BAND TECHNICAL PUBLICATIONS

BTP-HS-9

MATERIALS FOR HOUSE CONSTRUCTION

November 1990

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
Canada

BTP-HS-9

MATERIALS FOR HOUSE CONSTRUCTION

November 1990

This publication was developed for
Indian and Northern Affairs Canada by

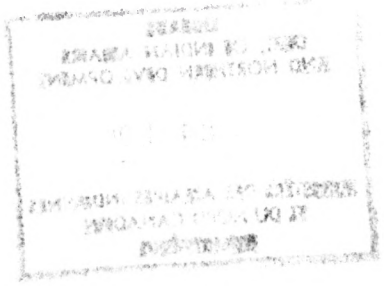
DIAND Technical Services Branch
A & E Services
Public Works Canada
Ottawa K1A 0H4

Copies available from
Technical Publications Section

QS-3498-000-EE-A1

Cette publication peut aussi être obtenue
en français sous le titre:

Matériaux pour construction résidentielle



MATERIALS FOR HOUSE CONSTRUCTION:

PRECONSTRUCTION PLANNING

Table of Contents

MATERIALS FOR HOUSE CONSTRUCTION:

PRECONSTRUCTION PLANNING

Table of Contents

(Cont'd)

MATERIALS FOR HOUSE CONSTRUCTION:

PRECONSTRUCTION PLANNING

Table of Contents

(Cont'd)

MATERIALS FOR HOUSE CONSTRUCTION:

PRECONSTRUCTION PLANNING

Table of Contents

(Cont'd)

PART II - BILL OF MATERIALS

FIGURES

TABLES

FOREWORD

This publication serves a dual purpose. As a Band Technical Publication (BTP) it forms part of an extensive library of practical information which DIAND Technical Services has produced for use by Indian leaders, managers and technical staff. BTPs cover a wide variety of technical subjects which may be encountered by people working on reserves. These subjects embrace the planning, design, construction, project management and maintenance of assets. BTP-HS-9 is part of a smaller sub-grouping devoted to the subject of house construction on reserves. Others in this sub-grouping cover site selection, blueprint reading, construction estimating and construction management.

A second purpose served by this BTP is as a "textbook" for a training course developed by DIAND Technical Services. Within the course, information in the BTP is supplemented by lectures, audio-visual presentations, and workbooks. Training courses are currently available or are under development for a number of topics related to house construction as well as other technical subjects.

Information about BTPs or Training Courses may be obtained from

Head, Training and Publications
Coordination Services Division
DIAND Technical Services
Les Terrasses de la Chaudière
10 Wellington St., 11th Floor
Hull, Quebec
K1A 0H4

MATERIALS FOR HOUSE CONSTRUCTION:

PRECONSTRUCTION PLANNING

1.0 INTRODUCTION

1.1 Purpose

This publication is divided in two parts. Part I covers the subject of quantity take-off and Part II deals with the preparation of a bill of materials.

1.1.1 Quantity Take-off

In house construction, you must deal with a wide variety of building products, materials, equipment, tools, appliances and accessories. Armed with a set of blueprints, you must first study the project and prepare a list of materials needed to build that house. Listing every single item to be used on a house construction project can be a difficult task. Quantity take-off is a method which allows you to relate the various materials to specific building activities or operations normally followed when erecting a house.

If you are familiar with the signs and symbols used on blueprints to indicate the various materials specified, you should be able to list those materials in an orderly fashion. There is no magic formula that can be applied to all building projects. Every job has its own characteristics and must be dealt with individually. Therefore, from the complete set of blueprints you are given to work with and the additional descriptions of the materials found in the specifications, you can prepare a complete list of materials needed to proceed with the actual construction of that house.

1.1.1 The Bill of Materials

The Bill of Materials is a document which contains the list of materials broken down into trades to assist the contractor when preparing to bid on a job, or the builder when preparing for construction.

There are a number of steps to follow to arrive at what is called a Bill of Materials which can be used for estimating the costs of a house, purchasing the materials, renting equipment, sub-contracting, etc., as well as for keeping an accurate record of all the expenditures, operations and general administration of a project.

Keep in mind that the Bill of Materials will serve as a record of the job it applies to and it will also be of great help for all your future projects. The information provided will help you organize future construction projects.

1.2 Intended Users

This publication is intended for band technical/management staff; supervisors of small projects; tradespeople; construction workers; and individual home builders interested in learning how to take off the quantities of materials from the blueprints and develop a Bill of Materials.

1.3 Scope

This publication does not cover the subject of estimating, which is a specialty requiring a good knowledge of many other aspects of project administration. It will show you how to proceed with the preparation of an estimator's list, using the proper units of measurement applicable to each type of material, allowing you to prepare your own estimator's list for costing which can then be used to get estimates from various suppliers.

As a note of caution, please remember that measurements are given in metric units with imperial measurements in brackets. A choice should be made as to whether to work in metric or imperial units. Do not try to mix the two sets of measurements, as conversions are not always exact. See Appendix 'A' for conversion tables.

PART I QUANTITY TAKE-OFF

2.0 QUANTITY TAKE-OFF

2.1 Benefits of Preparing for the Job

There are many reasons for following a good quantity take-off program and keeping an accurate record of every phase of the construction process including all the materials, equipment, labour and other aspects of the construction and administration of a project. Besides providing a complete record of the project, taking-off the quantities of materials in advance will save you a lot of time, money and worries at the construction stage. Here are some of the advantages of getting prepared for the job by listing in advance the types and quantities of construction materials required at every stage or activity:

1. You won't have to stop in the middle of a building activity, perhaps many times in a day, to drive to the lumber yard or hardware store to get those missing parts needed to complete the activity.

2. You'll be spared the possibility of having to use substitute materials that you don't want because you discover at the last minute that the supplier is temporarily out of stock and you would have to wait another three weeks to complete the activity.

3. You won't have to juggle with the assignment of labour in an attempt to adjust your work program because of unforeseen delays in material delivery or other inconveniences related to the procurement of materials.

   And there are many more advantages which you will be able to appreciate as you read on.

2.2. Original Purpose of Quantity Take-Off

The preparation of a list of materials, as a contract document, was originally meant to ease the burden of a contractor's estimator by providing a tailor-made document to be used for bids. This rigid form of contract document has been questioned over the years. Depending on the size and complexity of a job, it was found that the methods used to compile the quantities of materials could not all be used indiscriminately for all types of construction projects. In 2.4, we will look at the methods used in the industry and we will have the opportunity to compare the advantages and disadvantages of each one in relation to materials for house construction.

2.3 Saving Time, Money and Effort

After a construction project is completed, one of the first questions asked of any owner-builder is: "how much cheaper was it?" In addition to saving the 15% or so profit that a contractor usually adds to his cost, an owner-builder will also have made the type of saving that is called "the sweat equity". As we have seen, there are many good economic reasons for taking the extra time to get well prepared for a job. By establishing your own list of materials for construction and consulting material suppliers or shopping around, you may realize some substantial gains. Having your list of materials at hand will allow you to keep track of everything as you go. Most suppliers carry a wide variety of qualities. By planning ahead, you can keep track of your budget range and know in advance how it can be broken down. To get an idea of the general breakdown of the costs of house construction by a contractor, the following figures have been compiled:

General construction materials	42%
Labour	26%
Electrical wiring, materials and labour	6%
Plumbing, materials and labour (including a hot-water baseboard heating system)	10%
Contractor's overhead and profit	16%
Total	100%

An owner-builder can save substantially on the cost by looking after the administration of a project himself, preparing his own estimate of costs and of course, performing most of the work himself. So, to sum up, one purpose of quantity take-off for the preparation of a bill of materials is to allow us to make a realistic estimate of the costs.

Quantity take-off also gives us a complete record of expenditures and activities. One of the most common laments heard after the completion of a house is "I wish I had kept more accurate records". Many house builders do not take the trouble to set up a balance sheet for all building costs and stick to it rigorously. A lot of small purchases are just not recorded. The cost of tools and other costs are often overlooked. How many builders, for example, include transportation costs in their estimate? Or the many times they use their car or truck to run down to the store for materials? There are many things that are likely to get out of hand unless a carefully prepared record is kept of all the costs incurred. These should be all recorded in detail under the proper headings. As an owner-builder, no one will be more interested in saving money on the construction of your house than yourself.

So, once you have decided which method of quantity take-off best suits your purpose, you should strive to establish a comprehensive and accurate list of materials so that, at the end, you're not among those who say "I wish I had kept more accurate records" but instead, you will be saying "I know my house costs so much less because I have kept accurate records of all the expenses".

2.4 Methods of Quantity Take-Off (or how to do it)

Depending on the size and complexity of a project, taking the quantities of materials from the blueprints can be a difficult task unless a certain method is followed. Various methods have been devised according to the terms and conditions of the job, the category of project and personal preference. As mentioned before, there is no magic formula or exclusive method that can be applied to all types of construction projects indiscriminately. Each job is particular, and whatever method you choose to list the quantities of materials, remember to include all materials and pieces of equipment required for each step of construction.

There are 3 basic methods commonly used in the industry: the outline method; the elemental method; and the operational or activity method. Each of these methods is subject to some degree of variation depending on individual preference.

2.4.1 The Outline Method

In this method, the quantities of all measureable items are simply listed by type of materials without distinction as to where the materials go in the building project. No specific details are given.

2.4.2 The Elemental Method

This method consists of listing the materials or elements according to a standard material classification of elements which is used by estimators. This form of material listing is divided into major elements of construction. The same type of materials may appear more than once under different headings. This method is not easy to work with for pricing, and another list which groups all similar materials may have to be prepared for that purpose.

2.4.3 The Operational (or Activity) Method

In this method, every building operation or activity which occurs during construction forms the headings. Materials are described separately for each building operation. The main disadvantage of

this method is that it also makes pricing difficult, because similar materials also appear more than once under different headings. The activity method is broken down in more details than the elemental method.

2.4.4 Comparing the Methods

While the outline method may work fine for bidding on a job, it is not very convenient during construction. The other two methods are more likely to suit the building process and serve as a guide during construction by providing an accurate record of what a contractor or builder has to work with. And this is particularly comprehensive with the operational method.

For a large and complex project it may be a long process to prepare another list regrouping all similar materials for estimating, but this is not a major undertaking with a house project. Since the operational or activity method provides the best record of the job, as well as being helpful all through the construction process, it is the method which is followed through the rest of Part I.

Whatever method is used, it is very important to use the proper units of measurement because the total costs could be quite far from reality when unit measures are multiplied by the total number of units required.

3.0 UNDERSTANDING THE JOB CONDITIONS

3.1 Considering all the Parts

Before taking the quantities of materials from the blueprints, we should understand the job conditions and determine which building activities we are equipped to do ourselves, and which activities or operations will be totally or partially sub-contracted. We should also know what is readily available and what may have to be rented, and so on. Some of the questions that should be answered when "getting prepared" for the job are the following:

1. What is the scope or extent of the job and what work is involved?

2. Is there a work schedule with tight deadlines to meet or will we have plenty of time to complete our project?

3. What is the shape or condition of the site? Is it low and muddy and hard to drain or is it high and dry and easy to drain? (Hard to drain conditions should be avoided).

4. Is the "water table" high or low? (Inquire with the local authorities before you start.)

5. What site services are available?
   - Water?
   - Drainage?
   - Electricity? (Will a temporary hook-up permit be required?)
   - Others? (What are they?)

6. Which operations will be manual or mechanized? What kind of mechanical equipment will be required and for what operation(s); and with or without hired operators?

7. Are the materials available locally, or will some materials have to be brought in? If so, what materials and what will be the extra cost for transportation? Will the delivery time affect your work schedule?

8. Do you have all the tools necessary to do the job and are they in good working condition? If not, what tools will have to be bought or rented?

3.2 Construction Tools

Following on Tables 1 and 2 are lists of the hand and power tools that may be required for the construction of a house. You may use that list to determine which tools you may have to buy or rent.

