BUILDING ENVELOPE REHABILITATION

OWNER-PROPERTY MANAGER GUIDE

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Building Envelope Rehabilitation

Owner-property manager guide

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Foreword

The Building Envelope Research Consortium (BERC) was instrumental in providing overall direction and guidance for this book.

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Abbreviations and glossary

Abbreviations and definitions of terms used in this *Guide*.

ACEC
Association of Consulting Engineers of Canada

Addendum
A change to the bid package (usually a modification of the drawings and specifications) issued during the bid period and before execution of the contract.

Air barrier
Materials and components that together control the flow of air through an assembly and thus limit the potential for heat loss and condensation due to air movement.

AIBC
Architectural Institute of B.C.

APEGBC
Association of Professional Engineers and Geoscientists of B.C.

Assembly
The collective layers of components and materials that together comprise the complete, cross-section of the wall or roof.

ASTM
American Society for Testing and Materials. The ASTM website is: http://www.astm.org/

B.C. BC
British Columbia Building Code 1998

Balcony
A horizontal surface exposed to outdoors and intended for pedestrian use, but projected from the building so that it is not located over a living space or acting as a roof.

Barrett Commission
A commission of inquiry into the quality of residential construction. Led by former B.C. premier Dave Barrett, the commission was established in April 1998. The Barrett Report recommended action by all three levels of government, the building industry and various professions to strengthen consumer protection and restore confidence in the residential construction industry.

Base flashing
The part of the roofing that is turned up at the intersection of a roof with a wall or another roof penetration. It may be made of the same material as the main roofing membrane or of a compatible material.

BEP
Building Envelope Professional. The Building Envelope Professional reviews the building envelope design and reports to the project architect or co-ordinating registered professional with respect to environmental separation and the performance of materials, components and assemblies of the building envelope. For more detail about the BEP's role, see Appendix A.

Bid
An offer made by the contractor to enter an agreement with the owner for a price indicated on the bid form, and forms a bid contract until the period for acceptance is over.

Bond
A financial security for the performance of an obligation; usually a written document supported by a pledge of collateral.

Building envelope
Now called an environmental separator in building codes, the building envelope is the parts of the building that separate inside, conditioned space from unconditioned or outside space, such as windows, doors, walls, roofs and foundations.

CCAC
Committee of Canadian Architectural Councils

CCDC
Canadian Construction Documents Committee

Cap flashing
Sheds water from the tops of walls. Cap flashing must be sloped toward the roof to prevent staining of the exterior cladding. It is difficult to make cap flashing waterproof at the joints and intersections and it requires a continuous and waterproof membrane below it.

Cladding
A material or component of the wall assembly that forms the outer surface of the wall and is exposed to the full force of the environment.

Concealed barrier
A strategy for rain penetration control that relies on the combination of the cladding as well as a moisture barrier (sheathing paper or membrane) located further into the assembly to limit water ingress.

Co-ordinating Registered Professional (CRP)
A co-ordinating registered professional is a registered professional who co-ordinates all design work and field reviews of the registered professionals required for a building project. The British Columbia Building Code (B.C.BC), 1998, requires the owner of a building to retain a co-ordinating registered professional before obtaining a building permit.

Counter flashing
Prevents water from penetrating behind the top edge of base flashing. Counter flashing consists of a separate piece of flashing placed over the top of the base flashing. It is usually made of sheet metal.

Cross-cavity flashing
Intercepts and directs any water flowing down the cavity of a wall assembly to the exterior.

Deck
A horizontal surface exposed to the outdoors, located over a living space and intended for pedestrian use in addition to performing the function of a roof.

Deflection
A water management principle that uses features of the building and assembly geometry to limit the exposure of the assemblies to rain.

Drainage
A water management principle that uses surfaces of the assemblies to drain water away from the assembly.

Drip flashing
Directs water flowing down the face of vertical elements, such as walls or windows, away from the surface so that it does not continue to run down the surface below the element.

Drying
A water management principle that incorporates features and materials that facilitate diffusion and evaporation of moisture from materials that get wet.

Durability
The ability of a material, components, assembly or building to perform its required functions in its service environment over a period of time without unforeseen maintenance, repair or renewal.

Envelope
An environmental separator, generally between the inside and the outside of a building (including the ground), but also between dissimilar environments within the building.

Face seal
A strategy for rain penetration control that relies solely on the elimination of holes in the exposed exterior face of the assembly.

Field applied preservatives
Wood preservatives commonly applied at the job site using brush, spray, roller or other non-pressure method for protection against wood decay.

Flashing
Materials used to deflect water make water proof connections and protect underlying membranes from physical damage.

FSR
Floor-Space Ratio. Determined by dividing the gross, or total, floor area by the lot area.

Housewrap
A sheet-plastic material, which is used as a breather-type sheathing membrane, generally between the wall sheathing material and the exterior cladding. At one time a proprietary term, housewrap now represents a generic group of materials. One common housewrap is made of spun-bonded polyolefin (SBPO), another of perforated polyethylene.

HPO
The Homeowner Protection Office. The HPO is a provincial Crown corporation formed in response to the recommendations of the Barrett Commission

Report on the quality of condominium construction in British Columbia. The HPO was created under the Homeowner Protection Act, passed on July 28, 1998. The HPO officially opened Oct. 1, 1998.

The HPO is responsible for:

- Residential builder licensing.
- Establishing the framework for and monitoring the provision of mandatory third-party home warranty insurance.
- Administering a no-interest repair loan program and PST Relief Grant for owners of leaky homes.
- Research and education to benefit the residential construction industry and consumers.

Maintenance

A regular process of inspection, minor repairs and replacement of components of the building envelope to maintain a desired level of performance for the intended service life without unforeseen renewal activities.

Moisture content

The weight of water contained in the wood. It is expressed as a percentage of the weight of oven-dry wood.

Movement joint

A joint on a wall, which provides capability for differential movement of portions of the building structure (expansion joint) or prevents or localizes cracking of brittle materials such as stucco (control joint).

Operation

Of the building or envelope. Refers to normal occupancy of the building where the envelope is affected by interior space conditioning, changes to light fixtures, signs, vegetation and planters and accidental damage or vandalism.

Penetration

An intentional opening through an assembly through which ducts, electrical wires, pipes and fasteners are run between inside and outside.

Pressure treatment

The injection of wood preservatives into the wood at high pressure for protection against wood decay and termite attack.

Quantity surveyor

A quantity surveyor calculates the amount and cost of materials and labour needed for a building project and oversees financial contract administration during the project. A quantity surveyor can work for a contractor or for the client.

Rainscreen

A strategy for rain penetration control. It relies on deflecting most of the water at the cladding, a cavity that provides a drainage path for water that penetrates past the cladding and airtightness, which limits pressure differentials across the cladding, with the assembly to the interior of the cavity.

Rehabilitate

A program of comprehensive, overall improvements to building envelope assemblies and details so the building can fulfil its originally intended functions.

Renewals

Activities associated with the expected replacement of worn out components or materials of a building envelope and are typically for items with life cycles in excess of one year.

Repair

Replacement or reconstruction of envelope assemblies, components or materials at specific localized areas of the building envelope so that it can fulfil its originally intended functions.

RFP

A Request for Proposals (RFP) is a document defining the objectives for a project and asking for an anticipated scope of services, a list of staff who will be assigned to the project, a list of references, a schedule for carrying out the work and fee proposal.

Saddle

The junction of small horizontal surfaces, such as the top of a balcony guardrail or parapet wall, with a vertical surface, such as a wall.

Service life

The actual period during which building envelope materials, components and assemblies perform without unforeseen maintenance and renewals costs.

Sheathing

Materials, generally oriented strand board (OSB) or plywood, used to provide structural stiffness to the wall framing and to provide structural backing for the cladding and sheathing paper.

Sheathing membrane
A material in an exterior wall assembly intended to provide a water- shedding surface. This material limits penetration of water further into the structure once past the cladding. Waterproof-type sheathing membranes can also act as an air barrier and a vapour barrier. Materials include both breather-type sheathing membranes, such as sheathing paper and housewraps, and waterproof-sheathing membranes.

Sheathing paper
Asphalt-impregnated organic sheet material (breather-type sheathing membrane) that creates a water-shedding surface behind the cladding.

Stepped flashing
Is installed at the junction between a sloping roof and a wall running parallel to the slope. Both base and counter-flashing are overlapped and installed in pieces following the slope to form the complete stepped flashing.

Strapping
Vertically oriented lumber (usually pressure treated 1 x 2s or strips of pressure-treated plywood) that form the cavity between the cladding and the sheathing paper in a strapped cavity rainscreen wall assembly.

Strata corporation
Similar to a condominium corporation. The *Strata Property Act* replaced the *Condominium Act of B.C.* in 1999. The strata corporation has a legal obligation to repair and maintain the common property, common facilities and assets of the strata corporation.

Strata council
A group of owners elected to carry out the duties of the strata corporation.

System
Describes a combination of materials and components that perform a particular function, such as an air-barrier system or moisture-barrier system.

Through-wall flashing
A waterproof membrane or metal flashing placed under segmented precast concrete, stone masonry or brick units—known as copings—close to the tops of masonry walls to prevent water from entering the wall at joints in the coping. Through-wall flashing is also used to prevent capillary transfer of moisture through porous materials, such as concrete or masonry, if they extend from high-moisture locations, such as below grade.

Valley flashing
Installed in the valleys of sloping shingle roofs to give continuity to the roofing system.

Vapour barrier (also vapour diffusion retarder)
A material with low-vapour permeability, located within the assembly to control the flow of vapour through the wall assembly and limit the potential for condensation due to diffusion.

Walkway
A corridor exposed to outdoors that provides pedestrian access between suites and stairwells or elevators. It may or may not also be a roof.

Warranty
An agreement that provides assurance by a warranty provider (insurance program or contractor) to the owner that the warrantor will assume stipulated responsibilities for correction of defects and failure to meet specific performance criteria within a stated period.

Chapter 1—Introduction

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Chapter 1—Introduction

1.1 Background

This *Guide* is one of three publications about rehabilitating wood-frame buildings in coastal B.C. The *Building Envelope Rehabilitation—Consultant's Guide,* which is a companion to this *Guide,* has more technical detail and focuses more on the consultant's role in rehabilitation. *Managing Major Repairs,* published jointly by Canada Mortgage and Housing Corporation (CMHC), B.C.'s Homeowner Protection Office (HPO) and the B.C. Ministry of Municipal Affairs, focuses on rehabilitation in the context of the strata corporation and legal issues. It also is an overview of some technical aspects of rehabilitation.

Many wood-frame buildings in B.C. have moisture problems—and some have already been repaired once. Buildings that have never been rehabilitated and buildings that have been rehabilitated once will need work over the next few years. The fact that many buildings require a second rehabilitation emphasizes the need for the development of guidance with respect to effective rehabilitation measures.

This *Guide* is intended to give owners and property managers a better understanding of the technical concepts and issues of rehabilitation. It is also intended to create a better understanding of the rehabilitation process. This improved understanding will help owners make more-informed decisions, give property managers better guidance and create better communication among everyone involved in rehabilitating a building.

1.2 Rehabilitation process and roles

There are many stages in rehabilitating a wood-frame building and each stage involves different combinations of owners, property managers, consultants and contractors. Figure 1-1, is a flow chart showing the rehabilitation process and the people likely to be involved at each stage. The organization of this *Guide* follows the stages set out in the flow chart—Investigation-evaluation, Pre-construction, Construction and Service life.

Rehabilitation work takes a long time. Owners and property managers often do not realize how long investigation-evaluation and pre-construction can take. Figure 1-2 is a typical rehabilitation schedule. This *Guide* discusses, in detail, many of the tasks shown in Figure 1-2.

Owners, property managers and consultants have a significant role in every stage of rehabilitation. Usually, responsibilities are split between the strata council, the property manager and, in many cases, a building rehabilitation committee. Many smaller strata do not have a property manager but owners have the same responsibilities in rehabilitation as property managers in larger strata. The *Guide* deals with owner and property manager responsibilities as one role. Owners must determine the split in responsibilities based on their own circumstances.

Most buildings that are being rehabilitated are occupied throughout construction. For consultants and contractors, this is an added level of complexity in a project. For the contractor, it means more difficult scheduling and taking extra safety precautions. For residents, it is discomfort and inconvenience added to the expense of rehabilitation.

1.3 Cost-effective

The context of the term "cost-effective" is key to decisions made with the assistance of this *Guide.* Does cost-effective mean cost-effective within a warranty period or cost-effective

in the life cycle of the building? The life-cycle context is most relevant to this *Guide.* It is not at odds with a phased approach to rehabilitation or strategies representing higher risk to building owners if these risks are understood and acknowledged.

The context for cost-effective is viewed differently by the many different stakeholders. Even within a strata corporation, owner group views are likely to differ depending on the individual owner's financial status and long-term interest in the building. These different views include:

- A strata owner who is planning to sell as soon as possible.
- A strata owner who plans to be a long-term owner.
- The strata council, in responding to corporation and director obligations under the *B.C. Strata Property Act* (1998) and the *B.C. Strata Property Amendment Act* (1999) and regulations to the acts.
- Lending institutions for first mortgages.
- Lending institutions or guarantors for second mortgages to finance rehabilitation.
- Parties involved in the original design and construction of the building who may be asked to contribute to the rehabilitation.
- The rehabilitation consultant and contractor and their exposure to risk of future failure.
- The warranty provider, who will want to evaluate the risk of failure in the future. The warranty provider should be included in the design process.
- Future buyer of a strata unit.

Usually there is a range of alternatives for rehabilitating the building, each with its own costs and performance risks. Owners must make decisions and strive to understand the advice and information presented by consultants. They must also understand that a decision to pursue a certain strategy in rehabilitating the building envelope is distinct but related to the value of potential claims they may have against parties involved in the original design and construction of the building.

1.4 The Guide

The *Guide* is intended to provide guidance, mainly to owners and property managers, about repair and rehabilitation of building envelopes of multi-unit wood-frame buildings in the coastal climate zone of British Columbia. The terms "repair" and "rehabilitation" are interchangeable. In this *Guide* "repair" is replacement or reconstruction of envelope assemblies, components or materials at specific areas of the building envelope. "Rehabilitation" is comprehensive, overall improvement to building envelope assemblies and details. In both cases the intent is to improve the building envelope so that it can perform its originally intended functions.

This *Guide* does not provide guidance about the roles of owners, property managers and consultants in legal action associated with building envelope performance problems.

The *Guide* may be useful to other stakeholders in rehabilitation, helping them to understand roles and tasks.

Much of the material in the *Guide*, particularly process-related information, may apply to other climate zones and building types. However, some analysis of the impact of different climate factors and specific building attributes must be considered before using the *Guide.*

The *Guide* reflects current recommended design and construction practice. There are certainly many aspects of rehabilitation and technology that could benefit from further research and development: that is not the purpose of this *Guide.*

The *Guide* does not replace professional advice. When this guidance is incorporated into buildings, it must be reviewed by knowledgeable consultants and reflect the specific unique conditions and design of each building.

Figure 1-1—Typical rehabilitation project stages and participants

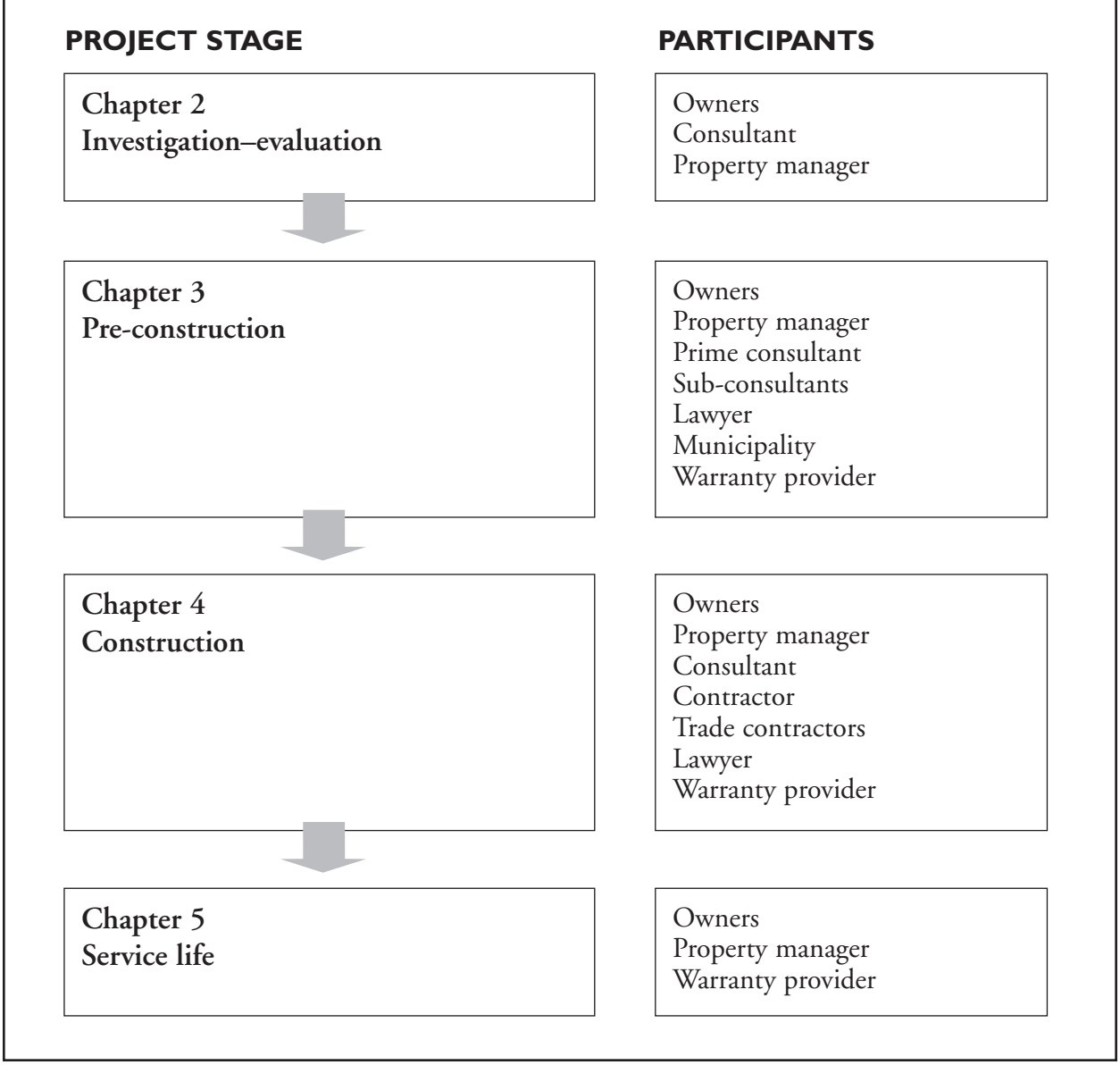
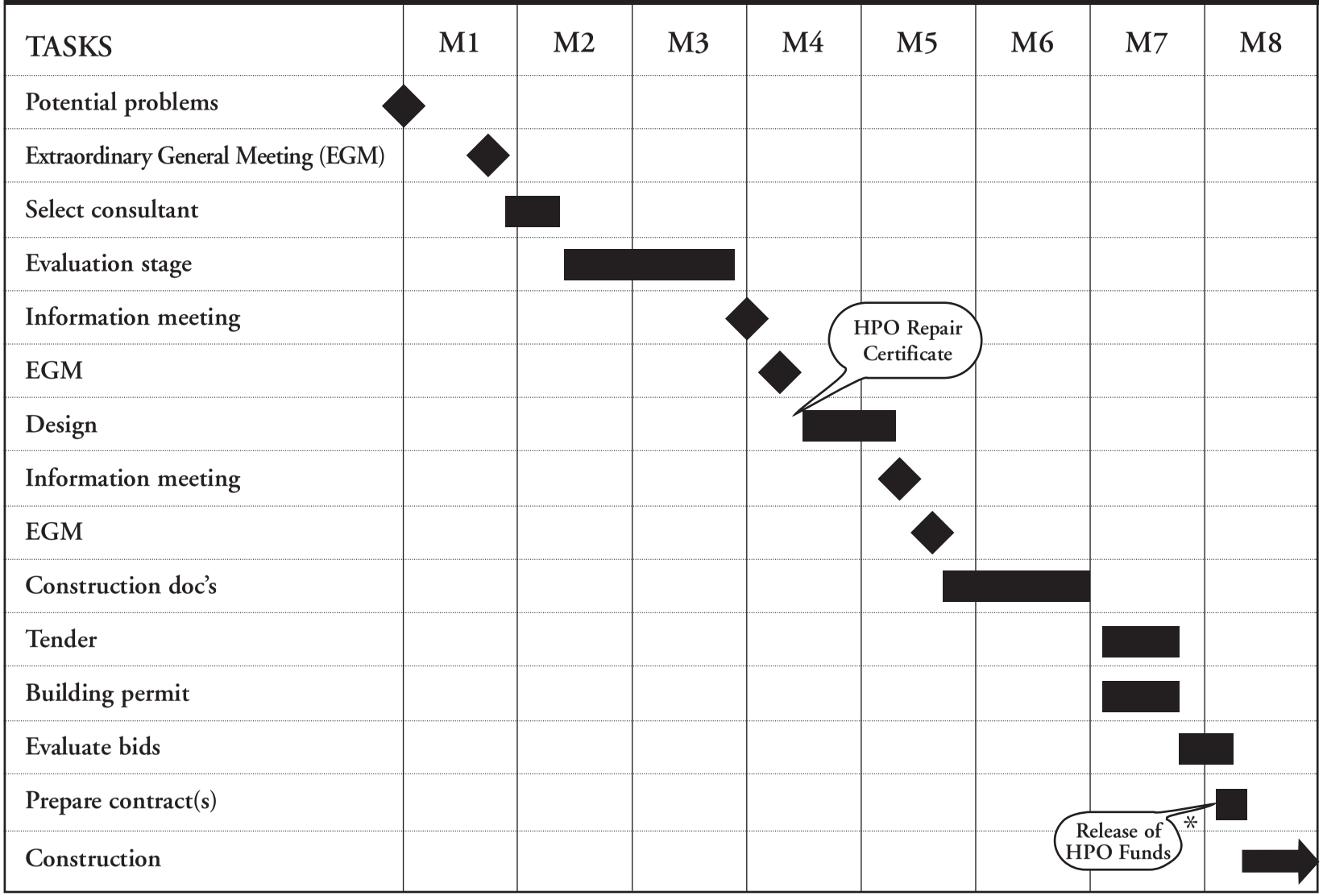


Figure 1-2—Typical schedule for building envelope rehabilitation



* Note: Repair certificate must be prepared and signed by a Building Envelope Professional (BEP) and submitted to the HPO as part of the application for the HPO's reconstruction loan program.

