a basement ceiling is relatively simple: there are a number of choices, none difficult to install. However, as mentioned, the issue of headroom can come into the picture when you choose a ceiling material.

There are several choices for a basement ceiling.

- Drywall: This is the simplest and most versatile surface, and can be painted or wallpapered for the effect you want. It's economical, but joints must be finished with tape and drywall compound—a relatively healthy choice.
- Acoustic tiles and panels: Their surfaces are designed to absorb sound, and also make an attractive ceiling surface. Tiles can be nailed or glued to metal tracks fastened to ceiling joists, or glued to an existing ceiling. Urea and phenol formaldehyde resins used to bind the fibres together can give off emissions.
- Suspended (drop) ceilings: These are available in acoustic fibreglass or mineral fibre panels or tiles; they hang below the ceiling on a system of metal "tees." They're useful to conceal hanging heating ducts or pipes, and allow access to services in ceiling space by removing a panel. They raise the same health concerns as acoustic tiles.
- Alternative materials: Many other options are available, including old-style tin ceiling panels, real plaster with a swirled finish or wood panelling; these add to the atmosphere in the basement.

Floors

For basic uses, such as a workshop or laundry room, a basement floor can be left unfinished. However, in most cases it's necessary to finish the floor, both to make a more comfortable surface and to contain any moisture migrating through the concrete slab. It's advisable to add insulation at the same time, both to stop the floor from being cold and to cut down on your energy consumption. The best way to do this is to build a new floor structure that includes both a moisture barrier and some insulation.

SOUNDPROOFING THE BASEMENT

Since a renovated basement is a space set off from the rest of the house, keeping downstairs noise from reaching the upstairs (and vice versa) may be a real concern. In that case, the basement ceiling can be used as a barrier to soundproof the new space.

The first step is to lay insulation batts between the ceiling joists—the thicker the batts, the more soundproofing you'll get. Then, you can install a drywall or tile ceiling using special resilient channels which minimize contact between the ceiling materials and the joists. If you choose a suspended ceiling, you can use insulation blankets that lie over top of the panels for soundproofing. Finally, choose ceiling tiles or panels that have a high noise reduction rating.

A ceiling treatment will do a lot to block noise transmission, but it won't cut it out entirely. Sound can leak through any opening in the building assembly, so seal all cracks and the holes around pipes and ducts where they penetrate the wall or ceiling. Also, the basement door must be well air-sealed, since a lot of sound can travel through the cracks. However, if you build an airtight basement, it should be checked to ensure that your heating equipment can operate safely and effectively.

One recommended technique uses wooden "sleepers" of 38 x 89 mm (2 x 4 in.) and rigid insulation panels. Sheets of polyethylene are laid over the concrete floor, overlapped and sealed together to make a continuous moisture barrier. The "sleepers" are laid flat on top of the polyethylene, and panels of rigid insulation are laid between them. Over that, on the warm side of the insulation, goes another layer of polyethylene, sealed to make an air/vapour barrier system. A subfloor made of sheets of exterior-grade plywood goes on top as a base for your finish flooring. This structure will give you a warm dry floor, as long as care is taken to deal with any moisture problems first and the air/vapour barrier system is continuous.

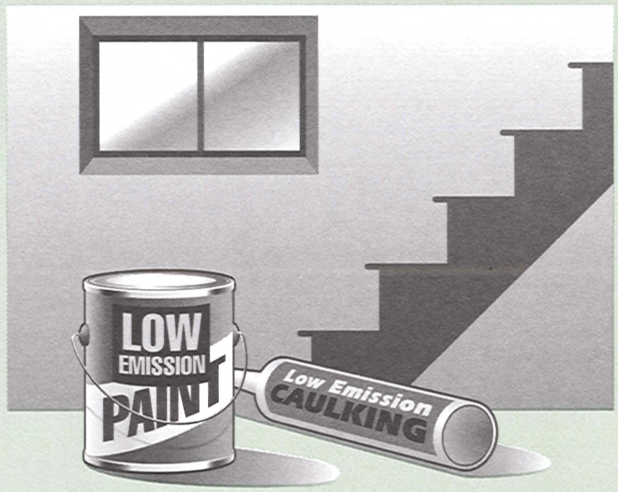
Some floor finishes are not normally recommended for basements because they are cold or can be damaged by moisture. However, if you have cured any moisture problems in the basement and installed an insulated subfloor, you should be able to use almost any floor covering you want.

Choose your floor surfaces to match the use the room will get. For entertaining or day-to-day living, comfort may be the main concern. If the basement is to be used for an active purpose such as a playroom or exercise room, durability and easy cleaning

BASEMENT FLOOR OPTIONS

Option	Advantages	Installation	Comments	Health
Resilient (vinyl) flooring	Easy to clean. Built-in "cushion" makes it easier on the feet than a hard surface. Comes in sheet flooring or tiles.	Usually cemented to the subfloor. Some sheet vinyl flooring can be simply laid in place, eliminating adhesive and its fumes.	Good for areas subject to spills and hard wear. Can be laid over concrete, but a subfloor is preferable.	Adhesive fumes can be a health hazard; use water-based adhesives. Vinyl releases emissions; hard tiles preferable to sheets.
Linoleum	Made of linseed oil mixed with wood flour, cork flour and jute. Returning to widespread use.	Usually cemented to the subfloor. Can be installed without adhesives.	Good for areas subject to spills and hard wear. Can be laid over concrete, but a subfloor is preferable.	Healthier choice than vinyl; gives off fewer emissions. However, linseed oil can irritate some people.
Carpeting	Soft on the feet, helps create a warm feeling.	Laid in place over underpad or directly on floor. Avoid glued applications.	High embodied energy, limited durability. Not recommended, especially if there is still chance of a moisture problem.	Contains chemical pollutants. Can harbour molds and other biological irritants.
Wood	Solid hardwood is fairly expensive but durable. Wood tile or parquet flooring less expensive but less durable. Available in a variety of woods and shades. Attractive, adds a comfortable feeling to room.	Strip and plank hardwood is nailed or stapled to a plywood subfloor. Parquet is commonly glued in place.	Wood can "cup" or warp in moist conditions. Should not be installed in a basement unless you have solved all moisture problems.	Generally good. Pre-finished hardwood preferable to unfinished to avoid emissions while finish is applied. Glued applications can release volatile gases.
Ceramic tiles	Long-lasting, attractive, easy to clean. Variety of colours and patterns available. Tiles come glazed and unglazed.	Glued to a plywood subfloor or underlay, or set into a bed of mortar laid on top of concrete floor or subfloor. Can be installed over a concrete floor, but an insulated subfloor makes warmer surface.	Have a hard surface, can be cold; this limits use in some basement areas. Unglazed tiles are less slippery. Can chip, hard to repair.	Healthy choice but adhesives can give off volatile chemicals.

YOUR BASEMENT AND YOUR HEALTH



The materials you use to finish your basement can make a big difference as to how healthy the new space is to live in. A number of commonly used materials give off chemical emissions that can have potentially harmful effects on your health. Here are some areas of concern.

- Walls: The solvents in oil-based or alkyd paints give off fumes during painting, and for some time afterward. This can be avoided by using low-emission, water-based paints; water-based latex paints can now be used for almost any application.

  Wallpapers are a popular choice, but the commonly used vinyl papers give off odours that can be irritating. Vinyl-coated papers have lower emissions than solid vinyl, but any paper can be a problem if moisture gets behind it, since mold can thrive on the gluten-based paste used on many of them. (See Chapter Seven for more on the health aspects of paints and finishes.)

- Floors: Vinyl flooring tends to gradually release, or off-gas, the chemicals it's made of; these can have health effects. The hard vinyl tiles emit fewer gases than flexible sheet vinyl flooring, but ceramic or well-sealed wood floors are healthier choices.

  The adhesives used to install vinyl and some other types of flooring, including tiles, can also be a health hazard. Some are petroleum-based and release a number of hazardous chemicals, including formaldehyde. Pre-glued vinyl tiles have lower emissions and low-toxicity water-based adhesives are available that are safer for you and for the installers.

  While carpeting can give a room a warm feeling, for your health, it's a bad choice especially where moisture problems may occur. Carpet fibres provide a good place for molds to grow, and it's difficult to get all the dirt and mold out of them even with regular vacuuming. Bare surfaces are a better choice.

- Other materials: Many furnishings are made of particleboard or medium-density fibreboard (MDF) which contain high levels of formaldehyde and release chemical vapours over time. For building purposes, exterior-grade plywood is a better choice; if you do choose manufactured furnishings made of particleboard, you can minimize emissions by covering all bare surfaces with a skin of plastic laminate or two coats of a water-based acrylic sealer.

become the major factors. For areas where you'll be standing a lot, such as a workshop or hobby room, choose a floor surface that's easy on your feet.

Heating

The first option to supply heat for a renovated basement is to add outlets to the existing system. If this is not possible, the other option is space heaters. These can save energy if you won't be spending a lot of time in the basement since you can heat it only when you need to. However, some space heaters use a lot of energy when they run, so using them continuously can be inefficient.

The Space Heating Options chart lists the main choices.

Lighting

Light is a critical element in a basement project, for the simple reason that most basements don't have much. Typically, small windows at the top of the foundation wall provide the only natural light, which means that most of the light for your new living space will be artificial, even during the day.

It is sometimes possible to increase the natural light that gets into the basement by upgrading the windows. This is an energy-efficient option, since it lets you use natural light during the day instead of turning on electric lights.

The easiest way to add light is by enlarging the window wells and adding white crushed stone and white liners to reflect more light inside. (Make sure such wells are drained properly to the footing drains). If that doesn't satisfy your needs, the next step is to add more window space. The first option is to enlarge an existing window opening and put in a larger window. This is easier if you extend the opening downward rather than widen it. In some cases, you can also cut new windows into the basement walls where they're needed.

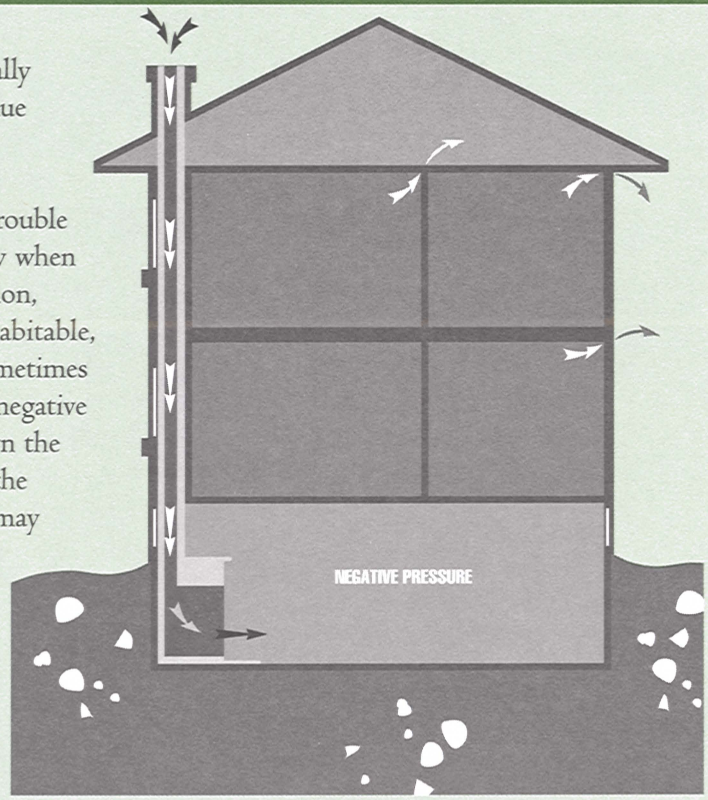
If you're installing new windows, awning windows are a better choice than the

SPACE HEATING OPTIONS

Option	Advantages	Efficiency	Comments/health concerns
Direct-vent gas fireplaces	Hook up to existing gas lines. Use exhaust pipe through wall to vent combustion gases.	60%–70%	Should have own source of outside combustion air. Zero-clearance fireplaces can be installed against existing wall.
Gas space heaters	Free-standing or wall-mounted models available.	60%–82%	Should have own source of outside combustion air and outside vent to exhaust combustion gases.
Electric baseboard heaters	Inexpensive. Easy to install.	100%	Heavy users of electricity, but small-scale use can make sense. Need own electrical circuit.
Electric convection heaters	Can be mounted on, or recessed into walls. Floor heaters also available for cold spots such as bay windows.	100%	Heavy users of electricity, but small-scale use can make sense. Need own electrical circuit.
High-efficiency woodburning fireplaces	Add cozy atmosphere.	50%–70%	Costly to install. Best in areas not used continuously.
Woodburning stoves	Add cozy atmosphere. High-efficiency models preferred.	55%–80%	Require special flue pipe and heat pad for safety. Best in areas not used continuously.

LOW-PRESSURE PROBLEMS

If your basement is naturally depressurized in winter (due to air leaks higher in the house) then all appliances with chimneys may have trouble venting properly, especially when they start up (see the section, Making Your Basement Habitable, on combustion gases). Sometimes a basement with a strong negative pressure will draw air down the chimney, especially when the appliance is not on. This may cause odour problems with woodburning equipment.



inexpensive horizontal sliders because they're more energy-efficient. To bring in even more light, there's the option of putting in a greenhouse window, which projects forward and admits light from all sides. This requires digging a larger well around the window, with a small retaining wall or a terraced wall made of railroad ties.

To really open up the wall, you can dig an even larger well and put in patio doors leading to an outdoor seating area or sunken garden. However, this can be done only if your foundation wall can be excavated safely.

Even with these enhancements, you'll need a well-designed lighting system for your new space. Since the basement is naturally dark, you need to supply adequate general lighting. However, there are also areas where people will be working, playing or eating, so you'll also need task lighting over areas such as desks, play tables and bars. As well, a basement is an area where

WINDOWS AS FIRE ESCAPES

Windows play a part in a house's fire safety system. Fire codes require opening windows on each floor to act as escape routes, so one or more of your windows will have to serve this purpose. These windows are usually located in bedrooms, and they must open to the outside without using any special hardware or special knowledge. See Windows and fire safety in Chapter Six for details on general requirements for fire escape windows, and check local fire codes for their requirements.

LIGHTING OPTIONS

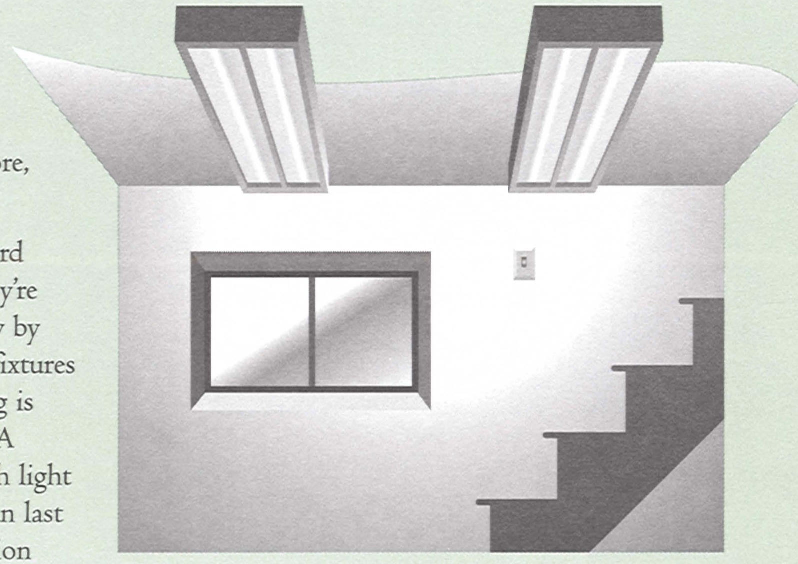
Option	Advantages	Comments
Overhead lighting	Many different types and styles on the market. If well-placed, can also provide task lighting.	Head space may limit you to those that mount flush to the ceiling. If they're the main light source and, if possible, put on dimmer switches to control light levels.
Recessed ceiling fixtures	Also called "spot lights." Require no headroom. Can be used both for general and accent lighting. Variations include "drop" lights for wider illumination, "eyeball" fixtures that let you aim the light, "pin" spotlights that throw a narrow beam of light.	Must be installed with a 7.6-cm (3-in.) clearance from insulation and other materials to avoid overheating. Some new models can be installed without requiring clearance.
Fluorescent panels	Provide good general lighting and use much less electricity than incandescent fixtures. Fit well into drop ceilings.	Give a "flat" light that creates no shadows or contours. Some people prefer them for a workshop or playroom rather than a work area or living room.
Indirect lighting	Soft, inviting type of general or accent lighting. Wall sconces throw a "wash" of light onto the wall. Wall-mounted valances conceal a fluorescent tube and throw light upward, down or in both directions.	Should be combined with direct lights for reading and task lighting.
Track lighting	Can be used for task or accent lighting. Tracks can be mounted on a ceiling or wall, depending on headroom.	Versatile, lights can be aimed where you want. Some fixtures allow lights to be added or subtracted at will.
Lamps	Floor lamps can be useful for general lighting in area that isn't covered by overhead lights. Desk or table lamps can be the easiest way to provide task lighting.	Floor lamps take up floor space.
Built-in fixtures	Lights built into a work or play station, such as a workbench or desk.	Light can be hidden behind an overhead panel or under a shelf. Should be located to shine onto the work and not into the user's eyes. Fluorescent fixtures most common, incandescent can be found.

you might want to create a quiet and cozy mood, so be sure your plan also includes some lower-level accent lighting.

Lack of ceiling height can limit the choices when you're buying basement lighting fixtures. In cases where there isn't enough headroom for regular overhead fixtures, you can compensate by using several recessed ceiling lights, wall-mounted lights or floor lamps.

Don't forget to plan lighting for the stairs. Since there'll be more traffic going into the basement, it's important to install fixtures that provide a good light level and throw some shadow so people get a sense of depth as they ascend or descend. As well, wire

SAVING ENERGY WITH LIGHT BULBS



The kind of lights you use can make a big difference in the look and feel of your new basement space. It also makes a difference in your energy consumption and, therefore, your energy bills.

Incandescent bulbs are still the standard for home lighting. However, while they're versatile, they waste a lot of electricity by generating excess heat. Especially for fixtures that are used a lot, fluorescent lighting is a much more energy-efficient choice. A 15-watt fluorescent tube gives as much light as a 60-watt incandescent bulb and can last 10 times as long. Today's new generation fluorescent tubes provide a more flattering light than the older tubes with their cooler, bluish light. For lighting a specific area, you can get similar savings with compact fluorescent bulbs. These often use standard sockets, with or without an adapter, and can be substituted for incandescent bulbs. The initial cost of fluorescent bulbs is higher, but in the long run you'll save money on your electric bill and on the cost of replacement bulbs, and you'll lessen the demand for electricity.

Tungsten-halogen lights are another lower energy alternative. Halogen lights give an intense, white light that's useful for task and accent lighting, especially in recessed lights and track lighting. They produce as much light as incandescent bulbs but use up to 50 per cent less power. Again, the high initial cost will be offset by your energy savings and the longer life of the halogen bulbs.

some of the basement lights so they can be turned on from switches at the bottom and the top of the stairs. This adds both safety and convenience.

The Lighting Options chart on the previous page lists the types of lighting fixtures you might consider for a basement renovation.

Making a Plan

Before you can make the right choices for your renovation, you should have a clear picture of what you want it to be. Use the Basement Priorities Worksheet to define exactly what you hope to create with the project: a recreation room where you can relax and where your children will have room to play, for example, or a flat where some family members can live without losing their privacy. At the same time, think about your long-range plans. Do you have a second use in mind after the first one has ended?

Once you have your overall goal set, you can concentrate on the more specific goals that are part of the project. These are the features that you'd like to include, such as a bar or an exercise centre or a sauna. Also include smaller features such as a particular type of lighting or floor surface you'd like to have. Mark each item according to its importance to you. Is it a high priority, that is, something you definitely want to have, or a low priority, something you'd like to have if it fits the plan and your budget?

Choosing options

Now you can choose the materials and strategies you want to use, from the options listed in the sections above. Keep in mind that the materials and techniques you pick must work together as a co-ordinated system. This is important not only for practical purposes, for example, lighting fixtures that fit perfectly into your suspended ceiling, but for style as

BASEMENT PRIORITIES WORKSHEET

	Details	Priority (high/low)
GOALS		
Short-term		
Long-term		
MAJOR FEATURES		
COMPONENTS		

BASEMENT OPTIONS WORKSHEET

Item	Options/details	Materials needed	Estimated cost
Walls	1. 2.		
Wall finish	1. 2.		
Floor	1. 2.		
Floor finish	1. 2.		
Ceiling	1. 2.		
Windows	1. 2.		
Doors	1. 2.		
Entrance	1. 2.		
Stairs	1. 2.		
Lighting	1. 2.		
Heating	1. 2.		
Electrical hookups	1. 2.		
Electrical appliances	1. 2.		
Plumbing hookups	1. 2.		
Plumbing fixtures	1. 2.		

well, so the whole renovation has a consistent and harmonious look.

Use a sheet of graph paper or a computer planning program to draw the finished project with all your choices in place, including your colour scheme. This could reveal changes that might make it look or work better—using a different style of lighting fixture, for example, or moving a built-in piece of furniture. Once you have an idea of your layout, mark it out with tape on the floor to see how it works in real dimensions.

Use the Basement Options Worksheet to decide which options you'll use.

Once you've chosen the materials for all the different parts of the project, you'll be able to make a more detailed materials list using the Basement Materials Worksheet below. This is useful not only for pricing purposes, but for a purchasing list you can use to schedule your buying. When you've made your purchases, update the worksheet so you'll have a record for future reference. Also attach all receipts and other project documents to the page so they'll be handy if you need to look at them.

PLANNING AN ACCESSIBLE BASEMENT

When planning your basement room or apartment, think about making it accessible for those with disabilities or restricted movement. This is important if someone in your house has a disability, but it can also be worthwhile if you're planning to spend your retirement years in the house. Future users of the house may also need these features.

The first problem in making the new basement usable for someone in a wheelchair, or with restricted movement, is providing an accessible entrance from the floor above. This can be done by building a ramp, or installing a motorized chair lift or elevator. Another approach is to provide an outside entrance that's accessible either directly or by using a ramp outside the house. If you have an immediate need, you can supply this type of facility now; if not, you can design your renovation to leave room for a future ramp or lift, and perhaps rough in any needed electrical services.

As well, there are a few special design features that can help make the space better for people with disabilities. These include:

- non-slip flooring
- adequate overall lighting, with contrasting colours for easy discernment of surface edges
- light switches 1,067 mm (42 in.) from the floor
- electrical outlets 457 mm (18 in.) from the floor
- hallways a minimum of 1,219 mm (48 in.) wide where doors open inward, and 1,524 mm (60 in.) wide where doors open outward, for wheelchair access
- a minimum 1,524 mm (60 in.) of turning space at corners
- doors 864 mm (34 in.) wide, or with a minimum clear passage of 813 mm (32 in.)
- no thresholds, or thresholds a maximum 13 mm (1/2 in.) high, with bevelled edges
- lever-type door handles or D-shaped pulls
- kitchens and bathrooms with 1,524 mm (60 in.) of turning space in front of sinks and cabinets
- knee space under sinks and extra toe space under cabinets
- turning space in front of, or beside, fixtures such as toilets and bathtubs.

For a full list of accessible design features for kitchens and bathrooms see chapters Nine and Ten.

If the project is to be done in a short period of time, it may be practical to have many of the materials delivered as the work gets started to avoid delays. However, if it is going to take a long time, it's more economical to buy the materials in stages as they're needed. This avoids the chance of damage to your materials while they're

BASEMENT MATERIALS WORKSHEET								
Item	**Materials (brand/ specifications**	**Quantity**	**Price per unit**	**Cost**	**Date needed**	**Date purchased**	**Supplier (address, phone no.)**	**Comments**
Wall structure								
Wall finish								
Floor structure								
Floor finish								
Ceiling								
Windows								
Doors								
Entrance								
Stairs								
Lighting								
Heating								
Electrical hookups								
Electrical appliances								
Plumbing hookups								
Plumbing fixtures								
TOTAL MATERIALS COST								

sitting around waiting to be used. It may also be necessary if you're getting the money in stages from your lender.

If you're hiring a renovator to do the project, scheduling the purchases will be part of the contract. However, having the materials list beforehand will help you get more accurate bids from prospective renovators.

Who'll Do the Work?

With a project as big as a basement renovation, whether to do the work yourself or hire a renovator can be a major decision. Some homeowners with good carpentry and handyman skills can do all or most of the work on a straightforward basement project themselves. This takes most of the skills involved in house building, so you should be sure your abilities are equal to the task if you attempt this.

As well, an extensive basement renovation can take a lot of time—usually considerably more than you've scheduled. Make sure you have a significant amount of spare time to devote to the project, unless you're content to have it go on for months. One alternative is to do some of the basic work yourself, and hire a renovator to do the rest. This can save some money without overtaxing your resources. Jobs many homeowners can do include:

- framing and insulating the walls
- installing drywall or panelling
- installing sheet or tile flooring
- painting or wallpapering.

For an extensive project, many people hire a renovator to handle the whole job. However, if you're being your own general contractor, you'll likely end up hiring one or more contractors to help build the new space. The structural work can be done by a general-purpose renovator or framer, but you'll probably need an electrician to plan and install the electrical circuits (in some areas this is mandatory), a plumber to make the plumbing hookups and install the new fixtures, as well as tradespeople to do the drywalling, flooring installation and finishing work. These can be found in the Yellow Pages™, through references from friends, building centres or industry organizations such as the local homebuilders' association.

Choose these people with care, following the guidelines in Chapter Three. Get three bids, and check the contractors' credentials, including their licence, experience, references from other customers and insurance.

Counting the costs

Since a basement renovation can take almost any form, the final cost of your renovation can range from modest to impressive, especially if you're building a complete apartment. Doing major structural work such as lowering the floor or excavating the foundation can add significantly to the overall cost.

PERMITS

A basement renovation is a project that can involve a significant amount of structural work, as well as changes to the electrical and plumbing systems of the house. These will require one or more permits and inspections for the different parts of the job (see Building codes and by-laws in Chapter Three for a discussion of building permits). Getting the permits will be a part of your preparations before the work starts; then, scheduling the inspections must become part of your planning process. If you hire renovators or subcontractors to do the work, they should get the permits; that way, they're responsible for complying with local codes.

Your materials list can give you a good idea of the cost of materials for the job. To get a total cost, you must add in the labour costs, permit fees and a good margin for cost overruns. If you take the project to professional renovators, they will give you a bid that includes all these factors. If you're doing the job yourself, you'll have to find out the cost of materials and any needed labour by visiting building centres and getting preliminary estimates from contractors.

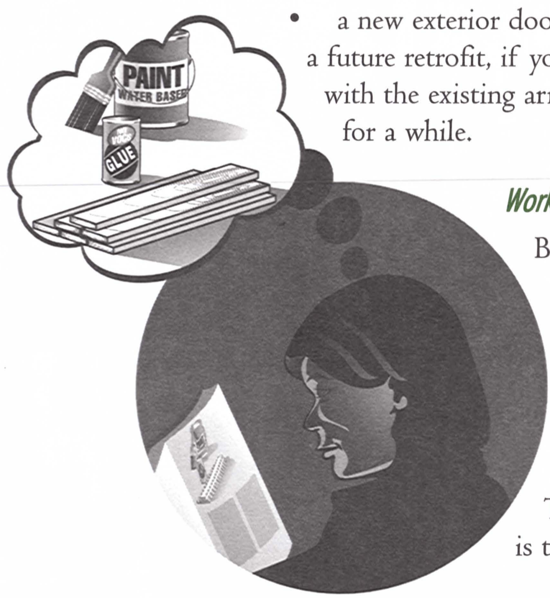
Don't forget to include "extras" such as any necessary demolition work, or carting away big items that you have to get rid of. If you're unsure about one of your choices, or you don't know what something will cost at this point, reserve an estimated amount as an allowance for that item.

If you find the costs are above your budget, you can reduce them by changing some of your choices to less expensive options, or by cutting down the size of the project and leaving some of it until later. In a basement renovation, you might save money by:

- choosing a lower-priced floor finish for a kitchen or bathroom which will get light use
- combining two rooms to cut down construction costs
- buying plainer light fixtures and replacing them later with the fancy ones you wanted
- painting a pattern onto the walls instead of applying expensive wallpaper.

In some cases, parts of the job can be put off for a couple of years until you have the money to get the components you want. Parts of the job you might put off include:

- the bar or kitchen, in a recreation room—the plumbing can be roughed in now for later use
- a shower or sauna (same strategy for plumbing)
- a new exterior door or window—a future retrofit, if you can live with the existing arrangement for a while.



Working healthy

Before the work begins, you should think about how to avoid health hazards while it's going on. The first step is to use materials with as few irritants as possible. This includes not only solid materials but paints and finishes. Wherever possible, plan to use water-based finishes that have low emissions (see Chapter Seven).

There are other measures that can help keep irritants low during the project.

- Arrange for window fans to ventilate the basement if there are jobs that create fumes, such as painting, staining or using an adhesive to apply flooring.
- Make sure the workers use dust bags or other ventilation systems if power saws or sanders are going to be used.
- Arrange for a plastic dust barrier at the opening between the basement and the rest of the house.
- Make sure workers will use proper face masks for work that's dusty or creates fumes.
- Insist on a thorough clean-up and vacuuming after work each day, and when the whole job is finished.

See Chapter Two for more tips on avoiding renovation hazards.

Putting it all together

If you're hiring a professional renovator to finish your basement, the final part of your planning is to choose which one you'll use, and to finalize the price and specifications for the job. If you're going to be your own contractor, you need to create a full picture of the project by yourself and estimate what it will cost.