TABLE 1

HAND TOOLS USED IN CONSTRUCTION

Items	Types
Measuring Tapes	(pocket type) 7.5 m (25 ft.)
	(steel) 30 m (100 ft.)
Squares	Carpenter (or framing) Try Combination Adjustable T-Bevel
Levels	Line Carpenter's Mason's Straight Edge
Plumb Bob and Builder's Lines	Precision Turned Cast Weight
Marking and Scribing Tools	Carpenter's Pencil Standard Pencil (and pocket knife) Chalk Line Self Chalking Applied Chalk
Gauges	Marking Gauge Butt Gauge (and butt marker)
Handsaws	Cross Cut Saw Ripsaw Backsaw (cross cut for precision work) Coping Saw Hacksaw (for metal)
Hammers	Nail Hammer Finishing 198 to 360 g. (7 to 12.7 oz.) General Purpose 454 to 567 g. (16 to 20 oz.) Framing Hammer over 567 g. (20 oz.)
Curved Claw	Straight (or ripping) Claw Bell Faced Flat Faced Checkered Face

TABLE 1 Continued

HAND TOOLS USED IN CONSTRUCTION

Items	Types
Handle Types	Wood Rubber Covered Steel Vinyl Covered Steel Leather Covered Steel
Sledge-Hammer (for heavy work)	Hand Drilling 0.9, 1.4 and 1.7 kg. short handle (2, 3 and 3¾ lb.) Full Sized(5.4 kg. and over) long handle
Hatchets	Half Hatchet (combined hammer head and cutting blade) - wide blade Shingling or Lathing - narrow blade
Wood Chisels	6 to 50 mm wide (¼ to 2 in.) Paring 150 mm (6 in.) or longer Firmer 100 mm (4 in.) long Butt 63 to 75 mm (2½ to 3 in.) long Mortice 50 mm (2 in.) long
Hand Planes	Bench (fore or jointer) Block Jack Specialty Rabbet Router Trimming
Boring and Drilling Tools	Bit Brace (or hatchet brace) Auger Bits from 6 to 25 mm (¼ to 1 in.) in diameter and from 178 to 250 mm (7 1/8 to 10 in.) length Expansive (or adjustable, cut holes from 25 to 125 mm (1 to 5 in.) in diameter) Automatic (for small pilot holes with drills from 1.6 to 4.4 mm (1/16 to 3/8 in.)) Forstner (for drilling holes partly through material)

TABLE 1 Continued

HAND TOOLS USED IN CONSTRUCTION

Items	Types
Fastening Tools	C-Clamp Bar or Pipe Clamp Parallel or Hand Screw Clamp Band or Web Clamp Spring Clamp Stapler (Heavy Duty)
Screwdriver	Slot Cabinet Philips Robertson Spiral Ratchet
Plasterer's Tools	Steel straight edge (or T) Utility knife (and blades) Hawk (for carrying joint compound) Taping Knives: 100 mm (4 in.) 150 mm (6 in.) 250 mm (10 in.) Corner Tool (form corner joints) Hand Sander Electric Sander (with supply of medium coarse to fine sandpaper)

TABLE 2

POWER TOOLS USED IN CONSTRUCTION

Items	Types, Use and Accessories
Stationary	
Table or Bench Saw *	Tilting Table Tilting Arbor (Most used)
* Used for:	Crosscutting Bevel Crosscutting Mitre Bevel Mitre Ripping Bevel Ripping
Circular Saw Blades	Rip Cross Cut Combination Hollow Carbide-Tipped Saw Blade Assemblies Dado Head Moulding Head
Radial Arm Saw	
Power Jointer	
Bench Grinder	
Portable Electric Tools (require safety precautions)	
Portable Hand Drill Common Sizes of Drill Bits are 6, 10	and 13 mm (¼, 3/8 and ½ in.) High Speed Steel Twist Bit Spade Bit Carbolide Bit Circle Cutter Countersink
Rotary Hammer	for brick, stone and concrete
Power Screwdriver	for wood, machine and self-tapping screws

TABLE 2 Continued

POWER TOOLS USED IN CONSTRUCTION

Items	Types, Use and Accessories
Portable Electric Handsaw Blades (sizes 184 to 235 mm)	Rip Cross-cut Combination Carbide-tip
Portable Electric Mitre Saw	common size is 254 mm (10 in.)
Portable Electric Jigsaw (or Sabre Saw)	Single-Speed Two-Speed Variable Speed
Blades for:	Wood Metal Plastic
Electric Reciprocating Saw	Works like the Sabre Saw but for heavy duty work
Portable Electric Sander	For finish woodwork and plaster joints

NOTE: Ensure that safety precautions are taken when using any power tool. All electrical tools must be properly connected to a grounded electrical outlet.

4.0 PLANNING THE JOB

4.1 Project Planning

The resources that must be considered in the project planning operation are facilities, equipment, materials and personnel.

Generally, the requirements of each individual phase of a project are broken down and considered separately. The method of construction is decided upon, the skills and equipment required are determined, and the time schedule requirements laid out. At that point, it becomes necessary to schedule each step of the operation to get maximum efficiency for the entire process.

4.1.1 Facilities

Before work can begin on any project, a number of facilities must be in place. These may include temporary office and equipment; storage buildings and/or covered storage; power generation capabilities (e.g. temporary hook-up); water supply and sanitary facilities.

4.1.2 Equipment

The equipment needed for the project should be listed according to the following criteria:

1. type of equipment,
2. size or capacity,
3. number of units needed,
4. length of time needed,
5. maintenance requirements, and
6. the jobs it will be needed for.

Without proper planning we may end up having to use undersized equipment, or we may not have enough or too much equipment. Therefore, it is best to work out, in advance, what will be needed.

Table 3 lists equipment used during house construction which is typically rented or supplied by a contractor.

4.1.3 Materials

In "getting ready" for a project, it is necessary to list all the materials that will be used in the construction of a house. This includes formwork, temporary structures, shoring, etc. In analysing requirements for the materials, the following points should be covered:

TABLE 3

EQUIPMENT RENTED OR SUPPLIED BY CONTRACTOR

EARTHWORK EQUIPMENT

Augers for truck or trailer mounting, vertical drilling	100 to 900 mm (4"x36") dia., 40.3 kW (54 hp), 3m (10') spindle travel. 4,2m(14') spindle travel.
Auger, horizontal boring machine	300 to 900mm (12" to 36"), 33.6 kW (45 hp) 300 to 1200mm (12" to 48"), 48.5 kW (65 hp)
Backhoe, diesel hydraulic, crawler mounted	0.4m^3 ($\frac{1}{2}$ yd^3) capacity 0.5m^3 (5/8 yd^3) capacity 0.6m^3 (3/4 yd^3) capacity 0.8m^3 (1 yd^3) capacity 1.2m^3 ($1\frac{1}{2}$ yd^3) capacity 1.5m^3 (2 yd^3) capacity 1.9m^3 ($2\frac{1}{2}$ yd^3) capacity 2.7m^3 ($3\frac{1}{2}$ yd^3) capacity
Gradall type, truck mounted	2.7 tonne (3 ton) @ 4.5m (15') radius 0.5m^3 (5/8 yd^3) capacity 0.8m^3 (1 yd^3) capacity
Backhoe-loader wheel type	30 to 34 kW (40 to 45 hp) 0.5m^3 (5/8 yd^3) 34 to 45 kW (45 to 60 hp) 0.6m^3 (3/4 yd^3) 60 kW (80 hp) 1m^3 ($1\frac{1}{4}$ yd^3)
Brush chipper, gas engine	150 mm (6") cutterhead, 26 kW (35 hp) 300 mm (12") cutterhead, 97 kW (130 hp) 375 mm (15") cutterhead, 123 kW (165 hp)
Bucket, clamshell, general purpose	0.3m^3 (3/8 yd^3) 0.4m^3 (1/2 yd^3) 0.6m^3 (3/4 yd^3) 0.8m^3 (1 yd^3) 1.2m^3 ($1\frac{1}{2}$ yd^3) 1.5m^3 (2 yd^3)
Bucket, dragline, medium duty	0.4m^3 (1/2 yd^3) 0.6m^3 (3/4 yd^3) 0.8m^3 (1 yd^3) 1.2m^3 ($1\frac{1}{2}$ yd^3) 1.5m^3 (2 yd^3) 2.3m^3 (3 yd^3)
Compactor, roller, 2 drum	900 kg (2000 lb) operator walking
Rammer compactor, gas	450 kg (1000 lb) blow

TABLE 3

EQUIPMENT RENTED OR SUPPLIED BY CONTRACTOR (Cont'd)

Vibratory plate, gas	325 mm (13") plate, 450 kg (1000 lb) blow 600 mm (24") plate, 2250 kg (5000 lb) blow
Curb builder	10.4 kW (14 hp), gas, single screw double screw
Grader, self-propelled	11.3 tonne (12.5 ton) 13.5 tonne (15 ton) 18 tonne (20 ton) 24.7 tonne (27.5 ton)
Hammer, pavement demolition, hydraulic, gas, self-propelled	450 to 562.5 kg (1000 to 1250 lb) 585 to 675 kg (1300 to 1500 lb)
Extractor, steam or air	96.8 kg. m (700 ft. lb) 138.3 kg. m (1000 ft. lb)
Roller, tandem, gas	7.3 to 10.9 tonne (8 to 12 ton) 2.7 to 4.5 tonne(3 to 5 ton)
Roller, towed type, vibratory, gas	94 kW (12.5 hp) 1.8 tonne (2 ton)
Roller, sheeps foot, double	1.5m (60")
Roller, Pneumatic tire, diesel	10.9 tonne (12 ton) 19.1 to 22.7 tonne (21 to 25 ton)
Roller, sheeps foot, self-propelled	4 wheel, 97 kW (130 hp) 223.8 kW (300 hp)
Roller, Vibratory, steel drum, pneumatic tire, diesel	8.2 tonne (9 ton) 13.2 tonne (14.5 ton)
Scraper, towed type	5.3 to 6.8m^3 (9 yd^3) capacity 9.1 to 13m^3 (12 to 17 yd^3) capacity
Scraper, self-propelled	4x4 drive, 2 engine, 10.6m^3 (14 yd^3) capacity 1 engine, 18.2m^3 (24 yd^3) capacity
Scraper, self loading	8.4m^3 (11 yd^3) capacity 16.7m^3 (22 yd^3) capacity
Shovel front attachment, mechanical	0.4m^3 (1/2 yd^3) 0.6m^3 (3/4 yd^3) 0.8m^3 (1 yd^3) 1.2m^3 (1½ yd^3) 2.3m^3 (3 yd^3)

TABLE 3

EQUIPMENT RENTED OR SUPPLIED BY CONTRACTOR (Cont'd)

Tractor, crawler with bulldozer, torque converter, diesel	56 kW (75 hp) 78 kW (105 hp) 104 kW (140 hp) 149 kW (200 hp)
Loader, crawler, torque converter, diesel	1.2m^3 (1½ yd^3), 60 kW (80 hp) 1.2 to 1.3m^3 (1½ to 1¾ yd^3), 71 kW (95 hp) 1.3 to 1.7m^3 (1¾ to 2¼ yd^3), 97 kW (130 hp) 1.9 to 2.5m^3 (2½ to 3¼ yd^3), 142 kW (190 hp)
Tractor loader, wheel, torque converter	4x4, 0.8 to 1m^3 (1 to 1¼ yd^3) 49 kW (65 hp) 1.2 to 1.3m^3 (1½ to 1¾ yd^3) 60 kW (80 hp) 1.3 to 1.5m^3 (1¾ to 2 yd^3) 75 kW (100 hp) 1.9 to 2.7m^3 (2½ to 3½ yd^3) 97 kW (130 hp)