Chapter 2—Evaluation

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Chapter 2—Evaluation

2.1 Introduction

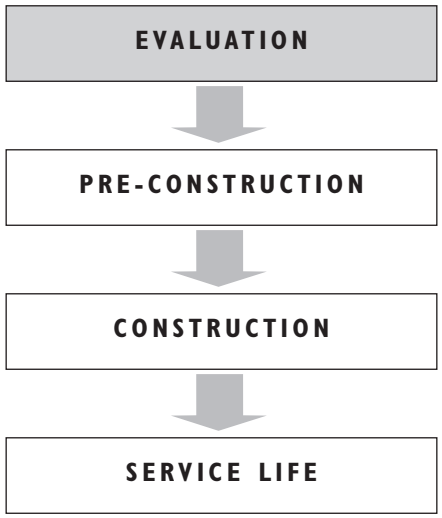
A call, or repeated calls, from occupants to the property manager or strata council about moisture-related damage is usually the first sign of a possible building envelope problem. The need is then to assess the reported symptoms. Once a particular problem has been identified, it is common to look at other areas of the building to see if there are other signs of damage. Is the damage related to a readily identifiable moisture source that can easily be repaired, or does it indicate a widespread, systemic problem? If it is an isolated problem, then is the cause readily apparent or does it require further investigation before determining an appropriate course for rehabilitation?

The answers to these questions determine the effectiveness of all the following rehabilitation efforts. If not considered or incorrectly answered, there may be an inappropriate rehabilitation that wastes effort and money.

For example, unsuccessful initial attempts at repairs—short-term fixes with a tube of caulking or application of a coating—often result from a poor evaluation of the symptoms. It is common for consultants to be called in after a considerable amount of money has already been spent in the hope that the problem was small and the fix was easy. For this reason, someone knowledgeable about building envelope performance should do the initial assessment. In a short time on site a knowledgeable individual can provide appropriate direction to start dealing with the problems, whether they are small or large.

Because of widely publicized moisture-related envelope failures, it is increasingly common for owners to become concerned about the condition of their building whether or not they are experiencing moisture problems. They may ask for an initial assessment to find out if they should be concerned. If they do not, the assessment may give them some guidance in identifying moisture problem symptoms or maintenance strategies to reduce the likelihood of problems. The evaluation techniques and guidance in these cases is similar, in level of effort, to the initial assessment of buildings with known moisture problems.

Rehabilitation process



2.2 Selecting and working with a consultant

Selecting a qualified, experienced consultant is critical to the success of the investigation and evaluation of a building. A qualified, experienced consultant is just as important for rehabilitation, to help ensure effective project delivery and long-term envelope performance.

To ensure a smooth transition from investigation and evaluation to actual rehabilitation, owners should check to make sure that the consultant is capable of investigating the problem and ensuring that rehabilitation work is effective.

People who are not consultants can find it difficult to choose a consultant. The following guidelines can help you select a consultant:

- Contact owner groups, homeowner associations and professional organizations such as the Homeowner Protection Office, the Condominium Home Owner's Association, the Architectural Institute of B.C. (AIBC) and the Association of Professional Engineers and Geoscientists of B.C. (APEGBC) The AIBC and APEGBC maintain a list of Building Envelope Professionals (BEP). This list is the best place to start your search for a consultant.
- Being on a list is no guarantee of qualifications or ability to perform. A list is a starting point. You should seek other references. The best source is other professionals—architects, engineers and lawyers—who regularly work with envelope consultants. They know the consultants' expertise and reputation within the industry. If you are thinking of legal action, they can tell you how credible a consultant is.
- Contact the BEP or firms that have a solid reputation. Ask for a general statement of qualifications and a list of relevant project experience. To judge qualifications, consider:

    - Staff qualifications and experience.
    - History in building sciences.
    - Availability of staff and resources.
    - Experience with similar projects.
    - Current workload.
    - Familiarity with best practices and current technology.
    - Proof of good standing with the Workers' Compensation Board.
    - Professional liability insurance.

- Make sure that the firms you consider were not involved in the original design and construction. If a firm was involved in the original design and construction, it will have a conflict of interest. Take it off your list.
- Select a short list of two or three qualified consultants and ask them to submit proposals. The Request for proposals (RFP) should define the project's objectives and asks the consultant to provide their anticipated scope of services, a list of staff who will be assigned to the project, a list of references, a schedule for carrying out the work and fee proposal.
- Contact references.
- Select a consultant. Confirm your selection formally in a letter to the consultant. When you select a consultant, consider fees based on value, not price. Emphasizing price ultimately works against you. A consultant making an overall effort to reduce fees will spend less time on the project or assign less-qualified staff or do less analysis of alternatives. None of these will benefit project quality or total project costs.

Try to keep the same consultant for evaluation and investigation and for design and construction. This creates continuity and reduces costs because you do not have to pay a new consultant to become familiar with your building and the project.

Your strata council should form a rehabilitation committee to liaise with the consultant and, later, with the contractor and the consultant. For continuity, keep as many of the original members on the committee throughout rehabilitation.

Once you select a consultant, hold a start-up meeting with the building envelope rehabilitation committee or strata council, the property manager and the consultant.

At the start-up meeting, clarify specifics of the proposal and identify any issues of concern. Setting up lines of communication, though, is perhaps the most important business at the start-up meeting.

The consultant needs a contact to arrange for access to the building and to obtain existing drawings and documents. The contact is usually the property manager, an owner living in the building or a maintenance person. The owners should also find someone who can tell the consultant the history of the building, the nature of problems and previous repair efforts.

In the investigation-evaluation stage, there is usually no need for regular meetings with the consultant. Usually a meeting is scheduled when the consultant completes the investigation-evaluation and reports on the findings. This meeting can include the strata council, the rehabilitation committee and the owners as a whole.

Communication becomes more frequent in the pre-construction and construction stages, as the need to make timely decisions grows. Later chapters of the *Guide* discuss this in more detail

Many owners employ a property management company to look after normal building operations and do the administrative work the *Strata Property Act* requires. It is common for the property manager to be the owners' representative and to liaise with consultants and contractors. Property management companies usually charge additional fees for the supplementary administrative and management tasks of a major rehabilitation project. The additional fees can be of great value to a strata. An experienced property manager can be an asset in rehabilitation. This is especially true if the strata has no members with expertise in either construction or strata process.

2.3 Identify potential problems

There are several reasons for deciding to evaluate the condition of your building:

- Individual owners report problems such as leaky windows.
- A general concern about their building's performance because of the many moisture-troubled buildings of similar design and age.
- Visual signs that moisture damage may be occurring.
- The presence of potentially problematic features and details.

While the first two reasons are sufficient to obtain help in evaluating the condition and performance of the building envelope, the last two require a certain amount of professional experience to recognize the need for evaluation.

2.3.1 Symptoms

Owners are often unaware that their building has potential moisture problems because they cannot recognize the visual signs of envelope failure. Table 2-1 lists visual symptoms that may indicate the occurrence of a building envelope failure. It is provided here to assist owners in establishing the potential existence of envelope problems, the possible cause and the need for professional help with investigation.

Table 2-1—Visual symptoms of potential problems

Visual symptom	Possible cause—source
Staining on wall cladding. See Photo 2-1.	An indication that there might be moisture behind the cladding.
Staining on concrete foundations below wall or column cladding. See Photo 2-2.	Leaching of wood extractives or breakdown products from within the wall to the foundation.
Uneven colouring of wall cladding.	May indicate water behind the cladding.
Efflorescence on stucco cladding.	May indicate water behind the cladding.
Staining around deck scuppers and below drain penetration through deck soffits. See Photo 2-3.	Deck membrane tie-ins to the scupper may not be appropriate; scupper may be back-sloped to deck, redirecting water inside the wall assembly.
Bulging in stucco cladding.	Wood-frame shrinkage causing movement and cracking of the cladding.
Balcony soffits that are stained or sagging. See Photo 2-4.	Probable indication of a balcony leak.
Deflections of window frames.	Caused by shrinkage of the wood structure or structural inadequacies in the window or the wood-framed structure possibly because of decay.
Efflorescence or rust staining on the underside of a suspended sandwich concrete slab.	Water may be trapped on top of the suspended slab. This water may be from wall or perimeter leakage.
Water staining at window heads.	Water leakage at window perimeter or into the wall assembly above the window.
Extensive cracking of stucco cladding. See Photo 2-5.	A possible point of water ingress.
Mold on interior gypsum board finishes. See Photo 2-6.	Sustained high levels of moisture present within gypsum board.
The presence of towels on windowsills.	Excessive condensation on the window frame or the window is leaking.
Water dripping from the head of windows on the interior.	Indication of water penetrating the walls or windows above the location of the dripping.

Photo 2-1—Staining on stucco cladding

Photo 2-2—Staining on concrete below cladding

Photo 2-3—Staining at scuppers and saddle interface

Photo 2-4—Staining on balcony soffit

Photo 2-5—Cracking of stucco cladding

Photo 2-6—Mold stains on inside surface of interior gypsum wallboard

2.3.2 Potential sources of moisture problems

Certain features of a building, referred to as details, may also suggest increased potential for building envelope failure. The presence of these specific details does not always mean that a failure will occur; however, these details have been associated with moisture ingress in many problem buildings. Figure 2-1 gives the location of a number of key details on the exterior of a building.

Figure 2-1—Typical details for wood-frame envelopes

KEY TO DETAILS

1. Scupper and rainwater leader
2. Parapet cap flashing
3. Control joint
4. Wall–window interface
5. Balcony door threshold
6. Balcony rail attachment
7. Vent hood
8. Rainwater leader attachment
9. Saddle detail
10. Deck drain
11. Junction between different materials
12. Window head
13. Window jamb
14. Windowsill
15. Overflow scupper
16. Planter
17. Wall–concrete slab interface
18. Balcony-wall interface

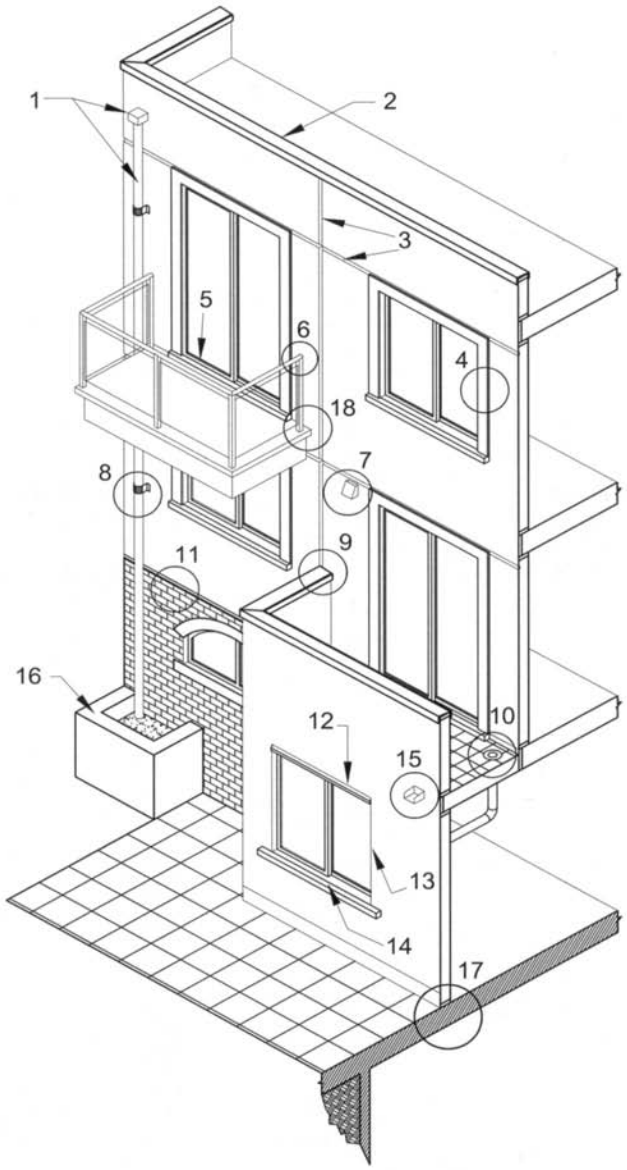


Table 2-2 discusses some of the details in Figure 2-1 in the context of potential moisture problems. Photographs of some details are also provided.

Table 2-2—Details and potential problems

Description of detail	Possible contribution to moisture problems
The method of integration of the windows within the wall assembly. See Photo 2-15.	Leakage either directly through the joints in the window frame or at the interface between the window frame and the adjacent cladding often provides a path for water ingress into the wall assembly.
Doorsills on balconies and decks not elevated above surface of balcony or deck.	Lack of sill height increases potential for water to pool against sill and for leakage.
Placement of doors without protection by overhangs.	Increases potential for wetting of doors and therefore increased potential for water ingress at these inherently difficult-to-waterproof elements.
Inadequate slope or back-sloped balcony membrane surface.	Increases likelihood of water entry into the wall, roof, deck or balcony assembly.
Gaps or cracks in the cladding. See Photo 2-9.	Possible source of water ingress past the cladding.
The condition of sealant used to seal wall penetrations.	Indicative of the quality of the initial construction or maintenance performed on the building, and potentially a water ingress point.
The method of integration of cap flashing to the wall assembly, known as a saddle connection. See Photo 2-12.	A poor detail at this location can result in water ingress.
The lack of membrane below cap flashing.	Water may leak at joints in the cap flashing and the lack of membrane under the cap flashing means that water will have direct access to the wall assembly.
Poorly lapped sheathing paper and flashing.	Water may gain access to the wall assembly behind the sheathing paper at these locations.
Loose waterproofing membrane on decks.	May be indicative of movement resulting in torn or separated membrane at the seams and termination points.
Control joints or reveal strips in stucco cladding. See Photo 2-13.	Possible source of water ingress behind the cladding.
The presence of elastomeric coatings on the cladding to correct a water ingress problem.	Although it may provide some short-term relief from water ingress, it slows drying of the wall and may accelerate wood deterioration.
Wood window trim that is installed directly on the building paper at the perimeter of the window.	Provides a potential water ingress point and holds moisture against the sheathing paper and sheathing.
Balcony railings installed on an horizontal surface. See Photo 2-7 and Photo 2-8.	Fasteners at mounting plates of desk railings are typical leakage points.
Poor parapet cap flashing details.	Possible point of water ingress into the parapet walls.
Poor dryer exhaust vents details. See Photo 2-11.	The warm and humid dryer exhaust air may be discharged within the wall or balcony assembly, causing wood decay.
Poor chimney vent details.	Possible point of water ingress.
Poor chimney to roof interface details. See Photo 2-16.	Allows water to accumulate against the interface between roof and wall assemblies, leading to potential water ingress.
Back-sloped flashing details. See Photo 2-14.	Allows water to pond and run off the flashing back into the wall assembly.
Poor planter wall to main building exterior wall interface detail. See Photo 2-10.	Possible water ingress point.

Photo 2-7—Water ponding and guardrail attachment through membrane providing potential water ingress point

Photo 2-8—Guardrail attachment through flat cap flashing on balcony upstand wall. Potential water ingress point at attachment point and at lap in flashing.

Photo 2-9—Crack at cladding transition between brick veneer and stucco. Lack of seal provides water ingress location

Photo 2-10—Poor detail at planter interface with wall assembly. Possible water ingress point where concrete meets stucco

Photo 2-11—Poor vent assembly; no flanges for tie in to sheathing paper and screen which can not be cleaned of lint that plugs exhaust. Could lead to moisture deposit within wall assembly.

Photo 2-12—Poor cap flashing to wall interface detail (saddle) with stucco removed; reliant on sealant only to maintain water tightness. Potential water ingress point.

Photo 2-13—Reveal-strip termination in stucco. Open joint and cracks at edge of reveal are potential water ingress points.

Photo 2-14—Back-sloped flashing directs water into the wall assembly

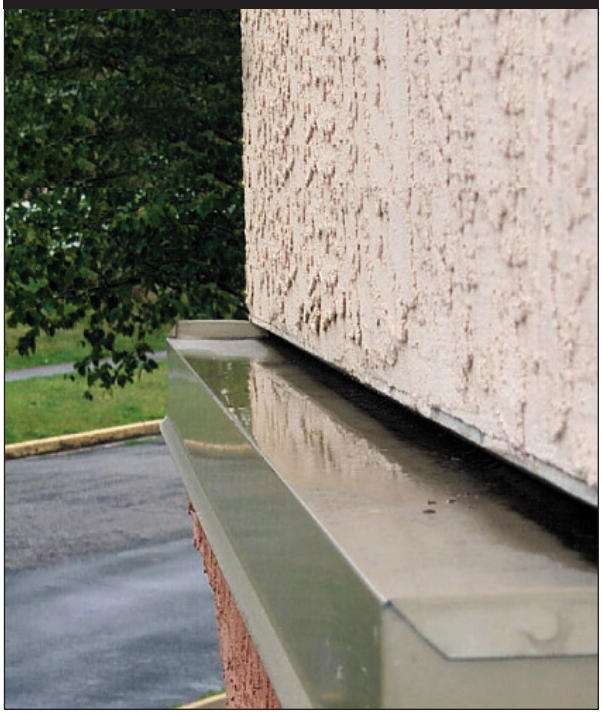


Photo 2-15—Windowsill detail at stucco interface; no sill flashing to direct water away from window to stucco interface and no sealant at window perimeter creates potential water ingress point

Photo 2-16—No cricket flashing at chimney to roof transition allows water to collect at roof to wall interfaces creating greater potential for water ingress

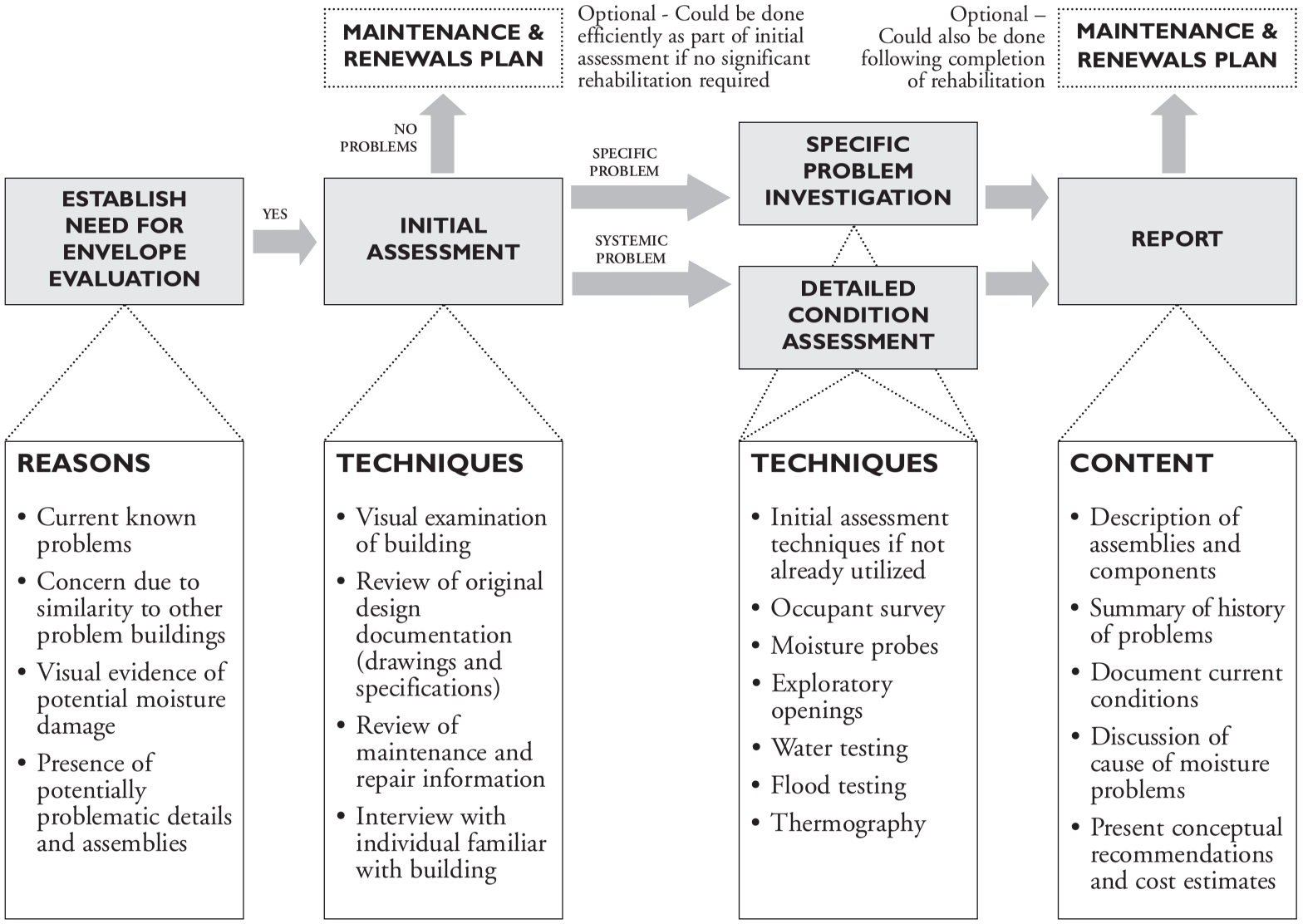
2.4 Evaluation process

The evaluation process, the extent and the type of investigative work required, varies from building to building. It depends on the size, age and complexity of the building and on factors such as the degree of repetition of basic building features. Consultants will provide advice on an appropriate scope of work.