Use the Project Planning Worksheet to enter all the materials, labour and other expenses the job will entail. This should allow you to arrive at a price for the whole job and see everything that will be needed.

As well, you must make a schedule so that the work progresses in a logical order and the tradespeople arrive when the construction is ready for them. You can photocopy the Gantt chart in Chapter Three to help you schedule the job.

Then, think about how you'll organize your day-to-day life to accommodate the work. If you're having excavation or serious structural work done, there will be significant disruption and mess. A big renovation may require cutting some services while new connections are being made. And remember that the tradespeople will have needs too, such as bathroom facilities. See Chapter Three for more information on living with a renovation.

Once all the pieces are in place, you can set about making the project a reality. It will still require a lot of work, and a lot of attention to detail, as it takes shape so the project is safe, healthy and successful.

FOR MORE INFORMATION

These publications offer more information on the topics in this chapter. The publication number for CMHC publications is shown in brackets.

Investigating, Diagnosing & Treating Your Damp Basement, CMHC (NHA 6541)

Clean-up Procedures for Mold in Houses, CMHC (NHA 6753)

About Your House: After the Flood, CMHC (CE7)

About Your House: Combustion Gases in Your Home, CMHC (CE2)

Guide to Radon Control, CMHC (NHA 6181)

Healthy Housing Basements, Fact Sheet 6, (PEO224)

Building Materials for the Environmentally Hypersensitive, CMHC (NHA 6742)

Canadian Wood-Frame House Construction, CMHC (NHA 5031)

Before You Renovate (catalogue), CMHC (NHA 6977)

Keeping the Heat In, Natural Resources Canada

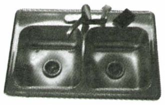
PROJECT PLANNING WORKSHEET

Job	Materials cost	Contractor name phone no.	Start date	Completion date	Labour hours/ rate	Labour/ contractor cost	Tools/ rentals	Permits/ fees	Other costs	Total cost

Chapter Nine

THE KITCHEN

- *renovating a kitchen is well worth it*
- *what's missing, what's causing problems?*
- *appliances, electricity and plumbing*
- *planning an accessible kitchen*



On the list of home renovation projects, redoing the kitchen ranks right at the top. That's partly because a kitchen renovation makes a house more desirable to buyers. However, it's also because the kitchen is an important part of the house, and one your family may spend a lot of time in—cooking, eating or just sitting and talking.

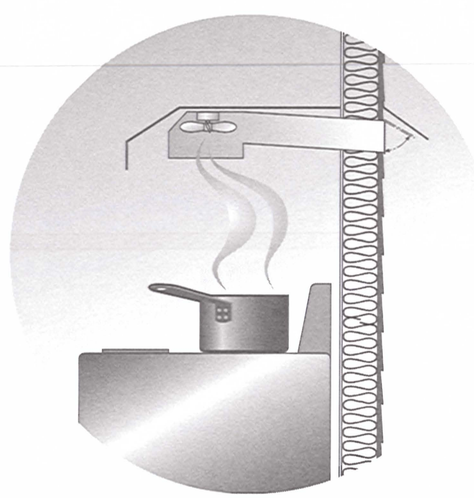
At the same time, renovating a kitchen is one of the most involved home projects you can attempt. Many different components go into a kitchen, from the stove to the countertop to the plumbing, cabinets and lighting. Putting them all together to make a finished room requires learning enough about those components to make educated choices along the way.

The choices you make when you're renovating for your own future use will be different from the ones you'd make when renovating for resale. But in both cases you want to end up with a room that's appealing, practical, comfortable and healthy—all while staying within your budget. It can be a tricky process, but the reward is a kitchen that's a better place to be.

What Are the Issues?

- Function: Above everything, kitchens have to work. That means things should be in places where they're easily accessible for the person cooking or preparing food. It also means that equipment such as sinks and stoves should be big enough for your needs, and well designed. They should be efficient, so you're not wasting energy. Function also includes things like lighting, electrical and plumbing services, and floor and wall surfaces, all of which must be suitable for your use.

  The way you use the kitchen is a key factor in designing a kitchen renovation. If you have a big family that spends a lot of time around the kitchen table, for example, your design will have to include a big eating area. If you just prepare food and take it into the dining room, a built-in breakfast counter may be enough eating space. If you do a lot of cooking and baking, you may need extra food preparation surfaces.
- Appearance: The kitchen is a public part of the house where people tend to spend a lot of time; thus, its appearance is important. Kitchens that have remained the same for a number of years can start to look tired. Many people renovate at least partly to give their kitchens a fresh face, new colours and a more modern style.
- Value: Studies done by the Appraisal Institute of Canada in 1996 show kitchen projects produce a higher return on investment than other renovations when the house is resold—typical returns are from 68 to 73 per cent. It's well known that the kitchen is one of the key areas buyers look at when they tour a house.
- Health: The kitchen is a major source of moisture and odours in the house. That means it's essential to provide adequate ventilation to keep the room and the rest of the house healthy. As well, some of the materials used in kitchen cabinets,



counters and other surfaces are made of materials that can have health effects, so it's important to look carefully at the materials you use.

What You Should Know about Kitchens

The kitchen isn't just another room in your house. It's a workplace, an eating area and, often, a gathering place. At the same time, it's a system of different parts that must work together to make it suitable for all those uses.

The are six main elements in a kitchen.

- Food preparation areas: This includes counters, sinks and sometimes tables. There should be enough continuous counter space to prepare food without being cramped, and it should be near the stove and sink to make work easier. Some work areas are built into a separate, stand-alone cabinet called an island.
- Eating areas: This can be a full table and chairs, or a breakfast counter built into the main counter or an island. It must be big enough for your family, with enough space for people to circulate comfortably. If you're planning to stay in the house for a long time, anticipate your needs in the future when your children grow up or new family members are added.
- Appliances: These include the stove, refrigerator, dishwasher and microwave oven, and are standard items in kitchens. But there are a number of variations on each, from basic models to high-tech designs and professional restaurant-type units.
- Storage space: This includes cabinets, drawers and cupboards. Together, they are one of the biggest visible surfaces in the kitchen, which means they tend to set the tone for the room's overall look. However, they also play a big part in how the kitchen works; you need storage for food, dishes, cookware and cleaning supplies.
- Lighting: This includes general lighting, which illuminates the entire room, and task lighting, which illuminates work areas such as sinks and counters. Some people also add accent lighting—localized lights that give the room visual interest or set off a particular area.
- Ventilation: This includes the range hood and wall or ceiling exhaust vents which act to expel steam, smoke and cooking odours to prevent moisture problems and keep the air fresh.

Kitchen layouts

Cooking requires you to move around among three key areas: the stove, sink and refrigerator. The path connecting these three points is called the work triangle, and how well it's laid out determines how easy it is to work in the kitchen. In most cases, the sink is situated between the other two points.

In an ideal situation, the distance between any two of the three points in the triangle is about 2 m (6 ft.) and no less than 1 m (3 ft.). This saves a lot of walking back and forth across the kitchen, but leaves enough room to move and work. Your major food preparation area should also be within this triangle. However, achieving this layout isn't always possible.

Kitchens come in a number of different basic layouts, each of which has its own design characteristics.

- L-shaped: These have two adjacent walls but no enclosing wall surface, so they're very accessible and have few obstructions to work around. However, the lack of a third wall can limit storage space. Some people construct an island or a breakfast counter to enclose the space and add some built-in storage.

- U-shaped: These have three walls with one open end. This layout allows for lots of cabinet and working space, and often makes an efficient work triangle possible.
- G-shaped: This is basically a rectangle, with a door opening at one end. It can provide ample wall space for storage, work spaces and eating areas, but can also feel closed-in and separated from the rest of the house.
- Corridor or galley: These have two facing walls, and are open at each end. The stove and sink are often on opposite sides of the room. This layout allows a lot of counter and storage space in a small area. However, it can be cramped.
- One-wall: The sink, stove and refrigerator are spread out against a common wall. These kitchens are very accessible, and take up very little space. However, they may be short of storage space, and the work triangle may be spread out. As with the L-shaped layout, some people add an island or breakfast counter to enclose the space, increase built-in storage and improve the work triangle.

Taking Stock

Most people renovate a kitchen because they're dissatisfied with the one they have. Before you start planning how you're going to improve your kitchen, you have to define exactly what elements it's missing, and what features are causing you problems.

This may already be apparent to you since you live with the kitchen every day, but taking a systematic look can help you pinpoint everything that needs to be done. Think about how you use the kitchen and what elements make life more difficult for you.

Many different problems cause people to renovate. Some involve the basic layout of things, while others involve the specific elements in the kitchen. Here are some of the common problem areas with kitchens.

Layout

In some kitchens, the shape of the room and the way things are organized can cause problems and make using the kitchen much more difficult than it should be. These problems include:

- an inefficient work triangle, with the sink, stove and refrigerator too far apart
- traffic problems, for example, the eating area or an island acting as a roadblock to people entering and leaving the room
- a closed-in feeling—a wall separating the kitchen from the dining room or other areas of the house, making it difficult to socialize while cooking
- a layout that puts things in awkward positions, for example, a sink cutting the counter space into small pieces that don't provide enough work space.

Appearance

The colours and styles in your kitchen may have come with the house, so they don't reflect your taste. Or, they may just be starting to look old. As well, if you've changed the decor in the surrounding rooms, the kitchen may now be a mismatch. The colour and texture of the cabinets set the tone for the room. If they're deteriorating or in an old-fashioned style, the whole kitchen can looked tired. If you've had the counters for several years, they may have been cut or burnt, or their finish may have deteriorated. Or, you may just be tired of the colour or pattern.

Space

The most common problem is a lack of counter space. Some kitchens didn't have enough to begin with. And today's kitchens often need room for a growing number of countertop appliances that leave little space for food preparation. As well, many kitchens don't have enough cabinets, or they have cabinets that aren't big enough for the uses they're put to.

The single, medium-sized sink that was the standard in kitchens for many years is often not adequate for people who do a lot of cooking. An extra sink for rinsing dishes or doing a second task can be a big improvement. As well, the existing sink may not be large enough for current use, or its surface may be damaged—especially common with old enamelled sinks.

Finally, smaller kitchens often have little or no space to put an eating area. This forces you to carry food out of the room for every meal and makes quick meals, such as breakfast, less convenient.

Lighting

Some kitchens just aren't bright enough. This can be because the room has only one small window. It can also be that the original lights are not adequate to make the room bright and cheerful when the sun's not shining. Shadows or inadequate light on important work areas, such as the sink, can also be a problem, making it harder for cooks to see what they're doing and to see into the cupboards.

Ventilation

Some kitchens have little in the way of ventilation; most have a range hood, but in some cases it's a "ductless" or "recirculating" hood that's not connected to a duct leading outside. As well, some range hoods don't perform well because the fans are not functioning properly (see Is your ventilation system working? in Chapter Four). A lack of proper kitchen ventilation can make your house too humid, and allow smoke and other vapours to spread throughout the house.

Heating

Frequent cooking can keep a kitchen warmer than the rest of the house much of the time. However, if the kitchen gets cold when the stove or oven isn't on, the heating outlets may not be adequate or not functioning properly.

Appliances

In many cases, the problem with the appliances is that they're old, not working properly and need to be replaced. In others, it may be that the family has grown, or its needs have changed, so you may need more capacity—a bigger oven or a bigger refrigerator, for example. You may also want special features such as a wall-mounted oven.

Services

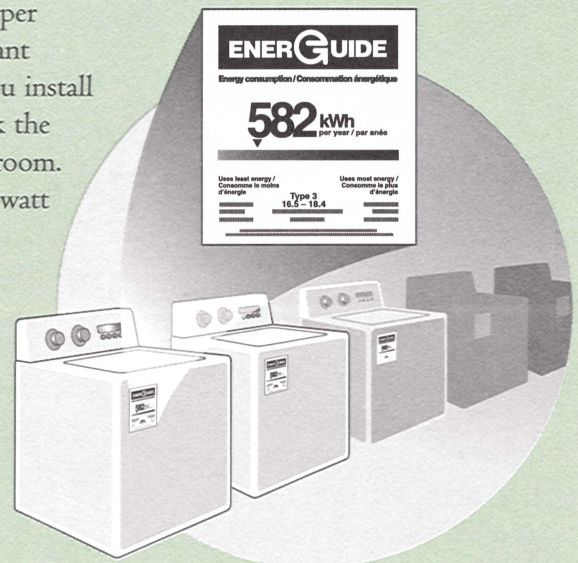
At the same time, look at the electrical and plumbing services in your house. These are the systems that make your kitchen work, and they must be up to standard to support any new equipment and the new demands of a renovation.

Electricity

The first step is to check the kind of electrical service you have. This should be written somewhere on your service panel. If your house is more than 20 years old, you may have an old 60-ampere service which may have to be upgraded if you're adding extra appliances or if it's showing signs of strain (for example, flickering lights or brownouts). If it's more recent, you'll likely have at least a 100-ampere service; however, it should still have some open connections for any new circuits you'll

APPLIANCES AND ENERGY

Kitchen appliances can account for between 20 and 40 per cent of your home's energy use. That means it's important to look at the energy consumption of the appliances you install in your new kitchen. The best way to do this is to check the EnerGuide rating posted on the appliances in the showroom. These show both the yearly energy consumption in kilowatt hours and where the appliance ranks on a scale of similar models.



The differences may not look large in some cases, but remember that they add up year after year: this is called the "second price tag." The extra cost of buying the least efficient model instead of the most efficient comparable model can be big. For a typical mid-range stove, the difference is $252 over its lifetime; for a refrigerator, it's $385. (To obtain an EnerGuide directory that lists the energy consumption ratings of major household appliances, call Natural Resources Canada.)

need for added appliances. If in doubt, have a qualified electrician look at your service.

Plumbing

If you're not going to be moving fixtures around or adding new ones, you may be able to use the existing plumbing hookups for a new sink or dishwasher. However, if you're moving fixtures, or adding new ones in new places, it will mean running new plumbing.

Open up the cabinet below your sink and look at the pipes there. If your house was built after 1950, you likely have cast iron, steel or plastic drain pipes; these should be adequate for your purposes, unless you've had problems, such as slow water flow. If your house was built before 1950, you may have lead drain pipes, which should be replaced. Water supply pipes are made of copper, brass, steel or plastic, and the existing ones shouldn't need upgrading.

If you are in doubt, have a plumber or house inspector look at your plumbing system. You may want to have old steel pipes replaced in order to modernize the system.

To get a better idea of what problems you have and what you have to work with, use a piece of graph paper or a commercial planning kit—these come both on paper and as computer programs—to do a scale drawing of your kitchen with all the cabinets and other features included.

Measure the length of each wall, at counter height, with a tape measure. For walls with windows or doors, measure the distance from each corner to the edge of the window or door frame; then measure the width of the window or door from one outside edge to the other. Also note the height of any window frames, how high the window is off the floor and what direction your doors swing. Opposite walls should be the exact same length; if they're not, the room is out of square, which could cause problems later. Also, check the corners with a carpenter's square to see if they're a true 90 degrees.

Mark the locations of your sink and appliances, with their dimensions, and the location of the drain pipe, water supply pipes, electrical hookups, ventilation fans and heat registers or radiators. Measure the width and depth of the cabinets and of any aisles between cabinets.

Then, do an inventory of your kitchen's design and equipment. Note what you currently have and any problems you see. List this information on the Kitchen Assessment Worksheet.

What Are the Options?

There are many ways of upgrading your kitchen, ranging from modest facelifts to major remodelling jobs that involve demolition and new construction. At the same time, there are dozens of alternatives among the materials and components that make up the new kitchen. Before you decide what you want to do, it's wise to consider the alternatives open to you.

Strategies

Your biggest choice involves the overall strategy you're going to use to make your existing kitchen a better place. These are some of the main options, from the simplest to the most ambitious.

Reface it

If your kitchen functions fairly well, but needs a brighter new look, you can choose just to have the cabinets and closets refaced. This involves replacing the existing doors and drawer faces with new ones sold by a kitchen outlet or building centre, and refinishing any other exposed surfaces with paint or veneers. The new doors come in a number of sizes and dozens of colours, designs and finishes. If you can't find doors that fit your cabinets exactly, you can have them custom-made. However, the cost of custom-made doors may be high, and it might make more sense to buy new cabinets.

Replace it

For a more drastic change, the next step up is to replace the old cabinets with new ones. At the same time, you may also replace the counters, sink or flooring, add some new appliances and repaint. The effect is a whole new look, but with little real structural work except tearing out and replacing the old cabinets.

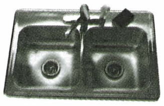
Change the layout

If the basic room is big enough for your purposes, but it's difficult to work in or just doesn't suit your lifestyle, you can choose to rearrange the pieces without altering the walls. This can include a number of changes, such as:

- replacing and moving the cabinets for a new configuration
- moving the stove or refrigerator to make a better work triangle or get more counter space
- making room for a breakfast nook
- adding a cooking or food preparation island.

Add a window or door

One way of brightening the room is to add a window, or replace an existing one with a bigger, better one. Kitchen windows are often situated over the sink, and can be



KITCHEN ASSESSMENT WORKSHEET

Room measurements	Wall 1	Wall 2	Wall 3	Wall 4	Ceiling height	Observable problems

	Existing elements, details (dimensions, age)	Condition	Problems
Layout			
Distance from sink, stove and refrigerator			
Food preparation area			
Eating area			
Storage space			
Windows			
Doors			
Elements			
Cabinets			
Counters			
Sink			
Faucets			
Stove/oven			
Refrigerator			
Room lighting			
Task lighting			
Ventilation			
Heating			
Wall surfaces			
Floor surface			
Ceiling			
Electrical service			
Plumbing			

difficult to enlarge without changing the room layout. However, you can choose to install a new window near the eating area, or put in a skylight if you have a roof surface directly above. Adding a door to the kitchen can make the room more accessible and allow you to take food outside for summer dining but may take away some counter space.

Open up the room

If your kitchen is small or has a closed-in feeling, one option is to remove or open up a wall between the kitchen and an adjacent room. This involves some real structural work, and you must determine whether the wall involved is a bearing wall, that is, one that supports the structure above it. If so, you'll have to add a beam to replace the wall you've taken out. In most cases, this is a job for a professional contractor.

Enlarge the room

If the kitchen is just too small for your purposes, you can choose to enlarge it. This can be done in two ways.

- Remove one or more walls to incorporate space from adjacent rooms. This can sometimes be done without much major structural work, if you have a laundry room or mud room beside the kitchen that can be easily incorporated. Or, you may be able to extend the kitchen space into an adjacent room by removing a wall and building an island or breakfast counter in the newly opened space.
- Break out an exterior wall and extend the kitchen outward. This requires major demolition and support of the exterior wall, and should be done by a professional contractor. However, it can be rewarding, since you can get a bright new space, with new windows and perhaps access to the outside, as well as more room.

Picking the pieces

Defining your style

In addition to the layout, the other key element in planning a new kitchen is the overall "look." The first decision is what style you want to use; this dictates the type of cabinets, appliances, wall finishes, lighting and flooring you select.

The styles to choose from include:

- contemporary typified by flat cabinet doors without knobs, simple lines and often by smooth, glossy surfaces for a modern look
- traditional using more wood, with panelled door faces and knobs, and matte finishes for a formal but comfortable look
- country with the use of light woods, rustic finishes and traditional materials such as painted wood furniture, ceramic knobs and wood floors to create an informal feeling.

The second main choice is the colours you'll use. A main factor in this decision is that of colours in the rest of the house. While the kitchen should have its own character, it shouldn't be a jarring change from the adjacent rooms. First, list the colours and accents you have in the other rooms. Then choose kitchen colours that will either co-ordinate with them or complement them. That doesn't mean they must be the same. If you want to use a completely different colour, you can still bring in some of the tones from the other rooms by using them as an accent colour; for example, if you have wood trim in the adjacent rooms, you can use matching wood baseboards or trim.

Some people use the cabinets to set the tone for the kitchen decorating scheme, while others use the floor colour. Both are large and dominant areas in the room. Choose one or the other for your dominant colour, and then choose counter, backsplash, wall and ceiling colours to match or accent the main colour.

Light tones are usually recommended for a kitchen, to keep the room looking bright. However, dark surfaces such as dark wood cabinets and panelling can give a kitchen a rich, comfortable look. If you use a dark colour scheme, be sure to provide ample lighting to keep the room from being dark.

STRUCTURAL CHANGES

It's usually feasible to make structural changes to the walls around the kitchen to enlarge or open up the room. However, before you firm up your plans, check to see what kind of wall or walls you're dealing with.

Walls that help hold up the house are called bearing walls. Exterior walls are usually bearing walls, but so are some interior walls; these usually run down the centre of the house, at right angles to the joists (check in the basement or attic to see the direction of the joists). Typically, the joists coming from opposite directions overlap where they rest on a bearing wall. Walls that don't carry structural weight are called non-bearing or partition walls.

Bearing walls can be removed or altered, but they must be replaced with a new structural support; usually this is a beam supported by posts on either side of the room. As well, the structure above must be supported with temporary wood-frame walls until the new support is in place. This is a job best left to a professional renovator and it's best to consult a professional if you're in doubt as to which are your bearing walls. Non-bearing walls can usually be taken down or cut into without weakening the structure around them.

Taking down a non-bearing wall, or tearing the drywall or plaster off a wall, is a job most homeowners can do. This is very dusty work, so dust masks and added ventilation are needed. Also, be aware that you may encounter wiring and plumbing pipes inside the wall. If there is a bathroom directly above the wall, the pipes may run down through the wall cavity; if there are electrical outlets nearby, the wires likely run through it. This raises the danger of inadvertently breaking pipes and causing a leak, or cutting live electrical wires. There might also be heating ducts or a heat register in the wall.

All this can cause extra expense if you have to have pipes, wiring or ducts rerouted. If you're hiring a renovator to do the job, this type of expense will not be included in the initial price unless you alert the renovator beforehand, so look for signs of these obstacles before you talk to the renovator, if possible.

Some renovations involve altering existing walls in order to install or move a window or door. This requires some skilled carpentry to frame the new openings, close in the old ones and refinish the outside wall where necessary. Again, look for wiring, pipes and heat registers once the walls are opened, and also check to make sure the studs are sound and haven't begun to rot. Any rotting wood must be replaced and any leaks repaired before the new work can go ahead.

If you're rebuilding exterior walls, or building new ones for an expansion, take care to provide adequate insulation in the wall cavities. This could require making the stud frames deeper so you can add extra insulation. At the same time, seal all cracks in the wall surfaces to prevent drafts and heat loss. (See Chapter Five for information on insulation and air sealing.)

And remember, a house is a system, so the changes you make may have effects on the air and heat flows in the house, the heating and air conditioning systems, or its structural strength. If you're having the job done by professional renovators, discuss the possible repercussions with them before you start. (For a full discussion of the house as a system, see Chapter One.)

Along with the colours, think about textures. Shiny textures, such as stone countertops and ceramic backsplashes, tend to make the room look bright and busy; less shiny surfaces, such as textured laminate counters and wallpaper, tend to tone down the colours and make the room feel more relaxed and informal.

Using watercolours, coloured pencils or your computer program to tint your drawings of the kitchen can help you visualize how it will look with the colours you're considering. You can also get an idea by looking at books and magazines that picture kitchens with different colour schemes. If you take your drawings to professional kitchen designers or renovators, they may be able to show you pictures of other projects with similar colour schemes.

BACKSPLASHES

The backsplash is the part of the wall surface behind the sink or countertop. Since it is splashed frequently, it's usually finished with a waterproof surface. Some countertops come with a raised backsplash attached.

Cabinets

Cabinets are one of the biggest and most important parts of the kitchen. Most of the cabinets sold now are the European, or frameless, style; however, there are a number of other variations involving the doors, drawers and accessories.

Most dealers carry a stock line of cabinets with some choice of door finishes. These cabinets come in standard sizes, which increase in 76-mm (3-in.) steps; matching filler strips are used to fill any room left over once the cabinets are put together. For more money, you can buy customized cabinets, which are stock units modified to meet your tastes or needs, or custom-made cabinets, which are built to your specifications. With custom cabinets you'll likely get more options to choose from, and the cabinets will fit your room without using spacers.

Most cabinets have frames made of particleboard or a composite wood material called medium-density fibreboard (MDF), coated with a skin of plastic laminate. Low-pressure laminate, sometimes called melamine, is usually used for vertical surfaces. The laminate comes in different qualities, designated by weight; weights over 100 grams are usually water-resistant and will resist yellowing better than a 70-gram laminate. Some cabinet panels are painted or faced with paper. This is not as durable as melamine.

For more money you can get cabinets finished in wood veneer, although they are still likely to be made of MDF. High-quality cabinets, usually custom-made ones,

KICKSPACES AND SOFFITS

The recessed space at the bottom of a base cabinet is called the kickspace. This allows you to stand close to the cabinet front without stubbing your toes. The space above the upper cabinets is called a soffit. This can be left open for storage or display (although dust and grease tend to accumulate here and it can be difficult to keep clean). It can also be covered with a molding or a valance, or boxed in with drywall. The soffit is sometimes used to hide the vent duct that runs from your range hood.

have frames of solid wood or softwood plywood. If plywood is used, all the surfaces should be laminated or sealed with a low-odour sealer to stop emissions.

Most cabinet doors are made of MDF, covered with a laminate, foil, veneer or sprayed-on finish. However, solid wood doors are also available, and for a showier appearance, you can choose glass-fronted doors, which may be divided into multiple panes with grilles (called "mullions").

Cabinets can have cupboards with swing-out doors, pull-out drawers or a combination of the two for storage space. Your preference depends on how you use the kitchen, but there are some variations to consider. For deep cupboards, you can get revolving lazy-Susan shelves to provide better access to things stored at the back. There are also special units to allow better access to the trapped space in a corner.

Standard pull-out drawers are available for cutlery, baking dishes, cookware, linen and garbage or recycling bins. Lower-priced drawers have bodies, or boxes, made of melamine-coated particleboard; higher-priced models may have hardwood or hardboard, steel or aluminum boxes. The quality of the moving parts also varies: lower-priced units may have simple sliders, while higher-priced ones often have metal rollers for smoother action and durability.

The Cabinet Options chart lists the different options available with kitchen cabinets.

Counters

The counter is the primary work surface in the room, and there are a number of different materials to choose from. Surfaces such as natural stone and solid synthetic countertops can be made in almost any form, but they may cost three times the price of the more common laminated countertops.

High-pressure plastic laminates are used for countertops, rather than the low-pressure laminates used for cabinets. Counter laminates also come in different grades, depending on the type of surface. For flat surfaces with no sharp curves, the standard choice is Horizontal Grade 10, which is 1.2 mm (.048 in.) thick. If the counter will be "postformed"—curved to make a rounded edge or a vertical backsplash—a thinner laminate is used, usually Postforming Grade 12, which has a thickness of 1 mm (.039 in.).

The supporting deck under the counter surface is usually made from particleboard or medium-density fibreboard (MDF), which emits formaldehyde. This can be a health problem if the bottom of the counter is not sealed (see Your Kitchen and Your Health, this chapter).

The Counter Options chart lists the common types of counters.

Sinks and faucets

Sinks were once a fairly simple item. Today, there are countless combinations of sizes, shapes, materials, colours and configurations.

There are different ways of mounting the sink on the countertop. Most sinks are top-mounted, or self-rimming, and overlap the counter surface around them. Others are flush-mounted, to sit level with a countertop (usually ceramic tile). For solid-surface counters, there are undermounted sinks, which sit below the counter surface and allow water to flow in freely from the counter; the sink is bonded to the surrounding surface. Solid-surface counters can also incorporate a sink built right into the counter surface.

The Sink Options chart lists the most common options for sinks.

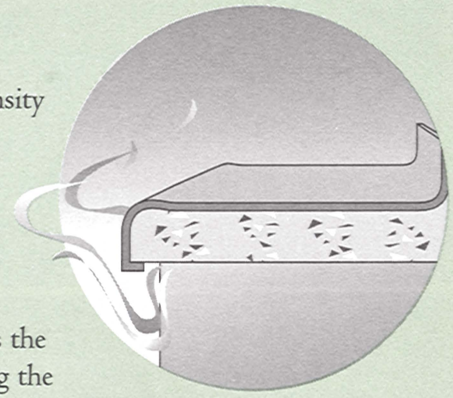
CABINET OPTIONS

	Features	Comments
STYLES		
Framed	Have full frame, with face boards that may be visible between doors.	Traditional style, now hard to find on the market.
Frameless or European	Doors completely cover front of cabinet, hinged on inside of side panels.	Alignment of doors is critical for proper appearance. Doors may have adjustable hinges.
Open	No doors, open for easy access.	Can add visual accent to the room by showing off dishware; however, any clutter inside cabinets is visible.
DOOR FINISHES		
Low-pressure laminate (melamine)	Plastic skin is sealed to door material.	Not as resistant to scratches and cuts as high-pressure laminates.
High-pressure laminate	Similar to melamine, but thicker and tougher.	More resistant to scratches and cuts than melamine.
Wood veneer	Thin slices of wood adhered to door material.	Look of solid wood. Scratches can reveal material beneath. May buckle and come off if not built properly.
Solid wood	Can be made of hardwoods such as oak, cherry or maple, or softwoods such as pine.	Durable, although can warp or crack. Softwoods are not as resistant to scratches and can release gases.
Polymeric foil (thermafoil)	Plastic material shrink-wrapped to door.	Produces glossy finish like polyester, but at lower cost.
Polyester	Plastic coating applied in sprayed layers.	Produces a high-gloss finish. Very durable, but can't be repaired. Expensive.
OPTIONS		
Handles	U-shaped or D-shaped pulls or knobs.	Choice may be based on look of doors and style of kitchen. Many doors don't require handles.
Valances	Wooden panels or mouldings above or below cabinets.	Help fill space or give units a more finished look. Can conceal lights for soft, indirect lighting.
Pull-out shelves	Sliding shelves give you easier access to things stored in base cabinets.	Variations include wire baskets, flat shelves, tilt-out garbage or recycling containers, pull-out tables or work surfaces.
Appliance garages	Counter-top cabinets provide space for storing small appliances out of sight.	May have swing-out or roll-down (tambour) doors.
Colour contrasts	Different colours for knobs or edges of cabinets and shelves.	Aid those with impaired vision in using kitchen.