CONCRETE EQUIPMENT

Bucket, concrete light weight	0.4m^3 (1/2 yd^3) 0.8m^3 (1 yd^3) 1.2m^3 (1½ yd^3) 1.5m^3 (2 yd^3)
Core drill, electric	19 kW (2½ hp), 25 to 200mm (1"to 8") bit dia.
Finisher, concrete floor, gas, riding trowel	1200mm (48") dia. 3 blade, gas, manual, 900mm (36") trowel 4 blade, gas, manual, 1200mm (48") trowel
Float, hand operated (bull float)	1200mm (48") wide
Grinder, concrete and terrazzo, electric, floor	
Well grinder	
Mixer, powered, mortar and concrete, gas	0.2m^3 (6 ft^3), 13 kW (18 hp) 0.3m^3 (10 ft^3), 19 kW (25 hp)
Mixer, concrete, stationary, tilt drum	1.5m^3 (2 yd^3)
Saw, concrete, manual, gas	6kW (18 hp)
Saw, conrete, self-prop., gas	22 kW (30 hp)
Vibrator, concrete, electric, 60 cycle	1.5 kW (2 hp) 2.2 kW (3 hp)

TABLE 3

EQUIPMENT RENTED OR SUPPLIED BY CONTRACTOR (Cont'd)

C) AIR TOOLS AND ACCESSORIES	
Air compressor, portable gas engine	28,317 cu. cm/sec (60 cfm) 75,512 cu. cm/sec (160 cfm)
Breaker, pavement	27 kg (60 lb) 36 kg (80 lb)
Drill, hand (jack hammer)	29.3 kg (65 lb)
Hammer, chipping	5.4 kg (12 lb)
Hose, air with couplings	15m (50') long, 19mm (3/4") dia. 25mm (1") dia. 38mm (1½") dia.
Drill, steel	22 x 600mm (7/8" x 2') 22 x 1800mm (7/8" x 6')
D) GENERAL EQUIPMENT	
Generator, electric, gas engine	1.5 to 3 kW 5 kW 10 kW 25 kW
Generator, electric, diesel engine	20 kW
Heater, space, oil or electric	0.02 kW/h (50 MB.h) 0.03 kW/h (100 MB.h) 0.09 kW/h (300 MB.h) 0.15 kW/h (500 MB.h)
Hose, water, suction with coupling	6m (20') long, 50mm (2") dia. 75mm (3") dia.
Discharge hose with coupling	15m (50') long, 50mm (2") dia. 75mm (3") dia.
Ladder, extension type	4.8 to 10.8m (16' to 36') long 12 to 18m (40' to 60') long
Builders level with tripod an rod	
Print sprayer, complete	3,775 cu. cm/sec (8 cfm) 8,023 cu. cm/sec (17 cfm)
Pump, centrifugal, gas	38mm (1½") 18,184 L/h (4MG/h 50mm (2") 36,368 L/h (8MG/h) 75mm (3") 68,190 L/h (15MG/h) 150mm (6") 409,140 L/h (9MG/h)

TABLE 3

EQUIPMENT RENTED OR SUPPLIED BY CONTRACTOR (Cont'd)

Pump, submersible, electric	38mm (1½") 250 L/m (55G/m) 38mm (1½") 375 L/m (83G/m) 50mm (2") 545 L/m (120 G/m)
Pump, diaphragm, gas, single	38mm (1½") dia. 50mm (2") dia. 75mm (3") dia.
double	100mm (4") dia.
Trash pump, self-priming, gas	50mm (2") dia.
Salamander, L.P. gas fired	(100,000 Btu)
Saw, chain, gas engine	0.45m (18") long 0.9m (36") long 1.5mm (60") long
Toilet, portable chemical	
Toilet, flush type	
Toilet, fresh water flush, garden hose	
Transit with tripod	
Truck, pick-up	0.68 tonne (3/4 ton) capacity - 2 wheel drive 4 wheel drive
Tractor	4x2, 27 tonne (30 ton) capacity 145.5 kW (195 hp) 186.5 kW (250 hp) 6x2, 36 tonne (40 ton) capacity 179 kW (240 hp) 6x4, 41 tonne (45 ton) capacity 179 kW (240 hp)
Welder, electric	200 A 300 A
Welder, gas engine	200 A 300 A
Wheel barrow (any size)	

1. type;
2. quantity;
3. shape, size and quality;
4. source of supply;
5. estimated delivery times;
6. comparative costs of alternative materials; and
7. responsibility for ordering.

4.1.4 Personnel

At the project planning stage, the project manager should establish a general list of the tradespeople and labourers required to execute the project. The distribution of tasks will be listed by activity when planning the actual job requirements.

4.2 Job Planning

The planning steps should follow the project through two or three possible methods of construction in order to determine which one is the best. Items that should be examined closely include

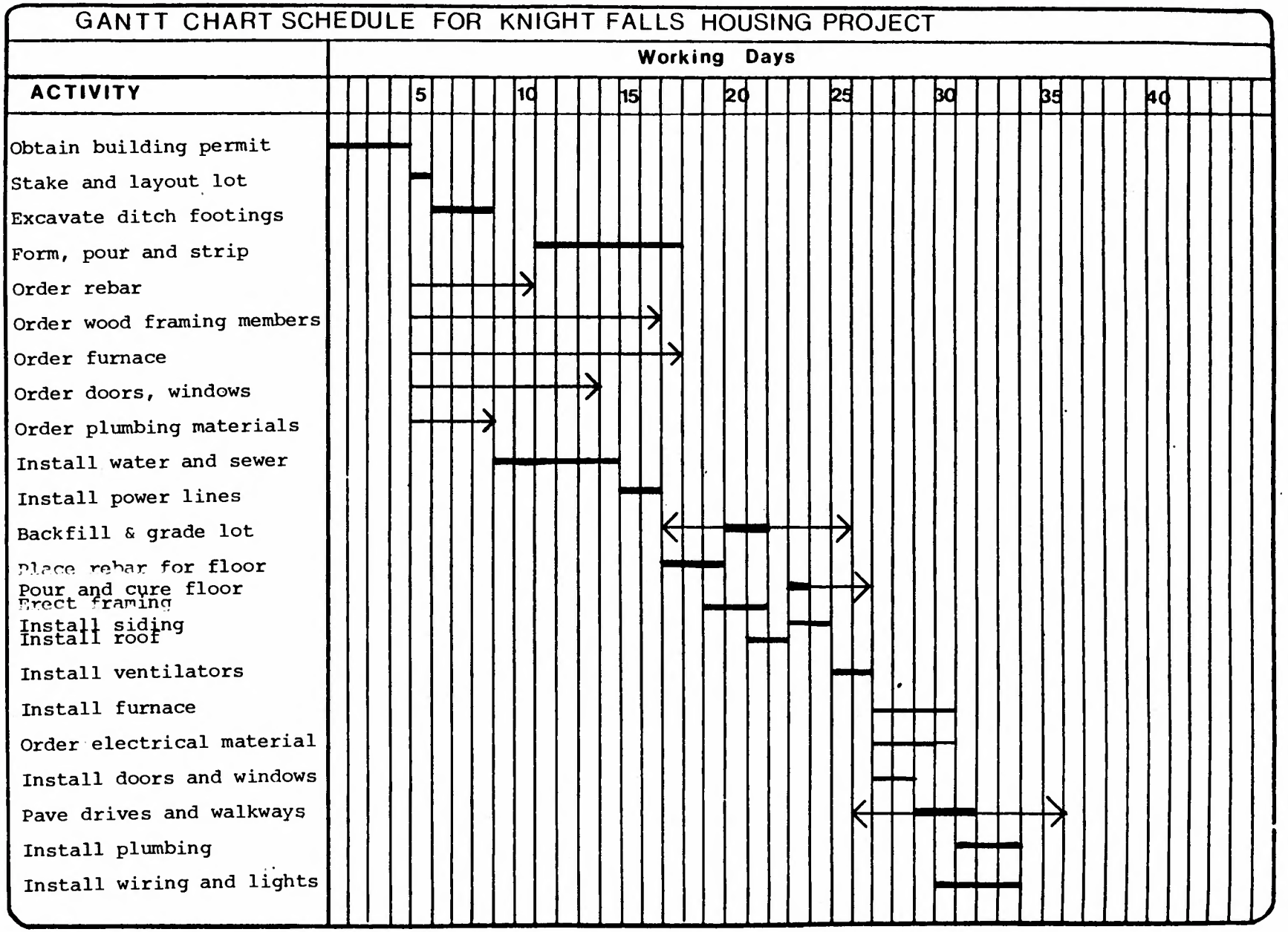
1. the sequence of operations;
2. changes that have to be made in materials;
3. machines that should be used, i.e., workload;
4. timing of the construction work; and
5. workers that should do the work, i.e., workload.

Once the general outline of how a project is going to be done has been drafted, individual steps to get the work done will have to be drawn. A chart called the "Gantt chart" is used extensively for that purpose. The Gantt chart plots activity against time and shows the expected time it will take to execute a series of operations. It lists the various operations or activities and the dates. Figure 1 shows a Gantt chart and how it is used in planning a housing project.

Another format may be used to include the equipment and personnel required. An example of this system is shown in Figure 2.

Whichever method you feel most comfortable with may be used. The important point is to try to foresee what and who will be needed to execute your project in order to minimize delays and other factors that could affect the project execution and cause unnecessary expenses and frustrations.

The chart in Figure 2 was established on a weekly basis for an industrial project. It could also be done on a daily basis. A daily chart would be more accurate and would provide more control but may not be necessary on a small project.



SAMPLE PLANNING CHART

FIGURE 1

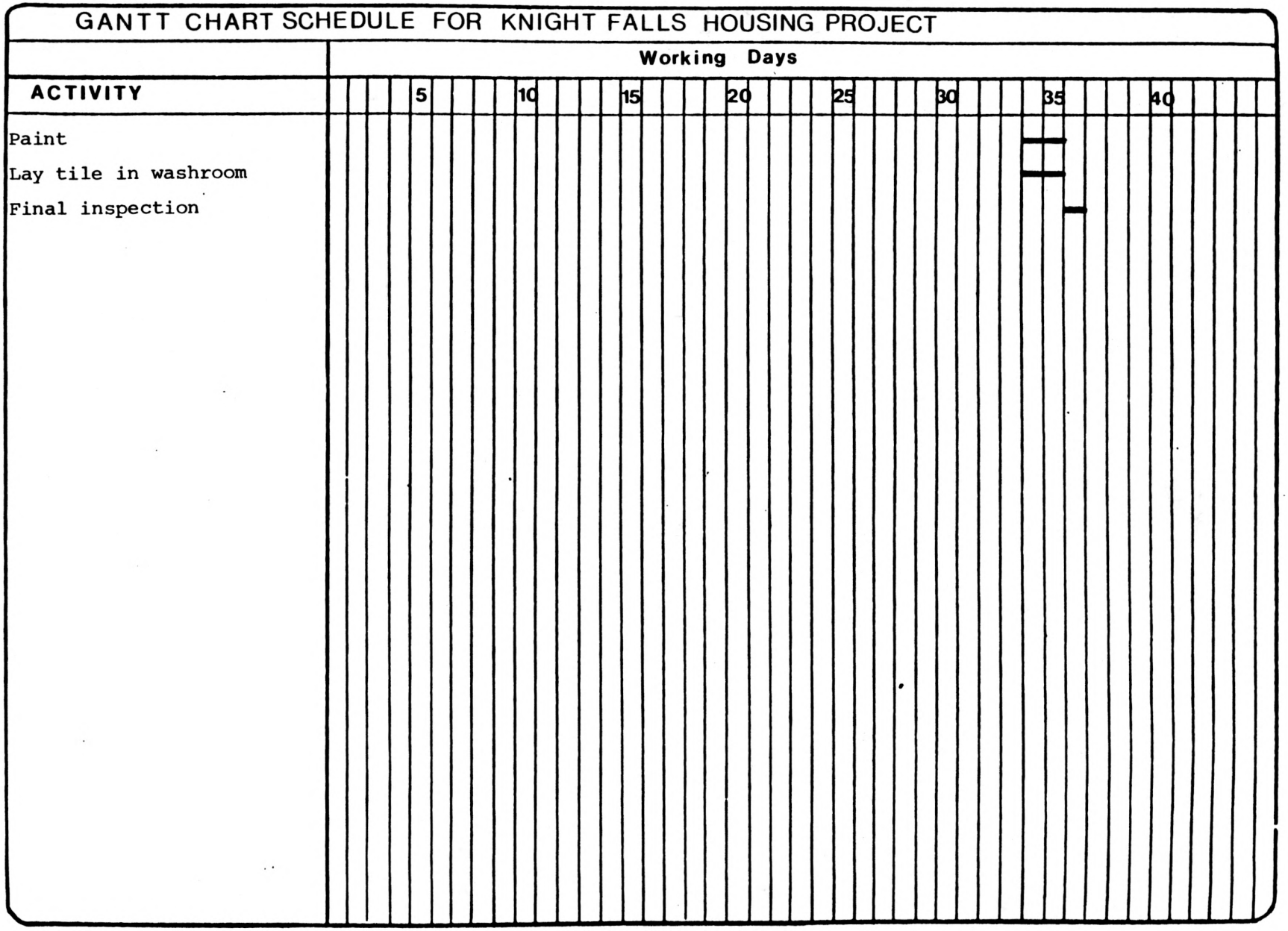


FIGURE 1 (CONT'D)