The following sections provide details of the evaluation process. Figure 2-2 summarizes the process. The summary describes distinct parts of an evaluation process and specific techniques associated with various aspects of the process. However, because no two buildings and no two situations are the same, the scope and flow of the process may be modified. For example, it is not unusual for the initial assessment to form the first few steps of a detailed condition assessment rather than a separate phase of evaluation. Similarly, moisture-probe surveys are sometimes done as part of the initial assessment.

Although evaluation's primary focus is identifying localized or systemic moisture problems and recommending solutions, evaluation also provides all the tools and information necessary to recommend longer-term maintenance and renewals. (Chapter 5—Building envelope manual, discusses maintenance and renewals plans in greater detail.) However, it is important to note that information needed for these plans can be efficiently gathered during the evaluation phase and that the scope and focus of the evaluation effort may have to be broadened slightly to include all envelope assemblies and components.

Figure 2-2—Evaluation process



2.4.1 Safety and health considerations

Safety of the occupants, workers and the public is the first priority in evaluation of a wood-frame building. Safety has to be assessed at all stages of rehabilitation, but begins during evaluation. There are two primary health and safety issues to consider as a result of moisture ingress: structural adequacy and the potential risks of exposure to mold.

Structure

The presence of fungi within the wood structure of the building at appropriate temperatures and moisture content can lead to the destruction of the wood cells. This deterioration reduces the ability of the wood to resist structural stresses and ultimately leads to a loss of structural capacity of the wood members. Rapid strength loss occurs before decay is obvious to the naked eye. Only a structural engineer should evaluate structural adequacy and determine if temporary measures are needed to make the structure safe.

Mold

Under certain circumstances, mold in the building envelope can be a health hazard. Mold must be recognized and dealt with during both the evaluation and construction stages in a rehabilitation project.

Advice from a consultant with appropriate qualifications and experience to evaluate the presence and impact of mold should be sought. The consultant should be able to demonstrate expertise and ability to collect mold using airborne, surface and bulk sampling procedures. A lab with American Industrial Hygiene Association (AIHA) certification or equivalent should analyse the samples. A qualified professional with experience in mold in building systems (primarily HVAC and building envelope) should interpret lab results.

Reasons for taking this precautionary step include:

- Occupants or workers suffer from cold or flu-like symptoms, malaise, headaches or rashes and these symptoms diminish when they are not at the building.
- Mold is visible on interior wall, ceiling or carpet surfaces.
- There is a musty, earthy or moldy smell in the building indicating the presence of hidden mold.

2.4.2 Initial assessment

Initial assessment relies exclusively on non-intrusive, or indirect, evaluation methods. These methods typically include visually examining the building, reviewing architectural drawings and maintenance and repair documents and interviewing an individual who knows the building's history. The conclusions from indirect methods are not as reliable as those from direct evaluation techniques.

If there are no reported moisture problems, the consultant uses information about exposure, building form, assemblies, details, components and materials to form an opinion about the level of risk. Some areas or assemblies in the building may be high risk and others low risk. If so, the consultant may recommend a detailed condition assessment of high-risk areas and recommend maintenance and renewals for the low-risk elements.

If the preliminary assessment of a known moisture problem reveals a small, localized problem, there are several options. The consultant could oversee the work of a contractor to make repairs. It is also possible that a good contractor will be able to go ahead without a consultant by refining the initial cost estimate and undertaking the work, but getting the consultant involved if a more significant problem becomes apparent on site.

If the initial assessment cannot determine the cause and appropriate conceptual rehabilitation strategy for a reported moisture problem, then the appropriate recommendation is a more detailed investigation using direct evaluation tools.

Similarly, if the initial assessment suggests a systemic failure due to widespread moisture problems then the appropriate recommendation is to undertake a detailed condition assessment.

The effort for this initial assessment varies depending on the size of the unit and the scope of the assessment. The scope could include the entire envelope (walls, glazed assemblies, roofs, balconies, decks, walkways, as well as at-or below- grade waterproofing) or could focus only on select elements of the building.

2.4.3 Detailed condition assessment

The initial assessment may identify the need for a detailed condition assessment. The purpose of this work may be multi-faceted but usually includes some combination of the following:

- Determining extent and severity of the damage or symptoms of systemic moisture problems.
- Determining the cause(s) of systemic moisture-related problems.
- Determining appropriate conceptual rehabilitation work strategies.
- Developing and outlining construction cost estimates and implementation plans.

Clearly, the level of investigative work changes if information is gathered to support litigation. Unless specifically requested, this is not normally the purpose of the condition assessment report. However, the factual information in the report may be used to later support opinions about the factors contributing to envelope failure. The condition assessment report, therefore, documents the current condition of elements of the building envelope. It may also provide information related to the specific sources of moisture or other physical factors that have resulted in the conditions.

The scope of work for the condition assessment should identify the actual purpose or purposes of the work. This includes the extent of the envelope to be reviewed (may only be part of the building or some of the assemblies) and the proposed methodology. The following is a generic scope of work for a condition assessment that focuses on development of a rehabilitation plan. Note that the first few tasks may have already been done as part of an initial assessment.

- Review the history and nature of the building envelope problems with occupants, available records and the building manager.
- Distribute an occupant survey to help determine the history, extent and nature of any moisture-related performance problems.
- Review available original design and construction documentation about the building envelope.

- It is not usually possible to lay out the exact plan for the field evaluation, as findings in the earlier tasks will dictate the focus of the specific field evaluation. In addition, findings early in the field evaluation may indicate a need for greater focus on one aspect of the construction and less emphasis on others. However, typical investigative techniques include:

  - Visually examining and photographing from the interior of the building of typical areas where moisture problems have appeared from the building interior.
  - Visually examining and photographing of the exterior of the building including typical wall assemblies, roof assemblies, window details, balconies and roof-wall intersection—all assemblies that form part of the scope of the review.
  - Sampling of the moisture content of the wood sheathing at high-risk locations throughout the building. Sampling is done with a moisture meter. Determining moisture content of the wood sheathing helps the consultant to assess whether the combination of exposure to wind and rain and potential water penetration sources have resulted in damage, or are likely to result in damage.
  - Making some small exploratory openings from the exterior or interior at the perimeter of windows, edge of balconies and at other locations of high moisture content readings to help confirm details of the construction, the presence of wood decay and potential water ingress paths. The assistance of a contractor is usually required to make and repair the exploratory openings. Normally, openings are temporarily patched so that no additional damage will occur. Permanent repairs can be done once the owners review the report's recommendations and a repair or rehabilitation program has been established. The number of exploratory openings depends on the results of the moisture probe survey and visual observations.
- Based on the results of the investigation, develop conceptual rehabilitation recommendations, alternative approaches where feasible and associated construction cost estimates.
- Prepare and submit a draft report giving the results of the investigation and recommendations. The owner's review provides the consultant with input on areas of the report requiring greater clarification, possibilities of phasing the work and considerations about doing rehabilitation work in an occupied building.
- Based on the owner's review, revise and submit the final report. It should contain supportive photographs and sketches, where appropriate.
- Meet with the owners to discuss the report, recommendations and follow-up activities in detail.

Photo 2-17—Typical moisture probe equipment

Photo 2-18—Typical exploratory openings at lower corner of window

Photo 2-19—Typical exploratory opening to confirm assembly materials and condition

Consultant fees for a detailed condition assessment depend on the size and complexity of the building and the scope of the assessment. They usually range from $4,000, for a 10-unit complex with few details and one cladding material, to $20,000 for a large—more than 100 units—complex with complicated building form and several cladding materials.

The consultant may recommend additional investigative work as a result of the detailed condition assessment. Typically this work may be necessary to clarify budgets, assess feasibility of other rehabilitation approaches, test windows or sample mold and identify species. This work may also be needed to verify implications of deferring some of the repairs–rehabilitation.

A consultant should not be selected for condition assessment on the basis of the number of exploratory openings or moisture probe readings, or both, that will be made. Patched openings are difficult to make esthetically acceptable and provide additional details for potential leakage. The number of openings and probes should be left to the consultant's discretion.

2.4.4 Specific problem investigation

A targeted or specific problem investigation may be warranted where problems are localized or where an initial assessment recommends it as a next step instead of a detailed condition assessment. The purpose of this work is usually to:

- Determine the cause of specific moisture problem (problems are only showing up at a few locations or are isolated to one problematic detail).
- Determine appropriate conceptual rehabilitation work strategies.
- Develop construction cost estimates and an implementation plan for conceptual rehabilitation work.

The essential difference between a detailed, specific problem investigation and a condition assessment is the focused nature of the investigation and—in some cases—more extensive direct evaluation. Water testing and larger exploratory openings are more far-reaching in a specific problem investigation.

In other respects, methodology and reporting should closely resemble the condition assessment. Costs for a specific problem investigation depend on the extent of required testing and the extent of field exploratory work. Because of the uncertain level of effort, consultants commonly work on a time-and-expense basis. A detailed condition assessment is usually on a fixed-fee basis.

2.5 Condition assessment and investigation reports

2.5.1 Report contents

After the consultant completes the on-site investigation and collects the data from visual observations, moisture probe results, exploratory opening findings, and so on, the information is evaluated and analysed. A report describes the investigation, findings and conclusions and recommends rehabilitation concepts. The report should also give preliminary costs. Format and layout of the report depends on the nature of the building and scope of investigative work. Although reports may be formatted in different ways, it is common to deal with each building envelope assembly and component separately. A typical report contains the following sections:

Introduction

Terms of reference
Brief outline of contractual relationship between owners and consultant. Dates of original proposal from consultant and letter of acceptance and approval to proceed with investigation from owners or property manager.

Report organization
A description of the report's structure and how it presents information.

Scope of services
A description of the consultant's scope of work as presented in the original proposal.

Documents reviewed
A list of documents about the original building and subsequent repairs, which the consultant reviewed before the on-site investigation. This section also typically lists and describes the building envelope assemblies and materials. Variation in the 'as-constructed' assemblies or details or material substitutions made during the original construction is noted in later sections.

Building description
A description of the building, including floor area, number of storeys, date of construction, and so on. In part, the description is to determine the building code classification of the building if it is not known or has not been provided.

Building history
A review of the significant activities affecting the building envelope since original construction. This includes rehabilitation work, replacement of windows, balcony membranes, or other materials and components, painting of the building exterior, and so on.

Field assessment of current conditions

Interior operating conditions and ventilation
A description of the building's interior environmental conditions, to identify areas of high humidity or unusual indoor conditions. Information includes locations of bathrooms and laundry exhaust fans, presence of humidistats and information about other mechanical ventilation if it exists.

Assemblies and components

Detailed discussion of each of the building envelope assemblies. Describes materials and records visual observations. Discusses results of the moisture-probe survey and exploratory openings. Usually, the results are plotted on elevation drawings or photographs. See Figure 2-3.

The following assemblies are typically included:

- Walls.
- Windows and doors.
- Roofs and decks.
- Balconies and walkways.
- At-grade assemblies (parkade roof slabs, foundation walls, planters.)

Discussion

A review of the findings of the investigation, specifically listing each of the envelope failures and describing the mechanisms involved. Identifies outline rehabilitation work strategies for each failure condition.

Rehabilitation plan and costs

The rehabilitation plan should reflect the integration of rehabilitation needs for all assemblies and components, establish priorities for the work and describe alternative approaches. The implications with respect to the need for future maintenance and repairs in addition to current cost of rehabilitation should also be presented for each alternative. Limitations of the cost estimates provided as part of the report are discussed in "Budgets," page 2-21.

Summary

A brief summary of the investigation carried out, the main findings and recommendations for rehabilitation.

Appendixes

Appendixes are usually included and may provide some or all of the following:

Glossary

A list of technical terms used in the report to assist owners who may not be familiar with construction industry terminology.

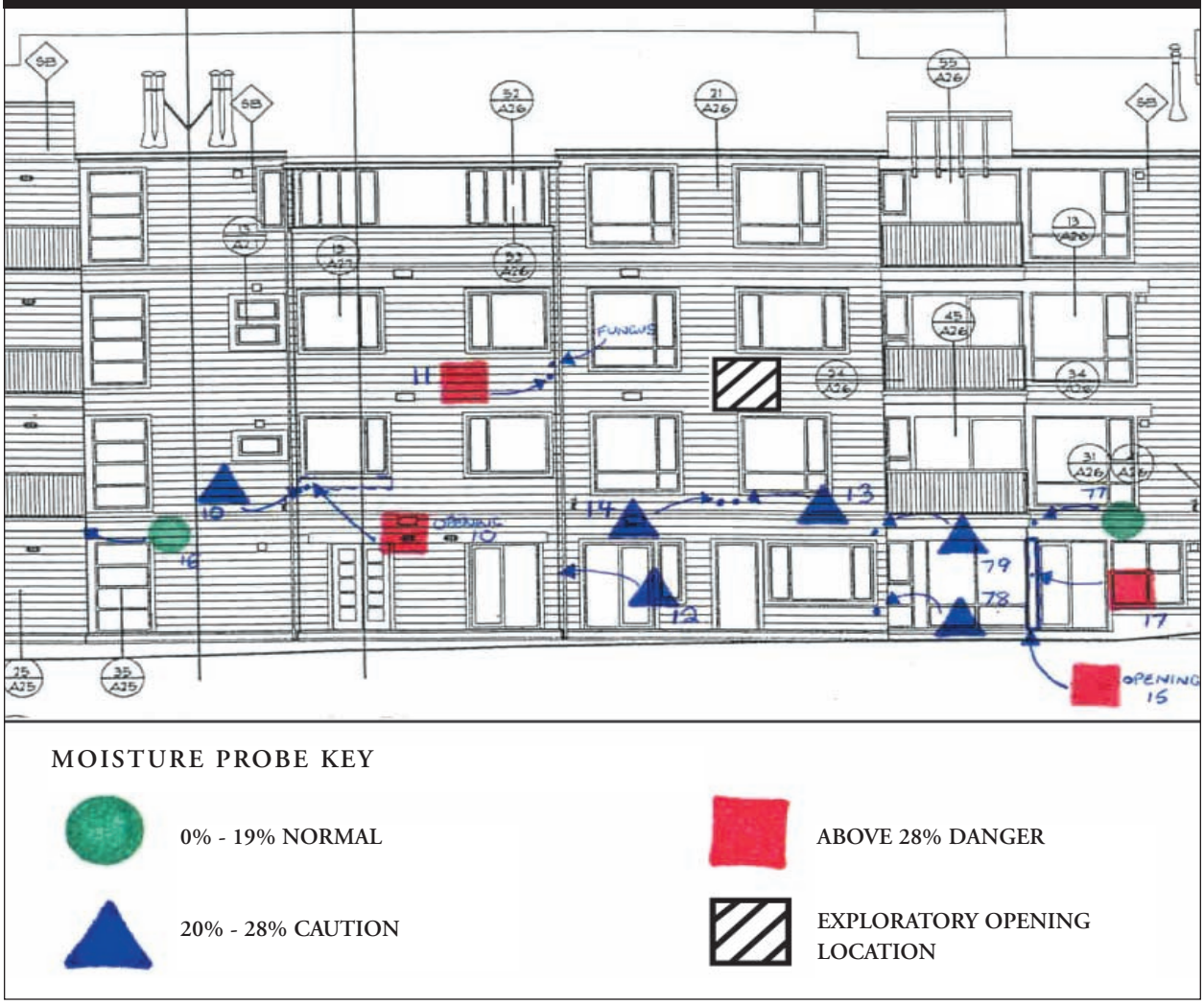
Elevation drawings

A set of elevation drawings (or photographs of the elevations) showing the location and results of moisture probe and exploratory openings work. See Figure 2-3.

Photographs

Photographs document visual observations, including those at exploratory openings. The photographs may be included in the body of the report but are more commonly an appendix.

Figure 2-3—Moisture probe survey and exploratory opening results



2.5.2 Evaluate report and consider options

The owners will need time to properly review and evaluate the condition assessment report, particularly if it identifies significant envelope problems that need extensive rehabilitation. It is not uncommon for owners to seek a second opinion and have the consultant's report reviewed by another consultant. Usually, this is not nearly as costly as the first consultant's work, since the second consultant can usually rely on the information gathered by the first consultant.

Typically, the report is given to the strata council or the owners' building committee first. All owners should have an opportunity to review the contents in detail, even though many will just want to know the main points—what rehabilitation work is needed and how much it will likely cost. It is best to make copies of the full report for all owners, or circulate copies among the owners. The strata council and the property manager should always have copies of the report available.

If the strata corporation has not already retained a lawyer, it should at this point. A lawyer should review contracts and advise about a second opinion, dealing with the original developer and taking further legal action.

The consultants should make a presentation to the owner group to briefly describe the investigation, the main findings and the recommendations. It is important that the consultant help the owners understand the evaluation, the need for rehabilitation and alternative approaches, if any. The presentation is also an opportunity for the larger owner group to ask questions and seek clarification. The consultant can also describe the next steps in rehabilitation and advise the owners how to proceed.

2.5.3 Decision to proceed

Owners may need considerable time to review and consider their position, particularly if the rehabilitation work is extensive and costly. Individual owners will need to discuss other financial options, negotiate adjustments to their mortgages, and apply to the Homeowner Protection Office reconstruction loan program. The HPO can be contacted at 1 800 407-7757 or (604) 646-7050. Information is also available on the HPO Web site at www.hpo.bc.ca

If the owners decide not to go ahead, there are legal risks and risks from continued deterioration of the envelope assemblies and structure.

The strata council will need time to formulate special resolutions (75 per cent vote) to raise the funds for rehabilitation and set a payment schedule for individual owners. There is often an understandable reluctance to proceed quickly to the next stage before all the necessary funds have been raised. While it is important that the owners not enter contracts to carry out repairs without knowing that all the money is available, raising the funds is time-consuming and can delay the process by many months.

Another approach is to raise the funds in two stages. Stage one funds cover consultant fees to design the rehabilitation work and produce construction documentation. (See "Design phase" and "Construction documents phase" in Chapter 3) Stage one funds are a relatively small portion of the overall rehabilitation cost and allow the consultant to proceed with the next stages of the program before the owners raise the funds to pay for the actual reconstruction work. (See Chapter 3—Pre-construction.) This advantage of raising funds in two stages is that more accurate cost estimates are available as the rehabilitation design is developed in detail.

This *Guide* does not deal with procedures for raising funds for rehabilitation projects. The strata council should determine the process, in accordance with the *Strata Property Act,* in consultation with its property manager and lawyer.

2.6 Budgets

In many ways, cost overruns or failure to meet project milestones are more often a result of unrealistic expectations and inadequate budgets than unanticipated conditions. It is essential to create realistic project budgets that accurately reflect probable costs. When preparing a rehabilitation budget it is pointless to be unrealistically optimistic and understate probable costs—this can result in owners committing themselves to a project that they

are unable to pay for. It is equally irresponsible to be overly conservative and inflate budget numbers—this can result in owners delaying or not proceeding with necessary repairs. (The *Strata Property Act 1998* requires refunds to owners.) To create a realistic budget, include:

- Consultant and legal fees.
- Goods and Services Tax (GST).
- An owners' contingency fund for unexpected problems.
- Construction costs, including an appropriate contingency fund for wood decay.
- Building permits.
- The need for occupants to leave their units for part of the rehabilitation project.
- Warranty or insurance costs.
- Provincial Sales Tax (PST). The PST should be included in the initial budget. A rebate can be obtained by applying to the HPO when the project is completed.
- Other costs that are not strictly part of the rehabilitation project, such as landscape repair, additional property management fees, additional security, and so on.

The consultant should provide preliminary estimates of most of the costs, with the possible exception of landscape, security, property management and legal costs.