Faucets all do the same job, so a basic model will likely suit your needs. However, there are several variations in style, which affect how attractive the faucet is and how easy it is to use. Most faucets are mounted on the sink using pre-drilled holes. The standard number of holes is three, but some modern one-handle faucets need only one hole, and for a faucet with two handles and a sprayer, you'll need four. Faucets can also

YOUR KITCHEN AND YOUR HEALTH

Many different materials go into a modern kitchen, and some of them have potentially harmful effects on your health.



- Cabinets and counters: Most of the particleboard and medium-density fibreboard used to make modular cabinets and kitchen counters contain urea formaldehyde glue, which emits formaldehyde and other gases that can cause chronic respiratory distress and other problems (see Chapter Two). Moisture in the kitchen enhances the release of these gases.

In most cases, the material is sealed in with a plastic skin, which brings the emissions down to an acceptable level. However, all surfaces—including the holes for the adjustable shelving—must be sealed. One large unsealed surface is the underside of the kitchen counter; the best way to seal this is to paint it with at least two coats of a water-based acrylic sealer. The underside of the counter above the dishwasher should also be covered with galvanized metal to protect it from humidity. The best way to seal all the surfaces is to have them factory-sealed or laminated.

Formaldehyde-free MDF is available, but you'll have to ask for it specially. Solid wood construction and solid wood doors are the best choice, although they usually cost more. Solid-surface countertops are also very low in emissions and can be installed without the MDF backing if they have proper support.

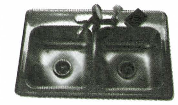
- Walls: Since kitchen walls get a lot of splashes and spills, they are often painted with alkyd paints, which have a tough, washable skin. The solvents in these paints give off fumes during painting and sometimes afterward. This can be avoided by using low-emission, water-based paints; water-based acrylic latex paints can now be used for almost any application and are washable.

Solid vinyl or vinyl-coated wallpapers are widely used in kitchens because they are scrubbable. The vinyl in these papers gives off odours that can be irritating. As well, the adhesives typically contain fungicides (chemicals that kill mold). These can also be an irritant. (See Chapter Seven for more on the health aspects of paints and finishes.)

- Floors: Vinyl flooring tends to gradually release, or off-gas, some of the chemicals it's made of; these can have health effects. The hard vinyl tiles known as vinyl composition tiles emit fewer gases than flexible sheet vinyl flooring. Natural linoleum, although made of natural materials, gives off linseed oil odours, which can be irritating to some people. Hard surfaces such as ceramic tiles are healthier choices.

The adhesives used to install vinyl and some other types of flooring, including tiles, can also be a health hazard. Some are petroleum-based, and release hazardous chemicals. Pre-glued vinyl tiles have lower emissions, and low-toxicity water-based adhesives are available that are safer for you and for the installers.

- Storage: Some of the cleaners and other chemicals in your kitchen can give off harmful chemical gases. If possible, include a vented cabinet for these and seal them in closed containers.



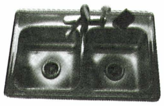
be mounted on the counter or wall, but the tap must be long enough to reach all the parts of the sink.

There are four major types of faucets.

- Double-handle: This is the traditional design, with separate hot and cold controls. Choices include knobs, handles or flat "wrist blades" which may be more practical for people with disabilities.
- Single-handle: Also called "centre-set," this type has a handle which tilts to control water flow and temperature. They are convenient to use with full or wet hands.
- Gooseneck: High, arced faucets leave room to work with large or tall vessels; they also have an elegant look.
- Pull-out sprayers: These extend using a flexible hose. They're good for washing vegetables or rinsing dishes and can be an extra unit or the main faucet.

COUNTER OPTIONS

	Features	**Comments**
MATERIALS		
Laminates	High-pressure laminate sealed to particleboard counter. Comes in many colours and designs; gloss, matte and textured finishes.	Can be scratched and cut; heavier grades somewhat more durable. Joint seams are visible.
Solid surfaces	Made of plastic resins such as acrylic and polyester, and minerals. Can be moulded into any shape. Available in many colours	No visible corner seams. Stain and scratch-resistant. Can be sanded or patched to repair damage. Thinner "solid veneer" surfaces available at lower cost.
Natural stone	Marble, slate and granite available.	Can be cut in many shapes. Natural colours and textures add to decor. Smooth surface without seams. Can scratch and stain, granite more durable than others.
Ceramic tile	Glazed ceramic tiles; large floor-type tiles most suitable.	Special edge and detail tiles available. Hard, long-lived, cleanable surface. Needs a base such as hardboard or plywood. Tiles can break or chip, will break plates dropped on them.
Wood (butcher block)	Made of wooden pieces laminated together to form solid surface.	Work surfaces should be treated with a non-toxic oil finish. Cuts or scratches can be sanded and refinished. Not a low-maintenance surface. Often used for cutting blocks and islands.
OPTION		
Edge trim	Strips of wood, solid counter material or other materials fit over the edge of the counter.	Useful for covering edge seams in laminate countertops. Aid those with impaired vision in using kitchen.

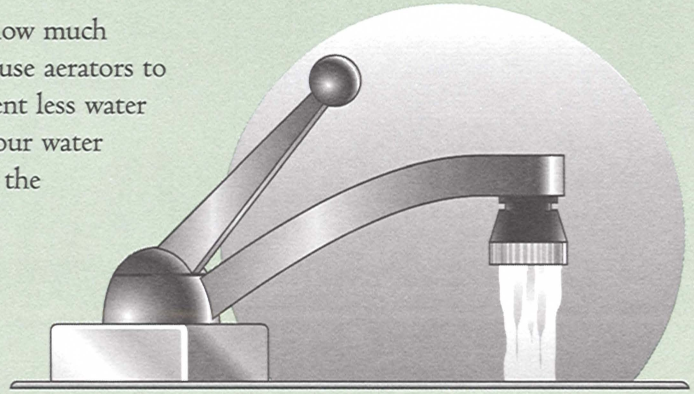


SINK OPTIONS

	Features	Comments
CONFIGURATIONS		
One bowl	Single bowl.	Traditional design. Useful where space is tight.
Two bowl	Two bowls in integrated unit.	Second bowl can be full-sized, for rinsing dishes, or a smaller bowl for rinsing vegetables (sometimes called 1 bowl).
Three bowl	Three bowls in integrated unit.	Often two full-sized bowls and a smaller bowl, sometimes with a garbage disposal.
MATERIALS		
Stainless steel	Steel with nickel and chrome added for stain-resistance.	Common material has bright look, is easy to clean.
Enamelled steel	Enamel bonded to pressed steel or cast iron surface.	Has a clean look. Available in a number of colours. Enamel can chip; thicker enamel in higher quality sinks.
Solid materials	Made of same synthetic mineral material used for solid countertops. Can be integrated into solid countertops.	Available in a variety of colours. Resists stains, scratches, burns and chipping.
Composites	Made of crushed minerals such as quartz and granite, bonded in a resin composite.	Durable materials, resist stains, scratching, heat and chipping.
OPTIONS		
Drainage boards	Flat or ribbed surface incorporated into one side of sink.	Good for draining dishes or washing vegetables.
Water filtration systems	Remove impurities from water.	Can use separate tap or main taps. Filtration unit mounts under sink.
Water dispensers	Special dispenser mounted on sink delivers water hot enough for hot beverages, or chilled water.	Come with a special heating or chilling unit mounted under sink.
Soap dispensers	Dispense detergent, liquid soap or hand lotion.	Mounted on sink. Convenient, reduce clutter.
Garbage disposals	Built-in appliances for disposing of soft waste.	Available with many sink units. Mounted under sink, connect to drain. Need an electrical connection. Not environmentally sound, increases burden on sewers; food scraps should be composted.
Drain baskets, colanders and cutting boards	Special units made to fit into standard and special sink shapes.	Convenient for food preparation.

RESOURCE NOTE

One issue to consider when buying a faucet is how much water it uses. Look for low-flow faucets, which use aerators to produce an adequate flow using up to 60 per cent less water than conventional faucets. These can decrease your water consumption, lower your water bills and reduce the demand on your local water treatment system.



Appliances

Ranges

Stoves or ranges now come in many different shapes, sizes and styles, from traditional models to "gourmet" or restaurant-style units with extra burners, stovetop grills and extra ovens.

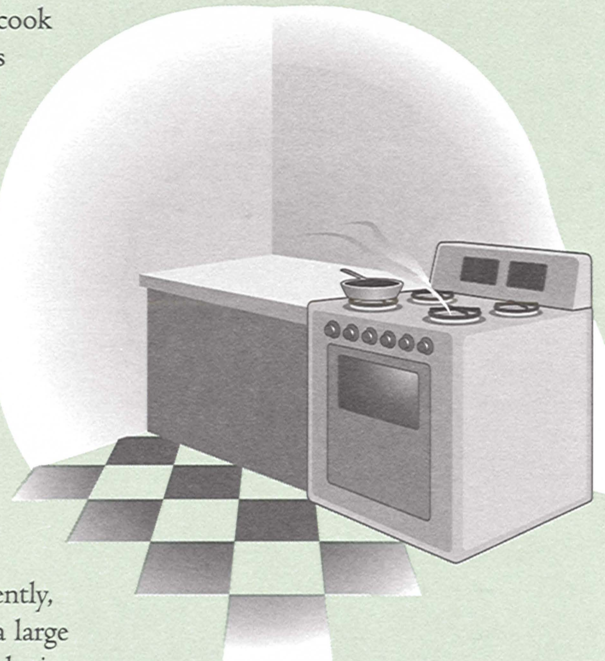
One of the main choices if you're buying new appliances is whether to choose electric or gas. Both are serviceable, and you may opt to stay with the energy source you have. Gas stoves tend to heat up faster than electric stoves, but they have drawbacks from a health standpoint (see Gas Stoves and Your Health). Some manufacturers produce ranges with a gas cooktop but an electric oven.

Here are the most common variations on basic stove design.

- Cooktops: These separate the burners from the oven. They can also be mounted on the kitchen counter or island; modular units may combine burners with a gas grill or griddle and a down-draft exhaust fan, which pulls air downward into an exhaust duct. (Since it reverses the natural flow of air, the down-draft exhaust requires a stronger fan than a conventional up-draft range hood.) The space below can be used for storage or, if left open, for knee space to permit use from a seated position. Cooktops can be either gas or electric.
- Separate ovens: These units can be built into base cabinets or wall cabinets. They separate baking from normal meal preparation; two ovens can be stacked above one another, or the space above and below can be used for storage.
- Extra ovens: Some ranges have a lower oven and another above, at eye level. Wall ovens are convenient for most cooks since they don't have to stoop or bend.
- Convection ovens: Circulate air throughout the oven with a fan for more even cooking. Food cooks faster and retains moisture.
- Ceramic cooktops: These one-piece surfaces have no crevice or cracks, and are easy to clean. The new surfaces are more durable than older models. The bottoms of pans must be perfectly flat for use with these cooktops.
- Halogen heat: This type uses an element like a halogen lamp to create intense heat. They heat up quickly, like

GAS STOVES AND YOUR HEALTH

Many people find using gas stoves an effective way to cook food. However, these stoves tend to emit harmful gases that can have health effects. One study of young women showed those who cooked with gas stoves had higher rates of asthma and respiratory problems than those who did not.



Natural gas, if burned completely, produces carbon dioxide and water. However, combustion is rarely perfect, and when the gas is not completely burned, the stove can emit carbon monoxide and nitrogen dioxide gases into the area around it. These gases are produced when the stove is burning and when it starts up. Operating a range hood while the stove is being used can remove some of the gases. However, most range hoods don't capture all the gases due to their design. To make them exhaust more efficiently, range hoods should be close to the cooktop and have a large surface area. They should also be wired to come on each time the stove is used.

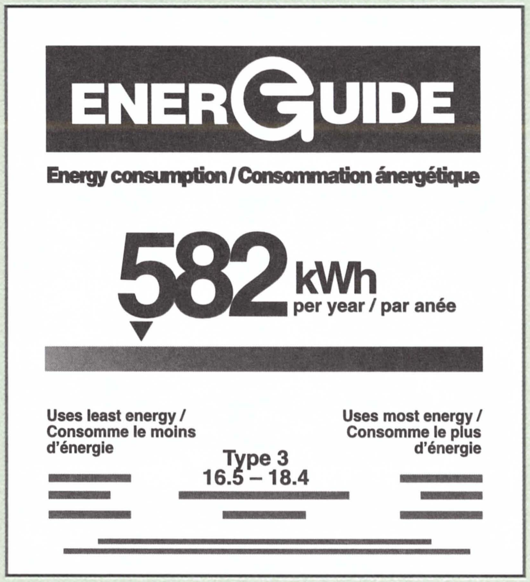
A preferred type of gas stove is a sealed combustion unit which has its own air supply and exhaust. This type of stove limits exposure to gas emissions since the combustion is enclosed and gases are not released into the air. Cooks will find that a sealed-combustion stove does not heat as fast as the open-gas type.

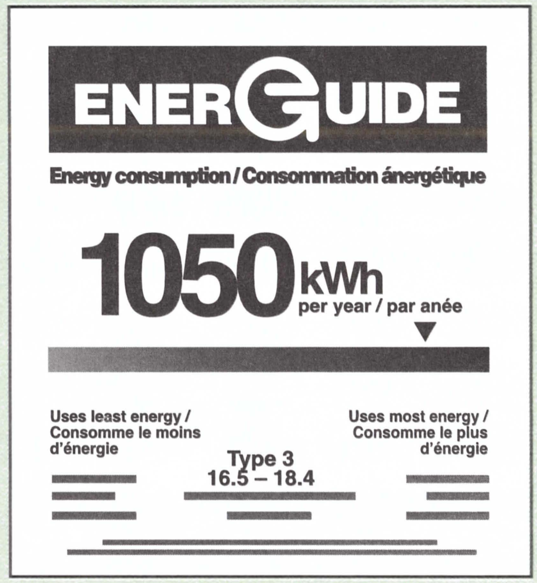
gas burners, but can be less than ideal for low-heat cooking.

- Magnetic induction heat: Using magnetic transfer of heat through the cooktop and pot to the food, this type is safer than others since the cooktop surface doesn't get hot. Usually, these are installed with ceramic cooktops; magnetic induction is more expensive than other types of heat.
- Self-cleaning oven: Here, the oven heats to a high temperature to burn off spills and stains when cleaning is necessary. Extra ventilation can be provided during the cleaning cycle to exhaust any odours produced. The cleaning program uses more energy, but extra insulation usually makes the overall energy consumption similar to conventional ovens.
- Continuous clean oven: This oven cleans itself as it is being used for cooking. The homeowner cannot control the odours produced by the cleaning process.

ENERGY NOTE

Ranges use a lot of energy, so it's wise to look at the EnerGuide label before you choose a new model. Generally, bigger ovens mean more energy consumption, but the consumption of comparable models can vary significantly.





Refrigerators

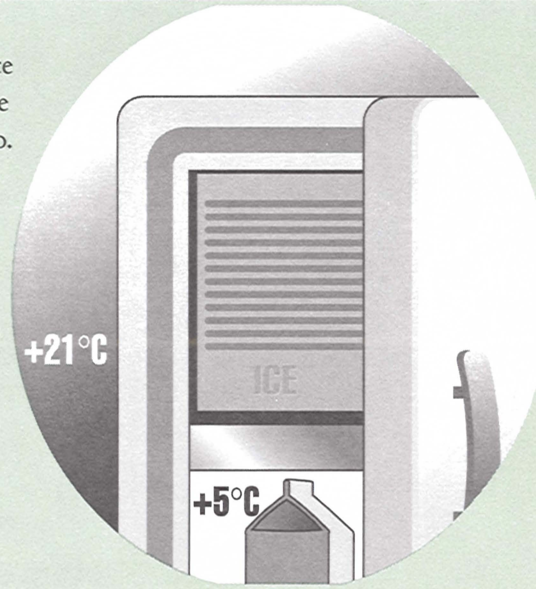
If you're replacing the refrigerator, it's important to get one that suits your lifestyle. If you load up on pre-packaged frozen foods or freeze produce, a large freezer is important. If you have a big family with young children, you'll need lots of space in the refrigerator section, or possibly a feature such as an external water dispenser. The size of the unit is also important. You need 340 litres (12 cu. ft.) for the first two people in the house; for three or four people, you may need 395 to 480 L (14 to 17 cu. ft.). For each extra person, add another 55 L (2 cu. ft.).

There are a number of variations on the standard refrigerator design. These are the main choices.

- Double door: Standard units have a separate door for refrigerator and freezer units. Their wide profile is good for storage.
- Single door: One door opens both refrigerator and freezer. Extra warm air entering freezer compartment makes it unsuitable for long-term storage.
- Side by side: Vertical refrigerator and freezer units. These offer lots of freezer space and good accessibility, especially for people in wheelchairs; the storage space may be too narrow for big items.
- Under the counter: Compact units fit into base cabinets. These can help save space in a small kitchen. The size of these units is limited, and their low position might make them difficult for some people to use.

ENERGY NOTE

Refrigerators are the biggest energy users in the kitchen, since they work hard both day and night. Modern refrigerators use less than one third the electricity of those made 20 years ago. However, there are still big differences between comparable models. Choose a unit with a good EnerGuide rating, and don't buy one bigger than you need—extra size usually means extra energy consumption. Don't keep your old one around for extra capacity; it will cost you far more in energy consumption than buying a slightly bigger, new fridge.



- Ice and water dispensers: Some refrigerator designs have a special outlet that delivers ice through the wall of the refrigerator. These refrigerators will require plumbing hookups.

Dishwashers

Most modern kitchens include a dishwasher. These are usually built into the base cabinets, but stand-alone models with finished tops are available. These are the main options to look for.

- Settings: Many models have two wash levels, better models have three; higher-quality models have several different cycles for different jobs.
- Noise insulation: Noise can be a factor with these appliances; look for extra insulation for quiet operation.
- Soft or solid food disposers: These minimize how much you have to rinse the dishes before loading.
- Heat on/off settings: These allow you to turn off heating elements and air-dry dishes to save energy.

Microwaves

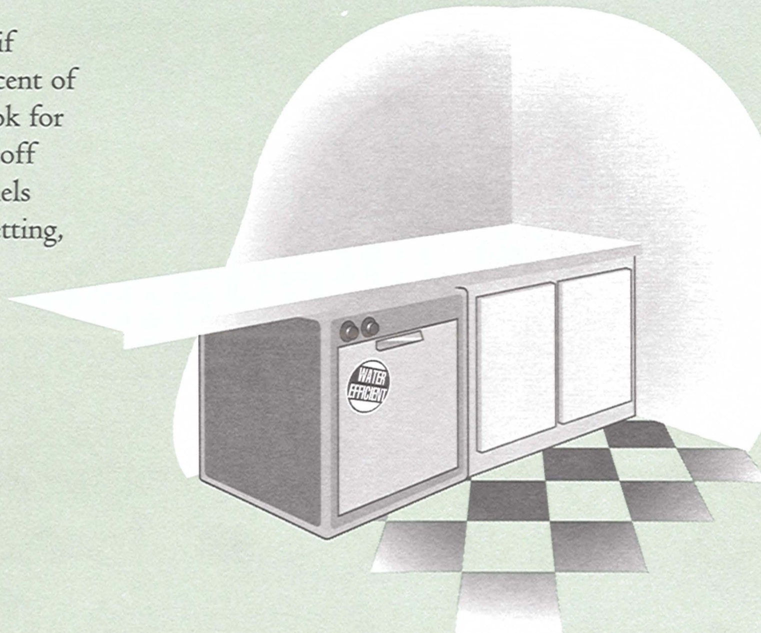
A microwave has also become a standard piece of kitchen equipment. These have an energy advantage since they cook using much less electricity than a stove or oven. However, microwaves are unlikely to replace regular ovens since they cook foods differently. You can give them a space on the countertop, hang them under a cupboard or build them into the upper cabinets. Size and power are important factors. The oven should be big enough to accommodate the biggest dish you want to use; ovens of 1 cu. ft. or above generally need a power supply of 800 to 900 watts.

There are several other features to consider.

- Turntables: These help achieve even cooking; some can be turned off.
- Pre-set cooking programs: These make cooking specific foods easier.
- Broilers and crispers: These allow you to achieve a crisp surface similar to foods cooked in a conventional oven.

ENERGY NOTE

Dishwashers consume a lot of energy if they're used frequently. About 80 per cent of the energy is used to heat water, so look for models that use less water. A heat on/off setting is also desirable. Look for models that have a booster heater, or "sani" setting, that brings the incoming water up to 60 degrees Celsius (140 degrees Fahrenheit) so you can turn your hot water heater down to 55° C (130° F) to save more energy.



THE BUILT-IN OPTION

When choosing new appliances, one of the major choices is whether to choose standard slide-in models or built-in units that are incorporated into the kitchen cabinets. Built-in units make the room look more unified or customized; it can also be easier to build storage space under and above them. However, they are shallower than slide-in appliances, which limits your storage space. And while they may not be substantially more expensive, the work involved in building them into the cabinets will add to the cost of the kitchen.

Lighting

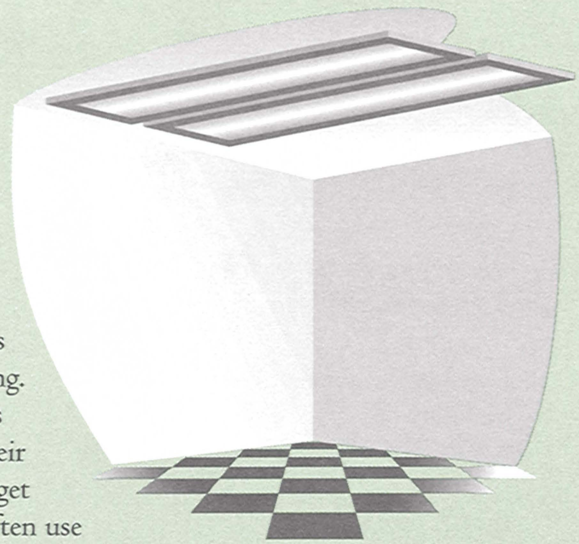
As a rule, kitchens should be bright. Natural lighting is desired, but if the amount of natural light is limited, pay extra attention to the colour of the walls and cabinets. Dark colours make the kitchen look less bright. Having big windows in a sunny exposure helps, but to make a good environment for cooking, eating and socializing at all times of the day, you need both adequate general lighting and good task lighting.

Aside from the lights themselves, put some thought into the overall lighting scheme. Using more than one type of light source can give the kitchen a more interesting look. As well, think about putting lights on dimmers, to create a more intimate sitting or dining area—this also saves electricity. Wiring lights to different switches allows you to illuminate one part of the kitchen while leaving the rest dark.

There are quite a few lighting options.

- Ceiling panels: Fluorescent panels produce good general light and fit well into suspended ceilings; new-style "warmer" tubes throw more flattering light than older ones.
- Recessed lights: "Pot lights" scattered across the ceiling combine to create general light; they can be hooked up with two or more switches to illuminate parts of the room separately. Different models can create different effects.
- Hanging or pendant lights: Variations include cone lights, globe lamps and chandeliers. These can be hung directly over work areas for effective task lighting.
- Track lights: Tracks can be wall- or ceiling-mounted; they aim lights in the same direction to produce overall illumination or in different directions to spotlight work or display areas.

SAVING ENERGY WITH LIGHT BULBS



The kind of lights you use in your kitchen can make a difference in your energy consumption and your energy bills. Incandescent bulbs are still the standard for home lighting, and there are many different types. However, they waste a lot of electricity by generating excess heat.

For general and under-the-counter lighting, fluorescent tubes and bulbs are a much more energy-efficient choice. A 15-watt fluorescent tube gives as much light as a 60-watt incandescent bulb and can last 10 times as long. Today's new generation of triphosphor fluorescent tubes emit a more flattering light than the older tubes with their cooler, bluish light. For lighting a specific area, you can get similar savings with compact fluorescent bulbs. These often use standard sockets, with or without an adapter, and can be substituted for incandescent bulbs. The initial cost of fluorescent bulbs is higher, but in the long run you'll save money on your electric bill and on the cost of replacement bulbs, and you'll lessen the demand for electricity.

Tungsten-halogen lights are another lower-energy alternative. Halogen lights give an intense, white light that's useful for under-the-counter or recessed lights, and for track lighting. They produce as much light as incandescent bulbs but use up to 50 per cent less power. Again, the initial cost is higher, but you will save energy and the bulbs will last longer.

- Under-cabinet lights: Fluorescent strips or halogen lights hidden under the front edge of overhead cabinets throw a wash of light over the counter or other work area; they can be added to existing cabinets.

Ventilation

The main source of ventilation in most kitchens is the range hood, which is positioned directly above the cooking surface and carries odours and pollutants out through the wall or roof via an air duct. Vent hoods are generally mounted or incorporated into a cabinet above the range. For stoves or cooktops in an island, canopy hoods can be hung from the ceiling above, or a "down-flow" vent can be used which draws the exhaust downward into a duct.

There are many different vent hoods on the market; the most important distinctions between them are air flow and noise ratings. Air flow is measured in litres per second (L/s) or cubic feet per minute (cu.ft./min.). Lower-powered units may have air flows of 100 L/s (200 cu.ft/min.) or less; higher-powered ones may have flows over 150 L/s (300 cu.ft./min.). Noise is measured in sones—the higher the sone rating, the higher the noise level. Sone ratings of 3.5 or below are desirable.

For effective ventilation, seriously consider installing a heat recovery ventilator (HRV), which ventilates the whole house, including the kitchen.

Wall surfaces

Your kitchen renovation may include ripping the old surface off existing walls and refinishing them, or building new walls. When it comes to applying the new surface, you want something that can give you a tough, washable finish that also goes along with the kitchen decor. There are three main choices.

- Drywall: This is the basic choice. Drywall can be cut to conform to irregularities in walls; paint, wallpaper and moldings can be used for a variety of finishes. It's economical, but all joints must be finished with tape and drywall compound.
- Wood panelling: Solid wood panelling is easy to install, can be used on an entire wall or as an accent and can set off a kitchen with wood cabinets and trim. Different grades and woods have different looks and prices; light woods make kitchens bright, dark woods lend a rich look.
- Ceramic tiles: Wall tiles are thinner and usually smaller than floor tiles; glazed tiles are usually employed for washability. These give the kitchen a bright look and are often used for backsplash areas.

HEAT RECOVERY VENTILATORS

A heat recovery ventilator (HRV) is a boxy-looking device usually installed near the furnace (if you have one), that transfers heat from outgoing exhaust air to warm the incoming fresh air as both pass through its heat exchanger coils. The result is warmed fresh air, with reduced heat loss and better humidity control.

Ceiling surfaces

Kitchen ceilings are just as important visually as the floor, since people look up as much as they look down. The ceiling can match the wall surfaces, or it can be a contrasting colour—often white—to make the room brighter.

Again, there are three main choices.

- Drywall: This is the simplest and most versatile surface for kitchen ceilings and can be painted or wallpapered for the effect you want. The finish you choose should be washable. It's economical, but the joints must be finished with tape and drywall compound.
- Acoustic tiles and panels: Their surfaces are designed to absorb sound but also make an attractive ceiling surface. Tiles can be nailed or glued to the existing ceiling. Suspended ceilings hang on a system of metal "tees" and can help bring down a very high ceiling or hide a deteriorated ceiling surface.
- Wood panelling: Solid wood panelling can be used for ceilings as well as walls. It can set off a kitchen with wood cabinets and trim. Use water-based finishes.

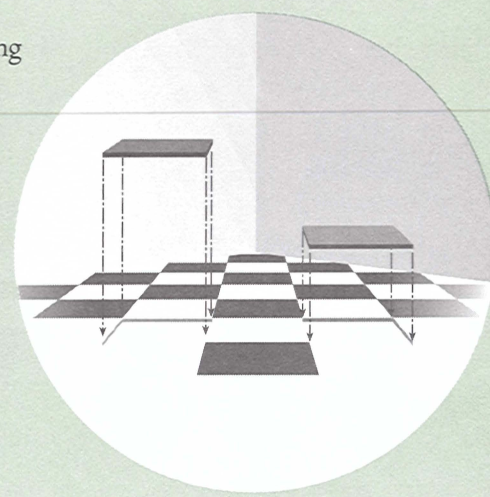
Floor surfaces

Generally, a kitchen floor should be durable and washable, since cooking and eating involve a few spills. The main choices for kitchen floors follow.

- Vinyl: Resilient vinyl flooring comes in sheets or tiles. It's usually glued to a plywood subfloor, but can be installed over a smooth existing floor finish. Vinyl is easy to clean and comfortable to walk on; it's durable, but higher qualities have a thicker wear layer. On the other hand, off-gassing of vinyl components can be a health concern.
- Linoleum: Similar to vinyl flooring, this is made from natural materials such as linseed oil and jute, cork dust and wood dust; solid-colour and patterned

RENOVATING FOR LIFE

Some of the materials you use in renovating your kitchen last longer than others; this saves the resources and energy consumed by replacing them. For example, ceramic tile flooring has a much longer life than vinyl flooring, and ceramic tile and solid surface countertops last longer than laminate tops.



matte finishes are available. The surface is hard wearing and long-lived, but gives off linseed oil odour which can be irritating to some people. Linoleum can be laid "dry," without adhesives.