FIGURE 2

SAMPLE COMPOSITE SCHEDULE

EQUIPMENT AND PERSONNEL SCHEDULE

PROJECT: Weeping River Plant

JOB TYPE	JULY				AUGUST					SEPTEMBER				OCTOBER					NOV.	
	4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	6	13
Site Clearing																				
Road Preparation																				
Ditch Draining																				
Tile laying																				
Building Substructure																				
Pile Driving																				
Foundation Building																				
Main Sewers																				
Branch Sewers																				
Water Mains																				
Power Lines																				
Pouring Equipment Bases																				
Erect Structural Steel																				
Installing Roof																				
Installing Machinery																				
EQUIPMENT																				
Truck Tractors	2	2																1	1	1
Truck Trailers	3	2	1					1	1										1	1
Bulldozers	3	3	2	2	2	2														
Tractors	4	4	1			1			2	2			1						1	1
Brush Shredder	1	1																		
Backhoe	2	3	3	3				2	2											
Dump Trucks		2	2	2	2															
Pile Driver										1	1	1								
Cranes	2	2											2	2	1	1				
Ditcher Wheel				2	2	2	2	2	2	2										
General Service Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Concrete Mixer					1	1	1				1	2	2							
Pickup Trucks	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	3	3	3
Mud Pumps		2	2	2			2	2												
PERSONNEL																				
Survey Crew	2	2	2	1	1			1	1			1		1		1				
Bulldozer Operators	3	3	2	2	2	2														
Truck Drivers	3	3	5	5	5			1	1	2	2								2	2
Tractor Operators	4	4	1			1			2	2			1						1	1
Backhoe Operators	2	3	3	3				2	2				3	2						
Pump Men		2	2	2			3	3												
Pile Driver Operator										1	1	1								
Crane Operator	2	2											2	2	1	1		1	1	1
Ditcher Operator				1	1	1	1	1	1	1										
Ditcher Crew				2	2	2	2	2	2	2										
Steel Placement Men						2	2	2			2	2	2							
Electricians	1	1													1	3	6	6	6	6
Mechanics	1	1	1	1	1	1					1	1	1							
Riggers	3	3	3								2	3	4	4				2	2	2
General Labourers	3	3	6	7	12	19	23	23	24	24	24	27	22	18	16	13	13	13	8	6
TOTAL	24	29	25	24	24	28	31	35	33	32	32	35	35	27	18	18	19	22	20	18

4.2.1 Equipment Requirements and Personnel Schedule

The need for equipment should also be broken down on a daily or weekly basis depending on the extent of the project. The same sort of breakdown can be calculated for personnel.

4.2.2 Schedule Balancing

Proper planning of a project helps balance the need for men and equipment. This is particularly important in isolated areas.

4.3 Materials and Services to Consider

We have looked at the general job conditions and job planning. Once we have laid out how we are going to proceed with the job, the personnel and the equipment, we are ready to develop a more detailed type of planning. We will examine the job on a step-by-step basis. We will establish each individual pre-construction and construction operation that has to be done to prepare the site and to install specific pieces of construction materials.

Figure 3 lists the various products and services that may be used for a new home. Some require decisions before construction begins. Others can be chosen during construction and still others don't need to be taken care of until the house is finished. With so many things to decide it is wise to reduce confusion by scheduling decisions in an orderly fashion.

FIGURE 3

MATERIALS AND SERVICES CHECKLIST

Items	Are we going to have this?	Amount budgeted	Approximate date to order	Arrangements made
Lot cost				
Legal fees				
Survey				
Building permits				
Insurance				
Lot preparation				
Demolish existing structures				
Remove topsoil and stockpile				
Bulk excavation				
Trenching				
Hand excavation				
Backfill				
Grading				
Foundations				
Concrete footings				
Concrete walls				
Concrete block walls				
Concrete stairs				
Concrete slabs				
Concrete driveways				
Concrete Walkways				
Concrete planters				
Framing work				
Posts and beams				
Floor joists				
Floor sheathing				
Wall Studs				
Ceiling joists				
Rafters				
Trusses				
Roof sheathing				
Exterior Finish				
Roofing shingles				
Roofing tar and gravel				
Roofing other				
Siding wood				
Siding masonite				
Siding vinyl				

Reprinted with permission from
Carpentry and Building Construction
metric edition
Copp Clark Pitman
Division of Copp Clark Limited
Publishers

FIGURE 3 (Cont'd)

Items	Are we going to have this?	Amount budgeted	Approximate date to order	Arrangements made
Siding aluminum				
Stucco				
Brick veneer				
Gutters and trim				
Doors				
Windows				
Storm doors and windows				
Interior Finish				
Doors and trim				
Kitchen cabinets				
Bathroom cabinets				
Built-in cupboards or bookshelves				
Built-in cabinets				
Panelling and mouldings				
Flooring				
Carpets				
Wood				
Sheet goods or tile				
Ceramic tile or slate				
Drywall or plaster wall finish				
Ceramic wall tile (bathrooms etc.)				
Gas connection				
Electric Hook up				
Water connection or septic system				
Oil system tanks and connections				
Landscaping				
trees, shrubs, seed, etc.				
patio paving, etc.				
fences and screens, etc.				
sheds and outbuildings				
blacktop driveways				
Site clean up and disposal				
Temporary heat, power, water, phone, etc.				
Cleaning building, windows, fixtures, mirrors, etc.,				
Interim financing costs				
Miscellaneous extras				

5.0 PRE-CONSTRUCTION ACTIVITIES

5.1 Site Preparation

Being familiar with the local requirements and the site conditions will save a lot of time and guesswork in "getting prepared" for the construction of a house. Many municipalites require that both the property and the position of the building on the lot be certified by a registered surveyor. Once the building location on the lot has been established and the setbacks from the front and side property lines conform with the local building by-laws, the preparation of the site can begin. Site preparation involves three activities:

1. demolition and removal work,
2. site clearing and grading, and
3. the installation of the batter boards.

5.1.1 Demolition and Removal Work

Following, in Table 4, is a list of the various site preparation activities that may be necessary prior to excavating. The units of measurement of each material or activity are also indicated.

5.1.2 Site Clearing and Grading

As well as excavating, you may have to clear the site of trees and brush, and grade it. Table 5 lists the operations involved, how they are estimated and what items are generally included.

The rates for site grading operations vary with the type of soil with increments of 10 to 15 cents per cubic metre (or cubic yard) from light through medium to heavy soil. Sundry hand operations (not exceeding 150 mm (6 in.) thick) are calculated on the basis of man hours per 100 square metres (or square yards).

The placing, levelling and compacting of a subbase for asphalt paving are measured in square metres (or square yards) stating the thickness, and the type and the density of compaction required. Hot mix asphalt paving is measured in square metres (or square yards), stating the thickness and the type and grade of hot mix asphalt to be used.

TABLE 4

MEASUREMENT OF MATERIALS FOR DEMOLITION AND REMOVAL WORK

Item or Activity	How Shown On Blueprints	How Estimated	Includes	Does Not Include
Small Building (Masonry & Wood)	Noted: To be Removed	Cubic Metres or Cubic Yards	Demolition	- Hauling - Disposal
Slab on Grade	Noted: To be Removed	Cubic Metres or Cubic Yards	Breaking the Concrete	- Hauling - Disposal
Concrete Foundations	Noted: To be Removed	Cubic Metres or Cubic Yards	Demolition	- Hauling - Disposal
Pavement (Bituminous)	Noted: To be Removed	Square Metres or Square Yards	Breaking the Pavement	- Hauling - Disposal
Sidewalk (Brick or Concrete)	Noted: To be Removed	Square Metres or Square Yards	Breaking the Sidewalk	- Hauling - Disposal
Curbs	Noted: To be Removed	Metres (Linear) or Feet	Breaking the Curbs	- Hauling - Disposal
Pipes (Concrete)	Noted: To be Removed	Metres (Linear) or Feet	Breaking the Pipes	- Hauling - Disposal
Masonry Walls (Solid or Cavity)	Noted: To be Removed	Cubic Metres or Cubic Yards	Demolition	- Hauling - Disposal
Removal of Rubbish	N/A	Cubic Metres or Cubic Yards (Basic Rate for Disposal to 8 km or 5 mi. from site)	- Hauling - Disposal	N/A
Fence Removal	Noted: To be Removed	Metres (Linear) or Feet	Removal	- Hauling - Disposal
Tree Removal	Noted: To be Removed	Each tree (Cost varies with the following range of diameters): 200 to 300 mm	- Axe Trimming - Cutting Down - Cutting Into 1200 mm (4 ft.) logs	- Hauling - Piling - Burning of branches - Removal of stumps - Clearing

TABLE 4

MEASUREMENT OF MATERIALS FOR DEMOLITION AND REMOVAL WORK (Cont'd)

Item or Activity	How Shown On Blueprints	How Estimated	Includes	Does Not Include
Tree Removal (Cont'd)		300 to 400 mm 500 to 600 mm or 8 to 12 in. 12 to 16 in. 20 to 24 in.		
Stump Removal	Noted: To be Removed	Each Stump	a) Grub and remove by hand or b) Blast and pull with tractor	- Hauling - Disposal

TABLE 5

MEASUREMENT OF MATERIALS FOR SITE CLEARING AND GRADING

Item or Activity	How Shown On Blueprints	How Estimated	Includes	Does Not Include
Clearing Trees and Brush	Noted: To be cleared	Per hectare or acre	a) Clear with bulldozer, pile and burn or b) with tractor and cable, pile and burn	- Sawing - Cutting - Trimming - Removal of stumps
General Site (Rough) Grading	Existing and Finish Grades Shown	Cost varies with area covered according to the following range; 120 m^2 143.4 yd^2 240 m^2 286.8 yd^2 300 m^2 358.5 yd^2 450 m^2 487.8 yd^2 750 m^2 896.3 yd^2 900 m^2 573.6 yd^2 1,200 m^2 1434 yd^2	Operations and maintenance of: - Loader - Tractor - Crawler-tractor - Hauled-tractor - Pusher-tractor - Hauled-scraper	- Spotting - Grade Checking

5.1.3 Installation of the Batter Boards

Once the exact position of the building on its lot has been established, the set reference points or locations of exterior corners of the building must be retained for reference until the foundation wall is put in place. To this end, batter boards are erected at each corner of the building as well as at every offset or jog in the foundation wall. Batter boards are usually set back at least 1,200 mm (4 ft) from the building line depending on the stablility of the soil and the room required for the excavating equipment. Figure 4 shows details of this procedure.