These estimates are useful to give owners an idea of the size of the project and to allow owners to make decisions about proceeding to the next steps in rehabilitation. The estimates, though, are not usually accurate enough to determine special assessments, as the rehabilitation program is not fully defined at this stage.

Chapter 3—Pre-construction, provides a more-detailed discussion of construction costs.

2.7 Evaluation stage—Owner and property manager checklist

- ❑ Owners decide to investigate building envelope condition because of reported problems or as a precaution.
- ❑ Owners develop a short list of qualified consultants to assess building envelope condition.
- ❑ Owners request proposals from several —at least three—selected consultants.
- ❑ Owners review and evaluate proposals and select consultant.
- ❑ Consultant provides questionnaire to strata council or property manager for circulation to all owners.
- ❑ Owners provide completed questionnaires and relevant documents about building envelope history to consultant.
- ❑ Consultant reviews documents and questionnaires before on-site investigation.
- ❑ Consultant carries out on-site investigation.
- ❑ Consultant collects and analyses data and writes a condition assessment report that includes—if appropriate—recommendations for rehabilitation.
- ❑ Consultant submits draft report for review.
- ❑ Strata council reviews draft report.
- ❑ Consultant makes revisions and submits final report.
- ❑ Final report is presented to all owners at an information meeting.
- ❑ Owners review report and seek clarification if required.
- ❑ Retain lawyer to provide guidance.
- ❑ Strata council seeks second opinion if desired.
- ❑ Owners review rehabilitation options and decide to proceed with selected option.
- ❑ Make application to HPO reconstruction loan program.

Chapter 3—Pre-construction

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Chapter 3—Pre-construction

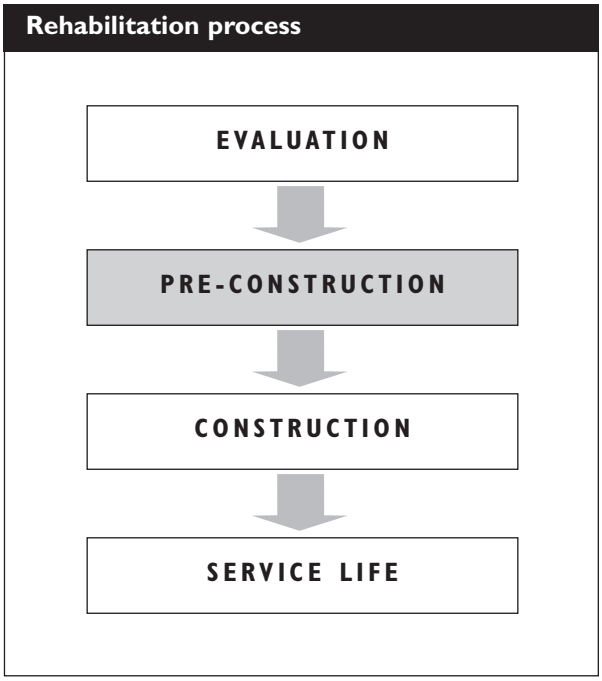
3.1 Introduction

This chapter outlines the tasks in a building envelope rehabilitation project and discusses the pre-construction stage in detail. The pre-construction stage follows the investigation and evaluation stage, although there may be some time between identifying a problem and deciding to proceed.

3.2 Rehabilitation project outline

The condition assessment report produced after evaluation of the building envelope presents conceptual level recommendations for rehabilitation and renewal. It is important to understand that these recommendations are not a basis for implementing remedial work. Conceptual recommendations need to be developed, refined and documented in detail before tendering construction work to contractors or obtaining a building permit.

Pre-construction typically begins with a design process, during which the consultant considers ways to deal with problems and helps owners make decisions about the rehabilitation. Once the owners make their decisions, the selected design is developed and documented in greater detail in drawings and specifications. These documents give the exact extent and nature of the work, materials to be used and so on. The drawings and specifications are used to obtain bids from pre-qualified contractors, obtain a building permit to do the work and as the basis for carrying out the rehabilitation. Once the owners select a contractor, usually based on the lowest bid, the project moves into the construction phase. During this phase,



the remedial work program designed by the consultant is implemented and repair and reconstruction takes place on-site. Chapter 4 discusses the construction phase in detail.

3.2.1 Temporary repairs

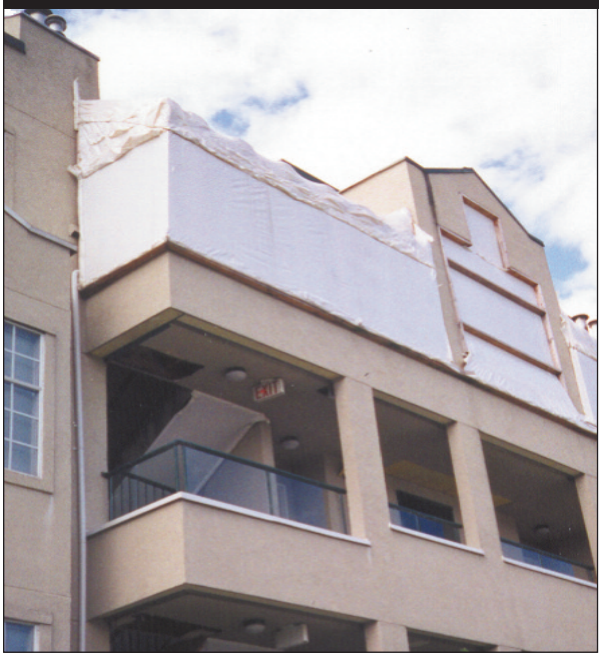
In some cases, a building needs temporary repairs before the main remedial work begins. These repairs are usually either emergency structural repairs or temporary tarping to prevent water ingress. See Photo 3-1 and Photo 3-2.

The only reason for temporary repairs is for life and safety concerns and to reduce deterioration and occupant discomfort between discovery of a problem and permanent repairs.

It is strongly recommended that consultants be involved in determining the appropriateness of temporary repairs.

Photo 3-1—Temporary shoring placed to support walkway structure

Photo 3-2—Temporary enclosure over top of stairwell and walkway to limit water ingress and damage until permanent remedial work is undertaken



3.2.2 Pre-construction phases

Pre-construction can be divided into three phases:

1. Design

Developing and reviewing various potential solutions to envelope problems and selecting the most appropriate solution.

2. Construction documents

Producing construction documents (drawings and specifications) to describe the selected design solution in detail so contractors can accurately determine costs and make competitive bids.

3. Tendering—Contractor selection

Obtaining competitive bids from several pre-qualified contractors and selecting one to do the remedial work.

3.2.3 Owner–Consultant agreement

The main parties in the pre-construction phase are the owners and the consultant. The owners may ask the property manager to represent them. Specialized sub-consultants, such as structural engineers or mechanical engineers, may assist the consultant.

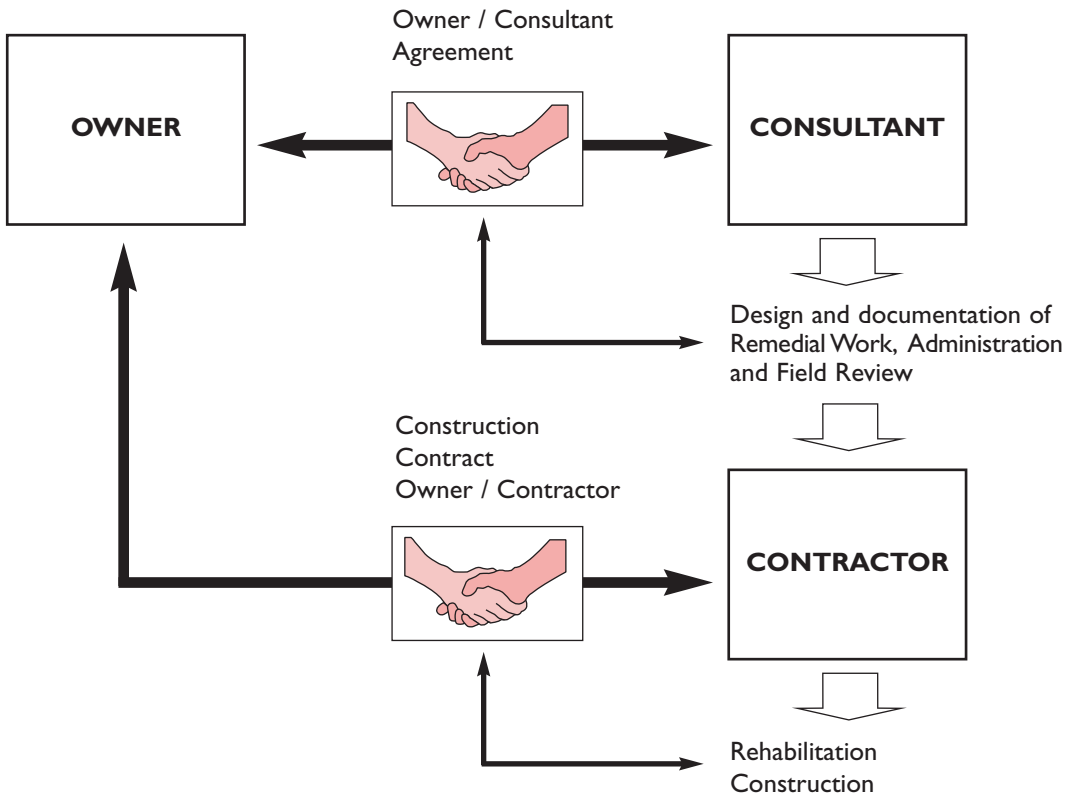
Ideally, the consultant who investigated the building and produced the condition assessment report will continue to be involved in the project. The importance of maintaining continuity is discussed in Chapter 2. If the consultant who originally evaluated the building is not involved in the pre-construction stage, the new consultant must review the previous work and to be satisfied that the evaluation and its conclusions are appropriate. In some cases, this may mean additional exploratory work or reconsidering of some of the previous recommendations.

Larger and more complex rehabilitation projects require a project team consisting of consultants from different disciplines. Owners will typically deal directly with one prime consultant who in turn retain and co-ordinates the specialist consultants. The consultant team will likely include the following:

- Prime consultant—Co-ordinating Registered Professional (CRP). Can be an architectural firm or an engineering firm.
- Building Envelope Professional (BEP), as designated by the APEGBC or AIBC who will also be the prime consultant in many cases.
- Structural engineer.
- Mechanical engineer.
- Code consultant.

The role of the consultant changes at this time from investigating and reporting to co-ordinating the rehabilitation construction project. This larger scope of work, as well as the value of both the consulting and construction activity, means that the owners and consultant should develop a new, more formal contract. This owner–consultant agreement covers the provision of professional services during the pre-construction and construction phases, as well as preparation of a Building envelope manual (discussed in Chapter 5). It is important to distinguish this agreement from the construction contract, which is signed later by the owners and the contractor selected to do the remedial work. (See Figure 3-1. Chapter 4 discusses construction contracts in more detail.)

Figure 3-1—Common arrangement of contracts and agreements



3.2.4 Standard forms of agreement

There are a number of standard construction industry owner–consultant contracts that should be used.

If the prime consultant is an engineer, use **ACEC-31—Owner–engineer agreement.** If the prime consultant is an architect, use **CCAC-6—Owner–architect agreement.**

It is not recommended that owners draw up their own contracts to cover what they may see as their project's unique conditions, no matter how tempting it is. It is very difficult to compose a new form of agreement that adequately addresses all the issues covered by the industry's standard forms.

Ideally a formal owner–consultant agreement should be signed before the consultant starts design work. However, developing and reviewing the contract may take some time. It is common for the owners, or the property manager on their behalf, to issue a letter to the consultant authorizing the consultant to start work before a formal agreement is signed. The owners' lawyer should always review the letter and the agreement before it is signed.

3.3 Understanding technical aspects of rehabilitation work

A detailed discussion of technical issues is outside the scope of this *Guide* and is unlikely to interest most owners. Those who are interested should review the *Consultant's Guide*. To help you make informed decisions, you should have some understanding of some technical issues. Several of the technical terms used in the following discussion are explained in the Abbreviations and glossary.

In most cases, current practice in rehabilitation of significantly damaged building envelopes differs from original construction in two fundamental ways:

- The use of rainscreen technology to better control rain penetration.
- The increased focus on design and construction of details.

3.3.1 Rain penetration control

Until recently, most walls of multi-family residential buildings in B.C. were designed as face-sealed walls. Face-sealed walls rely on creating an impervious barrier to water at the outer face of the wall. All openings, joints between materials, cracks and penetrations in the cladding must be completely sealed to prevent water entry. In practice, this is extremely difficult. Face-sealed walls will generally provide acceptable performance only in low-exposure conditions—conditions in which walls are not wetted often by wind-driven rain.

A rainscreen wall functions differently. The designer recognizes that some incidental water may penetrate the exterior cladding. A rainscreen wall allows the water to drain through a drainage cavity. In addition to providing drainage, the cavity limits the amount of water traveling further into the wall assembly.

It is important that property managers and strata councils understand why walls have failed and why different technology may be needed to rehabilitate the walls. Developing this understanding will help them better communicate the technical issues to the other owners and will help consultants and contractors as they implement the rehabilitation process.

Simply, the basic differences between face-seal and rainscreen wall assemblies in controlling rain penetration are illustrated in Figure 3-2 and Figure 3-3.

Fundamentally, three factors are needed for water to penetrate a building:

1. Water on the exterior of the building.
2. An opening for the water to move through.
3. A driving force (such as differential pressure, capillary forces, gravity) to cause the water to move through the openings.

Removing any one of these factors eliminates the potential for water penetration. If the wall assemblies are exposed to rainfall and can be assumed to get wet, wall design can manage only the openings and the driving force.

Wind will create a pressure difference between indoors and outdoors. In both face-seal and rainscreen wall assemblies, this pressure change occurs primarily at the most-airtight element in the wall construction since it provides the greatest resistance to airflow through the wall. This airtight material (or series of materials) is commonly referred to as the "air-barrier."

In a face-seal wall assembly, the air barrier is the outside surface of the cladding. It is the surface where the pressure drop occurs. Because this surface is frequently wetted, any imperfections in the face-seal surface will certainly lead to air movement through the holes. This creates a driving force that can bring in the water from the face of the cladding. See Figure 3-2. (The *Survey of Envelope Failures in the Coastal Climate of British Columbia* identifies poor details.) Once water penetrates the exterior cladding and enters the wall assembly, it is trapped. Face-seal walls have no way of dealing with water penetration. Wood components deteriorate because water either stays in the wall or dries very slowly.

In a rainscreen wall assembly, the air barrier can be established at several locations within the assembly. Figure 3-2 shows an air-barrier placed across the sheathing paper on the exterior surface of the sheathing. The cladding is not airtight—in fact, there are deliberate openings to facilitate drainage and drying. The pressure drop occurs primarily at the sheathing paper, not across the cladding. The elimination of the pressure drop across the cladding removes a driving force at the cladding. This greatly reduces the potential for water to move past the cladding.

Very little water reaches the air barrier membrane–secondary waterproofing surface on the other side of the cavity. Therefore, the probability of a minor imperfection in the air barrier allowing water penetration is significantly reduced.

The cavity also acts as a capillary break, reducing the opportunities for water to be trapped between the cladding and the sheathing paper. The cavity allows unrestricted drainage, by gravity, of any water that penetrates the cladding.

3.3.2 Rainscreen technology in wood-frame rehabilitation

In medium-exposure, wood-frame envelope rehabilitation, the rainscreen wall typically creates a drainage cavity behind the cladding. Installing wood strapping between the cladding and the remainder of the wall assembly creates the drainage cavity. See Photo 3-3 and Photo 3-4.

Figure 3-2—Performance of face-seal wall assemblies

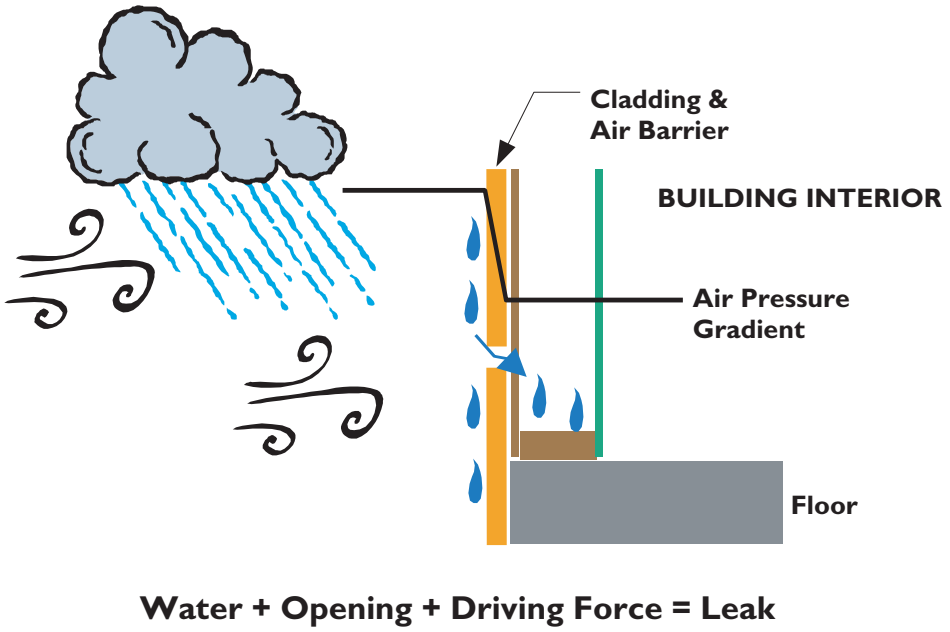
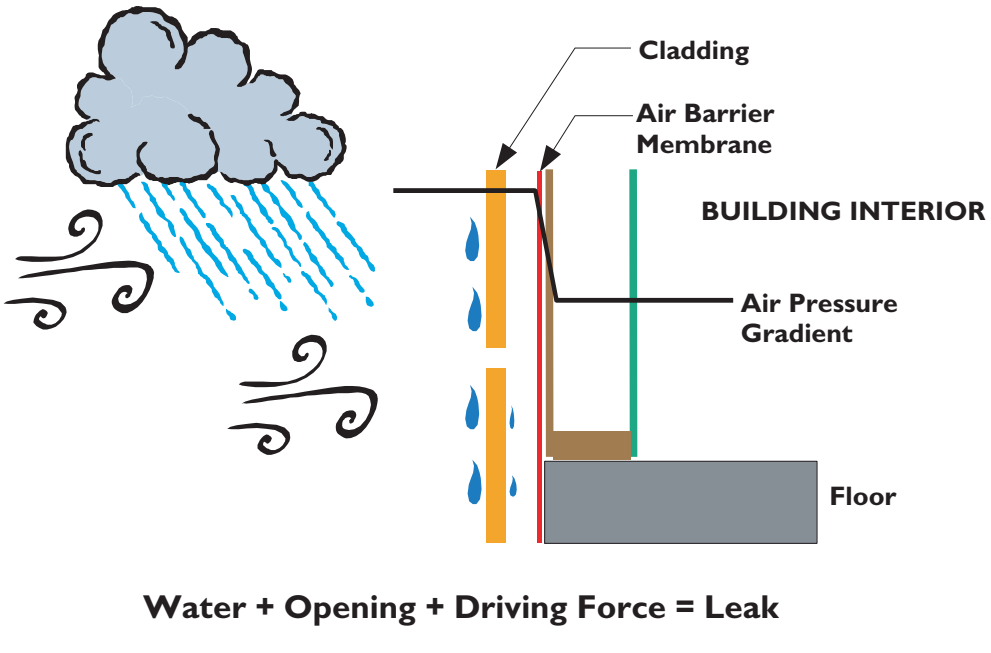


Figure 3-3—Performance of rainscreen wall assemblies



Note: These figures illustrate the impact of the driving force of the wind on water penetration. Other driving forces such as gravity can also result in water moving through an opening into the wall assembly.

Photo 3-3—Wood strapping applied over sheathing paper to create a drainage cavity. Photograph taken before the application of cladding. Any water penetrating the cladding and entering the cavity drains out of the wall at the base of the wall or at a cross-cavity flashing.

Photo 3-4—Strapped-cavity rainscreen wall at through-wall flashing location. Water in cavity is directed out of the cavity and away from the wall at the metal cross-cavity flashing. The vinyl bug screen attached to the bottom of the wood strapping prevents insects from entering the cavity.

3.3.3 Design and construction of details

Rehabilitation, in many cases, focuses more on design and construction of building details than original construction. This is particularly true when new wall and window assemblies are part of rehabilitation. Reconstruction of details can be a significant part of rehabilitation costs. Photo 3-5 shows a saddle detail constructed as part of a rehabilitation project. The enclosed CD-ROM shows rehabilitation of two details —balcony–wall interface and window. The CD-ROM shows the sequencing, from removal of existing cladding, through improvements to the detail and installation of the new cladding.

Photo 3-5—Rehabilitated detail at saddle interface. Note the sloped top surface of flashing to promote drainage, upturn of flashing behind cladding and self-adhesive membrane under metal flashing as the moisture barrier.

3.4 Design phase

The design phase is the part of the rehabilitation process requiring the greatest owner input. Evaluation sets out the scope of rehabilitation. Design develops the solutions to address the rehabilitation needs. Subsequent phases—preparation of construction documents, tendering and construction—simply implement design decisions and require much less input from the owners.