- Ceramic tile: Floor tiles are normally larger and thicker than wall tiles. Glazed tiles are usually chosen for washability; tiles with textured surfaces are less slippery when wet. Different coloured tiles can be used to make a patterned floor. This is a hard, long-lived, cleanable surface, but tiles can break or chip, and will break plates or glass items dropped on them. As well, they're hard to replace. Stone tiles are also available.
- Wood: Strip or plank hardwood flooring makes an attractive floor. Composite, or parquet, tiles are a cheaper option, but are shorter-lived and require adhesives. Wood floors should have a hard, washable finish such as water-based urethane. They're comfortable to walk on, not as hard as ceramic tile, but can be affected by water splashes.

Services

Electricity

Supplying electricity to your new kitchen can be simple or complicated. If your wiring is in good shape and you're just replacing old appliances with new ones in the same place, you may be able to use the existing wiring with little or no modification. However, it is still advisable to have an electrician look at your service before you start to tell you if your existing hookups meet current codes.

If you're installing new appliances or making significant changes to the present set-up, you'll have to run new circuits and, possibly, replace the existing wiring to install the new fixtures. If your existing service doesn't have enough open circuits to accept the new wiring, you'll also have to have a sub-panel added to your present panel or install a higher rated service. While you're upgrading, think about installing enough extra capacity for future renovations or other major appliances you may want to add.

Kitchen appliances have unique requirements. Stoves need a special, dedicated heavy-duty circuit, and appliances such as refrigerators, dishwashers and built-in microwaves also need their own circuits. There should be a "split duplex" receptacle or outlet every 914 mm (36 in.) along the counter, plus extra outlets near the eating area and other working areas. New lighting could also require some extra wiring.

In most cases, you'll need an electrician to install the new wiring and do any necessary service upgrades. A permit will also be required. Marking your appliances, outlets and lighting fixtures on your kitchen drawings will give you a better idea of what's needed. In some cases, all the work may not be evident until the old walls and fixtures are opened up and the old wiring is exposed.

SPLIT DUPLEX RECEPTACLE

A split duplex receptacle is an outlet in which the top and bottom halves are each connected to a different circuit. This allows each half to be used for an appliance without overloading the circuit.

Plumbing

If you're leaving your sink in the same place, and your present drain and supply pipes are in good shape, you may be able to use the existing plumbing for your new fixtures. However, if your design includes moving the sink to a new location—to an island in the middle of the work triangle, for example—this will involve relocating both the drain and supply lines.

Sinks are usually located near an existing drain pipe, and dishwashers are connected to the sink drain. These can be moved to any other location you want but a substantial move may require some serious rerouting of the supply lines and drain pipe, and a new connection to the vent stack. In a first-floor kitchen, pipes can often be run along an unfinished basement ceiling or wall below.

Moving plumbing fixtures any distance can require some expensive plumbing work. Think carefully before you commit yourself to moving your sink; this may raise the cost of the job considerably, so the improvement you get should be significant. As well, check your local building codes to see what limits they place on moving fixtures.

VENT STACKS

All plumbing fixtures must be joined to a vent stack. This is an upward extension of the main drain pipe (also called the soil stack) through the roof which allows air into the system so water can flow freely. In some cases, a separate vent pipe may service only one or two fixtures.

Heating

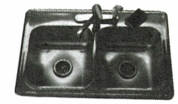
Most kitchen renovations don't enlarge the room enough to require extra heating. Retaining your existing heat registers, radiators or baseboard heaters will usually fill your needs. In some cases, you may have to relocate them to fit the new design which may require the services of a heating contractor. One option is to locate a register on the kickplate—the recessed front panel at the base of a floor cabinet.

If your renovation makes the kitchen substantially bigger, you can often add extra heat registers or radiators; most heating systems have enough capacity to support one or two extra outlets. If it's too difficult to run the ducts or pipes to the area you want to heat, a space heater, such as an electric baseboard heater or a gas wall furnace (the sealed combustion type), can do the job. The electric heater needs its own circuit, while the gas heater must have a gas supply line and a direct outside vent. (See the Space Heating chart in Chapter Four for more information.)

Another option is radiant floor heating, which uses water tubing under the floor covering to deliver heat. Radiant heating makes the floor warm, so it's very comfortable. However, it does require access to the floor cavity; this can be practical if you have an unfinished basement ceiling below, or if you're tearing up the subfloor to install new flooring. The cost of installing radiant systems is higher than most other forms of heat.

Making a Plan

The hard part in planning a kitchen renovation is putting all the pieces together to make a unified whole that satisfies your needs, while at the same time staying within your budget. The first step is to define your



goals and priorities so you can proceed in the right direction.

Define your kitchen goals in the Kitchen Priorities Worksheet, showing what you'd like to achieve with this project under the headings provided. For example, your Appearance goals might include making the kitchen look bigger or brighter, while your Function goals might be to create more counter space, update the appliances or change the working triangle to make cooking more efficient.

Once you set your goals, you can concentrate on identifying the different elements you'd like to include in the project. This "wish list" can include major features, such as a breakfast nook or an island, and particular components such as the type of cabinets, stove, lighting or floor surface you'd like.

While the What Are the Options? section outlined the main choices, the best way to narrow things down is by visiting kitchen showrooms, building centres and other places that sell the components that go into a kitchen. Note the make, model number, colour, finish and price of the things you like, and keep a detailed scrapbook. Pictures in magazines can help you visualize how these pieces will look when they're put together.

KITCHEN PRIORITIES WORKSHEET

	Details	**Priority (high/low)**
GOALS		
Function		
Appearance		
Health		
Value		
MAJOR FEATURES		
COMPONENTS		

Write down all the elements you'd like to include in the renovation. With a big project such as a kitchen renovation, you may not be able to afford everything you want, so it's necessary to set priorities. Rate each item according to its importance to you. Is it a high priority, something you need? Or, perhaps, it's a low priority, something you'd like to have if it fits the plan and your budget.

Creating a layout

Knowing the pieces you want is a good start to the planning process. The next step is to incorporate those pieces into an overall plan that is functional and suits the kitchen space you have to work with. This can be a difficult process, and if it's a major project, you'll likely take your options list to a professional kitchen renovator or designer at this point.

Whether you're going to have the job professionally done or be your own general contractor, it's worth making your own preliminary design for your renovated kitchen. This will give you a better understanding of what's involved with the renovation and what limitations you might have to live with.

If you're just replacing the existing elements with new ones that will sit in the same place, the new design will be primarily cosmetic. However, if you're considering changing the layout of the room—moving the appliances, adding new cabinets or doing structural work—you'll have to try a number of configurations to see what will work best with the space you have.

The best way to do this is to make a new diagram of your kitchen, using the basic dimensions from your earlier drawings. Then move the cabinets, appliances, eating area and other elements around to see how they work together in different configurations; this is easier if you make simple cutouts representing cabinets and appliances, or use one of the commercial planning programs. It may help to prepare both an overhead "plan view" and one or two side views, or elevations, to see how the walls and counters will look with different treatments. When you find a scheme you like, lay coloured tape on the floor and walk around the room to see how the dimensions work for traffic flow and accessibility.

Make sure all the pieces work together without causing any practical problems. For example, your cabinet and appliance doors should open without running into each other. In some cases, you can use a cabinet door that swings in a different direction to avoid a conflict; in others, you may have to change your design. As well, avoid positioning doors where they'll block traffic when they're opened, or putting an island where it will impede people walking into or out of the room.

Also, think about adding some extra features that allow you to use the kitchen for more than just cooking and eating. These might include a desk or small office space in an unused niche; an area for doing laundry, with a washer, dryer and counter space for folding clothes; or a seating area for entertaining. You can also include cabinets for a television or stereo system. For appearance, many people have a display area such as a plate rack, wine rack or glass-fronted cabinet to hold collectibles.

For the best visual impact, avoid making everything too straight and uniform. Many professionals advise designing your upper cabinets at different levels around the room, to add visual interest. Positioning lights and decorations at different levels can also keep the room from looking too static and regimented. The two-level theme can be good for work surfaces. You can plan most of the surface at a convenient height for the family member who does most of the cooking, and provide a section at a different height for another person who also cooks. If you're installing an island with a breakfast counter, consider making the food preparation surface a comfortable working height and the eating counter 762 mm (30 in.) high. It's both more comfortable and more interesting.

Planning aids

Here are some standard dimensions for common kitchen elements, to help you with your layout.

- Base cabinets are a standard 914 mm (36 in.) high (including the countertop) and 610 mm (24 in.) deep.
- Upper cabinets range from 813 mm (32 in.) to 1,067 mm (42 in.) high and a standard 305 mm (12 in.) deep.
- Standard stoves are 762 mm (30 in.) wide; some compact models are as narrow as 610 mm (24 in.).
- Separate cooktops need an average countertop of 762 mm (30 in.) long.
- There should be at least 610 mm (24 in.) of counter space beside a range or cooktop.
- Standard refrigerators range from 762 mm (30 in.) to 914 mm (36 in.) wide; some commercial models can be up to 1,219 mm (48 in.) wide.
- There should be a "landing area" of counter space measuring at least 381 mm (15 in.) on one side of the refrigerator.
- Sinks range from about 559 mm (22 in.) to more than 1,219 mm (48 in.) wide, with built-on draining boards.
- There should be 762 mm (30 in.) to 914 mm (36 in.) of counter space on both sides of a sink.
- Standard dishwashers are 610 mm (24 in.) wide.
- Dishwashers should be located within 305 mm (12 in.) of the sink for easy loading.
- There should be at least 914 mm (36 in.) of clear space between two facing cabinets, or between the counter and an island.
- For an eating counter, each person needs a space 610 mm (24 in.) long.

Choosing options

Now you can choose the materials and strategies you want to use from the options listed in the sections above. Keep in mind that the materials and techniques you pick must be functional and also fit in with all the other elements in the room, so the whole renovation has a consistent and harmonious look. As well, remember to look at energy and water efficiency as you make your choices.

Use the Kitchen Options Worksheet as a guide to help you decide which options you'll use.

Materials

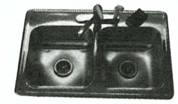
Once you've chosen the best options for all the different parts of the project, you'll be able to make a materials list. This is useful, not only for pricing, but for a purchasing list you can use to schedule your buying. When you've made your purchases, update the list so you'll have a record for future reference. Also attach all receipts and other project documents to the page so they'll be handy if you need to look at them.

PLANNING AN ACCESSIBLE KITCHEN

When planning a major project such as a kitchen renovation, think about making the room accessible for people with different needs. That includes those who may be shorter than average and would benefit from a countertop less than 914 mm (36 in.) high, and those with disabilities or restricted movement. This is important if someone in your house has a disability, but it can also be worthwhile if you're planning to retire in the house. Future users of the house may also need these features.

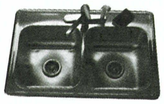
There are a number of design features that make a kitchen easier to use for someone in a wheelchair or with restricted movement. These include:

- non-slip flooring
- adequate overall lighting, with contrasting colours for easy discernment of surface edges
- light switches 1,067 mm (42 in.) from the floor
- electrical outlets 457 mm (18 in.) from the floor
- a door 864 mm (34 in.) wide, or with a minimum clear passage of 813 mm (32 in.)
- no threshold between the kitchen and adjacent areas
- a 1,524 mm (60 in.) turning space in front of counters, cabinets and appliances
- sinks and cooktops at a height of 864 mm (34 in.)
- upper cabinets with the lowest shelf no higher than 1,295 mm (51 in.) from the floor
- a double sink with bowls 127 mm (5 in.) to 178 mm (7 in.) deep with the trap located close to the rear wall for extra knee space
- an openable knee space at least 686 mm (27 in.) high, 762 mm (30 in.) wide and 254 mm (10 in.) deep under the counter to permit access in a wheelchair
- a recessed toe space at least 203 mm (8 in.) high and 203 mm deep under all base cabinets
- pull-out drawers rather than under-counter shelves, which are inaccessible from a wheelchair
- pull-out work boards at a height of about 762 mm (30 in.) which can often be fitted as pullouts between drawers
- lever faucet handles (preferably single-lever) with a flexible spray hose
- easy-to-use appliance controls, located at the front
- side-opening wall ovens.



KITCHEN OPTIONS WORKSHEET

Item	Options/details	Materials	Estimated cost
Wall structure	1. 2.		
Wall finish	1. 2.		
Floor structure	1. 2.		
Floor finish	1. 2.		
Ceiling	1. 2.		
Windows	1. 2.		
Doors	1. 2.		
Cabinets	1. 2.		
Counters	1. 2.		
Sink	1. 2.		
Faucets	1. 2.		
Stove/cooktop	1. 2.		
Wall oven	1. 2.		
Refrigerator	1. 2.		
Room lighting	1. 2.		
Task lighting	1. 2.		
Dishwasher	1. 2.		
Microwave	1. 2.		
Ventilation	1. 2.		
Heating	1. 2.		
Electrical hookups	1. 2.		
Plumbing hookups	1. 2.		
Other	1. 2.		

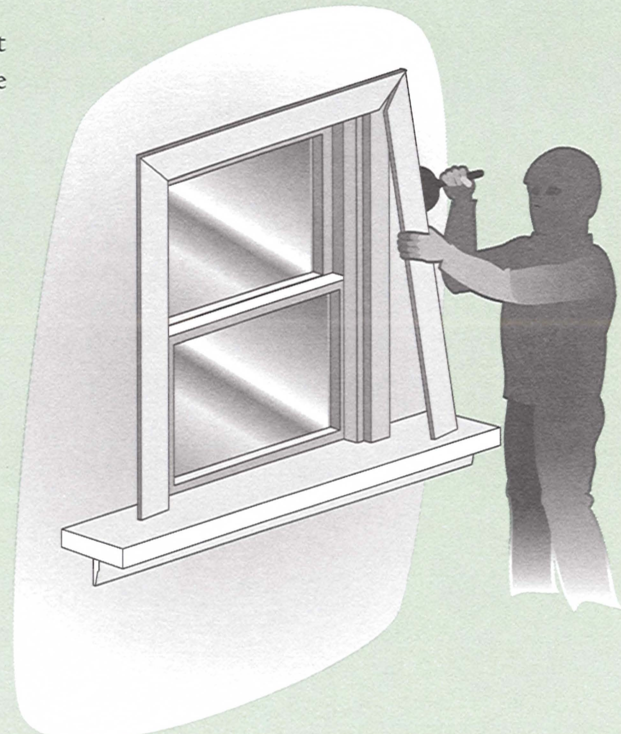


KITCHEN MATERIALS WORKSHEET

Item	Materials (brand/ specifications	Quantity	Price per unit	Cost	Date needed	Date purchased	Supplier (address, phone no.)	Comments
Wall structure								
Wall finish								
Floor structure								
Floor finish								
Ceiling								
Windows								
Doors								
Cabinets								
Counters								
Sink								
Faucets								
Stove/oven								
Refrigerator								
Room lighting								
Task lighting								
Dishwasher								
Microwave								
Range hood/fan								
Heating								
Electrical hookups								
Plumbing hookups								
Other								
TOTAL MATERIALS COST								

SALVAGING SOME VALUE

Don't automatically discard the materials you take out of your kitchen to make way for the new ones—some components may still have some useful life. If you remove it carefully, you may be able to reinstall the old wood trim and window and door casings after the walls are refinished. (Beware of lead paint; see Dealing with Lead Paint in Chapter Seven.) As well, structural wood and things like old lighting fixtures can sometimes be reused, and metal such as old cast-iron radiators can be sold to scrap iron dealers. If your old appliances are still working, try giving them away instead of throwing them out. Reusing old materials decreases pressure on our resources and our dumps. Check to see if there are recycling centres in your area.



If the project is to be done in a short period of time, it may be practical to have many of the materials delivered as the work gets started in order to avoid delays. However, if it is going to take a long time, it's more economical to buy the materials in stages as they're needed. This avoids the possibility of materials getting damaged while they're sitting around waiting to be used. It may also be necessary if you're getting the money in stages from your lender.

If you're hiring a renovator to do the project, scheduling the purchases will be part of the contract. But having the materials list beforehand will help you get accurate bids from prospective renovators.

Who'll Do the Work?

A limited kitchen renovation may be within the scope of a homeowner with good carpentry skills. However, this is a demanding project, and a bad job can be very visible—a kitchen with badly installed cabinets can hurt your home's resale value rather than raise it. You can often save money by doing some of the work yourself.

The list of jobs you may be able to do includes:

- removing old fixtures
- gutting old wall surfaces (see the cautions, above, about hidden hazards)
- removing non-bearing walls
- framing new walls
- installing sheet or tile flooring
- painting the new room.

Many kinds of contractors do kitchen work, but for a renovation of any size, it's best to take your preliminary plan to renovators who specialize in kitchens; their knowledge of the materials and techniques involved should result in a better job, and may even save you money in some places. These renovators are listed in the Yellow Pages™ or you may find them through references from friends or the local homebuilders' association.

A kitchen renovator can help you with your design—many have computer design systems to illustrate the options—and then carry out the project. Some will charge for the design service, while others will work on a "retainer," deducting the design fee from their final price.

As with any renovation project, get bids from three renovators, and follow the guidelines in Chapter Three for hiring a contractor. Look for affiliation with industry organizations such as the National Kitchen and Bath Association (NKBA). Some designers are also accredited as Certified Kitchen Designers, which guarantees a certain level of experience and training.

You'll probably need an electrician for the new wiring, a plumber for the plumbing work and, possibly, a heating contractor to install or move heating outlets, as well as tradespeople to do the structural work, drywalling, flooring and finishing work. Your renovator likely uses some subcontractors regularly. However, if you're hiring subcontractors yourself, follow the guidelines in Chapter Three. Look carefully at their qualifications, and ask some questions about how they intend to deal with any problems you might anticipate in your kitchen. This can be demanding work and it takes tradespeople with proper technical training. Use the Contractor Worksheet in Chapter Three to compare the tradespeople you're considering for the job.

Installation Notes

Renovating kitchens is a technical job, and exact measurements are necessary before the work begins. Complete and accurate measurements of the kitchen should be taken before ordering the needed cabinets and appliances. Your renovator or contractor should do this; however, if you're doing the work yourself, it will be up to you. These measurements are critical since the pieces fit together like a jigsaw puzzle; extra spaces will have to be hidden and oversized pieces will have to be replaced or altered.

Problems such as a sloping floor and uneven walls can also complicate the installation of cabinets and appliances. In most cases, shims (thin pieces of wood) can be used to make the components sit properly, but in others you may have to have a new subfloor installed. (Appliances usually have adjustable feet to compensate for a mild slope in the floor.) A room that's not square can also require special measures to make the cabinets fit together properly and the lines look right. If these problems are not dealt with properly, the horizontal and

PERMITS

If your renovation involves serious work on the structure of the house, the electrical or plumbing systems, it will require a permit (or permits) and inspections by your local building department or utilities. You'll have to get the permits before the work starts and schedule the inspections either beforehand or while the work is in progress. If you hire renovators or subcontractors to do the work, they should get the permits and schedule the inspections; that way, they're responsible for complying with local codes. (Chapter Three has more information on building permits.)

vertical lines will be a few degrees off and the kitchen will not look right.

Installation is especially important with frameless cabinets; the rows of doors must line up exactly or the whole thing will have an uneven, up-and-down look. Most now have adjustable door hinges, which simplifies the job somewhat.

Check all the components for colour matches and for surface imperfections, so everything looks the way it should. And store components with fragile surfaces away from the work site so they won't get damaged before they're installed.

Counting the costs

Costing a major kitchen renovation is a big job. If you hire kitchen renovators to do the job, they will give you an overall bid that includes the materials, labour and any other related costs. If you're acting as your own general contractor, your Kitchen Materials Worksheet can give you an idea of how much all the pieces will cost. You'll then have to get quotes from subcontractors to find out what the labour costs will be. In this project, demolition can represent a significant cost. Doing much of it yourself can save money, but you'll still need to haul away the big items you're ripping out, and you'll likely have to rent a waste container.

In a full-scale kitchen remodelling, the cabinets are usually the largest single cost, often accounting for about 40 per cent of the total. How much you spend on cabinets depends first on how many doors you buy; a full-height cabinet costs less than a stacked series of cabinets and drawers. Special features such as tilt-out drawers and storage racks or bins add to the cost, and so do things like special corner cabinets that don't "trap" the space in the deepest part of the corner.

If the renovation is going to be beyond your budget, you can get the cost down in two ways: first, by changing some of your choices to lower-priced options, or second, by leaving out some of those low priorities on your list and concentrating on the high-priority items. Choices that can help reduce the cost of the renovation include:

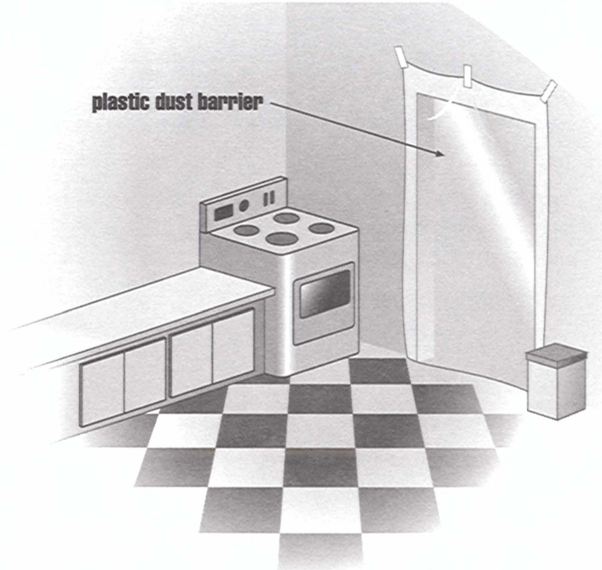
- choosing a laminate countertop, perhaps with an edge trim, instead of an expensive solid-material countertop
- choosing stock items instead of custom-made models; the cost is usually substantially lower
- buying reduced or end-of-line materials that can give you the quality you want at a lower price
- keeping some of your old equipment that's still presentable—the sink or stove, for example—until you can afford new ones.

In general, the simpler your design, the cheaper it will be. Ways to cut costs by scaling down your design include:

- leaving the sink in the same place instead of moving it which can save significant plumbing costs
- eliminating special shapes and contours that aren't part of the basic room layout—straight lines are cheaper
- adding a bay window to make the eating area feel more spacious instead of expanding the room.

Working healthy

Plan now to avoid health hazards while the work is under way on your kitchen renovation. As discussed above, the first step is to use materials with as few irritants as possible. This includes the cabinets, flooring, and paints and finishes; wherever possible, plan to use water-based finishes that have low emissions (see Chapter Seven). If you have to use materials with significant chemical



emissions, such as the cupboards, buy them in advance and store them in a well-ventilated place to let them release the worst of their pollutants before installation.

However, there are other measures that can help keep irritants low during the project.

- Arrange for window fans to ventilate the room if there are jobs that raise fumes, such as painting, staining or using an adhesive to apply flooring.
- Make sure the workers will use dust bags or other systems to control dust if power saws or sanders are going to be used.
- Arrange for a plastic dust barrier at the entrance between the kitchen and the rest of the house.
- Make sure the workers will use proper face masks for work that's dusty or creates fumes.
- Insist on a thorough clean-up and vacuuming after work each day, and when the whole job is finished.

See Chapter Two for more tips on avoiding renovation hazards.

Putting it all together

If you're hiring a professional renovator to finish your kitchen, the final part of your planning is to choose the one you'll use, and finalize the price and specifications for the job. If you're going to be your own contractor, you need to create a full picture of the project by yourself and estimate carefully what it will cost.

Use the Project Planning Worksheet to enter all the materials, labour and other expenses the job will entail. This should allow you to arrive at a price for the whole project, and see everything that will be needed.

As well, you must make a schedule so the work progresses in a logical order and the tradespeople arrive when the construction is ready for them. You can photocopy the Gantt chart in Chapter Three to help you schedule the job.

Then, think about how you'll organize your day-to-day life to accommodate the work. Since your kitchen will be out of commission, you'll need to make other eating and cooking arrangements while the job is in progress. And remember that the tradespeople will have needs too. See Chapter Three for more information on living with a renovation.

Once all the pieces are in place, you can set about making the project a reality. It will still require a lot of work, and a lot of attention to detail as it takes shape to ensure that the project is safe, healthy and successful.

FOR MORE INFORMATION

These publications offer more information on the topics in this chapter. The publication number for CMHC publications is shown in brackets.

Healthy Housing: Practical Tips, CMHC (NHA 6736)

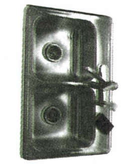
Housing for People with Disabilities, CMHC (NHA 5467)

Building Materials for the Environmentally Hypersensitive, CMHC (NHA 6742)

Healthy Housing Kitchens, Fact Sheet 1, (PE0219)

EnerGuide Directory: Energy Consumption Ratings of Major Household Appliances, Natural Resources Canada

Consumer's Guide to Buying and Using Energy-Efficient Lighting Products, Natural Resources Canada



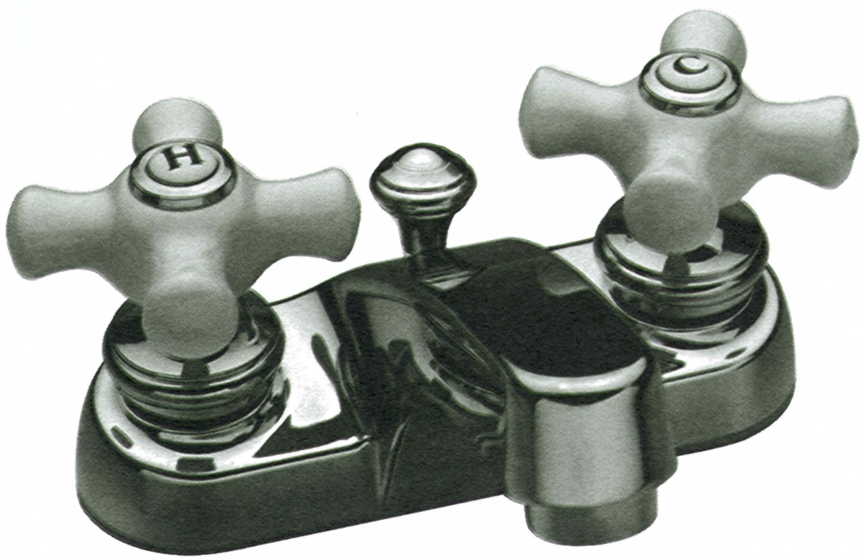
PROJECT PLANNING WORKSHEET

Job	Materials cost	Contractor (Name, phone no.)	Start date	Completion date	Labour hours/ rate	Labour/ contractor cost	Tools/ rentals	Permits/ fees	Other costs	Total cost

C h a p t e r   T e n

THE BATHROOM

- *bathroom renovations add value*
- *what you should know about bathrooms*
- *bathroom renovation strategies*
- *your bathroom and your health*



As with the kitchen, the bathroom is one of the most common interior renovations, and for the same reason: renovating here is more likely to add value to your house than most other improvements. The bathroom also plays an important role in making the house pleasant and practical to live in, so redoing it can produce real improvements in your lifestyle.

Increasingly, people use the bathroom as a refuge, a place to soak in the tub or enjoy a relaxing shower or even a steam treatment. This has given rise to a wide variety of special equipment, from whirlpools to special enclosures with body-massaging sprays which can turn a basic, functional bathroom into a very specialized environment.

Whether you simply renew your bathroom with new fixtures and a new floor, or install some specialized equipment depends on your lifestyle, your budget and your plans for the future. In either case, your aim will be to make a new room that's both functional and attractive.

At the same time, it should be a healthy place to be, and it should use water and energy efficiently, so it doesn't put unnecessary demands on our natural resources. The bathroom accounts for 75 per cent of water use in the home, and you can cut it significantly by using water-efficient fixtures.

What Are the Issues?

- Function: The bathroom is a working room. That means it has to be laid out with enough room to move freely, and the room must feel comfortable to use. It also means the fixtures, wall and floor finishes, and other components must be well designed, well placed and in good working order for the room to function the way it should.

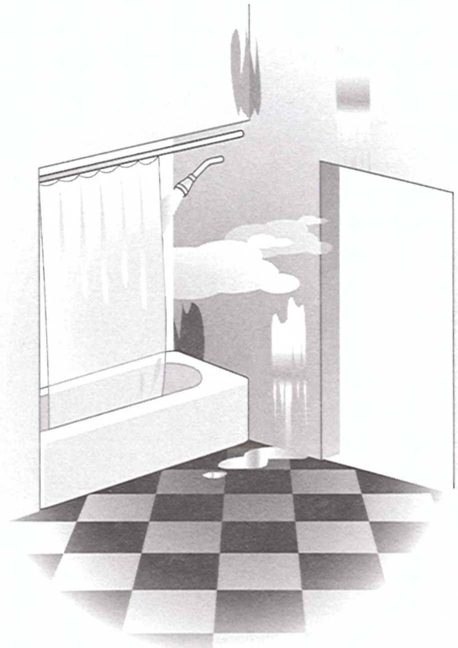
  Your actual use of the bathroom is a big consideration in deciding how to renovate it. If more than one person uses it at the same time, for example, you may need more space and special features such as two sinks. If you like to use it as a place to relax, a whirlpool tub or even a sauna might be a priority.
- Appearance: It's important that the bathroom be attractive, both for your family and for guests. Some people consider the bathroom a showpiece. Even if you don't, it's usually worth upgrading the look of an old bathroom that has gone out of style, or has just become dingy and hard to clean.
- Health: Bathrooms create a lot of moisture. This can cause problems by encouraging the growth of molds and can destroy building materials if it gets into the building structure. To stop this moisture from spreading and doing damage, bathrooms need the proper materials and effective ventilation. This should be part of your plan.
- Value: Along with the kitchen, the bathroom is a key factor when it comes to selling your house. Typical returns on your renovation investment range from 64 to 71 per cent. A house with attractive and modern bathrooms usually sells better than one with old bathrooms the buyer will have to renovate.