The materials required for the batter boards usually consist of 38 X 89 mm (2 in x 4 in) stakes driven into the ground. and 19 X 140 mm (1 in x 6 in) boards or 38 X 89 mm (2 in x 4 in) dimensional stock nailed horizontally to the stakes and parallel to the building lines. The top of the batter boards is usually level with the top of the foundation wall. Also, sufficient lengths of nylon line, running from corner to corner of the building on all four faces, are extended to the batter boards. A plumb bob is used to position the line directly above the corner points. Saw kerfs or nails will indicate on the batter boards the exact stop points of each line for the following:

1. outside of footing,
2. building line,
3. center of foundation wall,
4. inside of foundation wall, and
5. inside of footing.

For small jobs, however, these may be limited to the building line. The other lines would be measured from it.

6.0 ESTIMATING EXCAVATION WORK

6.1 Evaluating Soil Conditions

Before beginning to excavate, it is important to have an understanding of the soil, both surface and subsoil.

It is a good idea to bore test holes with an auger to find out what type of soil lies under the surface. This is usually done before the house is designed. The cost of excavating is influenced by the type of soil and its degree of workability. There are three main categories of soils: coarse grained; fine grained; and organic. Within these three categories are five groups. Figure 5 shows how these five groups are shown on drawings.

FIGURE 4

INSTALLATION OF BATTER BOARDS

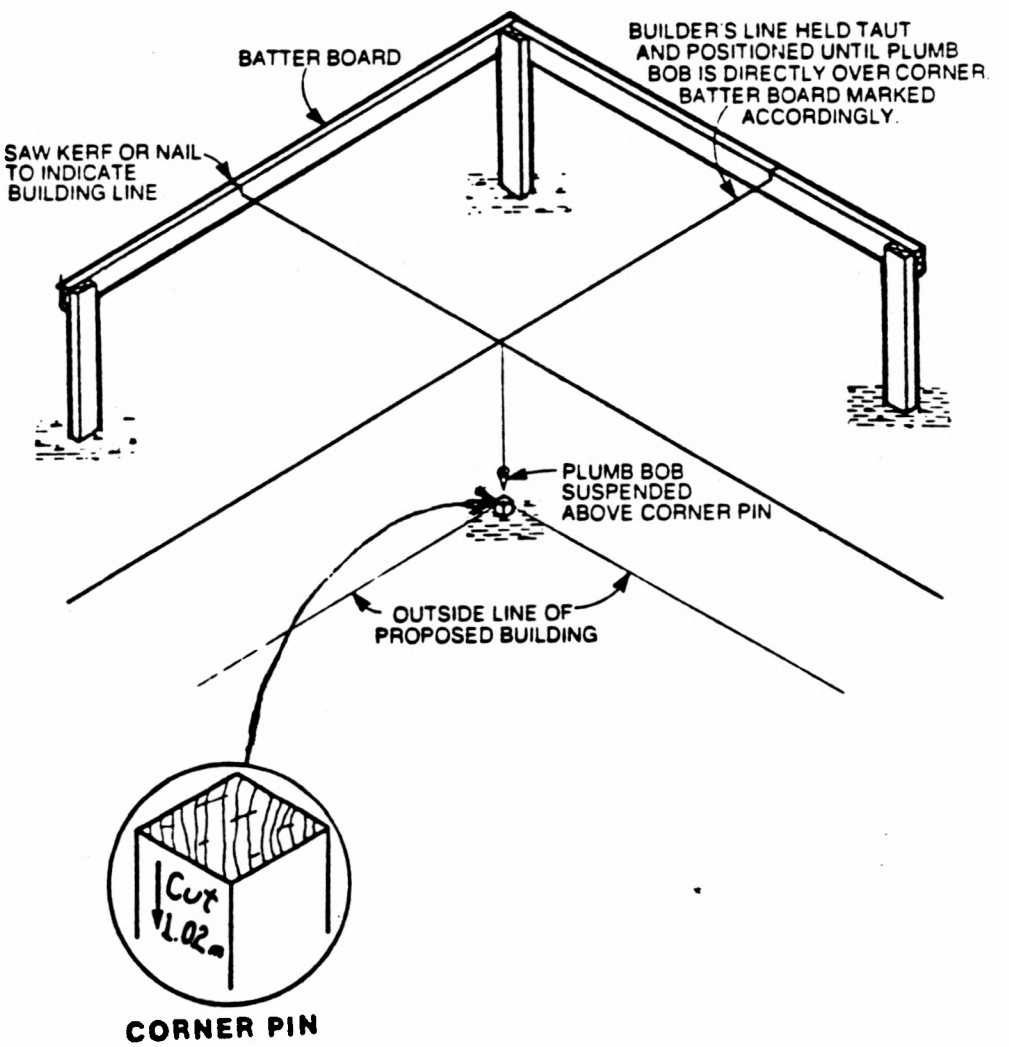


FIGURE 5

CATEGORIES OF SOIL

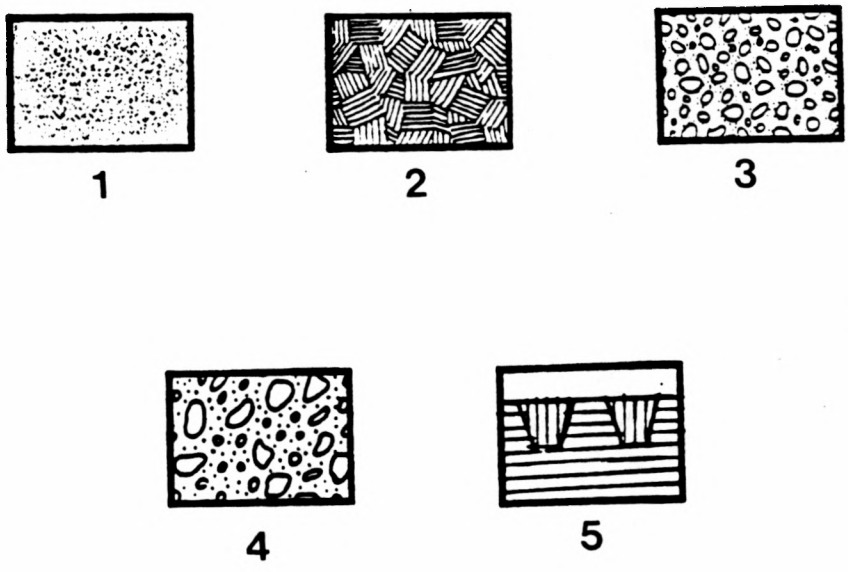
1- Light

2- Medium (or ordinary)

3- Heavy (or hard)

4- Hard pan (or shale)

5- Rock



6.1.1 Light Soil

Earth that can be shoveled easily and requires no loosening, such as sand is typically called light soil.

6.1.2 Medium or Ordinary Soil

This type of earth is easily loosened by pick. Preliminary loosening is not required when power excavating equipment such as power shovels, drag line scrapers or backhoes are used. This earth is usually classifed as ordinary soil and loam.

6.1.3 Heavy or Hard Soil

This type of soil can be loosened by pick but this loosening is sometimes very hard to do. It may be excavated by sturdy power shovels without preliminary loosening. Hard and compact loam containing gravel, small stones and boulders, stiff clay or compacted gravel are good examples of this type.

6.1.4 Hard Pan or Shale

This refers to soil that has hardened and is very difficult to loosen with picks. Light blasting is often required when excavating with power equipment.

6.1.5 Rock

Rock requires blasting before removal and transporting. This category may be divided into different grades such as hard, soft or medium rock.

6.2 Procedures for Estimating Excavation Work

The denser the soil, the higher the basic rate for excavating will be.

Remember: Excavation work is estimated by the volume of earth removed in cubic metres (or cubic yards, if preferred).

To calculate the volume of earth to be removed, the first thing to do is to add a minimum of 1,200 mm (4 ft) to the width and to the length of the house (that's 600 mm (2 ft) beyond each wall) as working space. If the soil is loose, such as sand or fine gravel, the working space should even be wider and the banks should be slanted to prevent a possible cave-in. The volume = width (including the working spaces) multiplied by length (including

working spaces) multiplied by the depth. The dimensions on the plan are either in millimetres or in feet. If in millimetres, convert into metres by moving the decimal point three digits to the left before multiplying. Example: 1200 mm = 1.2 m.

If the dimensions are in feet, multiply the width by the length by the depth in feet and divide the result by 27 to get the volume in cubic yards, then multiply the number of cubic yards by 0.76 to get the volume in cubic metres. Example:

40 ft. X 50 ft. X 5 ft. = 10,000 cubic feet.
10,000 divided by 27 = 370 cubic yards X 0.76 =
281.2 cubic metres.

If a good layer of top soil exists, the excavator's first job will be to strip it away. It is either taken away or carefully piled on one corner of the lot and covered with plastic sheets for future use when the final site grading takes place.

The equipment commonly used for excavating is either four-wheeled or track-type front end loaders or machine equipped backhoes. This normally includes operations of excavating and dumping on side lines or dumping into trucks, but does not include hauling or blasting.

6.3 Rock Excavation

Rock excavation is estimated by the metre (or yard) for drilling holes and by the cubic metre (or cubic yard) for blasting.

In listing the requirements, make sure everything is spelled out. Example: your heading should be EXCAVATION FOR HOUSE FOUNDATION (there could be other excavation needed such as for a shed or the installation of a drainage system, etc. BE SPECIFIC in order to avoid confusion.

6.4 Estimating Excavations - Summary Checklist

To sum up do the following:

1. Find out what kind of soil - soft, medium, hard?
2. Is there rock requiring blasting?
3. What equipment will be required?
4. Calculate the volume of earth to be excavated (including a perimeter workspace).
5. Get a price for

    a) bulk excvation;
    b) blasting if required; and
    c) hauling the excavated material away (except for what's needed for backfill, grading etc.).

6. If you are equipped to do it yourself, your list will include

    a) the operation and maintenance of your equipment and
    b) cleaning up the excavation bottom by hand shovel.

Example of Excavation Activity Listing.

Excavation For House Foundation

Soil = Medium (or ordinary)
Area to be excavated = (W) 8.7 m X (L) 9.9 m.
(28.5 ft x 32.4 ft)
Depth to be excavated = 2 m. (6.6 ft)
Volume of earth to be removed = 172.3m^3 (226 yd^3)
Operation = by contract @ ..... per cubic metre (or cubic yard) using front end loader.

7.0 TAKING THE QUANTITIES FOR CONSTRUCTION

7.1 The Importance of Being Specific

Before taking off the quantities from the blueprints, read the specifications and list the types of materials under the proper activity or material heading. For example, under the heading of Materials for the foundation wall, and the sub-heading CONCRETE BLOCKS for the foundation wall, you may write down the type of concrete blocks, the sizes, whether they are "light" weight or regular load-bearing, smooth finish or decorative and other characteristics identifying the specific material that is prescribed for the job. The idea is that there must be no possibility to substitute undesired or lesser quality material for what is intended, wanted or needed. If you are not sure about the quality required because you can't find the exact and complete description of a particular material, put a question mark or an asterisk after the name of the material, write it down on a piece of paper and note "to be checked or verified" beside it.

Remember that you are to describe all the materials needed for the job in order to provide a complete, concise and realistic basis for estimating the costs and purchasing all the right materials to build a specific house, not just any house. After you have noted the particular characteristics of the materials from the specifications, take a good look at all the blueprints to get an idea of the layout, the type of construction, the number of floors and the general design of the house. This may take just a few minutes but many little details will stick in your mind and this will help you as you go through the process of taking the quantities of materials for each particular building activity.

Table 6 lists the names and types of most of the products and accessories you will encounter in a house construction project. It will be useful in helping you list specific items by common name.

7.2 Rules for Quantity Take-Off

The three basic rules for taking off quantities are as follows:

1. Measure everything as shown.
2. Take and list everything that you can see on the blueprints.
3. Separate what is different.

7.2.1 Measure Everything as Shown

Do not approximate, do not average, do not round off the figures and do not change anything unless a change has been approved.