Owners are usually unaware of the many alternative approaches for rehabilitation. In addition, rehabilitation may be an opportunity to update the building's appearance and address other renewal needs cost-effectively. All of these alternatives have different performance expectations, risks and costs. Consultants should present the alternatives and opportunities to the owners, and give them guidance so they can make informed decisions.

Typical opportunities include:

- Adding canopies over doors.
- Changing cladding material for walls.
- Using different wall assemblies.
- Installing new balcony, deck and walkway surfaces, or changing them.
- Changing balcony guardrail configuration.
- Changing configuration of existing windows.
- Changing building colour scheme.
- Changing building features.
- Eliminating problematic details.
- Enclosing balconies or walkways.
- Deciding whether to install new windows or use the existing windows.

The following sections describe the main activities in the design phase.

3.4.1 Review condition assessment report

If there is a long period between the assessment of the building envelope and the decision to go ahead with remedial work, the consultant will have to review the condition assessment report—particularly the conceptual recommendations.

3.4.2 Phasing the work

Phasing work—rehabilitating in stages as funds become available—is one way owners can match spending with cash flow. Phasing results in some loss of sequencing and economy of scale because there are additional start-up, mobilization and demobilization costs.

One of the most significant issues is the loss of continuity and project-specific training by construction crews. Construction efficiency is always poorest at the start of a project. It improves continuously as crews become familiar with the place of the work and the project's requirements.

When the work is phased, construction crews move on and specific project knowledge is lost. The balance of construction is in the less-efficient start-up mode. The impact of phasing depends on the size of the phases and the nature of the project. The extra costs from phasing can range from one per cent to as much as five per cent of total construction costs.

3.4.3 Develop alternative design solutions

There is a basic reason for moisture-related failures in wood-frame buildings: the balance of wetting and drying is wrong. The wood materials within wall assemblies stay wet long enough, at the right temperature, for wood decay to start and persist. The decay continues and endangers the structure of the building.

The *Survey of Building Envelope Failures in the Coastal Climate of British Columbia* determined that exterior moisture or rain is—by far—the most significant source of moisture damage to wood-frame buildings. Other sources, such as condensation from air leakage, vapour diffusion and construction moisture, are much-less significant contributors. Controlling rain penetration is, therefore, the primary focus of rehabilitation. "Rain penetration control," in Chapter 3 discusses the basic science of rain penetration control.

There are several ways to control rain penetration. In some cases, one method is the solution; in other cases, the solution is a combination of methods. The methods include:

- Changing to rainscreen wall from face-seal assemblies.
- Eliminating details that may cause problems.
- Improving details.
- Adding overhangs or canopies to reduce the amount of wetting on walls.
- Replacing components, such as windows, with higher-performance components.
- Enclosing exterior spaces, such as walkways and balconies, to avoid exposure to rain.

Photos 3-6 to 3-12 are examples of these approaches on different buildings.

Photo 3-6—Addition of canopies over patio doors and extension to roof overhang over upper level arch windows to reduce exposure

Photo 3-7—Existing walls and balconies prior to rehabilitation

Photo 3-8—Rehabilitated building featuring rainscreen stucco clad walls, revised balcony guardrail, new windows and cross-cavity flashing at window head

Photo 3-9 (before rehabilitation)

Photo 3-10 (after rehabilitation)—Enclosure of walkway to reduce exposure includes addition of roof over upper level and addition of glazing in openings

Photo 3-11—Poor existing detail where planter walls tie into main building walls

Photo 3-12—Elimination of problematic detail by removing planter wall tie-in at building walls

Deciding which approach is right depends almost completely on the building. Building form, exposure to wind-driven rain, extent of current damage, zoning and building code restrictions—all have an impact. The consultant's design task is to consider all of the influences to arrive at acceptable and appropriate alternatives.

There are also many smaller issues that may not affect performance significantly and are sometimes discretionary. They include:

- Cladding types.
- Walkway or balcony surface finishes.
- Colours.
- Features such as cornices and bands.

Often the most obvious result of rehabilitation is a change in appearance. Any modification to a building's exterior, whether it is painting, changing cladding material, adding flashing or more extensive work, such as adding canopies, roof structures or balcony enclosures, can dramatically affect the overall esthetics of the building. People usually perceive esthetics in an individual and subjective manner and building designs, especially recent developments, cover a very wide stylistic range. For these reasons it is difficult to evaluate potential visual impact of any remedial measures in general terms.

Owners should take care to select profiles, materials and colours that complement or enhance the original design. Revisions that do not respect the original design may unfavourably affect the building's appearance and, ultimately, its resale value. In some municipalities, proposed design revisions may be referred to an advisory design panel, which will comment on proposed changes. This review process can delay building permit application and approval.

3.4.4 Municipal codes, regulations and processes

A review of all the codes, bylaws and regulations that apply to a building is an essential design phase activity.

There are two principal types of municipal regulations: zoning and planning bylaws and building bylaws or codes.

Zoning typically deals with what is allowed in terms of building size, height, location on site, materials, colours and so on. The municipal planning department through the development permit process regulates zoning.

The building code (or the building bylaw in the City of Vancouver) focuses on how buildings are built and deals with issues such as means of egress, fire safety, construction assemblies, protection from precipitation and so on. Code issues are dealt with through the building permit process. In addition to the building code, many municipalities have established additional requirements for building envelopes.

The consultant must liaise with the municipality throughout the pre-construction phase. The consultant should advise owners about all municipal requirements, building and development permit issues and the associated fees. The building code requires consultants to sign letters of assurance taking responsibility for the project with the municipal authority. If the project is large enough for a team of consultants, one of the team must be the coordinating registered professional (CRP). The CRP must be involved in all stages of the project and coordinate the work of the consultant team.

3.4.5 Compare and present alternatives

For many buildings there are several possible design solutions. Table 3-1 lists possible repair strategies and their impact on performance. The table also gives considerations and limitations for each strategy.

A rehabilitation plan could involve combinations of these and other strategies and different initial construction, renewals and maintenance costs. A plan may or may not change a building's appearance. One plan may have more or less risk for future performance than another plan. Proper presentation and analysis of the choices is the only way owners can make informed decisions about rehabilitation.

The owners must decide what the best choice is for them. They must decide how to balance risk, capital cost, durability, maintenance and renewals expenditures, appearance, cash flow and many other factors. The consultant's job is to clearly identify each issue and advise the owners.

The warranty provider will also have an interest in design decision-making since the provider will want to evaluate risk of future failure. It is therefore important to include the warranty provider in the design process, and that the consultant effectively explain the various alternatives and associated performance risks to the warranty provider.

A major consideration is cost. Owners should expect the consultant to compare the costs of reasonable alternatives and present the comparison to them. The comparison should include initial construction costs for rehabilitation, as well as anticipated renewals and maintenance costs (including consultant costs) over a set period. A reasonable period is a point between the life expectancy of the cladding and the life expectancy of the structure—30 to 50 years.

Table 3-2, is a case study for a building that needs extensive rehabilitation. Along with the costs associated with rehabilitation alternatives, risks and other factors are listed. Owners should expect a similar approach with similar basic information from their consultant.

Table 3-1—Repair strategy choices

Possible repair strategy	Impact on performance						Zoning/ development permit implications			Building Code implications			Effectiveness
	Reduce exposure	Repair damage	Eliminate details	Improve existing details	Less-sensitive assembly	Improve existing assembly	None	Minimal	Significant	None	Minimal	Significant	
Replace sealant				✓			✓			✓			Use in low-exposure situation where minimal damage has occurred, or in combination with other measures that reduce exposure conditions.
Add coating						✓	✓			✓			Use in mass wall assemblies. May also provide short-term relief from active leakage in face seal assemblies, but also reduces the ability for the wall to dry over the long-term leading to elevated moisture content if details still allow moisture ingress.
Add overhangs	✓							✓				✓	Use in situations where minimal damage has occurred and addition of overhangs (lower exposure) will have significant positive impact on performance of assemblies and details. Use in combination with improvements to existing assemblies and details.
Add canopy	✓							✓			✓		Use in reducing exposure conditions locally when existing windows and doors are to be left in place and/or details cannot be improved.
Add roof	✓								✓			✓	Use in situations where considerable area in plan could benefit from reduction in exposure conditions (upper level balcony, exposed walkway.) Can eliminate need for improvement to assemblies and details.
Enclose space	✓								✓			✓	Use in situations where building form facilitates the enclosure of space to reduce exposure conditions (walkways.)

Table 3-1—Repair strategy choices

Possible repair strategy	Impact on performance						Zoning/ development permit implications			Building Code implications			Effectiveness
	Reduce exposure	Repair damage	Eliminate details	Improve existing details	Less-sensitive assembly	Improve existing assembly	None	Minimal	Significant	None	Minimal	Significant	
Remove, waterproof window opening; reinstall windows		✓		✓			✓			✓			Appropriate where basic window performance is acceptable but perimeter detailing is suspect or contributing to leakage into adjacent wall assembly. May also be appropriate to defer expense of replacing poorer performing window replacement to the future.
Reconstruct saddle details		✓		✓			✓			✓			Use to improve detail where damage has occurred locally if in low-exposure conditions and in combination with improvements to wall assembly for higher exposure conditions.
New rainscreen wall assemblies					✓			✓				✓	Appropriate when damage is systemic due to many problematic details or inadequate existing wall assembly. Different rainscreen assemblies should be considered depending on exposure conditions.
New windows					✓			✓			✓		Use when existing windows do not meet performance expectations and cannot be effectively refurbished for given exposure conditions.
Use metal and glass guards rather than upstand walls		✓	✓					✓			✓		Use when existing guardrails and associated attachment details are deteriorated or structurally inadequate. May be more cost-effective in other situations rather than adapting existing guardrails to meet new wall assembly or balcony configuration.

Table 3-2—Cost analysis of alternatives

Building description and current condition

Three storey wood frame, 85 suites, stucco clad building, eight years old, roughly square in plan with large interior courtyard. Suites are accessed via exterior walkways which run around three sides of the courtyard. Medium exposure conditions for all walls, no overhangs. The suite walkway walls are partially exposed due to window wells that separate suites from walkways. Three stair towers and elevator core are enclosed. All suites have either balconies or, if at grade, a patio. The upper level balconies are uncovered. All balconies or patios are accessed from the suites via a sliding glass door and a wood swing door. The windows are non thermally broken aluminum concealed barrier type frames. The balcony and walkways are a urethane based membrane with concrete topping placed directly onto membrane.

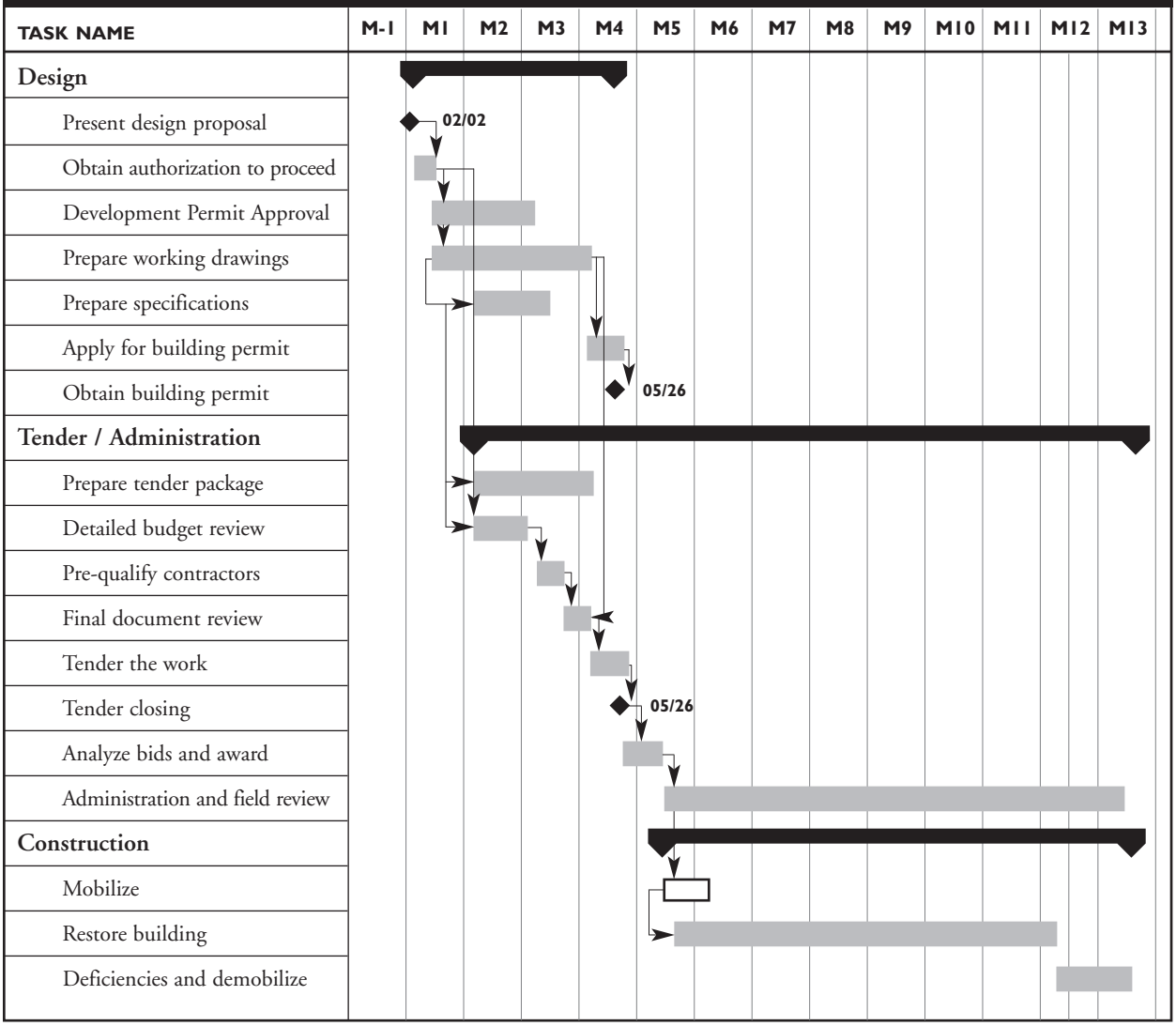
Damage to wood sheathing and framing is severe throughout the walkway structure requiring temporary shoring to be put in place. Damage is moderate at many of the balconies but particularly at upper level balconies and on the east face of the building. South, west and north faces of the building are damaged but less severely than the east elevation, indicative of the reduced exposure to wind driven rain. The incidence of problematic details is fairly consistent on all building elevations.

Rehabilitation plan			Renewals plan			Maintenance plan			Total 35 Year Cost	Risks	Other considerations
Description	Year	Capital costs	Description	No. of occurrences in 35 years	Capital Costs	Description	Frequency (Times per year)	Cost per Occurrence			
1 Minimum program										Significant risk that damage will proceed undetected in some areas. Significant risk that mold will impact on indoor air quality in some suites. Significant risk that walls will eventually need to be replaced in some areas regardless of high maintenance and renewals	Property values could be significantly affected over the long term due to inconclusive nature of strategy adopted. Possibly ongoing water damage and repairs required.
Replace all sealant and recoat with elastomeric	1999	$110,000	Replace sealant and recoat stucco walls every 5 years	7	$110,000	Inspect and adjust windows	0.5	$1,000			
Replace sealant in window mitre joints	1999	$20,000	Improve window sealant every 3 years	11	$10,000	Clean roof, balcony and walkway drains, gutters	2	$500			
Investigation to determine structurally unsound areas	1999	$50,000	Investigation to confirm performance every 3 years	11	$10,000						
Rebuild walkways and other areas where structural damage is severe	1999	$500,000	Contingency for structural repairs every 3 years	7	$50,000						
	Total	**$680,000**		**35 yr. Total**	**$1,340,000**		**35 yr. Total**	**$52,500**	**$2,072,500**		
2 Maintain form--strapped rainscreen wall assembly										Minimal risk of moisture related problems	High initial capital cost. Minimal maintenance requirements. Assembly performance lowers maintenance sensitivity.
Replace all windows	1999	$120,000	Clean stucco walls every 5 years	7	$10,000	Inspect and adjust windows	0.5	$1,000			
New strapped rainscreen walls on all elevations	1999	$2,100,000	Replace sealant every 5 years	7	$10,000	Clean roof, balcony and walkway drains, gutters	2	$500			
Resurface balconies with new membranes	1999	$200,000	Investigate to confirm performance every 5 years	7	$5,000						
Reconstruct walkways with new membranes	1999	$500,000	Recoat exposed stucco walls every 10 years	3	$70,000						
	Total	**$2,920,000**		**35 yr. Total**	**$385,000**		**35 yr. Total**	**$52,500**	**$3,357,500**		
3 Modify form--mixed wall assemblies										Minimal risk of moisture related problems	High initial capital cost. Minimal maintenance requirements. Assembly performance lowers maintenance sensitivity. Building appearance will change and approval required from municipality
Construct new roof/skylight assembly over window wells to reduce exposure of walkway walls	1999	$200,000	Clean stucco walls every 5 years	7	$10,000	Inspect and adjust windows	0.5	$1,000			
Replace 70% of windows (not walkways)	1999	$84,000	Replace sealant every 5 years	7	$10,000	Clean roof, balcony and walkway drains, gutters	2	$500			
New strapped rainscreen walls on all elevations except walkways	1999	$1,500,000	Investigate to confirm performance every 5 years	7	$5,000						
Isolated repairs to walkway walls and improve face seal	1999	$100,000	Recoat exposed stucco walls every 10 years	3	$40,000						
Reconstruct walkways with new membranes	1999	$500,000									
	Total	**$2,384,000**		**35 yr. Total**	**$295,000**		**35 yr. Total**	**$52,500**	**$2,731,500**		

3.4.6 Outline project schedule

For larger projects the consultant will provide a schedule (more detailed than the schedule in Figure 1-2) showing the main activities in both pre-construction and construction phases. The schedule will typically be a Gantt chart (Figure 3-4) that gives start and finish dates for each activity. The project schedule, particularly the construction phases, depends on factors the consultant cannot control and some flexibility must be allowed. The schedule is useful for owners because it gives key decision dates and—more important— is the basis for an assessment schedule to raise funds for the project.

Figure 3-4—Typical schedule for rehabilitation



3.4.7 Produce design documentation

The next stage in rehabilitation is construction documentation. Before then, the consultant should present the owners with conceptual drawings and other material describing the proposed design solutions. The owners should keep a record of the decisions they make about design options.

3.5 Construction documents phase

3.5.1 Activities

In some ways, the construction documentation phase continues design activities. The consultant continues to develop a detailed solution to the building envelope problems. By this stage the broad strategic decisions have been made. Now the focus is on more detailed technical aspects. Less input is needed from the owners as most of the important decisions have been made.

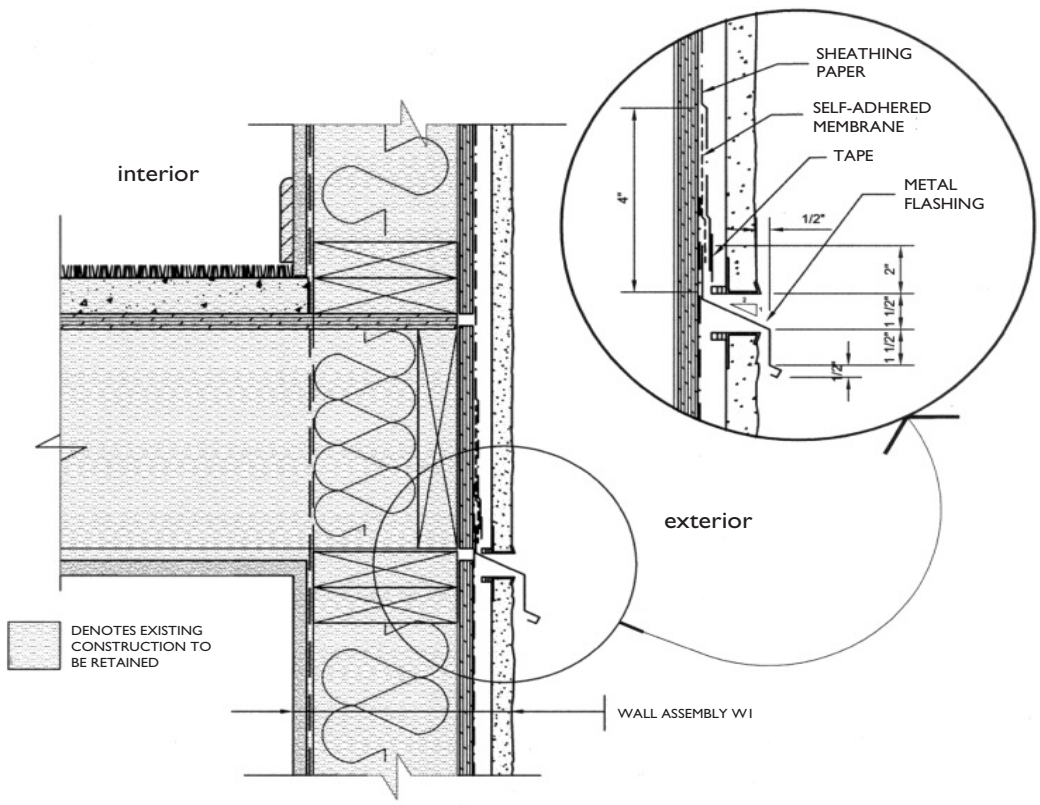
The key activity is producing the construction drawings and specifications. They describe the project in the detail contractors need to accurately evaluate the cost of doing the work.