What You Should Know about Bathrooms

As a working room, a bathroom has a number of elements that play a part in doing its job effectively. There are several main elements of a bathroom.

- The sink: Most bathrooms have one basic sink, but many modern bathrooms now have two. The sink is used frequently, and should be big enough for general use as well as functions such as washing hair and small laundry jobs. Sinks are usually set into the countertop of a vanity, which provides an area to set down brushes, hair dryers, razors and other things you need to keep at hand. As in the kitchen, the wall area behind the sink is called the backsplash.

- The toilet: The toilet is the second basic fixture, and the traditional design is still the standard. However, new designs have made toilets more water efficient, and there are alternative designs for better appearance. A companion fixture is the bidet, which is still in only a minority of Canadian bathrooms.
- The bathing area: This can be a simple, old-fashioned bathtub with shower attached, a tub and shower unit with enclosed walls and a door, or a separate tub and shower stall. It may be suited to your particular lifestyle or needs—some people enjoy luxurious fixtures, and some need special therapeutic baths or particular access features.
- Storage space: This usually consists of the vanity cabinet, the medicine chest above the sink, any additional cabinets and built-in cupboards. There must be a certain amount of storage for medicines and grooming equipment. The vanity is an important visual element in the bathroom and sets the tone for the room.
- Lighting: This may involve a single source, or several, depending on the size of the bathroom and your lifestyle. Generally, there must be good illumination at the sink and adequate general light through the rest of the room. Extra lights over specific areas may also be needed.
- Ventilation: This usually consists of an exhaust fan, which carries away moisture and odours. The fan must be powerful enough and work well enough to keep the air fresh and at healthy moisture levels.



Taking Stock

The first step in planning your bathroom renovation is to look at what you already have and identify any shortcomings. Since you use the room every day, you likely already know what's wrong with it from your viewpoint. But you may not have thought about the problems in a systematic way. There are a number of common problem areas in bathrooms.

Space

Small, cramped bathrooms are a common complaint. Too little space makes you feel confined and restricts your movement if there's not enough room between fixtures.

Appearance

The colours and styles used in the bathroom may not have been your choice, or they may be old and outdated. Or, the fixtures may be chipped and looking their age.

Fixtures

Your sink may be too small to wash in comfortably, or it may have little or no counter space where you can put anything down. In some cases, one sink may not satisfy your needs.

An old toilet can also be a problem. It can begin to work badly and show rust stains. As well, antiquated equipment uses a lot of water, and it's hard to fix and to find parts for.

Especially in an older house, the bathtub and shower may not be big enough for your purposes—people often want more room to stretch out, a tub big enough for two people or a whirlpool. And a bathtub or shower stall with a worn finish can be hard to clean and a good spot for mold to grow. It can also downgrade the appearance of the room. Remember, old styles can also date a bathroom.

Lighting

This can include the lack of a good-sized window to provide light during the day. Or, the old bathroom light may not illuminate the room well enough, especially the areas where people wash or apply makeup. Old lighting fixtures can also be an eyesore.

Ventilation

Many bathrooms built before the early 1970s had only a window for ventilation—not an effective strategy, and inconvenient, especially in the winter. As well, some bathroom ventilation fans don't work effectively, leaving the room damp and stale.

Heating

Since bathrooms are small, they should be easy to heat. However, the room may be cold in the morning, or it may be chronically cold if the radiator, heat register or baseboard heater doesn't deliver enough heat.

Services

At the same time, look at the plumbing and electrical services for the bathroom. These should be in good enough shape to support any new fixtures you'll be installing. If they're not, you'll have to have them replaced.

Plumbing

If there's a place where you can look at the pipes that serve your fixtures—the vanity under the sink, for example—you should be able to see what kind of pipes you have. If your house was built since 1950, you likely have cast iron, steel or plastic drain pipes; these should be adequate for your purposes, unless you've had problems such as slow water flow. If your house was built before 1950, you may have lead drain pipes, which should be replaced. Water supply pipes can be made of copper, brass, steel or plastic; these shouldn't need upgrading.

If you are in doubt as to what you have, ask a plumber or house inspector to look at your plumbing system. You may want to have the old pipes replaced in order to modernize the system.

Electricity

As well, look at the wiring in your bathroom. This can be done by removing a ceiling light or some other fixture—after first turning off the power to that circuit—and seeing what's in there. If you see old wire that has begun to crumble, you will likely have to rewire the room. Generally, if your house was built within the last 20 or 30 years, the old wiring in your bathroom is probably still in good enough shape to use for the new fixtures you'll be installing.

If it's older than that, you may require some new wiring.

To get a better picture of what you have to work with, use graph paper or a commercial planning kit—these come both on paper and as computer programs—to make a scale drawing of your bathroom, with the sink, toilet, tub or shower and other features included.

Use a proper tape to measure the length of each wall, as well as any doors and windows. Measure the distance from the corners of the room to the edge of the window or door frame; then measure the width of the window or door, from one outside edge to the other. Note the height of your window frame, how high the window is from the floor, and what direction the door swings. Opposite walls should be exactly the same length; if they're not, the room is out of square, which could cause installation problems.

Measure the width, depth and height of all the fixtures, and the distance between them. This will give you an idea of how much space you have when you replace them.

At the same time, inventory all the fixtures and the surfaces in the room, including their type and condition. Identify any problems you see that you might not have been aware of—some water damage or a leaking pipe, for example. Write the results on the Bathroom Assessment Worksheet.

What Are the Options?

Despite the small size of the room, there are a lot of choices to make as you approach a bathroom renovation. The first involves your overall strategy—what you're going to do to make the room the way you want it. The second comprises the wide variety of materials and components that go into the room.

Strategies

Bathroom renovations can range from modest facelifts with relatively low costs to ambitious projects with high price tags. Generally, renovations go up in cost as you make more structural changes, which require professional help. Even a relatively simple renovation can become expensive if you use high-quality, expensive fixtures and finishing materials.

Here are some possible strategies, ranging in cost from lower to higher.

Remove and replace

If your bathroom layout is functional but the look is old-fashioned and the surfaces are beginning to show some wear, the simplest option is to remove the old fixtures and replace them with new ones. This allows you to add extra storage space with a new vanity or storage cabinets. Replacing the floor surface and lighting fixtures, and adding a new exhaust fan make a complete new bathroom. Some plumbing and electrical hookups will be needed, but no major structural work is involved. However, removing the old bathtub often damages the wall around it, which must then be repaired or resurfaced.

Change the layout

If you want to improve both the function and the look of the bathroom, and the room itself is big enough, you may be able to change the layout and use it to more advantage. This may involve some structural, plumbing and electrical work, as well as the new fixtures. The options include:

- moving the sink or toilet to add a bigger tub
- realigning the fixtures to add a second sink, either in a two-sink vanity or in a separate area

BATHROOM ASSESSMENT WORKSHEET

Room measurements	**Wall 1**	**Wall 2**	**Wall 3**	**Wall 4**	**Ceiling height**	**Observable problems**

	Existing elements/details (dimensions, features)	**Condition**	**Problems**
Wall surfaces			
Floor surface			
Ceiling			
Windows			
Door			
Vanity			
Sink			
Faucets			
Cabinets			
Toilet			
Bathtub			
Shower			
Room lighting			
Task lighting			
Ventilation			
Heating			
Electrical service			
Plumbing			
Other			

- moving a fixture to install a separate shower stall away from the bathtub
- splitting the room into two separate areas, one for bathing and the other for the sink and toilet which usually requires adding a new entrance door.

Enlarge the bathroom

If your bathroom is too small for comfort, or if you want to add some new fixtures that won't fit, the next option is to enlarge the bathroom. This involves removing the wall into the adjacent room and pushing it back to "steal" enough space for your plans. If the adjacent room is a bedroom, there may be a long closet on the adjoining wall that you can incorporate into the bathroom so you don't actually make the bedroom smaller. The trade-off, of course, is that you'll have to replace the storage space in the bedroom. Another option is to incorporate a linen closet adjacent to the bathroom.

Enlarging the bathroom can give you enough room to add new features.

Some of the options include:

- a large whirlpool tub, perhaps one that can accommodate two (but remember the drawbacks in terms of energy and water consumption)
- a larger shower enclosure with features such as a steam generator
- a separate make-up table
- a dressing room.

All this involves some major structural work, as well as the new plumbing and electrical hookups, the new fixtures and surface materials. The costs can be high.

Add an extra bathroom

If your bathroom just isn't big enough for your needs, for example, if your growing family has to line up to use the facilities in the morning, another option is to add a bathroom. The easiest way to do this is to put a second bathroom back to back with the existing one, on the opposite side of a common wall. This allows you to use the same main drain pipe and water supply lines without major modifications. If the adjacent room is a bedroom, this creates an en suite bathroom or master suite.

The other option is to add a bathroom somewhere else in the house, for example, in a closet space or some unused space on the ground floor or the basement. Both these options usually require some major demolition and construction, new plumbing and electrical hookups, new fixtures and new surface materials. The costs can be high.

Picking the pieces

Defining your style

Just about any style or look can be used in a bathroom, as long as it works and suits your tastes. The best way to come up with a style for your renovation is to spend some time looking at showrooms and design magazines that specialize in kitchens and baths. When you find a style that you like, customize it to suit your own wishes.

Generally, the vanity and sink are the focal point for the bathroom, so choosing these sets the tone for the rest of the room. The toilet and bathtub will match the style and colour of the sink—white is still the overwhelming choice—and the floor and walls will co-ordinate with the countertop.

Almost any colour can be used, from white to black, with a wide range of accent colours. Light colours make the room bright and cheerful, while dark colours make it look more luxurious and create the feeling of a sanctuary. It's usually not necessary to co-ordinate the bathroom with the colours in the rest of the house; it stands on its own.

Along with colours, think about the textures you'll use. Shiny surfaces, such as stone and glazed tiles, tend to make the room look more formal, while matte textures, such as natural wood and unglazed tiles, give it a more informal, relaxed look. Taps and fixtures also lend some texture, from shiny chrome taps to antique brass or gold for a softer look.

To see how the colours you've chosen will look in your design, try using watercolours, coloured pencils or a computer design program to apply the colours to your drawings of the renovation. If you're using professional bathroom designers, they should have pictures of renovations with similar designs and colour schemes to give you a better idea of what yours will look like.

STRUCTURAL CHANGES

Changing the size or shape of your bathroom usually involves demolishing or cutting into the walls around it. This is usually feasible, but you must first determine what kind of walls you're dealing with.

Walls that help hold up the house are called bearing walls. Exterior walls are usually bearing walls, but so are some interior walls; these normally run down the centre of the house, at right angles to the joists (check in the basement or attic to determine the direction of the joists). Typically, the joists coming from opposite directions overlap where they rest on a bearing wall. Walls that don't carry structural weight are called non-bearing or partition walls.

Bearing walls can be removed or altered, but they must be replaced with a new structural support; usually this is a beam supported by posts on either side of the room. As well, the structure above must be supported with temporary wood-frame "walls" until the new support is in place. This is a job for a professional renovator, and it's best to consult a professional if you're in doubt as to which are the bearing walls. Non-bearing walls can normally be taken down or cut into without weakening the structure around them.

Taking down a non-bearing wall and tearing the drywall or plaster off a wall, are jobs most homeowners can do. However, this is very dusty work, so dust masks and added ventilation will be needed. Also be aware that you may encounter wiring and plumbing pipes inside the wall. You can inadvertently break a pipe and cause a leak, or cut live electrical wires. There may also be heating ducts or a heat register in the wall.

All this can cause extra expense if you have to have pipes, wiring or ducts rerouted. If you're hiring a renovator to do the job, this type of expense will not be included in the initial price unless you alert the renovators beforehand. So look for signs of these obstacles before you talk to them, if possible.

Building new bathroom walls is basic carpentry work. However, in some cases you will have to build the walls with 38 x 140 mm (2 x 6 in.) studs instead of the standard 38 x 89 mm (2 x 4 in.) used in interior walls, to accommodate the drain pipes for your new fixtures.

Resurfacing existing walls gives you a chance to renew your wiring and plumbing, if necessary. Once the walls are opened, look at the condition of the studs; any rotten wood must be replaced and any leaks repaired before you can finish the walls. Then, you must have adequate insulation installed in all exterior walls, and use caulking or other sealants to seal any cracks in the structure that air can leak through (see Chapter Five for information on insulating and sealing).

And remember, a house is a system, so the changes you make may have effects on the air and heat flows in the house, the heating and air conditioning systems, or its structural strength. If you're having the job done by professional renovators, discuss the possible repercussions with them before you start. (For a full discussion of the house as a system, see Chapter One.)

Vanities

A new, and often larger, vanity can be one of the most effective parts of a bathroom renovation. A bigger vanity gives you more counter space to work with and more storage space underneath. As well, many people opt to install a vanity with room for two sinks. This makes life easier if two people often use the bathroom at the same time.

Vanities are much like kitchen base cabinets, and are sold in the same way. The "stock" vanities sold at building centres are made in a standard range of sizes and colours; you can save money by buying an unassembled vanity and putting it together yourself. Some dealers will customize stock vanities to suit your tastes or purposes. If you want a particular size or style, or better quality, you can buy a custom vanity which is made to your specifications.

Most stock vanities are made of composite wood materials, particleboard or medium-density fibreboard (MDF), coated with a skin of plastic laminate. However, you can also get custom units made of solid wood.

The vanity is a big visual element in the bathroom, so its colour and finish are important. There are many to choose from, ranging from simple white to natural wood and decorator colours. The most visible part of the vanity is the doors: these can be made of MDF or solid wood, and they come in a number of different finishes.

The Vanity Options chart lists the common door finishes and other vanity options.

Medicine cabinets and mirrors

These have bodies made of steel, wood or plastic, and can be mounted on the wall

VANITY OPTIONS

	Qualities	Comments
DOOR FINISHES		
Low-pressure laminate (melamine)	Plastic skin is sealed to door material.	Not as resistant to scratches and cuts as high-pressure laminates.
High-pressure laminate	Similar to melamine, but thicker and tougher.	More resistant to scratches and cuts.
Wood veneer	Thin slices of wood adhered to door material.	Look of solid wood. Scratches can reveal material beneath. May buckle and come off if not built properly.
Solid wood	Can be made of hardwoods such as oak, cherry or maple, or softwoods such as pine.	Durable, good-looking. Softwoods are not as resistant to scratches as hardwoods and can release gases.
Polymeric foil (thermafoil)	Plastic material shrink-wrapped to door.	Tough, high-gloss finish, but can be scratched and cut like laminates.
OPTIONS		
Handles	U-shaped pulls or knobs.	Choice may be based on look of doors and style of bathroom.
Drawers	Come in different sizes for different types of storage.	Can be more practical and better organized than larger cabinet spaces.

YOUR BATHROOM AND YOUR HEALTH

Some of the materials commonly used in bathrooms give off chemical fumes that can affect your health. The amounts used tend to be small because of the size of the room; however, in a small bathroom they can be concentrated. The best approach is to choose materials that have the least harmful emissions.

- Vanities: Most of the particleboard and medium-density fibreboard (MDF) of which most vanities and other bathroom cabinets are made contains urea formaldehyde glue. This emits formaldehyde and other gases that can cause chronic respiratory distress and other problems (see Chapter Two). Moisture in the bathroom enhances the release of these gases.

  In most cases, the material is sealed in with a plastic skin, which brings the emissions down to an acceptable level. However, all surfaces must be sealed, including the edges and the holes for adjustable shelves. One large unsealed surface is the underside of the countertop; the best way to seal this is to paint it with at least two coats of a water-based acrylic sealer. However, the best way to seal all the surfaces is to have them factory-sealed or laminated.

  Formaldehyde-free MDF is available, but you'll have to ask for it specially. Solid wood construction and solid wood doors are the best choice, although they usually cost more. Solid-surface countertops are also very low in emissions, and can be installed without the MDF backing if they have proper support.
- Walls: Bathroom walls are often painted with alkyd paints, which have a tough, washable surface. The solvents in these paints give off fumes during painting and sometimes afterward. This can be avoided by using low-emission, water-based paints; water-based acrylic latex paints can now be used for almost any application and are washable. Semi-gloss is a good choice for bathrooms.

  As well, solid vinyl or vinyl-coated wallpapers are widely used in bathrooms because they are scrubbable. The vinyl in these papers gives off odours that can be irritating, and the adhesives typically contain fungicides (chemicals that kill molds), which can be an irritant. (See Chapter Seven for more on the health aspects of paints and finishes.)
- Floors: Vinyl flooring, a popular choice for bathrooms, tends to release gradually, or off-gas, some of the chemicals it's made of. These can have health effects. The hard vinyl tiles known as vinyl composition tiles emit fewer gases than flexible sheet vinyl flooring. Natural linoleum, although made of natural materials, gives off linseed oil odours which can be irritating to some people. Hard surfaces such as ceramic tiles are healthier choices.

  The adhesives used to install vinyl and some other types of flooring, including tiles, can also be a health hazard. Some are petroleum-based, and release hazardous chemicals. Pre-glued vinyl tiles have lower emissions, and there are low-toxicity water-based adhesives available that are safer for you and for the installers.

  As well, the grout used to fill the spaces between ceramic and stone tiles often contains additives that can be irritating while the grout is curing; epoxy grouts have a strong odour during curing. The sealers used to make grout more moisture resistant can also emit solvent vapours. Use grout with the lowest odour and provide good ventilation during application. Tile grout can also provide a place for mold to grow. However, using larger tiles limits the amount of grout surface, and good bathroom ventilation and frequent cleaning can prevent mold problems.

surface or recessed into the wall. Generally, bigger is better, since they tend to fill up quickly. Adding extra wall cabinets can also add welcome storage space.

Most medicine cabinets come with a mirrored front; however, if you're planning a wide vanity, consider a wider mirror. There are also medicine cabinets with mirrors that swing out for a three-way view.

Countertops

Bathroom counters are smaller versions of the counters used in kitchens, and they're made of the same materials. However, since they're usually not as big as kitchen counters, there generally are no seams on the countertop; this removes a common problem with laminate surfaces.

These are the common choices.

- Laminate: Plastic laminates are the most popular choice, and the least expensive. Laminate skin is glued onto a particleboard backing. Laminate is waterproof and durable, but can be cut and scratched. Some pre-shaped, or "postformed," laminate counters have an integral backsplash.
- Solid surface: Made of synthetic resins such as acrylic and polyester, and mixed with minerals, these have a luxurious look. They are easy to clean, damage resistant and can be repaired by sanding, but are expensive.
- Cultured marble: This is also made from polyester, with crushed marble. It has a luxurious look, but is not as damage resistant as some of the other solid surfaces. However, it is less expensive than solid surface.
- Ceramic tile: Glazed ceramic tiles are glued to a base such as hardboard or plywood; these make an attractive, long-lived surface, but the grout between the tiles can be difficult to clean and can become moldy; stain-resistant grouts are available. Tiles are less expensive than solid surface.

Sinks and faucets

Bathroom sinks come in a wide array of materials, shapes and sizes to fit every bathroom and every budget. A bigger sink makes tasks like small laundry jobs easier.

Most sinks are top mounted, or self-rimming, which means they overlap the counter surface around them. (These are sometimes called "drop-in" sinks.) There are also undermounted sinks, which sit below the surface of a solid counter and allow water to flow in freely; here the sink is bonded to the surrounding surface. Sinks can also be bonded seamlessly to a solid-surface counter for a one-piece countertop.

The Sink Options chart shows the main choices.

Bathroom faucets are a fairly basic item. However, there are a number of variations that can make them a better fit for your uses and your decor. Most are available in different finishes: the most common ones are chrome, polished brass, antique brass, ceramic, enamel and gold plate.

These are the main design options.

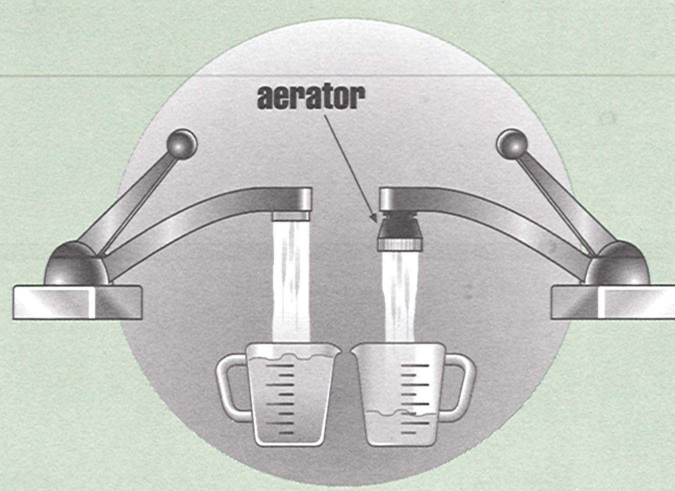
- Double handle: The traditional design, with separate hot and cold controls; choices include knobs, handles or flat "wrist blades" which may be more practical for people with disabilities. Some units have the handles incorporated into the faucet; others locate them off to each side.
- Single handle: The handle tilts to control water flow and temperature;

SINK OPTIONS

	Qualities	Comments
STYLES		
Vanity mounted	Sink mounted on countertop; can be self-rimming, undermounted or part of one-piece top.	Provides counter space and hides plumbing under the sink.
Pedestal	Free-standing sink with supporting pedestal.	Elegant look, leaves more room in a small bathroom. No built-in counter space.
Wall hung	Sink is hung from wall supports with no supporting pedestal.	Elegant look, leaves more room in a small bathroom. No built-in counter space.
MATERIALS		
Enamelled steel	Enamel bonded to pressed steel.	Long lived, surface can be chipped.
Enamelled cast iron	Enamel bonded to cast iron.	Long lived, surface can be chipped. Heavy, durable body.
Vitreous china	Made of fired clay with hard, glazed finish.	Durable, stain-resistant finish.
Cultured marble	Made of polyester resin with crushed marble.	Luxurious look of stone. Warmer surface than enamelled steel or iron. Soft surface can be damaged, and can't be repaired.
Solid surface	Made of plastic resins such as acrylic and polyester, and minerals. Can be moulded into any shape. Available in many colours.	Luxurious look. Hard, long-lived surface, can be repaired. Expensive.

RESOURCE NOTE

One issue to consider when buying a faucet is how much water it uses. Look for low-flow faucets, which use aerators to produce an adequate flow using up to 60 per cent less water than conventional faucets. These can decrease your water consumption, lower your water bills and reduce the demand on your local water treatment system.



there are both levers and turn-and-tilt knobs. Single handles are convenient to use with full or wet hands.

- Gooseneck: A high arc faucet leaves more room for small tasks.
- Handle spreads: Standard two-handle faucets have the handles located 102 mm (4 in.) apart. You can also choose a 203-mm (8-in.) spread; this must be specified when you buy the sink, so the holes can be bored in the right locations.

Toilets

Toilets are made from vitreous china, also called porcelain; this is made from baked clay and is long-lived and durable. They are made in a wide range of colours, to match your sink and tub, and in many shapes, from the common upright models to low-profile fashion styles. These are the common variations on the basic toilet design.

- Two piece: This is the traditional design, with the tank above the bowl.
- One piece: These incorporate the tank into the body of the toilet for a lower, streamlined look. These European-style models can be expensive.
- Elongated front: These have long, oval-shaped bowls; they are attractive and considered more comfortable to use than round-fronted bowls.
- Round front: These don't come as far forward as the elongated design; they can save space in a small bathroom.
- Wall-hung: These units do not have a supporting foot like conventional toilets; they are easier to clean under, but need special installation methods.
- Handles: These come in many different shapes and can be in a contrasting colour or match the bowl. They can be mounted on the left or right, front or side, and can sit horizontally or hang vertically; some units have push-button flushing.

Bathtubs

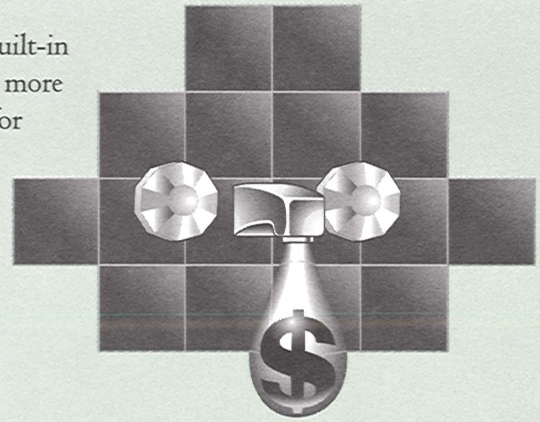
There is a wide range of choices in bathtubs, both in materials and in the styles available. Most houses have standard rectangular tubs, or even old-fashioned free-standing (also called claw-foot) tubs. Many people replace them with bigger tubs, often with extra features such as whirlpool jets.

RESOURCE NOTE

Many toilets now feature an ultra low volume (ULV) flush, which uses 6 L per flush instead of the 16L used by older models. Some compact models use a pressure system to achieve an effective flush; a larger water surface also helps. Low-volume units may cost a little more, but the water savings make the investment worthwhile. There's also a health benefit—since less cold water is added to the tank with each flush, there is less chance of condensation which can cause mold problems.

RESOURCE NOTE

While bigger tubs are more comfortable, they come with a built-in energy price. It takes more hot water to fill them, which uses more energy and raises your electricity bill. Buy a tub big enough for your needs, but for energy's sake don't go overboard. Also consider the extra water that is used and sent down the drain; this increases the demands on your local water treatment system.



If you do this, make sure the tub will fit into your house and your bathroom or your renovation could become very tricky.

The Bath Options chart lists the main options for bathtubs.

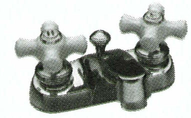
Showers

Like bathtubs, showers have acquired many new shapes and features in recent years. You can stick with a basic shower in the bathtub, add a sliding door or spend extra for a modular bath-and-shower enclosure or a separate shower stall. If you buy a large, one-piece enclosure or a big whirlpool tub, make sure it fits through your doors, and have it installed before any new framing closes off the area it has to go into.

Showers should have one central knob or handle for better control of water temperature. As well, it's wise to install a thermostatic mixing valve, a pressure balancing valve or an anti-scald valve to prevent the water from reaching scalding temperature if someone turns on the cold water somewhere else in the house.

There are several options.

- Compact showers: These small units are built to fit into small spaces; some are wedge shaped for corner installation.
- Hand-held shower heads: These allow you to use the shower head as a personal spray unit, making the shower head more versatile without using extra water; many have several different settings, including massage action.
- Body massage heads: Extra heads are built into the walls of the shower enclosure to give you an all-over spray; these increase water use and require extra plumbing hookups.
- Integral seats: Some shower surrounds have seats moulded into the unit for extra comfort and easier washing.
- Steam baths: These have a generator that produces steam to fill the shower enclosure; the shower acts to cool you and condense the steam. The unit must be completely enclosed and sealed.
- Saunas: These have an electric heater with volcanic rocks that heat the air in the unit; pouring water on the rocks creates steam. Small home units are available. Traditional designs use wooden seats and panelling.



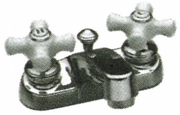
BATH OPTIONS

	Qualities	Comments
MATERIALS		
Enamelled cast iron	Made of cast iron coated with baked-on enamel.	Heavy; the surface is hard and can feel cold. Tends to cool the water while being filled; however, retains the heat better than other types of tub. More expensive than other types of tub.
Enamelled steel	Made of sheet steel coated with baked-on enamel.	Thinner and lighter than enamelled cast iron and not as damage resistant; tends to allow the bathwater to cool.
Acrylic	Made from acrylic plastic resin; can be moulded into any shape.	Light, with a softer surface than cast iron; used for large tubs and moulded tub surrounds. Colour goes through the material so scratches can be repaired. Less durable than cast iron.
Fibreglass	Made of glass fibres with a polyester "gel-coat" surface; can be moulded into any shape.	Light, with a softer surface than cast iron; used for large tubs and moulded tub surrounds. Colour goes through the material so scratches can be repaired. Less durable than cast iron.
OPTIONS		
Larger size	Many sizes available, some big enough for two or three people.	Allows more room to stretch out and relax, but takes longer to fill up; consumes more energy and water.
Different shape	Many different shapes and contours are available.	Makes tub more versatile. Adds comfort. May come in handy for fitting a tub into a small or oddly shaped bathroom.
Whirlpool	Jets move the water around the tub; some inject air into the water for a massage effect.	Relaxing; some people find therapeutic. Number of jets varies, from four to eight or more. Requires an electric pump.
Grab bar	Safety feature can be ordered as a built-in option on some higher-quality tubs.	Desirable option, for everyone's safety and for current or future use by seniors or people with disabilities or restricted movement.
Tub filler	Faucets for filling the tub come in different shapes and styles, and can be integrated into the tub.	Wide-mouthed styles available that fill the tub faster.