An estimate is to be as per plans and specifications and not as we think is required. If there is conflicting information between details or between the blueprints and the specifications, ask for clarification.

When a contractor prepares an estimate for bids, he is bidding only on what is shown. If changes are made after the award of a contract, it becomes a matter for "adjustment" between the contractor and the owner.

7.2.2 Take and list everything that you can see on the blueprints

This means take all that is shown on the blueprints. Do not leave anything out. We all make mistakes, and in breaking-off a whole building in small parts, we may omit some items if we're not careful. If we keep those two basic rules in mind, 1) taking off everything that we can see and, 2) taking off everything exactly as it is shown, we can minimize the risk of omitting something.

7.2.3 Separate what is different

Means separate items that will require special attention. Don't mix face brick with back-up bricks; or spruce, construction grade 39 x 135 mm (1½" x 5½") wood members with white pine, select grade, 39 x 135 mm (1½" x 5½") wood members, for example.

TABLE 6

LIST OF PRODUCTS AND ACCESSORIES

A

ACID-SOLDER
ADHESIVES-ASPHALT CEMENT
-CAULKING COMPOUND
-FOUNDATION COATING
-PLASTIC CEMENT
-ROOF CEMENT
ANCHORS WALL-DRYVIN
-FIBRE
-LEAD
-PLASTIC
-SCREW
-SHIELDS-EXPANSION
-SLUGIN
-SPRINGIN
-TAMPIN
-TOGGLE
APRONS-CARPENTER
ASBESTOS PAPER
ASH PUMPS
ASPHALT RAKE
AUGER BITS-BRACE
-ELECTRICIANS
-EXPANSIVE
-POST HOLE
-TOILET

B

BARS-CROW
-WRECKING
BARRELS-BOLTS
BATH-FAUCET
-SHOWER
-TRAP
BATHROOM ACCESSORIES-PAPER HOLDER
-SOAP DISH
-TOWEL BARS
BELL TRAP GRATES
BELLS-DOOR
-ROTARY
BELT SANDER
BELT-BELT DRESSING
-SANDING
-V-BELTS

B

BINDING-LINO
-PLASTIC
BITS-POWER TOOLS
-ROUTER
-SCREWDRIVER
BLADES-JIG-SAW B/D
- " " SKILL
-KEYHOLE
-SKILL
BLOCK & TACKLE
BLOCK-SANDING
BOLT CUTTERS
BOLTS-CARRIAGE
-CELLAR
-CHAIN
-EYE
-FOOT
-FLUSH
-HEXAGON
-LAG
-PAD
-PANIC
-STOVE
-SURFACE
-"U" BOLT
BOXES-MITRE
-TOOL
BRACES-BIT
-JAW
-SCREEN DOOR
BRACKETS-DOOR
-GLASS
-HAND RAIL
-SHELF
BRICKS-BRICKLAYERS HAMMER
-CHISELS
-JOINTER
BROOMS-CONCRETE
-CORN
-HOUSEHOLD
-WAREHOUSE
BRUSHES-FLOOR
-NAIL
-PAINT
-SCRATCH

TABLE 6 (Cont'd)

B cont'd

BRUSHES-SCRUB
-WALL
-WHITEWASH
-WIRE
BULL RINGS
BUSHINGS-IRON
BUZZERS

C

CABINET HARDWARE-AMEROC
-BONAVENTURE DESIGN
-CARRIAGE DESIGN
-CATCHES-CABINET
-HINGES
-KNOBS
-MONTERAY
-PLATES
-PULLS-CABINET
-SHELF HARDWARE
CABINET HARDWARE-ONWARD
-BACK PLATES
-CATCHES
-HINGES
-KNOBS
-PULLS
-SCRAPERS
CABLE-ANNUNCIATOR
-ARMOURED
-HEATING
-LAMP
-ROMEX
-STRAPS
CARBIDE-DRILLS
CASEMENT FASTENERS
CAST DRAINAGE FITTINGS
CAST IRON FITTINGS-BUSHINGS
-CAPS
-COUPLINGS
-ELBOW STRAIGHT
-ELBOW STRAIGHT REDUCING
-FLANGES
-PLUGS
-TEES STRAIGHT
-TEES REDUCING

C cont'd

CAST PRESSURE FITTINGS
CASTERS
CASTER CUPS
CATCHES-DOOR BUTTONS
CAULKING-CARTRIDGES
-COTTON
-GUNS
CELLAR-JACKS
CEMENT-ASPHALTS
-CARPET
-CONTACT
-LINO
-PLASTIC
-RUBBER
-THINNERS
CEMENT TOOLS-EDGERS
-FLOATS
-JOINTERS
-TROWELS
CHAIN LINK FENCE
CHAIN-HOIST
-PULLERS
-WRENCHES
CHALK-CARPENTERS
-LINE
-REFILLS
CHISEL-HANDLE
CHISELS-BRICK
-COLD
-CONCRETE
-TURNING
-WOOD
CHUCKS-SKILL
CHUCK KEYS-SKILL
CLAMPS-BAR
-"C"
-CABLE
-CARRIAGE
-COTTER PINS
-GROUND
-HAND
-MITRE
-SCREW
-SPRING
-S/S STEEL
-WEBB
CLAW HAMMERS

TABLE 6 (Cont'd)

C cont'd

CLAY PICKS
CLEAN OUTS
CLEANERS
CLOSER-SPRINGS
CLOSERS-DOOR
-SCREEN
-STORM
COMBINATION WRENCHES
CONCRETE MIX
CONDUIT
CONNECTORS-BOX
-MARR
COPPER-PIPE
-DRAINAGE
-TUBING
CORNER-IRONS
-PLATES
CRAYONS-LUMBER
-SOAP STONE
CRYSTAL LACQUER
CUTTERS-GLASS
-PIPE
-TUBE
CYLINDERS-LOCK

D

"D" HANDLE-SHOVEL
DADO
DEADLOCKS
DECK MOP
DOME DAMPERS
DOOR KNOBS-GLASS
-SCREWS
-SPINDLES
DOOR KNOCKERS
DOOR SETS-CHECKS
-HOLDERS
-PULLS
-SCREEN
-SPRINGS
-STOPS
-STORM
DRILLS-ACCESSORIES-SKILL
-BREAST
-CARBIDE

D cont'd

DRILLS-COUNTERSINKS-STANLEY
-ELECTRIC BIT
-ELECTRIC B/D
-ELECTRIC-ROCKWELL
-ELECTRIC-SHOPMATE
-ELECTRIC-SKILL
-EXTENSION
-HAMMER-ROCKWELL
-HAND
-H/S SPEED
-KITS-B/D
-MASONRY
-POINTS
-PRESS-ROCKWELL
-PRESS-SHOPMATE
-PUSH
-ROTARY
-STAR
-TWIST

E

EAVESTROUGH
EAVESTROUGH ACCESSORIES
EDGERS-CEMENT
ELECTRIC DRILL BIT
ELECTRICIAN-BITS
EXPANSIVE-BITS
EXTENSION RODS-CLOSET
EXTINGUISHERS-FIRE

F

FANS
FASTENERS-SCOTCH
-WOOD
FAUCET-ACCESSORIES
FAUCETS-BATH
-DECK-WALL MOUNT
-LAUNDRY
-LAVATORY
-OIL DRUM
-SEDIMENT

TABLE 6 (Cont'd)

F cont'd

FAUCETS-SHOWER
-SINK
-STOP
FENCE-ACCESSORIES
-CHAIN LINK
-ELECTRIC
-LAWN
-PLIERS
-POULTRY
-SNOW
FILE-HANDLES
FILES-ASSORTED
FILLERS-CRACK FILLER
-GROUT
-PLASTER OF PARIS
-PLASTIC
-POLYFILLA
-SPACHTLING
-WOOD
-WOOD DOUGH
FILTERS-FURNACE
-WATER
FIRE CLAY
FIRE EXTINGUISHERS
FLASHLIGHTS-BURGESS
-EVERREADY
-MALLORY
-RAYOVAC
FLOATS-CEMENT
-PLASTERS
-TANKS
FLOOR-GLIDES
-SAVERS
FLUORESCENT BULBS
FLUSH PULLS
FUEL-PROPANE
FUNNELS-PLASTIC
-TIN
FUSES
FUSIBLE LINKS

G

GALVANIZED SHEETS
GARBAGE CANS

G cont'd

GATE VALVE
GAUGING-TROWELS
GLASS-PANES
-CUTTER
-WHEELS
-WINDOWS
GLAZIER POINTS
GLOBE VALVE
GLOVES
GLUES-BONFAST
-CARPENTERS
-CELLULOSE
-CHINA
-DEVCON
-EPOXY
-GENERAL PURPOSE
-HOUSEHOLD
-LIQUID
-MARINE
-MUSILAGE
-PANITE
-PAPER
-PASTE
-PLIABOND
-RESIN
-WHITE
GRAPHITE
GRATES-BELL TRAP
GREASE-CARTRIDGE

H

HAMMERS-BRICK LAYERS
-CLAW
-HANDLE
-MACHINISTS
-MASONS
-NAIL
-PLASTIC FACE
-RAFTER
-RIVETTING
-RUBBER
-WOOD MALLETS
HAND TAPS
HANGERS

TABLE 6 (Cont'd)

H cont'd

HARDWARE CLOTH
HASPS-BOX
-SAFETY
HEATERS-BLANKETS
-CATALYTIC
-IMMERSION
-PADS
-PORTABLE WATER
-WOOD BURNING
HINGES-BOX
-BRASS
-BUTT
-DESK
-DOUBLE ACTING
-FLOOR
-PIANO
-SCREW & TRAP
-SHOWCASE
-SINGLE ACTING
-STRAPS
-TEE
-WARDROBE
HOES-MORTAR
HOOKS-COAT & HAT
-CORNICE
-CUP
-DRAPERY
-ROUND, SLIP OR GRAB
-"S" HOOK
-SHOULDERED
-WARDROBE
HOSE-COUPLINGS
-HANGERS
-NOZZLES
-RUBBER
-SPRAYERS
-SPRINKLERS
-VINYL
-WASHERS
HUMIDIFIERS
HOUSE NUMBERS
HYDRAULIC JACKS

J

JACKS-CELLAR
-HYDRAULIC
JOINT-CEMENT
-FASTENERS
-TAPE
JOINTERS-BRICK
-ELECTRIC-ROCKWELL

K

KERESONE-LAMPS
KEYS-BLANK
-HEXAGON
-HEXAGON SETS
-SKELETON
KICK PLATES
KNOBS-PLASTIC
-WOODEN

L

LADDERS-EXTENSION
-STEP
LAMPS-BRASS
-COLEMAN
-FLUORESCENT
-HOUSEHOLD
-INTERIORS
-KEROSENE
LANTERNS-BURGESS
-EVEREADY
-GLOBES
-KEROSENE
-MALLORY
-RAYOVAC
LATCHES-BAR DOOR
-GATE
-GRAVITY

TABLE 6 (Cont'd)

L cont'd

LATCHES-NIGHT
-SECRET
-THUMB
LETTER BOX PLATES
LEVELS-ALUMINUM
-TORPEDO
-WOOD
LINKS-CONNECTING
LOCKS-BOX
-CHEST
-DRAWER
-WARDROBE
LOCKSETS-CORBIN
-DOMINION
-KWIKSET
-WESTLOCK
-YALE

M

MACHINE SCREWS TAPS
MAIL BOXES
MATS-COCOA
-RUBBER
-STOVE
MOPS-DECK
-HEADS
-SPONGE
-STICKS
-WRINGER PAILS
-WRINGERS
MORTAR MIX
MORTISE-LOCKS

N

NAILS-ARDOX, STANDARD
-BASKET
-BOX
-CANOE
-COMMON BRIGHT
-COMMON GALV.