3.5.2 Construction documents

"Construction documents" is the term that describes all the written and graphic documents prepared by the consultant (and sub-consultants) to communicate the project's design and construction requirements. These documents include drawings, specifications and changes to these documents made during the tender period or construction, such as addenda, change notices and site instructions.

Drawings provide graphical information and identify the size, location and arrangement of various building assemblies, components and materials. Figure 3-5 is a typical rehabilitation detail that might be part of a construction document drawing package. Drawings are part of the building permit submission and many municipalities require that certain information be provided on permit application drawings. However, the primary function of construction documents—drawing, details and project specifications—is to give the contractor the information needed to do the work. Generic terms identify materials and components. Complementary technical specifications give detailed information on the type and application of materials and components, compliance with standards, workmanship and approved suppliers of particular materials and components.

Figure 3-5—Typical rehabilitation detail for cross-cavity flashing



3.5.3 Warranties, guarantees and bonding

Owners should ask their consultant for information about warranties, guarantees and bonding. Owners should have their lawyer and their consultant present them with information.

Since Sept. 30, 2000 a third party warranty has been required for all building envelope rehabilitation work. Minimum coverage is two years on labour and materials. If 60 per cent or more of any wall is replaced, an additional five-year water penetration warranty is required for that wall. Some warranty providers may offer more than the mandatory coverage, such as 10-year water penetration coverage.

Exceptions to these general requirements include buildings with repair costs less than the greater of $10,000 per building, or $2,000 per unit in the building. Clearly, for most envelope rehabilitation projects, the five-year warranty requirement applies. The warranty must be provided by an insurance company approved by the Financial Institutions Commission and must meet the requirements of the *Homeowner Protection Act* and regulations.

The intent of this warranty is to ensure the quality of repair and rehabilitation work. The warranty providers will need to review and

approve the project prior to providing a warranty, approve the consultants, approve the contractors, review the construction and possibly be involved in post construction inspections. It is therefore recommended that as part of the rehabilitation process a warranty provider be selected and involved early. This will allow the design to be reviewed with the provider; the warranty costs identified and included in the budget. This will avoid surprises at the tender stage about coverage, availability of approved contractors and costs. Contact the HPO for more information about details of the warranty program.

Owners should obtain information about the following performance "guarantee" vehicles:

- Bid bond.
- Performance bond.
- Warranty provided by the contractor through CCDC-2 (or similar) form of agreement.
- Consultant professional liability insurance (including the possibility of project-specific insurance).
- Third party warranty based on HPO's mandatory program.

3.5.4 Building permits

Building envelope rehabilitation is a construction project and requires a municipal building permit. Owners must apply for a building permit and pay the building permit fees set by the municipality. However, some municipalities have either waived the fees or will rebate them for rehabilitation. The consultant is the best choice to prepare permit documents and actually apply for a permit, on behalf of the owners. Preparing permit documents and applying for a permit should be part of the consultant's scope of services. The wait for a building permit varies, but it can be as long as six weeks. If the rehabilitation changes the building's appearance and requires development permit approval, the application can be more complicated and it can take longer to get a permit.

Apply for a building permit as soon as it is practical—usually when the work is tendered. Timing is important. Work cannot start until the municipality grants the permit. Owners must consider this timing when they make final arrangements with the contractor. Owners must also remember to include the cost of the building permit in the project budget.

The contractor is best-suited to obtain trade permits for plumbing or electrical work and to arrange for municipal inspections. The cost, effort and length of time required to obtain the trade permits are typically not significant. However, the tender documents should say clearly who is responsible for obtaining the permits.

3.6 Tendering and contractor selection

3.6.1 Construction implementation approaches

The consultant will provide information on different implementation approaches and help the owners select the appropriate approach for their project. Three basic approaches have evolved for construction projects.

First approach

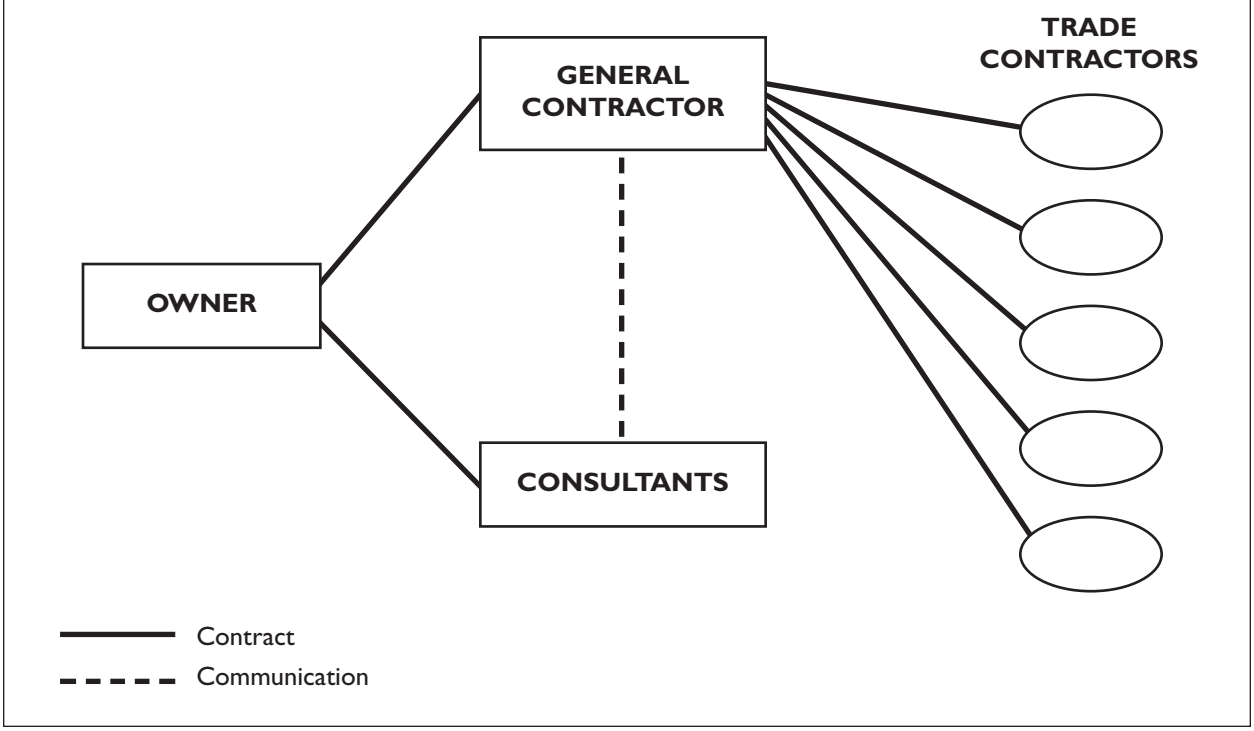
The first is the "traditional" approach. (See Figure 3-6.) It involves hiring a consultant or team of consultants to undertake design and produce construction documents (drawings and specifications) that are tendered to general contractors. The general contractor then contracts

independently with trade contractors for specific components of the work. Advice and input from a contractor may or may not be sought during the investigation and design stages.

The traditional approach is, by far, the most common model for rehabilitation projects. It requires the involvement of the owner, consultants and a general contractor in roles that are widely understood and recognized. This approach's advantage is that it provides a single point of responsibility and can generally be implemented with the least involvement of the owners.

Owner groups generally prefer the traditional approach because they are familiar with the concept of hiring one contractor for home improvements and because they perceive that the contractor is assuming the risk for construction-related issues. This perception is not entirely accurate in rehabilitation projects, as the single greatest risk is the cost of wood-decay repair. This risk stays with the owner until the owner and contractor agree, with the consultant's assistance, on the fair value of the rot repair and a reasonable adjustment to the construction schedule. Naturally, the owner is at some disadvantage in this process. The owner is committed to a contractor and the true impact of the rot repair is difficult to determine even with the help of an experienced consultant. For this reason, owners should tender only to contractors who are qualified and experienced in rehabilitation.

Figure 3-6—Traditional approach



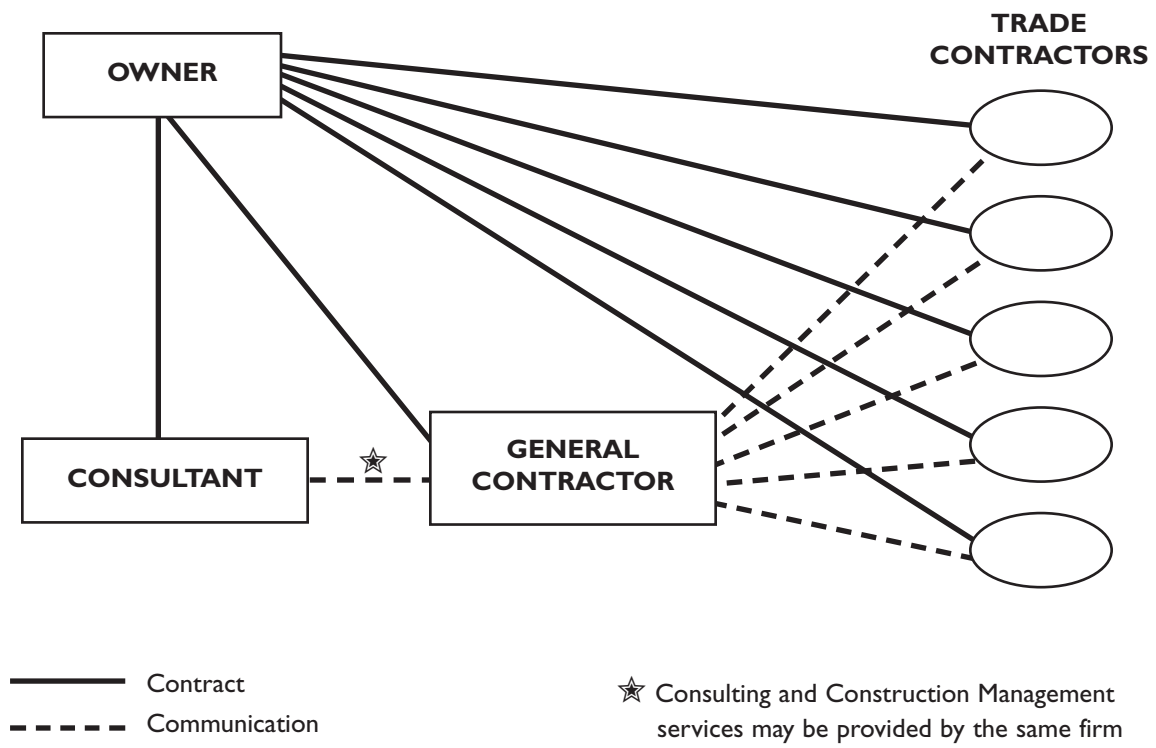
Second approach

The second is the "construction–managed" approach. Typically, the owner retains a consultant to perform many of the same investigation, design and field review services that are required in the traditional approach. The owner also retains the services of a construction manager to act as the owner's agent in co-ordinating and managing construction. Together, the consultant and the construction manager act on behalf of the owner as the construction management team. The work is tendered to select trade contractors who actually do the construction work. The trade contractors provide warranties and bonding.

Construction management services can be provided by specialty project management firms or by a general contractor who is suitably experienced in this form of construction. Figure 3-7 shows this relationship.

As a variation, the owner may retain a consultant who is qualified to offer construction management services in addition to design and field review services. There is no need for an independent construction manager and owners only need to deal with one entity.

Figure 3-7—Construction-managed approach



A unique feature of rehabilitation is occupancy of the building during construction. Sensitivity to this can often be the difference in the perception of a successful project by owners and occupants. The construction-managed approach offers more direct control over

scheduling and site management and can effectively accommodate the difficulties of working in an occupied building.

In many cases the building is being restored because of poor original design or construction practices. For this reason, owners know about the past mistakes and do not want similar mistakes. They want good consultants and good contractors. The traditional approach gives owners only limited control over the selection of the trade contractors, phasing and timing. The construction-managed approach can tender to individual trade contractors to better control the quality of the trades and still obtain competitive pricing.

A key aspect of the construction-managed approach is the ability to have construction expertise early in the design stage so there can be appropriate cost evaluation of alternate approaches. The ongoing involvement of the construction manager provides direct input to the design on construction issues as well as opportunities for cost savings before the work is tendered.

Third approach

The third approach is "design–build." It is essentially a turnkey approach to project delivery. A contractor and consultant team provides the project delivery on a unified basis with a design–build contract between the owner and contractor and a separate contract between contractor and consultant. This approach offers the advantage of only one point of contact and responsibility for the owner. However, it takes control of the process away from the owner almost completely and it becomes more difficult to demonstrate accountability.

The design-build approach is not recommended. Owners should confirm that the consultant's insurance is still valid in a design-build scenario. It may be necessary for the consultant to arrange project-specific professional liability insurance.

3.6.2 Tendering

Throughout the *Guide* there are references to the term "tender." The tendering process is the process by which the offers (contractor bids) are solicited, submitted, reviewed and a contractor selected.

Generally, issuing a tender is an offer by the owner to invited contractors to do the work in accordance with the terms and conditions of the tender documents, prepared for the owners by their consultant.

Since tendering is the process by which offers are made and accepted, it has very definite legal consequences and all participants have a number of explicit and implied responsibilities. Owners should be aware that the tender process is not to be taken lightly and must be conducted under the direction of professionals familiar with the process. For example, it is not acceptable for owners to return to the marketplace to try to find additional better prices once tenders have been received and opened.

Owners should always get legal advice about tender issues.

3.6.3 Selecting a contractor

The owner's consultant is generally the best resource for identifying contractors to ask to submit a tender. Contractors must be pre-qualified on their ability to perform the work. Select the contractor by competitive tender from a short list of three to five contractors.

While it is customary to have contractors compete for work in a competitive process price is not the only factor to consider. Value is much more important than the lowest price.

Owners and consultants can establish a list of invited bidders through a pre-qualification process. As a starting point, ask contractors to submit a fully executed CCDC-11. It is a valuable source of basic information about the contractor's history. Try to talk to the owners' representative for the contractor's most recent projects—do not rely solely on the list of selected contractor references given on the CCDC-11. Consider the following in pre-qualification:

- The contractor's ability to effectively manage the work.
- The contractor's ability to co-operate and work with the consultant.
- The contractor's reputation for completing work on time and on budget.
- The contractor's reputation for pricing extras and changes fairly and reasonably.
- The contractor's proven expertise in construction and rehabilitation.
- The financial strength and capability of the contractor

Everything that you will consider in selecting a contractor in a formal tendering process must be fully disclosed in the tender documents. The body of law about the tender process favours the low bidder unless other standards, and the basis for evaluating contractors on those standards, are clearly set out in the tender documents. If you do not clearly set out the standards, the low bidder may sue if not awarded the contract. Typical standards include:

- The price.
- The schedule.
- The strength of the specific superintendent to be assigned to the project.
- The contractor's specified hourly rates, unit rates, alternate prices or separate prices.
- The contractor's presentation of cost-saving proposals.
- Inclusion of all documents asked for in the tender offer, such as bonds, proof of suitable insurance coverage and proof of good standing with the Workers' Compensation Board.

3.7 Project costs

3.7.1 Distribution of total project costs

The design phase cost estimates are based on more detailed development of the proposed assemblies, more accurate area takeoffs and much more thought to phasing of the work and construction implementation. The consultant may ask a quantity surveyor or a contractor familiar with remedial work to help prepare cost estimates.

Once decisions are made, you can consider the project budget estimates as accurate to within 25 per cent.

The costs associated with the provision of a third party warranty must be included in the project budget. These costs may increase the total project costs by:

- Increasing construction costs because the warranty provider prefers a low-risk solution.
- Adding warranty fees to owners' costs, which can be from three to 10 per cent of construction costs.
- Adding hidden costs built in by consultants and contractors to cover additional administrative and indemnity provisions in the agreements they may have with the warranty provider.

Owners can use the estimates for overall project planning, obtaining approval for special assessment (the project estimate, plus + 25 per cent for owner's contingency fund) and to apply to HPO's reconstruction fund.

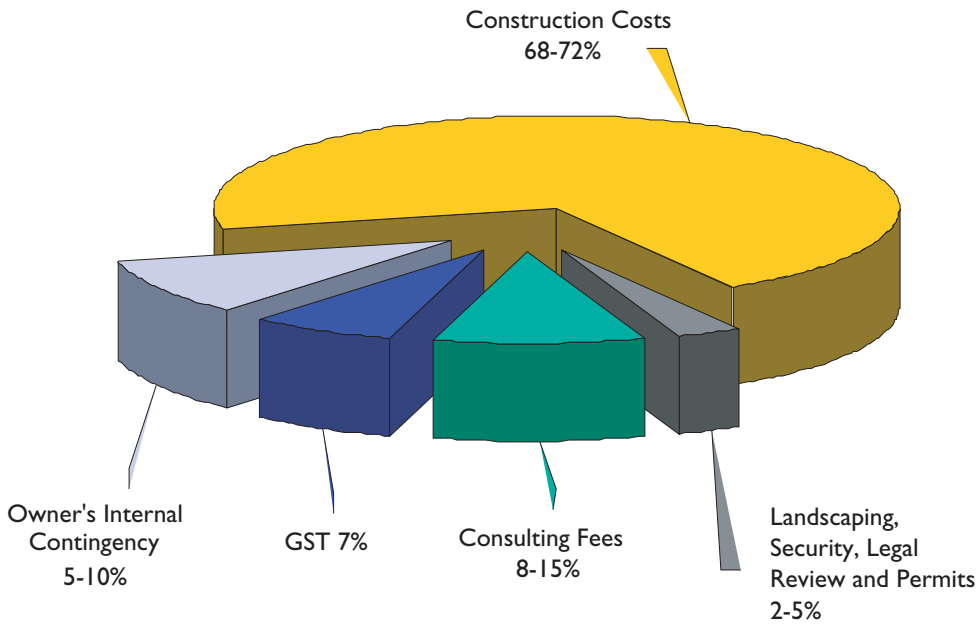
Near the completion of the construction documents phase (discussed in "Construction documents phase," page 3-20) the project estimate should be refined based on the nearly complete documents. It will again be necessary to involve a contractor or a quantity surveyor, and this cost should be included in the project budget. The contractor's review for budgeting purposes will likely result in more general comments and questions about the design documents. The contractor's review may identify cost-saving opportunities and help to develop a preliminary construction schedule and cash flow plan.

The pre-tender construction cost estimate should be combined with other project costs (discussed in Chapter 2) to arrive at an overall project estimate that should be accurate to within 15 per cent.

The tender of the construction work should not proceed without a completed estimate and the owners ensuring that there are funds to meet the cash flow requirements of the project. The detailed breakdown of this estimate will also form the basis for the evaluation of the bids. The owner's overall project budget should include a large-enough contingency fund to cover the upper end of the construction estimate. Usually, the contingency fund should be 10 to 15 per cent of construction costs.

Figure 3-8 shows the cost distribution for a typical project budget. Percentages vary depending on the size of the project. For example, the effort required for the consultant is similar regardless of the size of the project and therefore the fee, as a percentage, is higher for smaller projects.

Figure 3-8—Distribution of total project costs



The owner and the contractor should plan for various contingencies in the project. The contractor should include contingency in the bid for unforeseen or perceived risk items. The owners should have an overall contingency for unforeseen project costs. The construction budget should also carry a contingency for structural repairs and other possible costs. These are possible costs for which fixed-price bids cannot be obtained, as it is difficult, and even impossible, to determine their nature and extent.

It is important to note that contingencies are not necessarily going to be spent completely—amounts not spent are the property of the owner. On the other hand, those carried by the contractor within their bid remain with the contractor as profit if not spent during construction. This hidden contingency carried by the contractor can reflect poor quality, incomplete or unfair tender packages.

In some instances, contingencies for structural repair are identified before tendering. When the contract is awarded, some of these contingencies are eroded to make up for a higher-than-anticipated tender price. This borrowing from a structural repair contingency fund at the time of contract award can result in project budget problems as work proceeds if sufficient funds are not available to complete the work.