Lighting

Despite their small size, bathrooms need both overall and task lighting for specific areas. Some people also add accent lighting to show off a decorative area. A ceiling fixture combined with task lighting over or beside the vanity mirror is a standard way to create an adequate lighting scheme. In a small room, you can get enough light from task lights to illuminate the whole room.

For a large bathroom, task lights can be positioned over the bathtub, shower, toilet or dressing area, especially if they're separated from the rest of the room. If you don't have lights over the bathtub or shower area, choose a tub enclosure that will allow available light to filter through. Lights over showers or other wet areas must have a waterproof housing. Wiring the lights to different switches can help save energy since you can turn on only the ones you need.



RESOURCE NOTE

Especially if you have several people in the household, daily showering can use a lot of water. You can save a lot of this water by choosing a low-flow shower head; these generate a spray similar to a conventional shower head using up to 60 per cent less water. A low-flow shower head can save about 27,000 litres of water a year in a typical household, and save $35 or more a year in water heating costs. As well, think carefully before you buy a unit with extra body-massaging sprays; these can significantly increase the amount of water you use for showering.

Here are the main options for bathroom lighting.

- Ceiling fixtures: Ceiling-mounted incandescent fixtures can provide good general lighting; compact or flush-mounted models give more headroom. Some fixtures combine a light with an exhaust fan (see Ventilation, below).
- Recessed lights: "Pot lights" scattered across the ceiling combine to create general light, or throw pools of light on one area; adjustable models can be used to throw a wash of light onto an area.
- Strip lights: Fixtures with rows of incandescent lights can be effective above the mirror. Many experts recommend locating them on either side for the shadowless light that's better for doing make-up or shaving. These can consume more energy than simpler fixtures.
- Fluorescent panels: Fluorescent ceiling panels produce general light with few shadows; new-style "warmer" tubes cast a more flattering light than older ones.
- Fluorescent light tubes: Bar-shaped fluorescent fixtures can be used horizontally above the mirror or vertically on the wall; they provide even light with few shadows and are energy efficient.
- Wall sconces: Wall-mounted units cast light on the wall for an attractive muted look, good for accent lighting.
- Motion sensors: Some ceiling fixtures have a switch that turns the light on when someone enters the room and turns it off after all motion stops. These prevent people from leaving the lights on for hours after they leave the room.
- Night lights: Low-wattage lights make it easier to find and use the bathroom at night; may be included in combination units.

Windows

If your bathroom has one window, as many do, it may be time to replace it with a more serviceable one. If it's small, putting in a

SAVING ENERGY WITH LIGHT BULBS

The kind of lights you use in your bathroom can make a difference in your energy consumption and your energy bills. Incandescent bulbs are still the standard for home lighting, and there are many different types. However, they waste a lot of electricity by generating excess heat.

For general and over-the-vanity lighting, fluorescent tubes and bulbs are a much more energy-efficient choice. A 15-watt fluorescent tube gives as much light as a 60-watt incandescent bulb, and can last 10 times as long. Today's new generation fluorescent tubes emit a more flattering light than the older tubes with their cooler, bluish light. For lighting a specific area, you can get similar savings with compact fluorescent bulbs. These can often use standard sockets, with or without a separate adapter, and can be substituted for incandescent bulbs. The initial cost of fluorescent bulbs is higher, but in the long run you'll save money on your electric bill and on the cost of replacement bulbs, and you'll lessen the demand for electricity.

Tungsten-halogen lights are another lower-energy alternative. Halogen lights give an intense, white light that's useful for recessed and indirect lights. They produce as much light as incandescent bulbs but use up to 50 per cent less power. Again, the initial cost is higher but you will save energy and the bulbs will last longer.

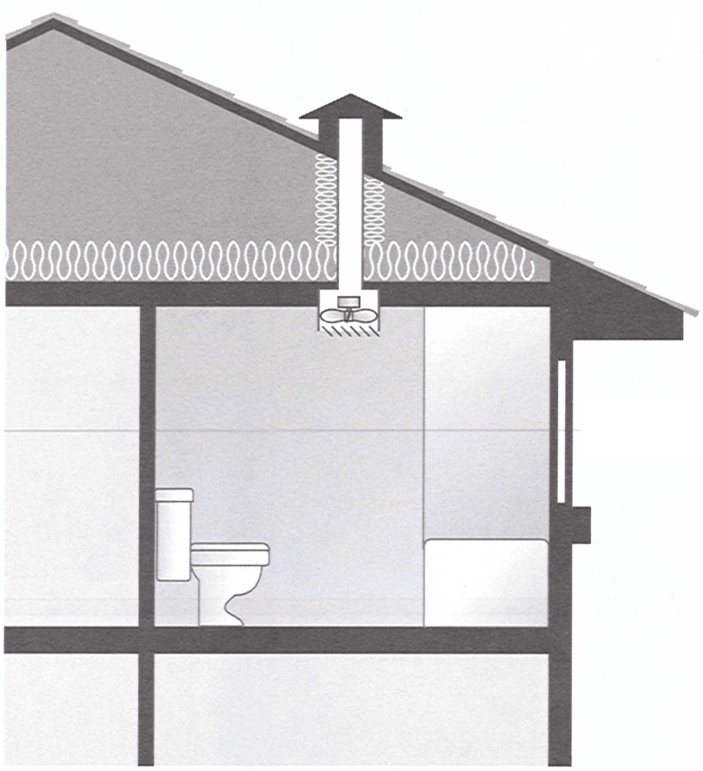
larger window can make the room a lot brighter during the day. If it's cold and drafty, replacing it with a new unit that has double or triple panes (called double- or triple-glazed) and good weatherstripping can make the bathroom much more comfortable (see Chapter Six for more information on windows).

In smaller bathrooms, there is little choice where the window can go since there's only one short stretch of outside wall. If you can avoid it in your layout, try not to put the window directly over the bath or in a shower area. This area can be cold, and it can cause condensation problems when steam hits the cool window surface in cold weather. If you can't avoid this layout, choosing vinyl or fibreglass window frames rather than wood or aluminum can reduce potential condensation damage.

Privacy is also an issue with bathroom windows, depending on where the bathroom is located. You can use frosted glass or glass blocks instead of a conventional window to provide privacy without losing light. Other options include locating the windows high in the wall or installing a skylight or light tube (a smaller unit with a reflective pipe that goes up to the roof instead of a full shaft).

Ventilation

Since bathrooms are generally small, a simple exhaust fan is capable of keeping them fresh and getting rid of the moisture generated by bathing and showering. To be effective, however, the fan must be connected directly to an outside vent or to your heat recovery ventilator, if you have one, with a well-installed air duct (see Chapter Four for information on vent fans). If you have two separate areas that need venting, for example, a separate tub and shower, you may need a vent in each area.



HEAT RECOVERY VENTILATORS

A heat recovery ventilator (HRV) is a boxy-looking device, installed near the furnace (if you have one), that transfers heat from outgoing exhaust air to warm the incoming fresh air as both pass through its heat exchanger coils. The result is warmed fresh air, with reduced heat loss and better humidity control.

The capacity of exhaust fans is rated by air flow, measured in cubic feet per minute. Most fans are rated for a certain number of square feet or metres; match this to the size of your room. Noise is also an important factor, since people tend not to use a fan that's noisy. A fan's noise level is measured in sones—the higher the number, the higher the sound level. Look for a bathroom fan with a rating of two sones or lower.

These are the common options available.

- Fan lights: These combine an exhaust fan with a ceiling light; the fan operates when the light goes on. The fan and light should operate independently so you can turn the light off but leave the fan on.
- Timer controls: Allow you to turn on the fan when the moisture level is high and have it turn itself off later.
- Humidity sensors: Turn on the fan when the humidity in the room reaches a certain level; the fan stays on until the humidity comes down to the level set on the humidistat.

- Intake vents: Vents connected to an outside vent opening allow fresh air into the bathroom to replace exhausted air—a good idea if your house lacks adequate ventilation.

RENOVATING FOR LIFE

Some of the materials you use in renovating a bathroom last longer than others; this saves the resources and energy consumed by replacing them. For example, ceramic tile flooring has a much longer life than vinyl flooring, and ceramic tile and solid surface countertops last longer than laminate tops; these materials can also be used for a long-lived wall surface.

Wall materials

Bathroom walls and ceilings need to be water resistant as well as attractive. Here are some common surfaces for building bathroom walls.

- Drywall: Ordinary gypsum drywall can be used in most parts of the room; it's inexpensive, durable and when painted is suitable for most areas that don't get wet regularly.
- Green board: This is gypsum drywall covered with a moisture-resistant face material and is used around bathtubs and shower stalls to prevent water damage; it acts as a base for a surface finish such as tiles.
- Cement board: This moisture-resistant cement-based backer board is also used around shower and bathtub enclosures to prevent water damage; it acts as a base for a surface finish such as tiles.
- Wood panelling: Solid wood panelling boards can make an attractive finish; cedar is very moisture resistant, but other wood such as pine can be used if it is sealed with a water-tight finish such as water-based urethane.

Finishes

- Paint: Bathroom walls that don't have a solid finish, such as tile, should be finished with a water-resistant, washable paint such as a kitchen and bathroom enamel or a hard-wearing acrylic latex. Avoid using alkyd paints, which emit hazardous chemicals (see Chapter Seven for more information on paints).
- Wallpaper: Some people use wallpaper in bathrooms; however, it can be an unhealthy choice, because any moisture that gets behind the paper can cause mold to grow. As well, vinyl-coated scrubbable papers give off vinyl odours (see Your Bathroom and Your Health, this chapter).
- Ceramic tiles: A popular finish, especially for tub and shower areas. Wall tiles are thinner and usually smaller than floor tiles; decorative finishes and designs can aid your decorating. Tiles are water resistant and washable, but the grout between them can be hard to clean; stain-resistant grouts are available.
- Stone: Panels of natural stone such as marble or slate can be used around showers and tubs, or in other parts of the bathroom; highly water resistant, these add a luxurious look but can be expensive.
- Synthetic materials: Panels of plastic or the solid surface materials used in

countertops can be used for the area surrounding a tub or shower. These are attractive and durable; high-quality solid surfaces last longer and are more resistant to damage.

Floor surfaces

Bathroom floors should be durable, water resistant and washable. That usually restricts you to hard or smooth surfaces. While some people use carpet in a bathroom, it is not recommended; it accumulates dirt and soaks up water, which creates a good place for mold and mildew to grow. Washable rugs are a better choice if you want a softer surface.

There are four main choices for a bathroom floor.

- Vinyl: Resilient vinyl flooring comes in sheets or tiles. It's usually cemented to a plywood subfloor, but can be installed over a smooth existing floor finish. Vinyl is easy to clean and comfortable to walk on; it's durable, and higher quality vinyl has a thicker wear layer on top. However, off-gassing can create health concerns (see Your Bathroom and Your Health, this chapter).
- Linoleum: Similar to vinyl flooring, linoleum is made from natural materials such as linseed oil and jute, cork dust and wood dust; solid-colour and patterned matte finishes are available. The surface is hard wearing and long lived. However, linoleum gives off odours that can be irritating (see Your Bathroom and Your Health, this chapter). Linoleum can be laid "dry," without adhesives, which reduces emissions.
- Ceramic tile: Floor tiles are usually larger and thicker than wall tiles. Non-skid tiles should be used since ceramics can be slippery when they get wet; dense or vitreous tiles resist moisture better and don't need a sealer. Ceramics provide a hard, long-lived, cleanable surface, but tiles can break or chip. Use different coloured tiles to make a patterned floor. Tiles made from stone are also available.
- Wood: Wood strip or plank floors are often found in old bathrooms and are sometimes installed in new ones. Because it can be damaged by heavy exposure to water, wood flooring may not be suitable for bathroom floors that will experience spills.

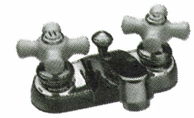
Services

Electricity

Bathrooms aren't big users of electricity. There may be enough room on an existing circuit to add the new fixtures you put in as part of your renovation: an extra light, a new outlet and a fan, for example. However, renovating an old bathroom with new equipment can involve adding a number of new outlets and fixtures, and possibly a pump or motor for a whirlpool tub. This may require running one or more new circuits from your electric service panel. If you're in doubt as to how much capacity you have or what you need to do, consult an electrician.

There should be at least one electric outlet in the room, usually located at the vanity for plugging in electric shavers and hair dryers. However, if you have a dressing area or make-up table you'll likely need one there too. Outlets near the sink or tub must be equipped with ground fault circuit interrupters.

If you're putting new fixtures in new places, you'll likely need an electrician to install the new wiring and perform any service upgrades needed. Marking your outlets and lighting fixtures on your



drawings will give you a better idea of what's needed. However, in some cases all the work may not be evident until the old walls and fixtures are opened up and the old wiring is exposed.

GROUND FAULT CIRCUIT INTERRUPTERS

A ground fault circuit interrupter (GFCI) is a special outlet that cuts the power immediately if a short circuit occurs, preventing the user from getting a shock.

Plumbing

Bathroom fixtures are usually clustered around the main drain pipe (also called a soil stack) in the house, for easy connections from the toilet, bath and sink. The easiest and cheapest option is to leave these fixtures where they are, or very close to the old location so you can use these hookups with little modification. Most fixtures can be moved wherever you want them if the hookups are done by a skilled plumber.

Moving the toilet can be more complicated than moving the other fixtures, since it should be located close to the main drain pipe or soil stack. Generally, it can be moved a metre (3 ft.) or so without causing a major problem. Moving it across the room can be difficult, since the drain pipe must run between the joists under the floor. If the joists run the wrong way, you have a problem.

Bathroom drain pipes can create noise problems, especially if you use plastic pipes. The best way to minimize this is to wrap the pipes with fibreglass insulation to muffle the sound. However, in an existing house much of the soil stack will be enclosed in the wall structure, so you won't be able to do a complete job.

As well as the drain pipe connections, all the fixtures must be vented so they'll work properly. This is usually accomplished by running a pipe up the wall to join to the soil stack above the level of the fixtures. Building codes vary on what you can do, so check with your local building department before you proceed.

VENT STACKS

All plumbing fixtures must be joined to a vent stack; this is an upward extension of the main drain pipe (also called the soil stack) which extends through the roof and allows air into the system so water can flow freely. In some cases, a separate vent pipe may service only one or two fixtures.

Each fixture also requires water supply lines (only cold water for the toilet). These can usually be connected from the existing lines with little trouble. They must be run through the wall or floor, so some demolition will be necessary if you're running them to new locations.

Heating

If you're renovating an existing bathroom, the existing air registers, radiators or baseboard heaters may be adequate, so you can leave them where they are. In other cases, you may have to move them to accommodate a new layout; this can usually be done without too much extra work but a heating or plumbing contractor may be needed.

If your bathroom is chronically cold, this is the time to address the issue. The problem could be that your furnace's distribution system isn't getting enough heat to the room. Have a heating contractor look at the system; in some cases it can be "retuned" to make it deliver more heat.

Where the old equipment isn't up to standard, you may have to invest in some new pieces. For example, you can replace an old radiator with a new-style hot-water convector, a baseboard unit or a heater that fits in the kickspace of your vanity. You'll get better performance and often better appearance. There are also wall-hung heating units that double as a towel warmer; these work using either electricity or water from your hot water heating system.

RECESSED SURFACE

The recessed surface at the bottom of a vanity is called the kickspace. It allows you to stand close to the cabinet front without stubbing your toes.

If you're building a brand new bathroom, you can usually have an extra heat register or radiator added to your existing system without straining its capacity. This should be done by a professional heating contractor. Another option for both old and new bathrooms is to add a spot heater such as an electric convection heater. These can also be installed in the kickspace of your vanity.

Finally, look at the insulation levels in the bathroom walls, and the efficiency of the window or windows. Cold walls and drafty windows can make the room uncomfortable even with adequate heat.

Making a Plan

The first step in making your bathroom renovation plan is to define your goals. What do you want to add to the existing room? What problems do you want to correct? Using the Bathroom Priorities Worksheet, write down what you want to accomplish with the renovation, under the headings provided.

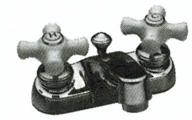
When you've defined your goals, you can make a list of the different elements you'd like to include in the new bathroom. These can be divided into two different categories: big elements, such as a separate bathing area or a room expansion, and smaller components, such as a double-sink vanity or a certain make or colour of fixture.

Many of the choices are outlined in the Options section, but you'll get a better idea of exactly what you want by visiting building centres, kitchen and bathroom showrooms, and home shows. As well, look through design magazines that deal with bathrooms for ideas on how to use different elements, and how they look together.

Because of space and money constraints, you may not be able to include everything you'd like in your renovation. On the worksheet, write down the things you'd like to include, rating each one as a high priority, that is something you need to have, or a low priority, that is something you'd like to have if it fits both the room and your budget.

Creating your design

The next step is to put the pieces together to make the new bathroom you want. If you're going to have the job done



BATHROOM PRIORITIES WORKSHEET

	Details	Priority (high/low)
GOALS		
MAJOR FEATURES		
COMPONENTS		

professionally, you can take your wish list to a professional bathroom designer or renovator at this point. However, whether you're going do the work yourself or hire someone else, it's helpful to make a preliminary drawing of your plan. This can help you determine what will and won't work in the amount of space you have, and what constraints you may have to work under.

Using a sheet of graph paper or a commercial planning kit, and the dimensions from your earlier diagram, draw in all the elements you'd like to use in your new bathroom. If you're just putting new fixtures in place of the old, draw in their sizes and shapes to see how well they will work.

If you're planning bigger changes, try moving the elements in the bathroom to places where you think they'll work better. This may be easier if you make scale-sized cutouts of the vanity, toilet and bathtub or shower that can be moved freely. If you're going to expand the bathroom, draw in the new walls to see how the room will look and how it will work.

In your design, try to imagine how people will move through the room, and how the elements will affect their movement. For example, the vanity door and shower door shouldn't block the centre of the room and they shouldn't run into one another when they're open. You can sometimes choose a door that swings in a different direction to avoid problems.

As well, think about storage. This is an important facet of the bathroom, and you may be able to get more by adding upper cabinets or shelves over the toilet. In some cases, combining storage with towel racks can help save space. If you're doing structural work on the walls, think also about building in a cupboard for extra storage: behind the door is often a good spot for a hidden cupboard.

Planning aids

Here are some standard dimensions and clearances for bathrooms, to help you with your planning. Some of the clearances recommended may be impossible to meet in a small bathroom: in that case, all you can do is try to ensure there's enough clearance to do what you have to do.

- Vanities are a standard 813 mm (32 in.) high and 457 mm (18 in.) or 533 mm (21 in.) deep; many people prefer heights up to 914 mm (36 in.), which can be had in custom vanities.
- In two-sink vanities, there should be at least 280 mm (11 in.) between the two bowls.
- There should be a clear space 762 mm (30 in.) by 1,219 mm (48 in.) in front of the sink. (Some of this can be knee space under the sink.) In a small bathroom, a passage 610 mm (24 in.) is acceptable, but may not provide access for people with disabilities.
- Toilets are commonly around 432 mm (17 in.) wide, and 660 mm (26 in.) to 762 mm (30 in.) deep; round-front models are less deep.
- There should be 406 mm (16 in.) from the centre of a toilet or bidet to the edge of any other fixture or surface beside it.
- There should be a clear space 1,219 mm (48 in.) square in front of a toilet or bidet; a space 762 mm (30 in.) or even 610 mm (24 in.) is acceptable, but may not provide access for people with special needs.
- Standard bathtubs are 1,524 mm (60 in.) long and 762 mm (30 in.) wide; for larger models, use the manufacturer's measurements.
- Shower enclosures should be at least 864 mm (34 in.) in each direction; 813 mm (32 in.) is acceptable but can restrict movement.
- Permanent seats installed in the shower should not be included in the 864-mm (34-in.) space.

PERMITS

If your renovation involves structural changes to the walls or floors, electrical or plumbing systems, it will require a permit, or permits, and inspections from your local building department or utilities. You'll have to get the permits before the work starts, and schedule the inspections either beforehand or while the work is in progress. If you hire renovators or subcontractors to do the work, they should get the permits and schedule the inspections; that way, they're responsible for complying with local codes. Chapter Three has more information on building permits.

PLANNING AN ACCESSIBLE BATHROOM

As you plan your bathroom renovation, think about making the room accessible for those with disabilities or restricted movement. This is important if someone in your house has a disability, but it can also be worthwhile if you're planning to retire in the house. Future users of the house may also need these features.

There are a number of design features that make a bathroom easier to use for someone in a wheelchair, or someone with restricted movement. These include:

- a door with a minimum clear passage of 813 mm (32 in.) which should slide open or swing outward
- a 1,524 mm (60 in.) turning space in the middle of the room
- no threshold between the bathroom and adjacent areas
- walls reinforced to support a 135-kg (300-lb.) weight for later installation of grab bars at the toilet, bath and shower, for example, sheets of plywood over the wall studs for good support
- a clear knee space at least 711 mm (28 in.) high, 203 mm (8 in.) deep and 762 mm (30 in.) wide under the sink, with an extra toe space 229 mm (9 in.) high and 229 mm deep at the bottom
- sinks with the trap located close to the rear wall and pipes under the sink insulated to prevent burns
- lever-type faucet handles (single lever preferred)
- a toilet that can accommodate a raised (elevated) seat add-on or permit the use of a rolling commode (wheelchair factors to consider include seat height, seat width and shape of bowl
- a roll-in shower with inside dimensions of 762 mm (30 in.) by 1,524 mm (60 in.) and a clear floor space 914 mm (36 in.) by 1,219 mm (48 in.) in front of it
- an adjustable-height shower head
- mirrors that are usable from a seated position
- a clear space at least 762 mm (30 in.) wide on one side of the toilet or at least 1,041 mm (41 in.) deep in front of the toilet to allow access from a wheelchair
- a clear space at least 762 mm (30 in.) wide and 1,219 mm (48 in.) along the length of the bathtub.

- Shower and bath controls should be accessible from outside the unit.

Choosing options

Now you can choose the materials and strategies you want to use from the options listed in the sections above. The materials and techniques you pick must work in the amount of space you have, and they must all fit together to give the room a consistent and harmonious look. As well, remember to consider energy and water efficiency as you make your choices.

Use the Bathroom Options Worksheet to decide which options you'll use.

Materials

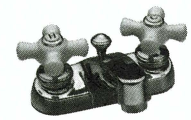
Once you've chosen the best options for all the different parts of the project, you'll be able to make a materials list. This is useful, not only for pricing, but also for a purchasing list you can use to schedule your

BATHROOM OPTIONS WORKSHEET

Item	Options/details	Materials	Estimated cost
Wall structure	1. 2.		
Wall finish	1. 2.		
Floor structure	1. 2.		
Floor finish	1. 2.		
Ceiling	1. 2.		
Windows	1. 2.		
Doors	1. 2.		
Vanity	1. 2.		
Countertop	1. 2.		
Sink	1. 2.		
Faucets	1. 2.		
Room lighting	1. 2.		
Task lighting	1. 2.		
Ventilation	1. 2.		
Room lighting	1. 2.		
Task lighting	1. 2.		
Heating	1. 2.		
Other	1. 2.		

buying. When you've made your purchases, enter them on the Bathroom Materials Worksheet so you'll have a record for future reference. Also attach all receipts and other project documents to the page so they'll be handy if you need to look at them.

If the project is going to be done in a short period of time, it may be practical to have many of the materials delivered as the work gets started to avoid delays. However, if it is going to take a long time, it's more economical to buy the materials in stages as they're needed. This helps prevent materials



BATHROOM MATERIALS WORKSHEET

Item	Materials (brand/ specifications	Quantity	Price per unit	Cost	Date needed	Date purchased	Supplier (address, phone no.)	Comments
Wall structure								
Wall finish								
Floor structure								
Floor finish								
Ceiling finish								
Windows								
Doors								
Vanity								
Countertop								
Sink								
Faucets								
Toilet								
Bath								
Shower								
Room lighting								
Task lighting								
Exhaust fan								
Heating								
Electrical hookups								
Plumbing hookups								
Other								
TOTAL MATERIALS COST								

from getting damaged before they're actually used. It may also be necessary if you're getting the money in stages from your lender.

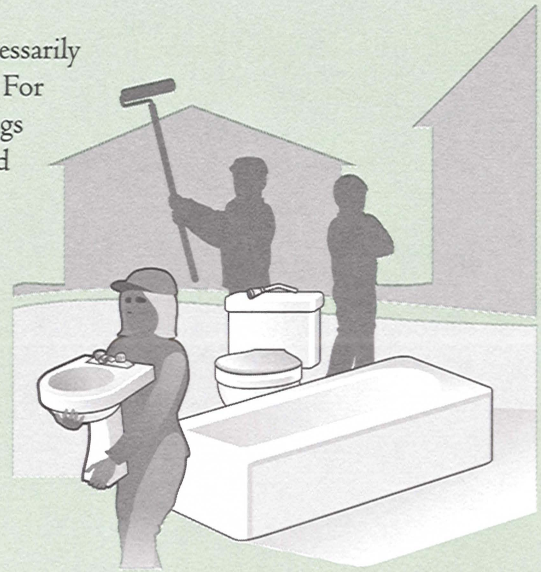
If you're hiring a renovator to do the project, making the purchases will be part of the contract. However, having the materials list beforehand will help you in getting accurate bids from prospective renovators.

Who'll Do the Work?

Much of the work involved with a relatively simple bathroom project can be done by a

SALVAGING SOME VALUE

The old materials that come out of your bathroom don't necessarily have to go to the local dump; they may still have some value. For example, old lumber, baseboards, and door and window casings can be reused if they're removed carefully. (Watch out for lead paint.) And plumbing fixtures can be refurbished, given away for reuse or used in a second or third bathroom. If that's not possible, they may be recycled: old porcelain fixtures can be crushed and used as granular fill, while metal tubs can be used for making steel. Old copper piping is also recyclable.



homeowner with good handyman skills. The list of jobs you may be able to do includes:

- removing old fixtures
- gutting old wall surfaces (see the cautions above about hidden hazards)
- removing non-bearing walls
- framing new walls
- installing sheet or tile flooring
- painting the new room.

For a renovation that involves serious structural work or a lot of new fixtures and materials, however, you'll likely use the services of professional renovators in order to get a professional-looking job. The best strategy is to use renovators who specialize in bathrooms; they will have the best knowledge of the materials and the problems involved. Most bathroom renovators will help you develop your design (often using a computer design system) and then carry out the project to your specifications. Some will charge for the design service, while others will work on a "retainer," deducting the design fee from their final price.

These can be found in the Yellow Pages™, through referrals from friends, or through your local homebuilders' association. As with any project, follow the guidelines in Chapter Three for hiring a renovator; get bids from three renovators and look for affiliation with organizations such as the National Kitchen and Bath Association (NKBA); some designers are also accredited as Certified Bathroom Designers, which guarantees a certain level of experience and training.

You'll also likely need an electrician for the new wiring, a plumber for the plumbing work and, if possible, a heating contractor to install or move heating outlets, as well as tradespeople to do the structural work, drywalling, flooring installation and finishing work. Your renovator probably has regular subcontractors. However, if you're hiring subcontractors yourself, follow the guidelines in Chapter Three. Look carefully at their qualifications, and ask some questions about how they intend to deal with any problems you might anticipate. This can be demanding work, and it takes tradespeople with proper technical training. Use the Contractor Worksheet in Chapter Three to compare the tradespeople you're considering for the job.

Counting the costs

How much your renovation costs will depend on two factors: the quality of the new fixtures and materials you use and how much professional labour is needed.

Because a bathroom is usually small in size, it can give you an opportunity to use some premium materials without straining your budget too much. For example, the overall cost of some expensive stone floor tiles may not be too high since you won't need many of them, and a solid surface vanity countertop will cost much less than if you used the same surface for a kitchen counter. However, buying high-end fixtures such as a whirlpool tub or a special shower enclosure can raise the price of the project quickly.

In terms of labour, the more you change the existing design, the more money it's likely to cost. And the older your house is, the higher the likelihood that the old plumbing and electrical wiring will need substantial work, which will also add to the cost. If you're using professional renovators, all these costs will be part of their bid. If you're acting as your own general contractor, you'll have to get estimates from a plumber, electrician and any other tradespeople you'll need.

All these costs can put the price of the renovation beyond your budget. However, you can reduce the costs in two ways: by moving from higher-priced materials and fixtures to lower-priced alternatives, and by simplifying your plan. You can help reduce the cost of your renovation by:

- using a good-quality laminate countertop instead of solid surface
- choosing stock items, for example, the vanity, instead of custom units
- shopping for quality materials being sold at close-out prices
- using dramatic lighting and decorating touches to enhance the look of the bathroom instead of expensive materials
- retaining one or more of the usable existing fixtures.

Ways of simplifying your renovation plan to save money include:

- choosing alternative plans that don't require moving a fixture
- leaving out one or more elements, for example, a skylight window, until later
- eliminating some of the finishing or accent touches, for example, costly accent tiles.

Working healthy

The best way to avoid health problems from the materials used in your renovation is to choose materials that produce the least irritants. As mentioned, this includes the vanity, flooring, paints and finishes, and the caulking used around the bathtub (see Chapter Five for information on the health aspects of caulkings). However, the work

itself can produce a number of health hazards, both for the workers and for the occupants of the house.

There are a number of ways to minimize these effects.

- Arrange for a window fan to ventilate the room if there are jobs that raise fumes, such as painting, staining or using an adhesive to apply flooring.
- Make sure the workers will use dust bags or other systems to control dust if power saws or sanders are going to be used.
- Arrange for a plastic dust barrier at the bathroom door to keep the dust from spreading into the rest of the house.
- Make sure the workers will use proper face masks for work that's dusty or creates fumes.
- Insist on a thorough clean-up and vacuuming after work each day, and when the whole job is finished.