N cont'd

NAILS-CONCRETE
-DOUBLE HEADED
-DRYWALL
-EAVESTROUGH
-FINISHING-ARDOX
-FINISHING-BRIGHT
-FLOORING
-LINC
-ROOFING
-SHINGLE
-UPHOLSTERS
-WALLBOARD
-WEATHERSTRIP
NIPPLES-ELECTRICAL
-PIPE
NOZZLES-HOSE
NUTS-MACHINE
-HEXAGON
-WING
NYLON FITTINGS

O

"O" RINGS
OAKUM
OIL DRUM FAUCET
OILERS
OILS-CREOSOTE
-CUTTING
-HIPPO
-HOUSEHOLD
-LEMON
-LINSEED
-MOTOR
-NEATSFOOD
-SEPARATOR
OUTLETS-CLOCK
-SURFACE

P

PADLOCKS

TABLE 6 (Cont'd)

P cont'd

PADLOCKS-CHAIN LOCKS
-CHAIN
PAILS-CONTRACTOR
-DAIRY
-FIRE
-GALVANIZED
-MOP
-MOP WRINGER
-STRAIGHT
-WATERING
PAINT-ACCESSORIES
-DRAMEX
-KITS
-MASONRY
-POLAR
-REMOVER
-ROLLERS
-TINTS
-TRAYS
PASTE-SOLDER
PENTOX
PICKS-CLAY
-DRIFTING
-MATTOCK
-PROSPECTORS
PIPE-TAPS
-TAPE
-GALV. AND BLACK
-STANDARD
PIPE JOINT-COMPOUND
PLANER-ROCKWELL
-SHOPMATE
PLANES-ROCKWELL
PLANES-BENCH
-BLOCK
-JACK
-PARTS
-RABBIT
PLASTIC-FITTINGS
-HOUSEWARES
-PIPE
-STEEL
-UTILITY, POLYETHYLENE
-WOOD

P cont'd

PLIERS-ASSORTED
-FENCH
-WRENCH
PLUGS-BOILER
POLLYFILLA
PORCELAIN-LIQUID
PROPANE-ACCESSORIES
-FUEL
PULLERS-NAIL
PULLEYS-AWNING
-BELT
-SWIVEL
-V-BELT
PUMICE
PUMPS
PUNCHES-NAIL
-RIVET
PUSH BUTTONS
PUSH PLATES
PUTTY

Q

R

RANGE-BOILERS
-CONNECTORS
REAMER WRENCHES
RIVETS-BLIND
-IRON
-POP
-SPLIT
-TINNERS
ROD SUPPORTS
RODS-ALL THREAD
ROLLERS-PAINT
ROLLERS DESK DRAWER
ROOF SHEATHING
ROPE-AWNING CORD, COTTON SASH
-CLOTHESLINE
ROTTENSTONE
ROUTER-ACCESSORIES-SKILL

TABLE 6 (Cont'd)

R cont'd

ROUTER-B/D
-ROCKWELL
-SHOPMATE
-SKILL
-STANLEY
ROUTER BITS-ROCKWELL
-SKILL
-STANLEY
RUBBER-CEMENT
-RESIN

S

SAND PAPER
SAND PAPER BELTS
SANDERS-B/D
-SHOPMATE
-SKILL
SANDERS BELT-ROCKWELL
-FINISHING-ROCKWELL
SANDING-BELTS-SKILL
- " -DIAMOND GRIT
-BLOCKS
SASH-FASTENERS
-HANGERS
-HOOKS
-LIFTS
SAWS-BUCKS
-CIRCULAR B/D
- " " SHOPMATE
- " " SKILL
-COPING
-DOVETAIL
-ELECTRIC-ROCKWELL
-HACK
-HAND
-JIG-B/D
- " -SHOPMATE
-SKILL
-ROCKWELL
-KEYHOLE
-KITCHEN
-MITRE
-POWERSHOP-DEWALT

S cont'd

SCISSORS
SCREEN DOORS
SCREENING-INSECT
SCREW BASES
SCREW DRIVERS
SCREW DRIVER-BITS
SCREW DRIVER QUICK RETURN
SCREW-EYES
SCREWS-MACHINE-FLAT BRASS
-ROUND BRASS
-FLAT STEEL
-ROUND STEEL
-CAP SCREWS-SOCKET HEAD
-SET SCREWS-SOCKET
-SQUAREHEAD
-WOOD BRASS-ROUNDHEAD SOCKET
-WOOD BRASS-FLAT, RD, OVAL, SLOT
-WOOD STEEL-FLAT, RD, OVAL, SLOT
-WOOD STEEL-FLAT, RD, OVAL, SOCKET
SETS-SAW
SHELLAC
SHOVELS-"D" HANDLE
-LONG HANDLE
-SAND
-SNOW
SINK TRAP
SINKS-STAINLESS
SLIDING DOOR LOCKS
SLIDING DOOR SETS
SOLDER-BAR
-WIRE
SOLDERING GUNS
SOLDERING TAPE
SPACHTLING PASTE
STAPLERS-REFILLS
STAPLES-DOUBLE POINTED
-ELECTRICIAN
-FENCE
-POULTRY
STARTERS-FLUORESCENT
STEEL WOOL
STEP LADDERS
STOVE-BOARDS
-CAPS
-CEMENT
-COLLARS

TABLE 6 (Cont'd)

S cont'd

STOVE-DAMPERS
-ELBOWS
-MATS
-PIPE
-THIMBLES
-WIRE
STOVES-COLEMAN
SWEEPERS-CARPET
SWEEPING COMPOUNDS
SWITCHES-KNIFE
-CANOPY
-ENTRY
-PULL CHAIN
-PUMPS
SWIVELS

T

TACKS
TACKLE BLOCKS-STEEL
-WOOD
TANK-RODS
-VALVES
TAP WASHERS
TAPE-CELLULOSE
-ELECTRICIAN
-MARKING
-MENDING
TAPES-MEASURING
-REFILLS
TAPS-MACHINE SCREW
TESTERS-ELECTRICIAN
THINNERS-CEMENT
-CEMENT
TILE-CEMENT
TOGGLES
TOILET-PARTS
-SEATS
TORCHES-ACCESSORIES
-PROPANE
TRACK-GLIDERS
-PULLS
-ROLLERS
-SHOWCASE

T cont'd

TRAPS-BATH
-BELL
-BELL TRAP GRATES
-LAVATORY
-"P"
-SINK
TROWELS-CORNERING
-GARDEN
-GAUGING
-MARGIN
-POINTING
-PLASTERING
-TILE SETTERS
-WINDOWS
TURNBUCKLES
TURPENTINE
TWINE-COTTON
-HOSIERY
-JUTE
-NYLON
-UTILITY

U

U-BOLTS
UNIONS

V

VALVES-CHECK
-FOOT
-LEATHER
-STEM PACK
-SWING CHECK
VINYL FILM
VISES-CHAIN

W

WALLSIZE

TABLE 6 (Cont'd)

W cont'd

WASH TUBS
WASHERS-LOCK
-PLATE
-TAP
WASTE BASKETS
WATER BOWLS
WATER FILTERS
WAXES-APPLIERS
-FLOOR
WEATHERSTRIP
WEDGES-HAMMER
-WOOD SPLITTING
WELL POINTS
WHELL BARROWS
WINDOW-HOLDERS
-SCREENS
-SETS
WIRE-ANNEALED
-ARMOURED
-BARBED
-HEATING
-LAMP
-PICTURE
WOOD FILLERS-GROUT
-PLASTIC
WOOD DOUGH
WOOD PRESERVATIVES-CREOSOTE
-FALULON
-HIPPO
-PENTOX
-REZ
WRENCHES ELECTRIC-ROCKWELL
-CAR
-CHAIN
-COMBINATION
-OPEN END
-PARTS
-PIPE
-SETS
-STRAP

If the take-off is correct and complete, costing the materials will be done with confidence. A poor, incomplete take-off will produce an unsatisfactory estimate.

On large projects, some estimators prefer to proceed by trades rather than by activities and tackle the excavation part after the foundation work has been taken-off. This allows them to have a better picture of the excavation requirements. For small straightforward projects, this is not critical.

The important thing is to organize a pattern that will allow you to keep track of every stage of the project and provide for an orderly and accurate estimate of costs.

Having chosen and developed an order of taking-off, stay with it. Each item will have its place, the take-off will go smoothly and the possibility of missing something will be greatly reduced. Also, a particular item will be easily found when you refer back to the take-off sheets, as the pattern you have used will be registered in your mind.

As you proceed with your take-off list, note the main dimensions that could be used more than once. This will save you having to calculate the areas over again when estimating the quantities of finishing materials, etc. Use a separate sheet for this and note what these dimensions apply to. (e.g. 7580 x 8750 mm, (25'3" x 29'2") out to out of foundation walls).

7.3 Procedures for Quantity Take-off

Following are procedures which will help ensure complete and accurate take-off:

1. Use columnar forms to list dimensions in sequence and locations (what they refer to). Leave a column for other findings and remarks.

2. Be consistent in listing dimensions, e.g., list length x width x height, in that order.

3. Use printed (rather than measured) dimensions where given.

4. Do not "round-off" quantities until the final summary is transfered to the bill of materials.

5. Mark drawings with different colours as items are taken off.

6. Keep similar items together; different items separate.

7. Identify location and drawing numbers to aid in future checking.

8. Measure or list everything shown on the drawings and described in the specifications.

9. Be alert for notes on plans such as N.T.S. (not to scale), changes in scale throughout the drawings, working with reduced size drawings (do not scale), or discrepancies between specifications and drawings.

10. Follow a consistent pattern, for example, start the quantity take-off at the lower floor and move up.

11. Take off floor plan quantities first, elevations next, then detail drawings.

12. List all gross dimensions that can be either used again for different items, or used as a rough check of other quantities for verification (exterior perimeter, gross floor area, etc.)

13. Be careful not to omit or duplicate an area.

14. Be sure the decimals are in the right place.

15. Exercise judgement and common sense rather than being overcome by a mass of computations.

16. Be sure you are using the proper units of measurement applicable to each type of materials.

7.4 Summary of General Procedures

Mark up the blueprints as you take-off or "clear" a piece of wall or an item. Shade-in lightly with a pencil or put check marks as you have completed the taking off of the materials for a particular area or item.

Use a separate "collection sheet" on which you may write down series of dimensions to be added and note what they represent.

Use a red pencil for deductions and queries. Underline in blue pencil the final total of every item on the take-off sheets. These will be the figures that will be transferred to the final estimate sheet (after the applicable percentage for waste or breakage is added).

Always check off an item or part as you "clear it".
Measure everything as it shows.
Take off everything that is shown.
If different, keep separate.

Figure 6 illustrates an example of an "outline" specification for an ordinary house.

FIGURE 6

OUTLINE SPECIFICATIONS FOR HOUSING

CMHC 24
6/77

Central Mortgage and Housing Corporation / Société centrale d'hypothèques et de logement

NHA OUTLINE SPECIFICATION

STARRED ITEMS* MUST ALSO BE INCLUDED ON PLANS

Builder's Job No.:	Lender's Reference:	CMHC Reference:

EXCAVATION: Soil type ..... Depth from Finished Grade to Footing Bearing 2200 (7'-4")

FOUNDATION: Material CONCRETE BLOCK WALL & CONCRETE FOOTINGS Footing Size: Walls 450 x 250 (18"x10") Columns 650 x 650 x 250 (26" x 26" x 10")

CONCRETE: Type READY-MIX Strength 20 MPa (3000 Psi) at 28 days; Reinforced:* ☐ Yes ☑ No

☐ Waterproofing OR ☑ Dampproofing Material ASPHALT

TILE DRAINS: PVC 100 (4") ☑ Perimeter ☐ Underfloor ☑ Sump Pump

EXTERIOR WALLS: 38 x 140 @ 400 (2"x6" @ 16" c.c) ☐ Solid Masonry ☑ Frame ☐ Other .....

EXTERIOR FINISH: Brick Type ..... ☐ Stucco ☐ Wood ☐ Other* PREFINISHED HARDBOARD SIDING

CHIMNEYS: ☐ Masonry; Prefabricated type INSULATED METAL Size ..... ☐ Other .....