3.7.2 Decisions affecting costs

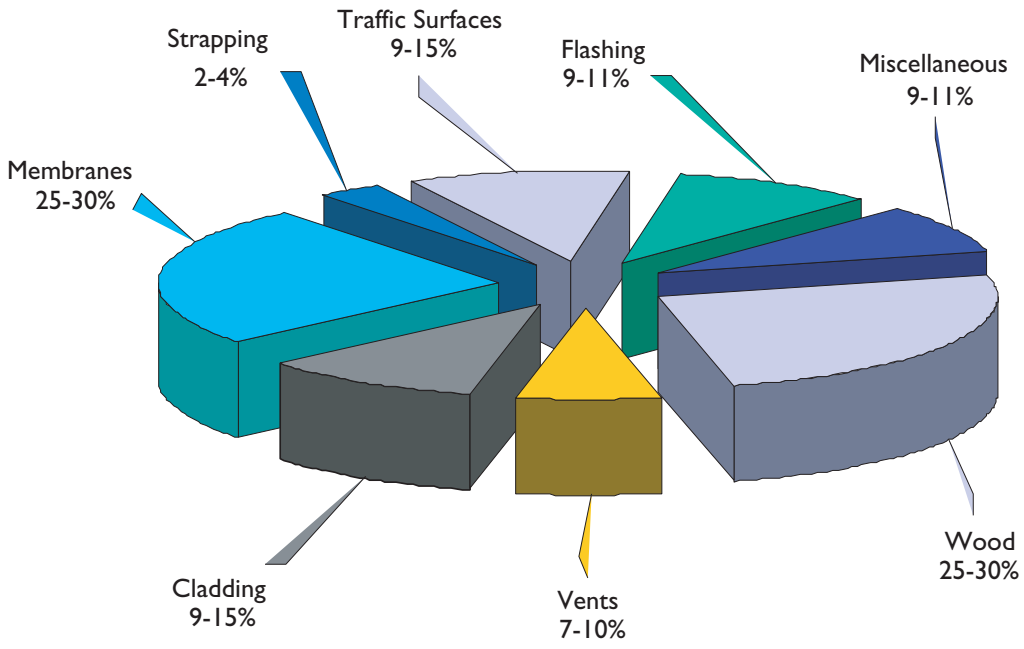
Construction costs are the most significant of the costs that make up the overall project budget. Using a typical cost distribution of materials, components and labour as the basis for discussion, the impact of various design decisions on the overall construction budget can be examined.

Bulk material costs (not including manufactured components such as windows) typically represent 20 to 30 per cent of construction costs and are generally distributed in accordance with Figure 3-9. Based on this figure a 20 per cent cost saving in the value of wood or membranes (the more significant relative materials) would reduce the cost of work in the order of 1.0 per cent to 1.8 per cent (20 per cent cost savings x 20 to 30 per cent of material costs x 25 to 30 per cent of total construction costs.) In fact, a 10-per-cent-saving on all materials would reduce the cost of work in the order of 2.5 to 3 per cent (10 per cent cost savings x 100 per cent of material costs x 25 to 30 per cent of total construction costs). It is unlikely that even dramatic changes in material selection will result in significant changes to the overall cost of the work.

Labour costs can be 40 to 60 per cent of the construction cost. It is evident that any gain in labour efficiency results in the most substantial relative decrease in the overall cost of rehabilitation.

Unfortunately, envelope rehabilitation is usually done in occupied buildings. This added complexity restricts the contractors' ability to work in the most efficient manner. Contractors must be sensitive to the needs of the occupants and use labour in ways that are not necessary in new construction. In order to encourage lower construction costs, owners should make every effort to facilitate the construction process and allow the contractor to work as efficiently as possible.

Figure 3-9—Distribution of materials costs



3.8 Pre-construction stage—Owner and property manager checklist

- ❑ Owners decide to proceed with rehabilitation work.
- ❑ Consultant advises owner about need for specialist consultants and co-ordinating registered professional (CRP).
- ❑ Retain consultant, sign owner–consultant agreement after review by lawyer.
- ❑ Consultant begins design of rehabilitation program:
    - ❑ Reviews recommendations from previous investigative or assessment work.
    - ❑ Develops design alternatives.
    - ❑ Reviews proposed design changes and other development permit or zoning issues with the municipal authority.
    - ❑ Reviews building code and other regulatory issues.
- ❑ Review and revise project budget for design alternatives.
- ❑ Consultant presents design alternatives and budget to owners.
- ❑ Consultant presents other construction implementation approaches to owners.
- ❑ Meet with and select warranty provider for rehabilitation project.
- ❑ Present and review proposed rehabilitation program with warranty provider.
- ❑ Owners review and approve design alternatives, budget and construction implementation approaches.
- ❑ Consultant prepares construction documents.
- ❑ Review and revise project budget based on final construction documents.
- ❑ Consultant prepares list of qualified contractors.
- ❑ Owners and their lawyer review construction documents, bid package and list of contractors to be invited to bid.
- ❑ Owners approve construction document package, budget and bidders list.
- ❑ Consultant invites bids from pre-qualified contractors.
- ❑ Consultant assists owners apply for building permit.
- ❑ Consultant reviews tenders, summarizes results and presents to owners.
- ❑ Owners select successful contractor(s).

Chapter 4—Construction

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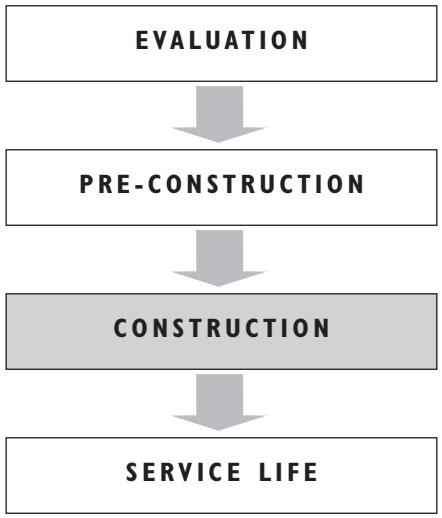
4.1 Introduction

The nature of the rehabilitation project changes dramatically when construction begins. For the first time, owners have physical evidence that the building is being repaired. It may have taken a year or more of investigation, decision-making and design work to get to this stage. Owners, who up to now have been dealing solely with the consultant, now have to make a legal agreement with a contractor or contractors to physically undertake the remedial work. As discussed in Chapter 3, there are three primary approaches to contracting for construction services; the traditional (general contractor) approach, the construction-managed approach and the design–build approach. This chapter considers the traditional (general contractor) approach only. (See Chapter 3—Pre-construction, for a more detailed discussion of the three implementation approaches.)

The construction contract between the owners and the contractor should not be confused with the owner–consultant agreement. The owner's contract with the consultant continues as it covers the professional services that the consultant provides during the construction. In addition, many standard construction contracts (between owners and contractor) set out a role for the consultant in administering and interpreting the construction contract. See Figure 4-1.

Rehabilitation process



The consultant's role changes in an important way at this stage in the project. During the investigation and design stages, the consultant acted as the owners' agent and represented their interests. Now, the consultant's role in administering the construction contract requires the consultant to interpret the contract conditions without bias to either the owner or contractor. In most cases this does not result in difficulties, but owners should be aware that the consultant has these responsibilities in addition to responsibilities to the owners.

Figure 4-1—Relationship between contracts and project stages

	PROJECT STAGES		
AGREEMENT	EVALUATION	PRE-CONSTRUCTION	CONSTRUCTION
Evaluation agreement			
Owner–consultant agreement			
Construction agreement			

Work normally done by general contractor	Work normally subcontracted
Removing existing cladding Window installation Interior repairs Removing, repairing deteriorated wood framing	Scaffolding Balcony and roof membranes Balcony guardrails Stucco or other cladding Metal flashings
Work normally done by contractors hired by owner but not part of rehabilitation project	**Work normally done by contractors hired by suite owner but not part of rehabilitation project**
Landscaping Lawn sprinkler system	Interior finishes

Using a typical, stipulated-price contract (CCDC-2), the most common contractual method, the owners have only one contract, with a general contractor. The general contractor's own staff does some of the remedial work.The general contractor also subcontracts much of the work to specialized-trades contractors. The owners do not deal directly with the sub-trades. An example of some of the work carried out by general contractors and work subcontracted is provided below.

4.1.1 Construction schedule

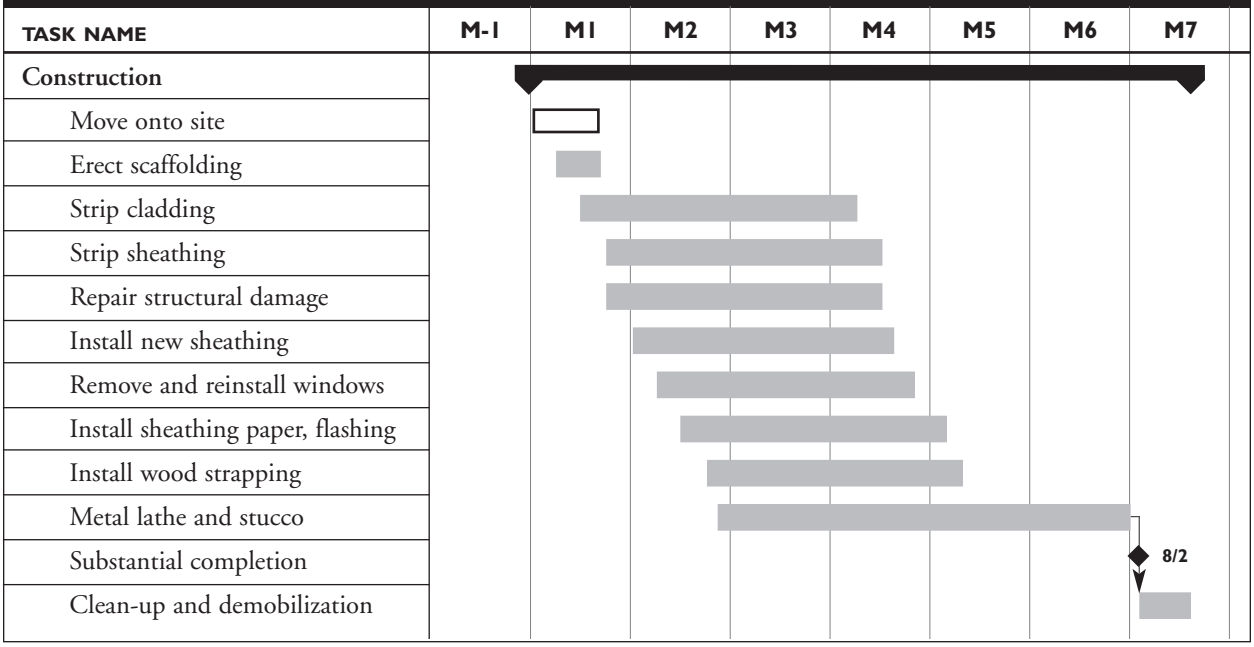
It is difficult to determine exactly how much time a rehabilitation project will take because it is a complex process, involving several different contractors and many different activities. However, it is generally in the contractor's best interest to finish the project as quickly as possible. The time the project takes depends on:

- The size and complexity of the project.
- The amount of repetition needed in details and assemblies.
- The amount of wood decay and deterioration that is found.
- Unanticipated deficiencies in original construction that must be corrected.
- Changes that the owners ask for in the scope or nature of the work.
- Unforeseen access restrictions.
- Unusually bad weather.

Usually, bid documents ask the contractor to indicate how long it will take to complete the project. When the contract is awarded and an actual start date set, the contractor will provide a detailed construction schedule, usually as a Gantt chart. Figure 3-4 is a Gantt chart.

The schedule shows each rehabilitation activity, with a start and finish date. The contractor will be required to update the schedule at regular intervals to show scheduling changes for particular activities or a change in the completion date. Figure 4-2 is a simplified Gantt chart for rehabilitation of a typical wood-frame building.

Figure 4-2—Typical schedule for wood-frame rehabilitation construction. Applying stucco takes longer than other tasks because of the time stucco needs to cure.



Many of the tasks shown in Figure 4-2 take the same time to complete. Most activities overlap because work is done systematically. Starting with the erection of scaffolding, a crew assigned to each task moves around the building doing different "waves" of work as it progresses. Note that the "application of stucco" task has a longer duration than other tasks due to the curing time involved.

The building is rehabilitated according to the design prepared by the consultant and described in the contract documents. This chapter does not attempt to describe the technical aspects of construction, but focuses on administrative issues, roles and responsibilities. The following discussion considers administration of construction in three stages:

- Construction start-up.
- Ongoing construction activities.
- Completion.

4.2 Construction start-up

4.2.1 Letter of intent

Once the owners select a contractor a contract can be prepared and sent to the owners' lawyers to review. This may take several weeks. However, work can start without a formal contract. The owners give the contractor a "letter of intent." The letter tells the contractor that the owners accept the bid, that they intend to sign a contract based on the bid and asks the contractor to start work. The owner's lawyer should review the letter of intent and it should be sent to the contractor before the pre-construction meeting.

4.2.2 Pre-construction meeting

Before construction starts there should be a pre-construction meeting to introduce the owners and the general contractor. The meeting should be attended by the following:

Strata council members
Ideally, all council members should attend. However, if the council has a building sub-committee it may delegate this responsibility to the committee.

Building property manager
The property manager typically plays an important role in day-to-day administration and liaison with the owners, consultant and contractor. An individual or firm could be hired to do this.

General contractor's project manager
The project manager is responsible for the contractor's administration of the project. The project manager makes regular visits to the site but is based in the contractor's main office.

General contractor's project superintendent
The contractor's on site representative, responsible for day-to-day operations, co-ordination of sub-trades, site safety.

Consultant–project engineer/architect
Most likely the person the owners worked with in the investigation and pre-construction stages. Administers the construction contract and co-ordinates activities of the consultant's field representative.

Consultant's field representative
The consultant's on-site representative. Makes regular site visits to review contractor's work for conformity with the contract.

4.2.3 Agenda items

Introductions (Contacts, telephone numbers, and so on)

Introduce contractors, owners and consultants to each other. Make and distribute a list of personnel and their telephone numbers—including 24-hour emergency numbers for the contractor.

The owners should designate an individual or small group to be the liaison between the main owner group and the contractor.

This individual or group will deal with construction issues such as:

- Suite access.
- Notice to owners.
- Approvals for small items and taking requests for more significant decisions to the council.
- Co-ordinating site access and use issues, such as material storage locations.
- Assist in communicating with owners and occupants as work progresses.

At certain times, for example, when carrying out small portions of work in suite interiors, the contractor may need to be in daily contact with an owners' representative.

Contractors submissions (insurance, bonds)

The contractor provides the owners with proof of insurance coverage and bond documents required by the contract. The owners or the owners' lawyer keeps originals.

Owners submissions (insurance, building permit)

The owners provide the contractor with the building permit and copies of the approved permit documents. The permit and drawings must be kept on site at all times and be available for inspection by the municipal building inspector. In some cases, the contract may require that the contractor obtain the building permit and pay permit fees. In this case, the consultant should provide copies of the drawings and other information to the contractor to submit to the municipality. The owners at this stage

should check with their insurance broker to ensure that their policy has no exclusions for construction work.

Contractors schedule

The contractor's bid indicates the time required to complete the project. At this stage, contractor should provide a detailed construction schedule. (See discussion in "Construction schedule," page 4-4.)

Lien holdback account.

The *Builders Lien Act* applies to all construction contracts over $100,000. It requires that a holdback trust account be established in the joint names of the owner and contractor. See discussion about payments to contractor in "Certificates of payment," page 4-8.

Contractor's office and materials storage locations

The location of the contractor's site office and materials and waste storage areas should be discussed. If the project site is large enough, the contractor may use a site trailer for office and storage space. If the site area is small, the contractor may have to put the trailer on the municipal sidewalk or street. There are fees for this use of municipal property and to rent a trailer. A common practice, which saves the owner's money, is to allocate two or three spaces in the underground parkade to the contractor for an office and secure storage.

Existing planting removal and protection

Owners should understand that construction will probably destroy landscaping within about 2.5 m (8 ft.) of the building. If it is left to the contractor to repair and replace, charges will likely be added to the work at marked-up rates. Most multi-unit residences have a business relationship with a landscaper and can arrange for removal and replacement of landscaping, separate from the rehabilitation contract.

Safety plan

Site safety issues should be discussed, including exits in case of fire and temporary disconnection of fire alarm and sprinkler systems.

Security

Additional security precautions may be necessary. All parties should review the overall security of the building during construction and develop a plan.

Shop drawing review process and schedule

This is an administrative issue, primarily of interest to the consultant. Shop drawings are detailed drawings produced by trades contractors showing particular components of the design. They are reviewed by the consultant and must be provided to the consultant on a set schedule in order not to delay the project.

Arrangements for field review

This is primarily a contractor-consultant issue. A procedure for field review, reporting and follow-up on deficiencies must be established. Decisions include important mock-ups, testing of assemblies and frequency of visits.

Record drawings

The consultant will give the contractor an additional set of drawings to use to note minor changes made because of site conditions. See "Record drawings," page 4-10.

4.3 Ongoing construction activities

Owners must realize that once construction starts they will be living on a construction site for several months. Working on an occupied building is difficult for the contractor and trades contractors, and in many ways more difficult than new construction. Co-operating fully with the contractor makes construction as efficient as possible.

Photo 4-1 shows a typical wood-frame rehabilitation project underway. Parts of the construction work are visible as are a typical scaffolding and enclosure arrangement. The green netting contains demolition debris and allows both air and light to pass through easily, but restricts the passage of wind-driven rain onto the platform and is a deterrent to access to the scaffold platform.

Occupant safety is a major concern during construction. The contractor, through the site superintendent, is responsible for site safety; however, it is common for the consultant to provide a list of basic safety precautions for the owners.

Access to suites is primarily required to work on windows. The normal process is to remove the existing window, reframe as required, waterproof the window opening and reinstall the existing window. Usually, this only takes a day. The suite is never left open at night. If windows are replaced, the process is the same. There may be several weeks between reframing and waterproofing and arrival of the new windows. If so, the existing windows stay in the rehabilitated opening until the new windows arrive.

Access to suites is also required to deal with wood decay at balconies that extends into the suites, or to complete patching of the interior drywall finish because of damage caused by exterior work.

Photo 4-1—Scaffolding and temporary enclosure for a wood-frame rehabilitation project

Note different stages of construction visible (wood strapping, cross-cavity flashing, wire lath and sheathing paper).

4.3.1 Certificates of payment

Usually, the contractor is paid at the end of the month for work completed during the month. Based on an agreed schedule of costs for each portion of the work, the contractor submits a "progress draw" to the consultant for review

and approval. The draw gives the percentage of each portion of work completed and the cost of the work. The draw also gives the amount paid to the contractor previously for each item and the amount claimed for the current month. The progress draw should also indicate the costs of approved change orders and the total adjusted construction cost.

The consultant reviews the contractor's draw and confirms that the work has been completed to the stage indicated and generally conforms to the construction documents. The consultant visits the site close to the date of the draw to make an accurate estimate of progress. The consultant may change the amounts claimed based on a different interpretation of the percentage of work completed. Revisions are discussed and agreed on with the contractor before the consultant issues a certificate of payment to the owner.

The certificate of payment lists the amount to be paid to the contractor, including GST, and the amount of the lien holdback to be paid to the trust account. Once a certificate of payment is issued, the owners must pay the contractor within five days, although normal practice is to process the claim as quickly as possible. At the same time the contractor is paid, the lien holdback amount is paid into the lien trust account. The owners break their agreement with the contractor if they do not pay the full amount of the certificate of payment.

4.3.2 Field review

The consultant visits the site at regular intervals to view the contractor's work. Owners sometimes misunderstand this aspect of the consultant's work.

The term "field review" has been carefully chosen to indicate periodic sampling of the construction to help ensure general conformity with the construction documents. It does not mean full-time inspection or supervision. In normal contract arrangements, the contractor is solely responsible for carrying out the work in accordance with the contract documents. For this reason the contractor has control over the means and methods used. It is not appropriate for the consultant to be involved in how the contractor does the work. The consultant should not be expected to take on responsibility for guaranteeing that the work is carried out in accordance with the contract.

The number and frequency of field reviews depends on the complexity, size of the project, the stage of construction and—to some degree—on the efficiency and abilities of the contractor. Typically, the consultant's field representative visits the site at least once a week and writes a site-visit report that is distributed to the contractor, owners and other consultants if applicable. The building envelope professional (BEP) also visits the site, but not as often as the field representative.

4.3.3 Progress meetings

Meetings should be held regularly to review progress and discuss construction issues. The owners' representatives (usually a member of council or the building committee), the property manager, the contractor's project manager and superintendent and the consultant should attend the meetings. Normal practice is for either the contractor or the consultant to keep and distribute minutes of progress meetings.

The agenda should review:

- The schedule.
- Quality issues.
- Costs and adjusted contract price.
- Site safety and cleanliness.
- Any other issues related to the relationship between the owner and occupants and construction.

In addition to the owners' involvement at these meetings, there is a need to establish an owner as the liaison with the consultant and the contractor, as well as an owner-review process for progress claims, lien account management and issuing cheques.

4.3.4 Changes in the work

Although every effort is made to fully document the nature and extent of the work in the contract documents, some changes during construction are inevitable.

There are two components in particular in rehabilitation of wood-frame buildings that cannot be fully quantified or documented before construction.

Repair of deteriorated framing

The extent of damage to the structural wood framework and the amount of deteriorated framing that needs removing and replacing.

Deficiencies in existing construction

Poor framing during original construction that cannot be seen until exposed in rehabilitation. Handling of changes that increase or decrease the contract price must be fair to all parties. Failure to do so can lead to bad relationships, disputes and litigation.

Owners must recognize that a contractor is entitled to recover the costs of a change—including the work itself, site overhead costs, office overhead costs and an amount for profit. Likewise, contractors must be aware that owners are entitled to a fair credit for work not completed and that costs for extra work must be fair and justifiable.

In preparing the tender and contract documents the consultant sets out ways to handle the cost of unforeseen work. These include:

- Payments based on a time-and-material basis.
- Unit-price method.
- Lump sum, fixed costs where a change can be clearly measured.

All these methods have a place in determining the cost of unforeseen work. The tender and contract documents must clearly define the method of payment for extra work or changes and include rates for labour, materials and equipment.