See Chapter One for more tips on avoiding renovation hazards.

Putting it all together

If you're hiring professional renovators to do your renovation, your next step is to choose the one you think will do the best job, and sign a contract. The renovators will put the pieces together to make the work go forward. However, if you're going to act as your own general contractor, the final part of your planning is to assemble all the parts of the plan in one place, so you can see what's involved and get a good overall cost estimate.

In order to do this, use the Project Planning Worksheet at the end of this chapter to enter all the materials, labour and other expenses the job will entail. This should allow you to arrive at a price for the whole job and see everything that will be needed to make the project a reality.

As well, you must make a schedule so that the work progresses in a logical order and the tradespeople arrive when the construction is ready for them. You can photocopy the Gantt chart in Chapter Three to help you schedule the job.

Then, think about how you'll organize your day-to-day life to accommodate the work. If this is your only bathroom, you'll need to supply other facilities once the fixtures have been pulled out. A chemical or portable toilet will likely be essential, and you'll have to find a shower and other facilities for washing up. Remember that the tradespeople have needs, too. See Chapter Three for more information on living with a renovation.

Once all the pieces are in place, you can set about making the project a reality. It will still require a lot of work, and a lot of attention to detail, as it takes shape so the project is safe, healthy and successful.

FOR MORE INFORMATION

These publications offer more information on the topics in this chapter.

Healthy Housing: Practical Tips, CMHC (NHA 6736)

Housing for People with Disabilities, CMHC (NHA 5467)

Building Materials for the Environmentally Hypersensitive, CMHC (NHA 6742)

Healthy Housing Bathrooms, Fact Sheet 2, (PE0220)

Consumer's Guide to Buying and Using Energy-Efficient Lighting Products, Natural Resources Canada

PROJECT PLANNING WORKSHEET

Job	Materials cost	Contractor (Name, phone no.	Start date	Completion date	Labour hours/ rate	Labour/ contractor cost	Tools/ rentals	Permits/ fees	Other costs	Total cost

Chapter Eleven

THE DECK

- *popular and inexpensive*
- *from footings to stairs*
- *defining your deck needs*
- *making a plan*

One of the easiest ways to add new and enjoyable living space to your house is to build a deck. It's a popular summer project, and inexpensive: the price is usually lower than for most other renovations, and the result is an attractive and useful new space that makes outdoor living more enjoyable.

For the summer months, a deck is like having a second living room or den. And in some cases, it's the best use of a lot that's not big enough for much activity, or has a shape or slope that makes it difficult to use. If you have an extensive garden, a deck can also become part of the overall design, creating a good place to sit and enjoy your gardening labours.

Building a deck is not a major project, as renovations go. In fact, it's a favourite do-it-yourself project for homeowners. However, as with any other renovation, there are a number of things to know before you start out; some of these concern the principles and materials involved, while others concern your health and the efficient use of resources. And the project can't start before you do some careful planning, for example, where the deck will go and what it will look like.

If you take the time to look into the basics of deck building and make a well-thought-out plan, your deck can take shape quickly, and you'll be enjoying it before long.

What Are the Issues?

- Function: Even though a deck is a fairly simple structure, it must be designed and located so it's easy to use, and provides the right amount of space in the right locations for the purposes you intend. Access must be well planned, and seating areas may need protection from the sun. Extra features, such as privacy screens and built-in benches, can also make using the deck more convenient.
- Appearance: A deck can be a very visible feature of the house, so it must look good in addition to working well. Its colours and shape should fit in with the style of your house for a pleasing overall impression.
- Health: Some of the materials used in building the deck can have health effects because of the chemicals they contain, so choosing the right materials and using them properly is important. As well, steps must be taken to prevent problems with moisture and mold.

What You Should Know about Decks

Decks are basically wooden platforms held up by posts. However, they have a number of parts that must be in place for the whole structure to stand straight and strong. These are built in order, from the ground up.

- The footings: These form the base for the posts that hold up the deck. They are made of concrete poured into holes dug in the ground and must be sunk below the frost line—the depth differs from area to area. There are several ways to make a footing, but many people use special tubes that allow you to pour a cylindrical column of concrete. The footing projects up above the ground surface, to keep the wooden posts from touching the earth. This footing is sometimes replaced by a concrete pad in areas where soils are stable and not susceptible to frost heaving.
- The posts: Wooden posts, usually of 89 x 89 mm (4 x 4 in.) lumber, form the main support for the deck. These are set on top of the footings and fastened in place, often using a special metal fitting called a "saddle." In some cases, the posts can continue up through the deck surface and form railing supports. Bracing boards are often

fastened between the posts below the deck to make the structure sturdier, and are advisable if you get large snow loads.

- The header or ledger: Most decks are attached to the house using a long board called a header or ledger. This is secured flat to the wall using lag screws sunk into the house's floor or wall structure. For solid brick houses the header is fastened with expansion bolts sunk into the bricks.
- Beams: Laid across the posts are one or more beams which support the structure above. These can be a single board, such as a 38 x 235 mm (2 x 10 in.), or two smaller dimension boards fastened together face to face. The beams can be set directly on top of the posts, or bolted to their sides if the posts continue up through the floor; in this case, two boards are used, one on each side of the post.
- The joists: After the beams comes a layer of joists, usually 38 x 184 mm (2 x 8 in.) or 38 x 235 mm (2 x 10 in.) boards, set on edge. These are attached to the house by securing them to the header board. They can be attached using metal joist hangers; in some cases they are set on top of the header, in which case it's called a ledger. At the other end, they rest on top of the beam or are attached to it with joist hangers. Short pieces of wood (called blocking or cross bridging) may be nailed between the joists for extra strength. Facing boards run around the edge of the joist frame.
- The decking: The finish surface of the deck is usually made of good-quality decking boards, nailed across the grid of joists. There should be a 3 mm (1/8 in.) space between the decking boards to let rain drip through, and the top surface should be 25 mm (1 in.) below the level of the door sill to keep rain water from running into the house.
- The railing: Most decks need a railing to keep people from falling off. These can be supported by the deck posts, or by independent posts secured to the frame. Railings can take almost any form, from a bench to a series of horizontal boards to a latticework fence. However, the standard design includes a horizontal top and a bottom rail, with vertical rails, called balusters, in between. A flat board called a cap rail can be added on top for a finished surface to set things down on.
- The stairs: Raised decks also need a set of steps to lead down to ground level. These are composed of wide side panels called stringers, with steps or treads, and sometimes with vertical facing boards below the treads, called risers. Stairs often need a railing, and they should have appropriate lighting for night use.

Taking Stock

To make an effective deck plan, you have to know two things: first, the needs you want the new living space to fill and second, the kind of site you have to work with. Both factors will have a big influence on how and where you build your deck.

Defining your needs

Just as with any other part of the house, a deck should be suited to your lifestyle. It should have areas for the activities you do most often, and it should provide easy access to the surrounding areas that you use regularly. In most cases, the activities you'll use the new deck for are basically the same ones you use your outdoor areas for at present. Use the Deck Lifestyles Worksheet to make a list of the outdoor activities you pursue now.

These activities will dictate how much space you need, and how it should be laid out. One important detail is how many people you're likely to have on the deck at the same time. On the Deck Lifestyles Worksheet, estimate how many people would attend the biggest party you might have on your new deck. One rule of thumb is that there should be 1.8 m^2 (20 sq. ft.) of space for each person, so for 12 people you would need 22 m^2 (240 sq. ft.).

At the same time, the deck should be suitable for use by all the members of your family. That includes elderly people and small children, which means safety and access may be issues. For example, good railings are important for elderly people, as well as stairs that are easy to use, with good lighting and sturdy hand rails.

If small children will play on the deck, you'll need railings that prevent them from falling off, even if the deck is not far off the ground. The balusters must also be set the proper distance apart so children can't get their heads between them (see Railing Rules in the What Are the Options section for required measurements). You may want to raise the height of the railing behind benches or other surfaces a child could climb up on, or provide a closable barrier to block off the stairs. Well-designed handrails on both sides of the stairs can also be useful for young children. In addition, you might avoid pressure treated wood for the deck surface so your children won't be in contact with the chemicals it contains.

DECK LIFESTYLES WORKSHEET

Family dining		Children playing	
Cooking		Sunbathing	
Conversation		Hobbies	
Parties		Using a pool	
Reading		Using a hot tub	
Maximum number of people likely to use deck at one time			

Assessing the site

The second basic element in your planning is the site. At this point, you may know exactly where you want to put the deck, or you may be undecided. Either way, however, it's important to take a good, critical look at your house and your lot to see what elements and what space you're working with.

Using a sheet of graph paper, make a scale drawing of your lot and your house. If you have a site plan for the house, you can use it to ascertain the measurements. Otherwise, take a long tape measure and find the dimensions of the lot and the house, and the distances from the house to the lot line on each side. (If you don't know where the lot line is, this is a good time to find out—it's usually marked by surveying stakes in the ground.)

Draw in any driveways, trees, shrubs, flower beds, ponds and outbuildings, as well as the entrances to your yard and the location of the front and back walls of the houses next door. As well, clearly mark any irregularities, such as areas where the ground slopes away or where you have a drainage problem, and any features you might want to showcase (a beautiful view of the garden, for example) or block out (an ugly view of a tool shed, or your neighbour's back door). Mark the locations of any services in the yard, such as an outdoor water faucet, or electric or telephone lines. Plotting all these features may be easier if you divide your diagram into a number of equal-sized squares.

Next, think about the yard's exposures. Since you haven't pinpointed the size and location of the deck, the best strategy is to go out in the yard at different times of the day and see which areas are in the sun or shade. This can help you in positioning the key areas of the deck; you'll likely want some sun during the day, but a very exposed location may require sun screens. Remember that the sun changes its position in different seasons, so do this over several months, if possible. In most parts of Canada, you'll be most concerned with the sun's position from late spring to early fall, since that's when you can use the deck. But on the West Coast, you may be able to use it year round, so you'll need to check the sun's position in winter.

As well, check the prevailing wind direction over a number of days, to see which areas tend to be windy and where the wind is coming from. Putting a small weather vane or a flag at the probable deck level can help you see which way the wind is blowing.

Note the kind of soil you have around your house. You can sink the required footings for your deck in most kinds of soil, but the job could be more difficult if there is solid rock where you want to put the deck, or if the house is new and the soil has been disturbed during building. Loose soil must be compacted to make a firm base for your footings. If you have a septic tank, check the exact location of the tank and field. At the same time, find out if there are any buried gas, phone or power lines in the yard that might be disturbed when you dig your footings. If in doubt, phone the utility; don't find out by digging into something and damaging it.

Use the Deck Site Assessment Worksheet to note the dimensions of your yard, and any features or obstacles that might figure into your planning process.

Building codes

At this point, it's also necessary to find out what local codes and by-laws pertain to decks and outbuildings. Building codes specify things such as the requirements for railings around the deck, the size of beams and joists needed, and the number and size of steps required.

As well, check the required setbacks in your municipality; these distances regulate how far any structure must be from the lot line, and may limit your choices when it comes to locating the deck. If you want to go outside these guidelines, you may need a zoning variance in order to get your permit.

What Are the Options?

Now that you have a good idea of your situation and your needs, you can begin to look at the choices available to you as you design your deck. You need to consider both design options, which involve the shape and style of the deck, and the different choices of materials to use in building the deck.

DECK SITE ASSESSMENT WORKSHEET

Dimensions of yard	Irregularities
Positive features	Comments
Negative features/obstacles	Comments

Design options

Designing a deck is both a challenge and an opportunity to use your imagination. You can build a basic square platform, or turn it into a free-form construction with several sections that flow across your yard. Almost anything can be done, as long as it suits your house and your lifestyle. Here are the main options to consider.

Location

- Attached to house: The majority of decks are attached to the house, for direct access from a back or side door. The deck can extend the whole width of the house or be located off-centre for a more interesting profile. Or, it can be centred around a specific area, to provide a walk-out without becoming a major architectural feature. The main advantage of an attached deck is convenience. It also changes the look of the house, which can be either a benefit or a problem, especially if you have a beautiful, old house.
- Remote locations: If there's an area away from the house that would make an ideal sitting place—an area surrounded by flower beds or flanking a pond, for example—you can choose to locate your deck there instead of adjacent to the house. This can give you a chance to take advantage of a sunny part of the yard, if the house is mostly in the shade, or it may allow you to use a big shade tree for protection from the sun. However, it means you should provide a path to the deck so people don't get their feet wet when the grass is heavy with dew or rain.
- On grade: In locations where the door from the house is at ground level, or in some remote location, the most convenient plan is to build the deck right on, or just above, the ground. This makes access easier, and it simplifies construction since you won't need a full-size staircase or long posts for support.
- Raised: Most decks are raised off the ground at least a few feet. How high is usually dictated by the height of the exit door that opens onto the deck. If a walk out deck would be more useful from the second floor of your house, you can raise the deck to that level. For a higher deck, you just use longer support posts, but this may change some of the building requirements.

Shapes and forms

- Square: The easiest option is to build your deck in a square or rectangular shape, with square edges. This conforms to the shape of the lumber, and requires no special cutting and contouring, which minimizes the labour involved. It can also be the best match for a house that has a very basic, square shape.
- L-shaped: A variation on the basic shape is to turn the deck around a corner of the house or a deviation in the exterior wall. This makes a more interesting shape, and can add some useful extra space. It may even give you an opportunity to provide walk out access from two sides of the house.
- Angled or contoured: If a regular, square-cornered deck seems too static and unimaginative, you can choose to change the shape by angling some of the edges, or by rounding them so the deck has a more natural, organic look. Moulding the deck around a rock garden or some other natural feature can make it look like a natural part of the yard instead of something added on.
- Multi-level: You can add even more interest by building two or more platforms, set at different levels.

RAILING RULES

The National Building Code recommends a railing or guard for any deck that's more than 610 mm (24 in.) off the ground. The railing should be at least 914 mm (36 in.) high for decks up to 1,803 mm (71 in.) above the ground; for higher decks, it should be 1,067 mm (42 in.) high. The spaces between the slats, or balusters, in the railing should be no more than 102 mm (4 in.) wide for the safety of children. As well, any staircase with more than three steps should have a handrail at least 813 mm (32 in.) high on at least one side. These standards are for single-dwelling units, and local standards may vary. Check your local building department for the requirements in your area.

DECK OPTIONS

Option	Features	Comments
Stairs	Variations include curving steps, with landings if the descent is long, and ramps to make the deck accessible for people in wheelchairs.	Essential if your deck is more than a few inches above the ground.
Railings	Can be open slats, turned stiles, semi-solid panels, or can incorporate benches or planters.	Essential if the deck is more than 610 mm (24 in.) high. Visually enclose the deck and help define its shape.
Benches	Built-in benches around the edge of the deck or in conversation or eating areas. Can double as a railing (check building codes for requirements).	Reduce need for movable furniture. Space below can be enclosed and used for storage. Can reduce usable open space.
Privacy screens or fences	Screens of wood latticework, slat fences, trees or shrubs.	Provide visual shelter from street or neighbours' yard.
Sun and wind screens	Latticework, slat, louvred or solid screens.	Provide shade and stop prevailing winds.
Planters	Built-in planters can be stand-alone units or part of the outside railing.	Add an attractive accent, can be used for herbs or vegetables.
Cooking facilities	Can be a built-in barbecue pit, base for gas barbecue or counters for food preparation.	Make outdoor dining more convenient. Outdoor electrical outlet can be a handy addition.
Gazebos	Enclosed seating areas, usually circular, with roof.	Add an attractive accent, give the deck a visual focus. Provide an intimate area for conversation or reading.
Roofs	Roof structures made of latticework or wooden boards set on edge, supported by posts. Block sunlight in the hottest part of the day.	Make the deck more comfortable during sunny weather. Add an attractive accent, give the deck a visual focus. Varying spacing of roof members adjusts the amount of light admitted.

These can overlap, with a small step down from one to the other, or they can be a series of distinct areas with steps between them. If the deck is raised, you can plan the platforms to lead you down and into the yard below.

Wood designs

A simple and cost-effective way to add visual interest to the deck is to install the decking at an angle, or at more than one angle. You can lay it at any angle between 45 and 90 degrees to the joists; however, to make some designs work, the joists may have to be installed at an angle to the house.

The angle you choose for the decking should work well visually with the layout of the house, the deck and the surrounding features. You can install the decking at two different angles to divide a flat, one-level deck into two areas visually. Or, you can use different angles for different tiers of a multi-level deck. Fancier variations include alternating angles to make a herringbone pattern, or using different angles to create designs.

Other ways to create a pattern with decking include alternating wide and narrow boards, or constructing the surface of small "parquet" frames or grids of 38 x 89 mm (2 x 4 in.), usually 1 m (3 ft.) square. By laying these at alternating angles, you can approximate the look of parquet flooring.

As well, you can get a finer-looking surface by installing the decking boards set on edge instead of laying them flat. However, since this uses much more wood, it is not an efficient use of natural resources.

Extra features

After the overall shape of the deck, there is also a variety of built-in features that can make it more functional and more attractive. Some, like stairs and a railing, may be essential, depending on how high off the ground your deck is. Others are optional, lifestyle features, but they can still make a big difference to the deck's appearance and its use.

The Deck Options chart on the previous page, lists the most common features.

Landscaping

While you're planning the deck, you should also plan the landscaping that goes around it. The right plant and landscape features can add to the deck's appearance, but just as important, they can make the whole yard healthier and more resource efficient.

It's important that the earth be sloped away from the house to keep water from pooling up beside the foundation wall or under the deck. This should have been done when the house was built, but the earth next to the house sometimes settles, so add some fill if you don't have a good slope. The minimum required slope is two per cent.

Next, think about planting some trees or shrubs around the deck to provide shade, block out unsightly views or prevailing winds, and absorb street noise. Evergreens provide a dense cover, while small deciduous trees may let some light through for a more filtered shade. Choose trees that will grow to a height that is right for your house—tall enough to provide a barrier, but not tall enough to dwarf the house and deck.

If there is a tree growing in the area where you want to build your deck, you might decide to cut it down. This may not be necessary, however. Think about incorporating it into the deck design: you can frame an opening in the joists for it to grow through and surround it with a bench or planter if you like, giving the deck both shade and a natural feeling.

You may also want to plan some new gardens around the deck. These can be very effective if your deck leads down into a garden path. Any kind of plants can set off a deck, but if your area is dry for part of the year, think about using plants that survive well without excessive watering. If the area is shaded by trees or a building, choose plants that don't need sun. If it's open to the sun, consider plants that need a lot of sun.

This approach is part of a type of gardening called the Xeriscape, which reduces water consumption by creating gardens with drought-resistant and hardy plants. Many of the plants that survive best in local conditions are those native to the area or naturalized plants, for example, the black-eyed Susan, bloodroot, lupine and purple cone flower. Local gardening groups can tell you which drought-resistant native species thrive in your area.

By building your deck, you likely have already cut down your need for watering by reducing the amount of grass in your yard. You can reduce it further in a number of other ways.

- Plant hardy native ground cover and perennials instead of grass in low-traffic areas.
- Group plants according to their need for water.
- Use mulch in flower and shrub beds to reduce loss of moisture.
- Install a rain barrel or a cistern to collect water for gardening use.
- Use a soaker hose instead of spraying or using a sprinkler, and water in the evening to avoid evaporation during the heat of the day. If you do have lawn areas, water only during drought periods.

Changing the entrance

To get the best use from your deck, any entrances from the house should give you easy access to it. That means they need to be in the right place so they don't create a disruptive traffic pattern inside the house. It also means they should be big enough that it's easy for people to move in and out if you're having a party.

If you have a small door leading into the deck area or one that's badly located—in a small kitchen, for example, where people will have to push by you as you cook—you may need to replace or relocate it. This will mean cutting into the exterior wall and may require temporary support for the wall structure while the work is going on.

Generally, a wide door gives the best access to a deck. Many people choose a sliding glass patio door. These can create problems with drafts in winter and overheating in summer, as well as a possible security risk since they can be hard to lock. Alternatives include French doors or garden doors, which swing open instead of sliding and are easier to weatherstrip effectively. (See Chapter Six for more information about windows and doors.) It may also be possible to convert a picture window into a wide doorway without changing the opening drastically.

Windows can also be a factor in your planning. The new deck may obscure an existing window, or you may want to install a new window to provide an outlook onto the deck. In some cases, you can provide both access and a view by installing a door with large windows.

You can solve some access problems by locating the deck so it makes the best use of the access you have—bringing it around the corner of the house to incorporate a side door, for example. In other cases, you just may have to put in a new door or window. This will add time, labour and expense to the job, making the project a little bigger than you may have originally planned.

Picking the pieces

Wood

Many kinds of wood can be used for deck building. However, most types are not resistant enough to moisture and insects to be used without some kind of chemical treatment. Because of this, most decks are built of a few types of wood that can resist weather and pest damage.

The most common woods used for decks include the following.

- Cedar: While it's a relatively soft wood, cedar is a standard decking material because it contains natural chemicals that make it resistant to rot and insect damage. Western red cedar has an attractive brown colour that greys with age, while eastern white cedar has a lighter colour. Cedar can be left unfinished, or treated with a stain or sealer to help it keep its colour. It is not structurally as strong as some other woods, so you may have to space the joists closer together if you build a deck entirely of it. However, it resists warping and cracking better than some other woods. One strategy is to use it only for the most visible parts of the deck, such as the decking, railing and stairs.
- Redwood: Like cedar, redwood is naturally resistant to rot and insect damage. It has an attractive red colour that weathers to grey; stains can be used to preserve or restore the colour. Stronger than cedar, it is expensive and

HOW LONG WILL A DECK LAST?

A wooden deck can last anywhere from 15 to 50 years or more. However, its lifespan depends on the quality of the wood and how well it's protected from mold and rot, which will cause it to deteriorate over the years. Using cedar redwood or pressure treated wood is a good start, since this type has built-in rot resistance. But even with pressure treated wood, moisture can get in if every surface is not protected, so all edges cut during the building process must be treated with a paint-on preservative that's available where finishes are sold. The most vulnerable spot is the ends of the boards; these can rot easily, especially when they are nailed up against another board where moisture can be trapped. Using metal joist hangers, which provide a small space at the end of the joist, can help prevent this type of rot.

As well, location and maintenance play a part in preserving the deck. Conditions such as overhanging trees that drip water onto the deck, or an unvented crawl space beneath, can keep the wood damp much of the time, which promotes rot. A clutter of leaves left lying on the deck surface can also trap moisture against the wood, so it pays to keep the surface clean and free from debris.

can be hard to find in Canada. One strategy is to use it only for the most visible parts of the deck, such as the decking, railing and stairs.

- Pressure treated wood: This is ordinary lumber—commonly pine—treated with a preservative that's forced into the wood under pressure at high temperatures. The common preservative for residential building use is chromated copper arsenate (CCA). Pressure treated wood is resistant to moisture and insect damage; it has a distinctive green colour, and can be stained or painted. The quality of the wood can vary, and so can the penetration of the preservative. As well, there are health and environmental concerns about CCA, so some people prefer to use cedar for deck surfaces (see the section, Your deck and your health, this chapter).
- Plastic wood: Made from sawdust and recycled plastic grocery bags, this decking material makes good use of resources. However, it doesn't have the structural strength for use as posts and joists. It can be cut, drilled, sawed and screwed like regular wood, and doesn't crack or splinter. You can stain it—the manufacturer recommends a solid stain—or leave it unfinished. Widely available in central and eastern Canada, it's more expensive than regular decking.
- Other woods: You can buy other species of wood and soak the boards in a bath of preservative such as copper naphthenate to make them weather resistant enough to use for your deck. However, this method doesn't allow the preservatives to penetrate as well as with pressure treated wood, so the deck is unlikely to be as well protected. As well, it involves a lot more work than buying pressure treated or cedar lumber.

Choosing wood

The wood you buy should be marked or stamped with the species and grade. For construction purposes, wood species fall into four different categories, which are often represented by a standard abreviation or short form.

- Spruce, pine and fir (SPF): These are standard building woods. This category includes lodgepole and jack pine, but not other pine species. A lot of pressure treated wood falls into this category; spruce and fir do not absorb the preservative well, so pine is the recommended species to use. It may be difficult to find out which species has actually been used when you buy pressure treated wood.
- Douglas fir and larch (D-Fir L): These are hard woods good for building, but are not usually used for decks; they do not have the natural rot resistance of cedar and are not as treatable as pine.
- Hemlock and fir (Hem-Fir): Pacific Coast hemlock and anabilis fir are good building woods and are pressure treated for use in decks.
- Northern species (North): This includes Western red cedar, the common deck material, as well as red pine, ponderosa pine, western and eastern white pine, and other woods that don't fall into the other categories. These woods do not have the same strength as SPF, so they are subject to different design rules, for example, when used as joists they must be spaced closer together.

Besides the type of wood you use, take some time in choosing the grade and quality of wood. There are five basic grades of construction wood, based on its straightness and the number of cracks and flaws.

Select Structural is the top grade, not usually used for deck building. Number 1 is high quality, Number 2 is standard quality, Number 3 utility wood and Number 4 economy wood. For structural members such as beams and joists, lumber graded Number 2 or better is recommended. Decking boards have their own grading designations, which vary with the manufacturer. Generally, western red cedar decking is classified as either clear or knotty; in both categories, the "Architect" grade is higher than the "Custom" grade.

Generally, better grades of wood will have fewer knots and imperfections. This means a more attractive deck; it also means a higher price. Check the wood carefully, no matter what grade you buy. Try to avoid twisted or crooked boards, and those with cracks, splits and "wanes" (edges with bark or missing wood). Boards with a slight crook or bow can be bent into place as they are installed. However, starting off with sound, straight wood should give you a better looking deck and fewer problems with cracking and knots popping out or bleeding.

In most cases a few standard sizes of lumber are used for deck building. For decking, 32 x 89 mm (5/4 x 4 in.) and 32 x 140 mm (5/4 x 6 in.) boards are often used in addition to the regular sizes; the "5/4" designation means the boards are a nominal 1 1/4 in. thick. These decking boards usually have a rounded ("radius") edge for better appearance.

The Common Lumber Sizes chart lists the most common dimensions for deck lumber.

COMMON LUMBER SIZES

Members	Common dimensions
Posts	89 x 89 mm (4 x 4 in.), 140 x 140 mm (6 x 6 in.)
Beams	38 x 140 mm (2 x 6 in.), 38 x 184 mm (2 x 8 in.), 38 x 235 mm (2 x 10 in.), 38 x 286 mm (2 x 12 in.) (doubled if necessary)
Headers/ledgers	38 x 140 mm (2 x 6 in.), 38 x 184 mm (2 x 8 in.), 38 x 235 mm (2 x 10 in.)
Joists	38 x 140 mm (2 x 6 in.), 38 x 184 mm (2 x 8 in.), 38 x 235 mm (2 x 10 in.)
Decking	32 x 89 mm (5/4 x 4 in.), 32 x 140 mm (5/4 x 6 in.), 38 x 89 mm (2 x 4 in.), 38 x 140 mm (2 x 6 in.)
Railings	38 x 89 mm (2 x 4 in.), 38 x 140 mm (2 x 6 in.)
Railing balusters	38 x 38 mm (2 x 2 in.)
Stair stringers	38 x 286 mm (2 x 12 in.)
Stair treads	38 x 64 mm (2 x 3 in.), 38 x 89 mm (2 x 4 in.), 38 x 140 mm (2 x 6 in.)

Finishes

Cedar and pressure treated wood can be left unfinished and weathers down to a greyish colour after a couple of years. However, many people choose to finish decks to get a pleasing colour that matches the house and to provide some protection from the rain and sun.

The most common type of finish used for decks is a penetrating deck stain or sealer. These sink into the wood, and often contain wax to help repel water and prevent rot. As well, they contain agents to protect the wood from mildew and the sun's ultraviolet (UV) rays. However, they don't last forever, and have to be reapplied every few years.

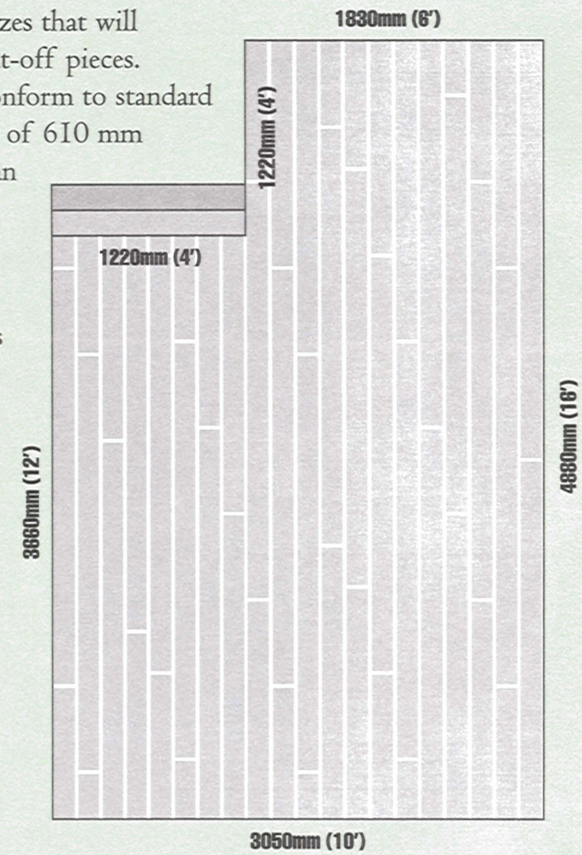
There are four basic choices for finishing a deck.