Consultants must review contractor change quotations as soon as possible and encourage the owners to respond promptly. Delayed decisions can affect the overall schedule and add cost.

4.4 Completion

4.4.1 Record drawings

It is common to require the contractor use one set of the contract drawings to prepare record drawings. These record changes from the contract documents caused by site conditions and changes ordered by the consultant. The extent to which the record drawings include new wood-framing members needs to be clarified, preferably within the general requirements section of the contract documents. The drawings should also record

locations of concealed mechanical and electrical services. At the end of the project, the record drawings must be turned over to the owner. The municipality may also require a set of record drawings.

4.4.2 Commissioning meeting

A final project meeting should be held involving the consultant, contractor and owner. The purpose of this meeting is to hand over all project completion documents, including product warranties, record drawings and building envelope manual (maintenance and renewal plans). Minutes should be taken so there is documentation of the handover.

4.4.3 Warranty reviews

Within one month of the end of the project warranty period (usually one or two years following substantial completion), the consultant must review the performance of the building envelope, and document and notify the contractor of items that require attention to complete the work.

4.5 Construction stage—Owner and property manager checklist

- ❑ Owners provide selected contractor with "letter of intent."
- ❑ Contractor begins to mobilize.
- ❑ Pre-construction meeting to introduce contractor and owners.
- ❑ Owners appoint one individual to act as liaison with contractor and consultant and define the authority of the individual to make decisions.
- ❑ Owners establish who will attend progress meetings on their behalf.
- ❑ Owners, together with contractor, set up a lien account.
- ❑ Consultant drafts agreement between owner and contractor(s).
- ❑ Owners' lawyer reviews proposed agreement between owner and contractor(s).
- ❑ Owners sign agreement with contractor(s).
- ❑ Consultant does field reviews and submits reports to owners.
- ❑ Contractor submits progress draws to consultant for review.
- ❑ Consultant reviews progress draws and certifies payment.
- ❑ Owners make progress payments to contractor(s) and consultant.
- ❑ Owners' representative(s) attend progress meetings.
- ❑ At substantial performance of the rehabilitation work, the owners should prepare their own list of deficiencies to be submitted along with the consultant's list to the contractor(s).
- ❑ Attend final commissioning meeting with consultant and contractor(s).
- ❑ Owners' consultant makes application to HPO for the provincial sales tax rebate.
- ❑ Note warranty inspection dates and ensure that inspection takes place.

Chapter 5—Building envelope manual

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Chapter 5—Building envelope manual

5.1 Building envelope manual

Near the end of construction, the consultant should prepare a building envelope manual. Preparation of this manual is consistent with the *Strata Property Act* (1998) and the *Strata Property Amendment Act* (1999). The manual gives the framework for developing, updating and incorporating detailed maintenance and renewal plans in the continuing operation of the building.

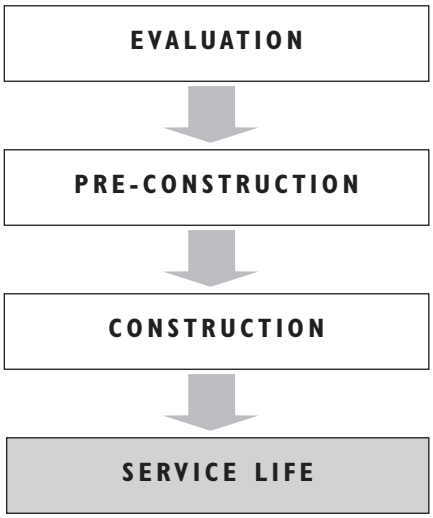
The owner–consultant agreement should clearly state whether a building envelope manual is part of the consultant's basic service or an additional service.

Chapter 3—Pre-construction, focuses on factors influencing decisions about the durable construction of the building envelope. A logical extension of this is providing guidance about maintenance and renewal so owners can continue to manage their building with durability and long-term performance in mind.

Although maintenance and renewal plans form the core of a building envelope manual, the manual could also include:

- A description of the building envelope assemblies.
- A description of how each assembly is intended to control various moisture sources.
- Guidance to controlling interior conditions and their impact on the envelope.
- Guidance about the attachment or addition of features to walls, balconies and roofs, such as fasteners through membranes.
- A list of materials and components used in construction, with product data sheets where appropriate.
- A list of consultants and contractors involved in the project and their areas of responsibility.
- Warranty documents for building envelope assemblies.

Rehabilitation process



This section discusses development of a maintenance plan and a renewal plan for the envelope assemblies. Similar plans could be developed for the entire building and integrated into one document. Although usually presented as separate documents, maintenance and renewal plans are very dependent on each other. Poor maintenance could mean higher renewal costs or having to spend money on replacement earlier than would have been required with a more responsible maintenance plan. For this reason, it is critical to update both the maintenance plan and the renewal plan regularly, usually every two to three years.

The concept of maintenance and renewal planning for an envelope assembly is analogous to the life of automobile tires. Tires may provide 80,000 km of reliable service if regular care is given to inflation pressure, alignment and abnormal hazards—operations and maintenance. After 80,000 km, tires may continue to perform, although if inspected there will be much less tread and the walls will show signs of cracking.

Continued use of worn tires carries well-known risks, ranging from the inconvenience and cost of a flat tire to injury and loss of life from losing control of the vehicle because of tire failure. Prudent automobile owners replace tires at the end of their useful life and avoid exposure to unacceptable risks—renewal.

A more comprehensive discussion of durability, life cycle costing and the relationship between initial design and construction, maintenance and renewal is in *CSA S478-95 Guideline on Durability in Buildings.*

5.2 Maintenance planning

Maintenance of the building envelope increases the probability that components and assemblies fulfil their intended functions and realize their intended service lives. Failure to maintain can result in damage to other envelope components and assemblies, including interior finishes, and reduce the structural capabilities of the envelope assembly. Maintenance planning for the building envelope assemblies involves describing inspection and maintenance tasks and scheduling them.

The maintenance plan for each building is unique. It must reflect the functional characteristics of each envelope assembly. For example, an existing wall assembly in medium-exposure conditions uses a face-seal exterior moisture control strategy. Because there is no damage, the wall is left in place. The maintenance plan for the wall is quite different than a plan for a rainscreen wall assembly that places little reliance on the sealant to fulfil intended functions. The sealant in a face-sealed assembly would require frequent—once a year — inspection and maintenance. The rainscreen assembly may require inspection only every second year and sealant replacement or repairs every five years.

Maintenance activities are also a fundamental part of the warranty program. Failure to undertake some specified warranty activities may void warranty coverage. In addition, inspections to identify warrantable items should be incorporated into the maintenance plan.

Table 5-1 gives maintenance recommendations and time frames for a horizontal, wood-siding, concealed-barrier assembly incorporating a vinyl, concealed-barrier window assembly.

Table 5-1—Sample maintenance plan

Component	Recommendation		Time frame
	Inspection	Maintenance	
Wood siding	Inspect finish on wood siding for evidence of staining, discolouration, fading, chalking or peeling.	Maintenance activities could include repairs to item creating concentration of water leading to staining, localized refinishing or cleaning.	Twice a year
Sealant	Inspect sealant for cracking, loss of adhesion or bulging.	Maintenance work may include replacement of sealant at some locations, or addressing excessive joint movements through modification of a detail	Annual
Windows	Inspect hardware and weatherstripping.	Adjust to ensure good operation and fit.	Annual
Doors	Inspect hardware and weatherstripping.	Adjust to ensure good operation and fit	Annual
Exhaust vents	Inspect exhaust vent screens for lint collection.	Clean if required.	Annual

The maintenance plan must reflect the competence of the individual inspecting the component. For example, more specific guidance in the form of checklists and resulting actions is required if a property manager or an untrained resident of the building is doing the inspection. Very little guidance is needed for a professional who is regularly involved in the design, construction and maintenance of the building envelope. Ideally, a customized checklist and resulting action list should be created which is specific to each individual building.

Inspection and maintenance may trigger a renewal activity and is a good way to keep the renewal plan up to date. For example, if maintenance notes frequent adjustment for window hardware, it may make sense to replace it with less maintenance-intensive hardware.

The maintenance plan may also include operating guidance. In particular, the building's mechanical ventilation system should be addressed since it can have a significant impact on the performance of the envelope assemblies. Cleaning of exhaust vents, as described in Table 5-1, is one example. Another may be instructions about when to use bathroom and kitchen exhaust fans, or about keeping interior relative humidity below critical levels. Repeated inspection findings of humidity-related damage may prompt a recommendation to install humidistat controls on exhaust fans.

5.3 Renewal planning

During a building's service, planning for renewal activities identifies the timing, cost and nature of both the expected repair and replacement and for renewal activities resulting from premature deterioration of a component. At the time of construction however, the plan will be largely based on theoretical or textbook knowledge of typical life expectancies for components and assemblies.

The development and funding of a renewal plan is independent of the mandatory contingency fund contribution amount in the Strata Property Act. The mandatory amount may or may not be enough for a specific building's renewal needs.

As with a maintenance plan, a renewal plan should ideally consider all elements of the building, not just the building envelope. Once the renewal needs are identified, a funding plan can be established. A plan allows for gradual funding, through monthly fees, for anticipated expenditures rather than the surprise of special assessments. It is usually considered adequate to plan for likely renewal expenditures within the next 20 years. Forecasting beyond 20 years is difficult and it is unlikely that building owners will start to save for expenditures that far in the future. Table 5-2 shows what could be incorporated into a renewal plan.

Table 5-2—Sample renewals plan

Item	Recommendation	Time until renewal	Renewal cost
Roof	Replace roof and associated perimeter flashing	20 years	$100,000
Stucco wall assembly	Clean and recoat wall with new acrylic coating	10 years	$30,000
Stucco wall assembly	Replace sealant at window perimeters	5 years	$6,000
Windows	Replace insulating glass units	Phased—done as units fail over 10 years, beginning in year 15	$2,000 a year
Doors	Replace door hardware	20 years	$3,000

The plan can be much more detailed if desired, to include, for example, component and material specifications for each recommendation.

Renewal requirements depend very much on maintenance activities and the quality of the original design and construction. For this reason, renewal plans should be updated once every two or three years. At that time, the condition of each component can be assessed and the timing and cost of the renewal activities adjusted to reflect the actual in-service condition.

Appendix A

Building Envelope Professional—guidelines for professional practice

At the time of production of this document, the BEP designation was not being granted by the AIBC and APEGBC. Nonetheless, the scope of services set out below accurately reflects those items typically undertaken by professionals operating as consultants in the field of envelope rehabilitation.

1. **Basic Building Envelope Professional services**
The role of the *Building Envelope Professional* (BEP) is to provide review of the building envelope design to the project architect or co-ordinating registered professional with respect to environmental separation and the performance of materials, components and assemblies of the building envelope. The responsibility for the design and field review of the construction of new buildings rests with the project architect, except when a professional engineer is providing architectural services under the AIBC/APEGBC Memorandum of Agreement.

   The usual phases of the *Basic Services,* as discussed below, are generally organized in a consulting agreement according to the sequential stages of a typical project. They are intended to assist the *Building Envelope Professional* (BEP) in addressing the *Building Envelope* performance as defined in Part 5 of the Building Code.

   For the purposes of this document, element means an assembly, component or material forming part of the *Building Envelope* and performance means performance with respect to Part 5 of the Building Code.

1.1 **Conceptual or "schematic" design phase**
In the conceptual or schematic design phase, the *BEP* shall:

1.1.1 Attend as required, meetings with the Consultant and design team to obtain information regarding the functional, esthetic, cost and scheduling requirements. The *BEP* review should focus on the *Building Envelope* elements and performance requirements defined in Part 5 of the Building Code.

1.1.2 If required, assist the *Co-ordinating Registered Professional* (CRP) in identifying the need for any specialist envelope consultants who may be required for the project.

1.1.3 Review the design criteria and environmental loads for the Building Envelope assemblies in consultation with the CRP.

1.1.4 Review applicable codes, standards, regulations, restrictions, insurance requirements and other factors affecting the performance of the building envelope.

1.1.5 Review compatibility and interaction with other building systems.

1.1.6 Review the preliminary design concept, together with alternate design concepts where appropriate.

1.1.7 Consider the requirements of other design professionals and provide information relating to the *Building Envelope* design, as they require.

1.2 Design development phase

In the design development phase, wherein the accepted conceptual design is developed in sufficient detail to enable commencement of the *Contract Documents* by all participants in the design team, the *BEP* shall:

1.2.1 Review preliminary drawing of such *Building Envelope* elements as: walls, windows (and glazed elements), roofs, balconies, decks and typical interface details between elements of the *Building Envelope.*

1.2.2 Review durability of *Building Envelope* elements and consider maintenance, renewal and service life requirements. Specific consideration should be given to the following items:

(a) Expected service life of the *Building Envelope* elements;

(b) Consideration of the layering of *Building Envelope* elements, so that repair and replacement of elements with shorter services lives does not require the removal or replacement of items with longer service lives; and

(c) Materials compatibilities and resistance to various mechanisms of deterioration, given the nature, function and exposure of the materials.

1.3 Contract documents phase

In the contract documents phase the *BEP* shall:

1.3.1 Review the construction documents to verify that they describe *Building Envelope* elements that achieve the performance criteria that were established during the Schematic Design Phase and further developed during the Design Development Phase.

1.3.2 Provide technical input into the specifications.

1.3.3 Assist in establishing testing and inspection requirements.

1.3.4 Assist the client in obtaining the required approvals, licenses and permits, including preparation of the relevant documentation required by the authority having jurisdiction.

1.4 Bidding and negotiation phase

In the bidding and negotiation phase the *BEP* shall:

1.4.1 Provide assistance to the CRP in preparing addenda to the design and clarification of the construction documents as required.

1.5 Construction phase

In the construction phase, the *BEP* shall provide services for all *Building Envelope* elements which the *BEP* has reviewed in earlier project phases.

Some items reviewed by the BEP may also require review by other members of the design team or by testing or inspection agencies. Such work may include waterproof membranes, glazing, pre-cast concrete elements, welding, proprietary products and primary and secondary structural elements.

Construction phase services shall include, but not necessarily be limited to the following and may vary depending upon the complexity of the job and the experience of the contractor.

1.5.1 Attend construction meetings, if required.

1.5.2 Assist in confirming, reporting and scheduling procedures for testing and field reviews.

1.5.3 Assist in confirming that the qualifications of fabricators meet the specifications.

1.5.4 Assist in review of submissions for general compliance with the contract documents.

1.5.5 Assist with the review of *Building Envelope* related shop drawings and other submissions for general conformance with the contract documents and the intent of the design.

1.5.6 Provide enhanced field review, visiting the site at sufficiently frequent intervals, appropriate to the stage of construction and review a substantial number of the details (rather than just a representative sampling) to observe the quality and the progress of the construction of those elements reviewed by the *BEP*. The term "enhanced field review" is used to differentiate the level of review which a *BEP* shall provide, which supplements the level of field review and assurances which shall be provided by the architect and other registered professionals.

1.5.7 Review reports provided by material and component manufacturers, as well as other reports prepared by professionals reviewing *Building Envelope* elements.

1.5.8 Prepare site visit reports outlining observations and deficiencies in the work and bring them to the attention of the CRP.

1.5.9 Make site visit reports available to the authority having jurisdiction upon request.

1.5.10 Assist in arranging for and observing the mock-up and/or testing of key envelope elements such as wall assemblies or window installations, where required.

1.5.11 Review the continuity of thermal insulation, moisture, air and vapour barriers.

1.5.12 Review drainage paths.

1.5.13 Review the acceptability of the moisture content of wood products.

1.5.14 Review that components and materials used are those specified in the contract documents.

2. Additional services provided by the *Building Envelope Professional*

In addition to the *Basic Services*, the *BEP* may be required to provide the following *Additional Services* if they become necessary during the course of the project.

They are generally not considered part of the basic services, as discussed in the preceding sections and may require a review of the service agreement between the BEP and their client.

Examples of additional services are:

2.1 Work resulting from changes to the project as originally described and agreed to under the contract between the BEP and client, such as changes in scope, schedule, cost, complexity, diversity or magnitude of the project;

2.2 Review of alternate designs and related documentation after selection of the *Building Envelope* designs are made during the conceptual design and design development phases;

2.3 Review of alternate or substitute assemblies if requested by the BEP's client for tendering to obtain competitive bids for such items such as propriety products;

2.4 Work connected with the review of documents for tendering segregated contracts, pre-tendered contracts, phased or fast-track construction;

2.5 Assistance in preparing or reviewing construction cost estimates;

2.6 Review of alternate designs or products after completion of the contract documents;

2.7 Special physical model analysis such as wind-tunnel;

2.8 Full-time inspections of construction;

2.9 Review of additional submissions when occasioned by improper or incomplete submissions;

2.10 Work resulting from corrections or revisions required because of errors or omissions by others; and

2.11 Work resulting from damage during construction as the result of fires, man-made disasters, or natural disasters.

References

Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) and Architectural Institute of British Columbia (AIBC), *Building Envelope Professional—Guideline for Professional Practice, Vancouver, B.C., 2000.*

British Columbia Ministry of Municipal Affairs, *British Columbia Building Code* 1998, Victoria, B.C., 1998.

___, *Strata Property Act* (1998).

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Canada Mortgage and Housing Corporation (CMHC), *Best Practice Guide: Wood-frame Envelopes in the Coastal Climate of British Columbia,* Ottawa, 1999.

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___, British Columbia Homeowner Protection Office, British Columbia Ministry of Municipal Affairs, *Managing Major Repairs: A Condominium Owner's Manual,* Vancouver, B.C., 1999.

City of Vancouver Community Services, *City of Vancouver Building Bylaw No. 8057 1999,* Vancouver, B.C., 1999.

Web sites

These Web site addresses were correct as of Feb. 1, 2001.

ACEC—Association of Consulting Engineers of Canada
http://www.acec.ca/
AIBC—Architectural Institute of B.C.
http://www.aibc.bc.ca/
APEGBC—Association of Professional Engineers and Geoscientists of B.C.
http://www.apeg.bc.ca/
ASTM—American Society for Testing and Materials
http://www.astm.org/
B.C. Buildings Corporation
http://www.bcbc.bc.ca/
B.C. Housing—British Columbia Housing Management Commission
http://www.bchousing.org/
B.C. Ministry of Municipal Affairs and Housing
http://www.gov.bc.ca/marh/
Barrett Commission
http://www.sdes.gov.bc.ca/housing/barrett.htm
BOMA BC—Building Owners and Managers Association BC
http://www.boma.bc.ca
BOMA Canada—The Building Owners and Managers Association of Canada
http://www.boma.ca/
Canada Mortgage and Housing Corporation
www.cmhc-schl.gc.ca
Canadian Association of Home and Property Inspectors-B.C.
http://www.cahi.bc.ca/
Canadian Home Builders' Association of British Columbia
http://www.chbabc.org/
Canadian Home Builders' Association
http://chba.ca/
Canadian Institute of Treated Wood
http://www.citw.org/
Canadian Standards Association
http://www.cssinfo.com/info/csa.html
CCDC—Canadian Construction Documents Committee
http://www.ccdc.org/
CHOA—Condominium Home Owners' Association of BC
http://www.choa.bc.ca/
City of Vancouver
http://www.city.vancouver.bc.ca/
Forintek Canada
http://www.forintek.ca/
HPO—B.C. Homeowner Protection Office
http://www.hpo.bc.ca/
ICBA—Independent Contractors and Businesses Association of British Columbia
http://www.icba.bc.ca/
IREM—Institute of Real Estate Managers
http://www.irem.org/
Mold
Canada Mortgage and Housing Corporation and Health Canada both have information about mold. To get to the information, go to the Web addresses below and search for "mold."
Health Canada
http://www.hc-sc.gc.ca/
CMHC
www.cmhc-schl.gc.ca
PAMA—Professional Association of Managing Agents
http://www.landcentre.ca/pama/
Strata Property Act information page
http://www.fic.gov.bc.ca/strata/index.html
Urban Development Institute
http://www.udi.bc.ca/
Vancouver Island Strata Owners Association
http://www.visoa.bc.ca/
Workers' Compensation Board of B.C.
http://www.worksafebc.com

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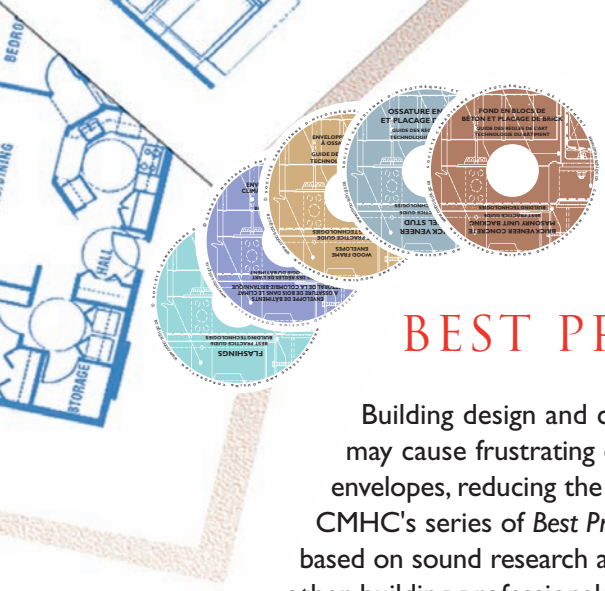

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