- Clear stain: This doesn't hide the grain of the wood, but may darken the colour somewhat.
- Semi-transparent stain: This stain hides the grain somewhat and is available in a number of colours. It's best used if you want to change the colour of the wood or restore its natural tone.
- Solid stain: This type of stain hides the grain of the wood much like paint and

USING WOOD EFFICIENTLY

When buying wood, you can avoid waste by buying sizes that will need the least cutting and produce the fewest short cut-off pieces. This can be done easily if you make your deck size conform to standard lengths of lumber, which come in incremental lengths of 610 mm (24 in.); a small change in the dimensions on your plan can save money and wasted wood.

There are several other ways of using resources wisely as you build your deck. These include using durable materials that will last under harsh weather conditions and require minimal maintenance; choosing materials made from resources that can be renewed and replenished quickly, such as fast-growing woods; reusing materials or buying materials with recycled content, such as plastic wood; using materials produced locally to reduce the burden on the transportation system; and choosing non-toxic materials, such as cedar, which don't have a negative effect on our environment.



can be tinted in a wide range of colours. Because it may peel or scuff when used on horizontal surfaces; make sure you choose one recommended for deck floors.

- Paint: This finish provides a smooth finish with a more traditional look and can be the best choice for a house with painted wood siding or a colonial style. It can also peel or scuff when used on horizontal surfaces.

The most important factor, no matter what finish you use, is to choose one meant for decks. Some won't stand up to the foot traffic of a deck floor, and interior finishes such as varnish that form a hard surface will crack when exposed to the elements in an outdoor application. Also, whenever a finish is applied to deck materials, all surfaces including the underside should be finished as well.

Fasteners

It's possible to build a deck entirely with nails, screws and bolts. However, today there is an extensive variety of metal hangers and connectors that can make the job simpler.

The most common connectors are joist hangers, U-shaped brackets that are nailed to a header board and support the end of the joists, and post bases or "saddles," which sit on the concrete footings or pier and hold the bottom of the post in place. Some post bases are adjustable so you can raise or lower the post to counter any movement of the structure. However, there are many other connectors, including ties that allow you to install decking boards without any visible nails, and others that secure the top railing without nailing through the top surface. If you choose to use several kinds of connectors, you may need help from your lumber or hardware dealer in identifying which ones you need, and how many.

Even with the connectors, however, you'll still need to use nails or screws to make the boards secure, and bolts to join large dimension lumber such as posts and beams. These must all be made of hot-dipped galvanized metal, stainless steel or aluminum, or they will rust and create stains throughout the deck.

Lighting

Lighting is an aspect of deck building that some people overlook in the early planning stages. It is important to provide adequate light for the entire deck surface, as well as the doorway leading onto the deck, and the stairs. You might also want to design your lighting so you can throw pools of light onto different areas while leaving the rest dark, for atmosphere.

A number of different types of lights can be used, and there are special lighting fixtures made specifically for decks. Some of these use a low-voltage system, which makes them energy-efficient and easier to install (see Electricity, below). However, all fixtures used on a deck must be designed for outdoor use and mounted in waterproof electrical boxes. There are several options.

- Flood lights: These can be mounted on the house or a post for general lighting. Narrower beams can throw a pool of light onto a certain area, or can be aimed onto nearby plantings or up into a tree for dramatic effects.
- Post lights: These are mounted on top of railing posts; several are often used for general lighting.
- Foot lights: These low-mounted lights are used to illuminate stairs for night use; you may also want to light a path into the garden adjacent to the deck.
- Entrance lights: Wall-mounted coach or globe-type lights illuminate the doorway and the area around it.
- Deck lights: A variety of lights are available that mount on almost any surface of the deck, or on a wall, to throw a soft light onto the deck; many of these are low voltage.

Electricity

Decks usually don't have a large need for electricity. However, you'll likely need some outside wiring for your lighting fixtures, and you probably want an outlet or two so you can plug in appliances and a radio or television. (Be aware that these could create a nuisance for your neighbours.) All these fixtures should be drawn into your plans for the deck.

If you're installing only a few lights, you should be able to add them to an existing electrical circuit; in some cases, you can run the wiring from an existing outdoor fixture. If your existing circuits are fully loaded, or if you're adding a number of new fixtures, you may need to run a new branch circuit from the service panel.

Outlets are usually installed on the wall of the house and must be in weatherproof boxes with covers that snap shut to keep water out. They should be equipped with a ground fault circuit interrupter and may need to be on a dedicated circuit. The wiring for other fixtures can be run under the deck boards; however, it must be protected from weather and damage by using rigid pipe conduit. Low-voltage cables pose little risk of electric shock and do not need as much protection as conventional cables, but covering them can be wise if you have small children, or if you're worried about animals gnawing on them.

Before you start, check with your local electrical utility to find out what local codes require. You may need an electrical permit and an inspection for the work you're going to do.

GROUND FAULT CIRCUIT INTERRUPTERS

A ground fault circuit interrupter (GFCI) is a special outlet that cuts the power immediately if a short circuit occurs, preventing the user from getting a shock.

Your deck and your health

There are a number of elements involved in a deck that can affect your health.

The wood

Pressure treated wood has been a common deck material for years, but there are lingering doubts as to how safe it is. Chromated copper arsenate contains chromium, copper and arsenic salts, all of which can have health effects if you're exposed to significant amounts. While manufacturers say the chemicals pose no health threat once the wood is dry, there are fears they may leach out over time, especially when in contact with water or earth.

To minimize contact with pressure treated wood, you can use it for the structural members such as posts, beams and joists, with cedar or plastic wood for decking and above-deck structures. As well, follow these rules.

- Don't use it for any surfaces that food will be prepared on.
- Don't use it or store it indoors.
- Don't use wood chips or sawdust from pressure treated wood in your garden or for animal bedding.
- Don't burn waste wood in a fireplace or wood stove, since this releases toxic chemical vapours.

You also need to use special care when working with pressure treated wood. Wear a dust mask, eye protection, gloves and a long-sleeved shirt or blouse when cutting or drilling it, to avoid getting sawdust in your eyes or on your skin. Then launder the work clothes separately from the other household clothes and thoroughly wash any areas of skin that came into contact with the dust.

Cedar decking wood hasn't been treated with a preservative. However, it does contain natural chemicals which can be irritating to some people, especially when they are exposed to the sawdust. You can minimize exposure to these during cutting by wearing a mask, eye protection and protective clothing.

Finishes

Most of the stains and finishes made for decks are oil-based and, like oil or alkyd paints, they contain solvents that give off irritating fumes when they dry. This may not be as much of a problem as with indoor finishes because the irritants disperse better outdoors. As with paints, water-based (usually called "latex") finishes are a healthier choice. These are most commonly found in solid-colour stains, but clear and semi-transparent stains can be found. If you're sensitive to irritants, wear an appropriate mask during the application and avoid exposure while the finish is drying.

Moisture

In many cases, the area below the deck is closed in for the sake of appearance. However, this creates a crawl space that can turn into a breeding place for molds unless you take measures to prevent moisture from building up. The best strategy is to supply some ventilation by using latticework instead of solid lumber to enclose the deck. This also helps to keep out animals.

To ensure that water doesn't form pools under the deck, make certain the earth is sloped away from the house. Cover the earth with a layer of gardening (geotextile) fabric, which will allow water to pass through but will inhibit growth of grass and weeds. If you'll be walking in the space or if you'll use it to store things, spread a layer of sand on top of the weed barrier to protect it. Cover the sand (or the weed barrier) with an inert, non-organic, clean, coarse granular material such as crushed rock or pea gravel. This cover will hold down the weed barrier and protect it from the sun's ultraviolet rays.

Making a Plan

Once you've thought about your needs, surveyed your site and viewed the major options, it's time to start defining your plan. To make sure the new deck serves your purposes, it's best first to focus on your goals for the project.

On the Deck Priorities Worksheet, write down what you hope to achieve with your deck project, using the headings to help define your thoughts. For example, under Function, you might want an area that's handy for outdoor dining, a place for parties or for your children to play; under Appearance, you might want a deck that fits in well with the modern or traditional style of your house.

Next, you can choose some of the elements that will go into the deck. These include both major features, such as a gazebo or built-in planters, and more basic elements, such as the type of wood, finish and style you prefer. Use the worksheet to assemble a list of your preferences.

If you're working with a limited amount of money and you think the deck might strain your current budget, mark any optional items according to their importance to you. Are they a high priority, something you definitely want to have, or a low priority, something you'd like to have if it fits the plan and your budget? This will give you some room to adjust if the costs are higher than you anticipated.

Creating your design

If you're having your deck built professionally, you may involve the deck builder right from the early design stages. However, if you're building the deck yourself, you'll likely design it yourself. And making your own preliminary design is also useful if you're approaching a professional deck builder; it will give you a better understanding of what's involved, and what limitations you might have to deal with.

The first step is to select the site. From the preliminary sketches you did in the Taking Stock section, you already have a picture of the area you have to work with, and the obstacles or features it includes. Now, make several photocopies of that sketch, and draw in the shape of your deck, in the spot where you think it will work the best. Think about how easy access will be from the house, and where the staircase should be for entry to key areas of the yard. As well, think about whether you'll be covering up important features, such as a basement window or a service connection, and how you can

DECK PRIORITIES WORKSHEET

	Details	Priority (high/low)
GOALS		
Function		
Appearance		
Health		
MAJOR FEATURES		
COMPONENTS		

compensate. For example, you can create a cutout in the deck to avoid blocking a window.

Next, think seriously about the shape and design of the deck. Your site plan, which looks at the property from above, will allow you to see how the shape and size fit with the existing dimensions of the house. The deck should look like part of the house, not something that has been added as an afterthought.

One way to make the deck blend in with the house is to match the colours and textures of the wood with the outside surfaces of the house. For example, you can finish the deck with a stain or paint that matches the house siding. Another way is to use architectural details such as posts, railings or a gazebo to match the woodwork or style of the house.

Think also about the size of the deck. It must be big enough to accommodate the maximum number of people you calculated in your Deck Lifestyles Worksheet. However, don't size it for a one-time event or make it so big that it dwarfs the house and yard. Putting a very large deck in a small yard can look odd but, if your lot is very small, or if it has an extreme slope, covering much of the space with a deck may make sense.

When you've settled on a location and a size, you can experiment with different shapes and design features. If you decide to use different angles or contours, design them so the resulting shape is harmonious with the house and landscape; avoid abrupt angles that make the deck look out of proportion. As well, design the deck so there are adequate areas and facilities for the activities you identified in your lifestyles checklist. Consider features that can add both function and interest, such as multiple levels, a roof structure or gazebo, a series of ramps or staircases leading into the yard, or a pond or rock garden around the deck.

If you're unsure about your design abilities, you can get ideas from books and magazines that have pictures of different deck designs. And wherever possible, look at other decks in the neighbourhood, especially on houses similar to yours. This can give you the best idea of how different designs and colours look in real applications.

You'll likely have to create several tentative designs to get one or two that you think will work. Once you have chosen a couple, draw all the elements in place and "walk through" them on paper, seeing how the traffic flow will work and how much space there will be for different activities. If this is difficult to gauge, try using string, hoses or chalk lines to mark the outline of the deck and built-in features on the ground; then walk through the deck plan physically to see how it fits.

Once you've decided on a plan, you'll have to make good scale drawings of the deck. The first should show it from the top (the "plan view"); this should include the house and lot and also indicate the location of the adjacent neighbours' houses. Then, draw some views (called elevations) showing the deck from two different sides. Make these to scale as well, drawing in the heights and all the other dimensions. This will give you a better idea of how the deck will look, and could prompt you to change your design to make it blend in with the house more naturally or establish a better visual balance. Both a plan view and elevations will likely be required to get your building permit.

PERMITS

Even though your deck may be just a basic platform, it will probably require a building permit and an inspection to make sure it complies with building codes. Getting the permit will be a part of your preparations before the work starts. If you hire carpenters or renovators to build your deck, they can arrange to get the permit. You may also need an inspection which can be arranged by you or your renovator.

Designing an accessible deck

If someone in your household has a disability, it will be necessary to make sure he or she can use the deck without difficulty. This involves a few design elements to make access easier and provide good mobility for people in wheelchairs or with limited mobility. These features can also be worthwhile if you're planning to retire in the house. Future users of the house may also need them.

Features that can make your deck more accessible include:

- a door 864 mm (34 in.) wide, or with a minimum clear passage of 813 mm (32 in.)
- a sloped threshold no higher than 19 mm (3/4 in.) above the deck surface—less than the normal recommended height (you can slope the deck slightly away from the door to provide drainage)
- a ramp leading from the deck to the yard (for a low deck, this may be easy but for a higher deck, a ramp with a slope greater than 1 in 20 is needed, with handrails on both sides)
- a turning circle at least 1,524 mm (60 in.) square in the major activity areas of the deck
- cooking and food preparation surfaces at a height of 864 mm (34 in.).

Materials

You should now be able to list the materials you'll need for your deck. This will help you get an approximate cost for the project. The main job, of course, is estimating the wood. First, you need to know how many posts you need to support the size of deck you're building. Then, by drawing the structure to scale, you can count how many beams, headers, joists, decking boards, stair and railing members you'll need.

The spacing of the posts, the size of the beams and the spacing of your joists can vary with the type of wood you decide to use. The trick is to decide on a combination of spans and board dimensions that will provide enough strength to make the deck strong and give it a solid feeling. The charts should help you make these choices; they are calculated for the type of loads typically encountered in decks, and differ from the normal requirements for floors.

The Recommended Beam Sizes chart contains a number of combinations of post spacing, joist spans, and beam sizes to choose from as you design your deck. To use it, decide how far apart you want to place your posts—the farther apart you place them, the fewer holes you'll have to dig. This is your post spacing. Then figure out how far the beams need to be from the house; this is your joist span, or the distance the joists will have to run. Finally, choose which type of wood you're using for your beams, and you'll see a recommended size for the beam.

For example, if you locate your posts 1.8 m (6 ft.) apart and you have a 3-m (10-ft.) joist span, you'll need a 38 x 184 mm (2 x 8 in.) beam made of pressure treated pine (which is in the SPF category). If you use beams of western red cedar, which falls in the northern category, you'll need a 38 x 235 mm (2 x 10 in.) beam.

The Recommended Joist Spans chart sets out the maximum allowable distance your joists should stretch before they need an extra beam for support. The distance varies depending on the size of your joists, their spacing (how far apart they are) and the species of wood you're using. For example, if you use 38 x 235 mm (2 x 10) joists and space them 406 mm (16 in.) apart, your maximum joist span with pressure treated pine (SPF) would be 4.3 m (14.1 ft.).

The spacing of the joists is your own choice; generally, 406 mm (16-in.) spacing gives the deck a more solid feeling than 610 mm (24 in.). However, your choice may also be influenced by the type of decking you use. The Decking Selection and Joist Spacing chart shows the recommended spacing with the common types of decking boards.

Be aware when calculating decking that the boards are actually narrower than their nominal width; a 2 x 4 actually measures about 38 x 89 mm (1 1/2 x 3 1/2 in.), and a 2 x 6 about 38 x 140 mm (1 1/2 x 5 1/2 in.). As well, a gap of 3 mm (1/8 in.) is left between the boards to let rain drip through.

Remember to include built-in structures, such as benches, planters or roofs, when you do your inventory, as well as privacy screens. If you're doing the project yourself, also remember to add a good 10 per cent more lumber for waste and mistakes. Then there are nails, screws, joist hangers and any other hardware you're likely to need. The list also includes electrical wiring, outlets and fixtures, and any surrounding features such as trees, flowers or rocks for a rockery.

RECOMMENDED BEAM SIZES WITH DIFFERENT WOOD SPECIES

Post spacing	Joist span	D-Fir L	Hem-Fir	SPF	North
1.2 m (4 ft.)	2.4 m (8 ft. .)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)
	2.7 m (9 ft.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)
	3.0 m (10 ft.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)
	3.3 m (11 ft.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)	38 x 184 mm (2 x 8 in.)
	3.7 m (12 ft.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)	38 x 140 mm (2 x 6 in.)	38 x 184 mm (2 x 8 in.)
	4.3 m (14 ft.)	38 x 184 mm (2 x 8 in.)	38 x 184 mm (2 x 8 in.)	38 x 184 mm (2 x 8 in.)	38 x 235 mm (2 x 10 in.)
1.8 m (6 ft.)	2.4 m (8 ft.)	38 x 184 mm (2 x 8 in.)	38 x 184 mm (2 x 8 in.)	38 x 184 mm (2 x 8 in.)	38 x 235 mm (2 x 10 in.)
	2.7 m (9 ft.)	38 x 235 mm (2 x 10 in.)	38 x 235 mm (2 x 10 in.)	38 x 184 mm (2 x 8 in.)	38 x 235 mm (2 x 10 in.)
	3.0 m (10 ft.)	38 x 235 mm (2 x 10 in.)	38 x 235 mm (2 x 10 in.)	38 x 184 mm (2 x 8 in.)	38 x 235 mm (2 x 10 in.)
	3.3 m (11 ft.)	38 x 235 mm (2 x 10 in.)	2 — 38 x 140 mm (2 x 6 in.)	38 x 286 mm (2 x 12 in.)	2 — 38 x 184 mm (2 x 8 in.)
	3.7 m (12 ft.)	38 x 235 mm (2 x 10 in.)	2 — 38 x 140 mm (2 x 6 in.)	38 x 286 mm (2 x 12 in.)	2 — 38 x 184 mm (2 x 8 in.)
	4.3 m (14 ft.)	38 x 286 mm (2 x 12 in.)	2 — 38 x 184 mm (2 x 8 in.)	2 — 38 x 140 mm (2 x 6 in.)	2 — 38 x 184 mm (2 x 8 in.)
2.4 m (8 ft.)	2.4 m (8 ft.)	38 x 286 mm (2 x 12 in.)	2 — 38 x 184 mm (2 x 8 in.)	2 — 38 x 184 mm (2 x 8 in.)	2 — 38 x 184 mm (2 x 8 in.)
	2.7 m (9 ft.)	38 x 286 mm (2 x 12 in.)	2 — 38 x 184 mm (2 x 8 in.)	2 — 38 x 184 mm (2 x 8 in.)	2 — 38 x 235 mm (2 x 10 in.)
	3.0 m (10 ft.)	38 x 286 mm (2 x 12 in.)	2 — 38 x 184 mm (2 x 8 in.)	2 — 38 x 184 mm (2 x 8 in.)	2 — 38 x 235 mm (2 x 10 in.)
	3.3 m (11 ft.)	2 — 38 x 235 mm (2 x 10 in.)	2 — 38 x 184 mm (2 x 8 in.)	2 — 38 x 184 mm (2 x 8 in.)	2 — 38 x 235 mm (2 x 10 in.)
	3.7 m (12 ft.)	2 — 38 x 235 mm (2 x 10 in.)	2 — 38 x 184 mm (2 x 8 in.)	2 — 38 x 184 mm (2 x 8 in.)	2 — 38 x 235 mm (2 x 10 in.)
	4.3 m (14 ft.)	2 — 38 x 235 mm (2 x 10 in.)	2 — 38 x 235 mm (2 x 10 in.)	2 — 38 x 235 mm (2 x 10 in.)	2 — 38 x 286 mm (2 x 12 in.)

Notes
1. Maximum size considered 38 x 286 mm (2 x 12 in.).
2. Two-member beam largest built-up beam considered. Nail built-up beam so it acts as a single member.
3. Minimum post size 89 x 89 mm (4 x 4 in.).

Chart courtesy of the Canadian Wood Council.

Use the Deck Materials Worksheet to enumerate all the materials you'll need for the project. Then, if you haven't already done so, spend some time at your local building centre and get a price for all the different pieces. This will allow you to come up with a materials price for your deck.

If you want to save some work, your local lumber yard may be able to do a quick calculation of how much lumber you'll need based on the measurements of the deck. They can give you a price at the same time. Some building centres also sell packages with all the lumber needed to build a deck of a certain size. However, you may have to modify these if your deck isn't the standard rectangular shape, and add extra lumber for any extra built-in features.

Who'll Do the Work?

Building a deck is one project many homeowners can do by themselves. However, it's best if you have some carpentry skills and some building experience. The posts must be installed properly and in the right places, the deck must be well secured to the house, and the railings and other details must be well built for the deck to look good. This all becomes more difficult as the design gets more complex. As well, because of all the wood you'll use, there's a lot of lifting and manual work involved. And you'll need some special tools, such as a post-hole digger, something to mix concrete in and a drill capable of penetrating the siding material to attach your header.

RECOMMENDED JOIST SPANS

Joist spacing	400 mm (16 in.)								600 mm (24 in.)							
Species	D-Fir L		Hem-Fir		SPF		North		D-Fir L		Hem-Fir		SPF		North	
mm (in.)	m	ft.	m	ft.	m	ft.	m	ft.	m	ft.	m	ft.	m	ft.	m	ft.
38 x 140 (2 x 6)*	2.7	8.9	2.7	8.9	2.7	8.9	2.4	7.9	2.4	7.9	2.4	7.9	2.4	7.9	—	—
38 x 184 (2 x 8)*	3.3	10.8	3.7	12.1	3.7	12.1	3.0	9.8	2.7	8.9	3.0	9.8	3.0	9.8	2.4	7.9
38 x 235 (2 x 10)*	4.3	14.1	4.3	14.1	4.3	14.1	3.7	12.1	3.3	10.8	3.7	12.1	3.7	12.1	3.0	9.8

*Blocking required at 1.9m (6 ft. 3-in.) intervals

DECKING SELECTION AND JOIST SPACING

Decking types	Size	Joist spacing
32 mm (5/4 in.) radius edge	32 x 90 mm (5/4 x 4 in.) 32 x 143 mm (5/4 x 6 in.)	400 mm (16 in.) 600 mm (24 in.)
38-mm (2-in.) lumber No. 1 or No. 2 and better	38 x 89 mm (2 x 4 in.) 38 x 140 mm (2 x 6 in.)	400 mm or 600 mm (16 or 24 in.) 400 mm or 600 mm (16 or 24 in.)

Charts courtesy of the Canadian Wood Council

DECK MATERIALS WORKSHEET

Item	Materials (brand/ specifications	Quantity	Price per unit	Cost	Date needed	Date purchased	Supplier (address, phone no.)	Comments
Sono tubes								
Concrete								
Posts								
Beams								
Header/ledger								
Joists								
Facing boards								
Decking								
Stair stringers								
Stair treads								
Stair risers								
Railings								
Railing balusters								
Cap railing								
Nails/fasteners								
Joist hangers								
Other hardware								
Finish								
Wiring								
Lighting fixtures								
Outlets								
Plantings								
Other								
TOTAL MATERIALS COST								

Many people opt to hire a carpenter or a renovator who does decks to build the project for them, especially if they're planning an ambitious, multi-level deck with a lot of extra features. These professionals can be found in the Yellow Pages™, through references from friends, or through local building centres. They can also help you with your design, and may have preferences for different materials that suit the local climate. Use the guidelines in Chapter Three for choosing a renovator or contractor, taking care to get references from previous customers and look at their decks, if possible.

A third option is to hire a professional to set the posts and build the supporting structure, then finish the decking and railings yourself. Or, you can hire professionals to do the whole project and work along with them to save labour costs.

Counting the costs

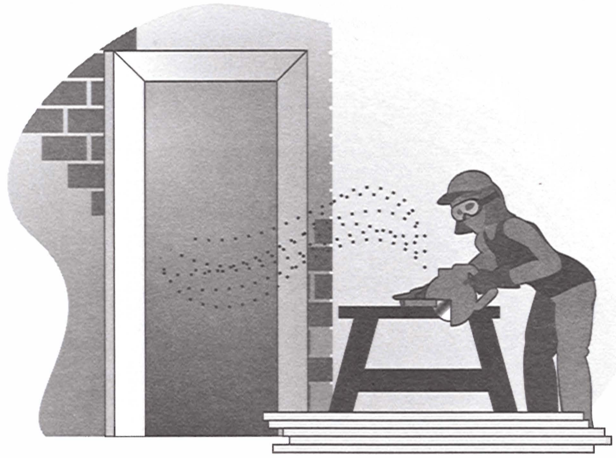
The total cost of a deck project has two major components: the materials, which are mostly wood, fasteners and hardware, and the labour. If you hire professionals to build the deck, they will give you an overall bid that includes the materials, labour and any other related costs. If you're doing it yourself, the Deck Materials Worksheet will give you the basic cost of the project.

If the final price is more than you budgeted, the best way to cut the costs is by simplifying the design. Making the deck smaller is the simplest way to cut down the amount of wood needed. However, you can also save labour and materials costs by such changes as building a simple roof structure for shade instead of a fancy gazebo, or using a basic staircase instead of a fancy one.

As well, if you can't afford all the features you want, you can build the basic deck now, with supports in the right places to add extra features later. In some cases, you can even add another level to the deck in a year or two.

Working healthy

Since a deck is built outdoors, the chances of causing an air quality problem in the house while the job is going on are low. However, since there will be a lot of wood-cutting and finishing, there is potential for



some health hazards during the project. You can minimize these in several ways.

- Make sure all workers respect the rules for handling and cutting pressure treated wood (see Your deck and your health).
- Make sure dust bags are used for dusty work such as sawing and sanding.
- Make sure workers wear proper face masks for work that's dusty or creates fumes.
- Close all windows that open onto the work site when any sawing or finishing is going on.
- Don't bring work clothes and boots into the house; these can spread sawdust and chemical vapours.
- Insist on a thorough clean-up after work each day, and when the whole job is finished.

Putting it all together

If you're hiring a professional deck builder for your project, the final part of your planning is to choose the one you'll use, and finalize the price and specifications for the job. If you're going to be your own contractor, you need to create a full picture of the project by yourself, and come up with a good estimate of what it will cost.

The Deck Materials Worksheet should cover most of what you'll need for the project, but there are other expenses, including building permits and any tradespeople or labourers you hire. If you need to get an overall picture of the project, use the Project Planning Worksheet to enter all the materials, labour and other expenses it will entail. This should allow you to arrive at an overall price, and see everything that will be needed.

As well, you should make a schedule so the work progresses in a logical order and any tradespeople needed will arrive when things are ready for them. Copying the Gantt chart in Chapter Three can help you schedule the job.

Deck building doesn't disrupt daily life the way an interior renovation often does. However, be prepared to make some adjustments while the work is going on. If you're using a renovator or tradespeople, they will need parking space and the use of a bathroom and other amenities. And you'll have to furnish a space for the shipment of wood when it arrives, and keep it protected from the weather (and from thieves) until it's used. The work will also be noisy, so alert the neighbours.

Once all the pieces are in place, you can set about making the project a reality. However, it will still require a lot of work, and a lot of attention to detail, so the project ends up safe, healthy and successful.

FOR MORE INFORMATION

These publications offer more information on the topics in this chapter. The order number is shown in brackets.

Healthy Housing: Practical Tips, CMHC (NHA 6736)

Healthy Housing Landscape Fact Sheet, CMHC (PE0227)

Housing for People with Disabilities, CMHC (NHA 5467)

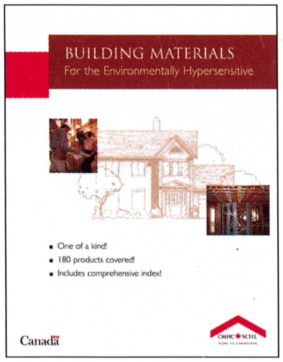
Design Options for Barrier-Free and Adaptable Housing, CMHC (PE0185)

Building Materials for the Environmentally Hypersensitive, CMHC (NHA 6742)

PROJECT PLANNING WORKSHEET

Job	Materials cost	Contractor name, phone no.	Start date	Completion date	Labour hours/ rate	Labour/ contractor cost	Tools/ rentals	Permits/ fees	Other costs	Total cost

HEALTHY HOUSING™ RENOVATION PLANNER



Building Materials for the Environmentally Hypersensitive

For people who are environmentally hypersensitive, even low levels of contaminants in the air can cause problems ranging from discomfort to debilitating illness. This book provides information on pollutant emissions and other considerations for more than 180 building materials and finishes commonly used in residential construction.

$29.95

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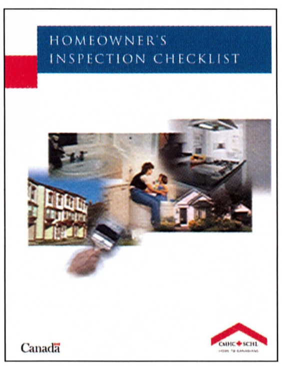

Homeowner's Inspection Checklist

A comprehensive Checklist that teaches homeowners how to inspect their homes to identify potential problem areas and then act on them before repairs become costly. Make your home safer, more energy efficient and more comfortable year-round. Learn how to: look at your house as a system; quickly identify necessary repairs, replacements or maintenance; and determine if a qualified home inspector or building expert should be hired. Includes a handy preventive maintenance calendar for routine checks and upkeep.

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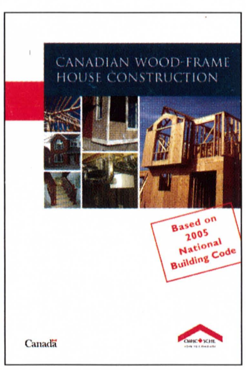

Canadian Wood-Frame House Construction

This national bestseller contains illustrations, sizing tables, planning notes and other practical information on wood-frame house construction. Tips on Healthy Housing™ are also provided to improve indoor air quality and reduce environmental impact. Topics include: footings and foundations; framing and roof sheathings; exterior and interior finishes; plumbing, heating and wiring; insulation, fire and sound control; ventilation; and much more.

$25.95

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