FIREPLACE* ☐ Wood or Coal ☐ Electric ☐ Gas Size of Flue or Vent .....

CONSTRUCTION DETAILS

MEMBER	SPAN	SPACING	SIZE/THICKNESS	MATERIAL AND GRADE
BEARING PARTITIONS*		400 o.c (16")	38 x 79 (2"x 4")	SPRUCE - GRADE 'D'
OTHER PARTITIONS*		400 o.c	38 x 79	"
BASEMENT COLUMN*			75 ø (3")	STEEL-TELESCOPING
FLOOR JOISTS*		400 c.c	38 x 184 (2"x8")	SPRUCE-CONSTRUCTION GRADE
FLOOR JOISTS OTHER*				
CEILING JOISTS*				
RAFTERS*				
TRUSS*				WOOD-NAILED-'W'-SPRUCE
BEAMS*			3-38 x 235 (2"x10")	LAMINATED-SPRUCE
ROOF SHEATHING			19 (3/4")	PLYWOOD-SHEATHING GRADE-T&G
WALL SHEATHING			12 (1/2")	" "
SUBFLOORING			19	" " T&G
TILE UNDERLAY			6 (1/4")	" G1S

WINDOWS: Type of Frames WOOD-PINE or CEDAR (MATCH WINDOWS) Type/Name of Sash AWNING

SPECIAL GLAZING: ☑ Storm Sash ☑ Fly Screens

DOORS: Type of Frames WOOD-PINE or CEDAR Exterior Doors - Size and Type 44 THICK-WOOD-SOLID CORE (1 3/4") " "

Interior Doors - Size and Type (1 3/8") 34 THICK-FLUSH PANELED-MAHOGANY Storm Doors - Size and Type .....

KITCHEN CUPBOARDS: ☑ Wood ☐ Metal ☑ With Doors; Counter Top PREMOULDED-PLASTIC FINISH

INTERIOR FINISH: ☐ Plaster Drywall - Type and Thickness GYPSUM PLASTER BOARD - 12 (1/2")

AREA	FLOORS INCLUDE THICKNESS	WALLS AND CEILINGS	DECORATION
LIVING ROOM		DRYWALL	PAINT
DINING ROOM			"
KITCHEN			"
VESTIBULE			"
BEDROOMS			"
BATHROOMS	CERAMIC TILE	CERAMIC TILE & DRYWALL	" (DRYWALL)
RECREATION ROOM			
OTHER			

INSULATION: Type and Thickness: Exterior Walls FIBERGLASS BATTS

Basement/Crawl Space: Walls RIGID-STYROFOAM-50 (2") TO INSIDE Ceilings FIBERGLASS BATTS

Roof ..... Floor ..... Slab POLYETH. 0.15 MOIST. BAR. (6 mil)

ROOFING: Type ASPHALT SHINGLES Grade or Weight 106 kg (235 lb) Eavestroughing ☐ Yes ☑ No

PLUMBING: ☑ 3 Piece ☑ Shower over Bath ☐ Shower Cabinet ☑ Laundry Tubs

EXTRA PLUMBING: .....

DOMESTIC HOT WATER: Method of Heating ELECTRICITY Pipe Material COPPER Wattage/Recovery Capacity of Heater .....

Type of Tank RHEEM TE-40C Capacity of Tank 182 L (40 gal) Rental ☐ Yes ☑ No

HEATING SYSTEM: Type of Fuel OIL Type of System FORCED AIR LOW BOY Details MODEL OF 72-112 .....

.....

ELECTRICAL SERVICE: No. of Amperes 200 No. of circuits 24-32 Wiring: ☐ Aluminum ☑ Copper Special Wiring: .....

Special Equipment ELECT. RANGE-220 VOLT WIRING / SPACE IN PANEL FOR DRYER

OWNERSHIP: List all equipment subject to Conditional Sales Contract or Lien .....

.....

SPECIAL FEATURES: EXHAUST FAN OVER RANGE-ELECTROMEC MODEL VR 30/94 L/S

BATHROOM EXHAUST FAN-ELECTROMEC MODEL BE-6-28 L/S

ELECT. FIXTURE ALLOWANCE - $500.

HARDWARE ALLOWANCE = $800.

TYPE OF SURFACE* Walks ..... Driveway ..... Parking Area ..... Other .....

PARKING* ☐ Garage ☐ Carport ☐ Parking Pad No. of Cars .....

LANDSCAPING: Sodding ..... Area Seeding ..... Area ☐ Shrubs ☐ Trees

I certify that the house(s) will be built in accordance with this Outline Specification and the accompanying plans and with the Residential Standards. The instructions on the reverse side have been noted and will be followed.

Date:	Applicant's Signature:

7.5 House Construction Activities

When taking the quantities for construction, it is a good idea to list the various materials according to a sequence of operations or activities. The next 10 sections present specific instructions on how to do this in a systematic way for the following:

1. Footings (Section 8), including

   a) foundation wall footing, and
   b) interior post footings;

2. Foundation Wall (Section 8) including

   a) concrete blocks and
   b) poured concrete;

3. Interior Posts and Center Beam (Section 8);

4. Basement Floor Slab (Section 8);

5. Floor Structure, Sheathing and Basement Stair (Section 9);

6. Exterior Wall Framing and Sheathing (Section 9);

7. Roof Structure and Sheathing (Section 9);

8. Roofing (Section 9);

9. Exterior Doors and Windows (Section 9);

10. Interior Partition Framing (Section 9);

11. Plumbing, Heating and Ventilation (Sections 10 and 11);

12. Electrical (Section 12);

13. Insulation, Air/Vapour Barrier and Ceiling Strapping (Section 13);

14. Exterior Wall Finish (Section 14);

15. Interior Wall and Ceiling Finish (Section 15);

16. Interior Doors (Section 16);

17. Finish Woodwork (Exterior and Interior) (Section 17);

18. Hardware and Miscellaneous metals (includes nails, screws, etc) (Section 18);

19. Caulking, Weatherstripping, Painting, Ceramic Tile (Section 19); and

20. Floor Coverings (other than ceramic tile) (Section 20).

8.0 FOUNDATION WORK

8.1 Materials Used in Foundation Work

When you take off the quantities for foundation work, you will have to deal with a variety of materials, from concrete to polyethelene vapour barriers. Table 7 lists the materials you will have to deal with, how each is measured, and how each is sold. Table 8 provides information on how to calculate the necessary quantities of mortar and reinforcing steel. Figures 7 and 8 provide other details for estimating footings and foundation walls.

8.2 Footings

There are two types of footings: foundation wall footings, and interior posts footings.

The materials required for the foundation wall and interior posts footing are concrete, reinforcing bars, anchor bolts and forms.

8.2.1 Concrete

Concrete is estimated by volume and in cubic metres or cubic yards. To get the volume of concrete required for footings multiply the length by the width by the depth given.

$$V = l \times w \times h$$

The simplest way to measure the lengths of all the foundation wall footings including those of external stairs is by using center lines as guides. Center lines are drawn along all four foundation walls. Where these center lines meet will be the starting and stopping points for all the lengths needed for calculating the quantities of materials required for the foundation wall footing.

The same principle applies, as we will see later on, to get the total length of a poured concrete foundation wall and the formwork.

It has been found in practice that the long method which consists of measuring the full lengths of footing on two parallel walls and deducting the width of those lengths of footing when measuring the lengths for the other two wall footings takes twice as much time and gives exactly the same result as the center line short-cut method.

TABLE 7

MATERIALS FOR FOUNDATION WORK

Material	How Measured	How Sold
Concrete	Cubic metres (m^3) or Cubic Yards (yd^3)	Cubic metres (m^3) or Cubic Yards (yd^3)
Reinforcing bars	Linear Metres or Feet	Mass (or weight)
Anchor bolts	Unit	Unit
Formwork	Square metres (m^2) or Square Feet (ft^2)	Square Metres (m^2) Square Feet (ft^2)
Concrete blocks	Square Metres (m^2) or Square Feet (ft^2) (100 blocks per $8m^2$) (100 blocks per 86 ft^2)	Unit
Mortar (Cement)	Cubic metres (m^3) Cubic Feet (ft^3)	Bag 31.5 kg (70 lbs)
Durowall Reinf.	Linear Metres or Feet	Linear Metres or Feet
Wood sill plate	Linear Metres or Feet Unit of Standard Length	Linear Metres or Feet Unit of Standard Length
Steel posts	Unit	Unit
Gravel or Crushed stone	Cubic metres (m^3) or Cubic Yards (yd^3)	Cubic Metres (m^3) or Cubic Yards (yd^3)
Sand	Cubic metres (m^3) or Cubic Yards (yd^3)	Cubic Metres (m^3) ton or Cubic Yards (yd^3)
Polyethylene V/B	Square metres (m^2) or Square Feet (ft^2)	Roll $93m^2$&$139.5m^2$ coverage (1000 ft^2 and 1500 ft^2)
Dampproofing	8 litres per $9.3m^2$ (2 gals per 100 ft^2)	4 litre (1 gallon) can
Parging (Cement)	Square metres (m^2) or Square Yards (yd^2 of a given thickness or Cubic metres (m^3) or Cubic Yards (yd^3) of parging material	Bag 31.5 kg (70 lbs)

TABLE 8

CALCULATING QUANTITIES: MORTAR AND REINFORCING STEEL

TABLE OF ASTM STANDARD REINFORCING BAR SIZES

BAR SIZE DESIGNATION	WEIGHT POUNDS PER FOOT	NOM DIMENSIONS - ROUND SECT. DIAMETER (INCHES)	CROSS SECT. AREA SQ IN	PERIMETER (INCHES)
# 3	.376	.375	.11	1.178
# 4	.668	.500	.20	1.571
# 5	1.043	.625	.31	1.963
# 6	1.502	.750	.44	2.356
# 7	2.044	.875	.60	2.749
# 8	2.670	1.000	.79	3.142
# 9	3.400	1.128	1.00	3.544
#10	4.303	1.270	1.27	3.990
#11	5.313	1.410	1.56	4.430
#14	7.650	1.693	2.25	5.320
#18	13.600	2.257	4.00	7.090

NOTE:
Bar sizes #14 and #18 are generally not carried as local warehouse stock items

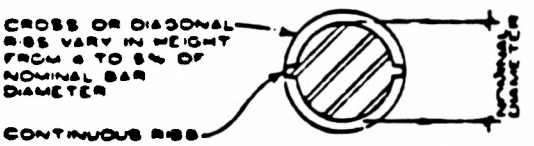
COMMON STYLES OF WELDED WIRE FABRIC - TWO WAY TYPE -

STYLE DESIGNATION	SECTIONAL AREA WEIGHT LONGITUDINAL	TRANSVERSE	LBS PER 100 SQ FT.
2 x 2 - 14/14	.030	.030	21
2 x 2 - 16/16	.018	.018	13
4 x 4 - 4/4	.120	.120	85
4 x 4 - 6/6	.087	.087	62
4 x 4 - 8/8	.062	.062	44
4 x 4 - 10/10	.043	.043	31
6 x 6 - 4/4	.080	.080	58
6 x 6 - 6/6	.058	.058	42
6 x 6 - 8/8	.041	.044	30
6 x 6 - 10/10	.029	.029	21

NOTE:
Style designation - First two numbers indicate longitudinal and transverse wire spacing in inches and the later two, A.S & W. wire gauge The above commonly warehoused styles are furnished in (5) ft wide by (150) ft. long smooth wire rolls, however 11 ga. fabric is furnished galvanized only

Economic use of welded wire fabric in sheets or rolls in lieu of reinforcing varies from three tons for light weight fabric to fifteen tons for heavy weight fabric On large jobs fabric can be made with deformed or galvanized wire, and with varying wire size and spacing.

NOTE
REBAR = REINFORCING BAR



CROSS SECTION OF REINFORCING BAR

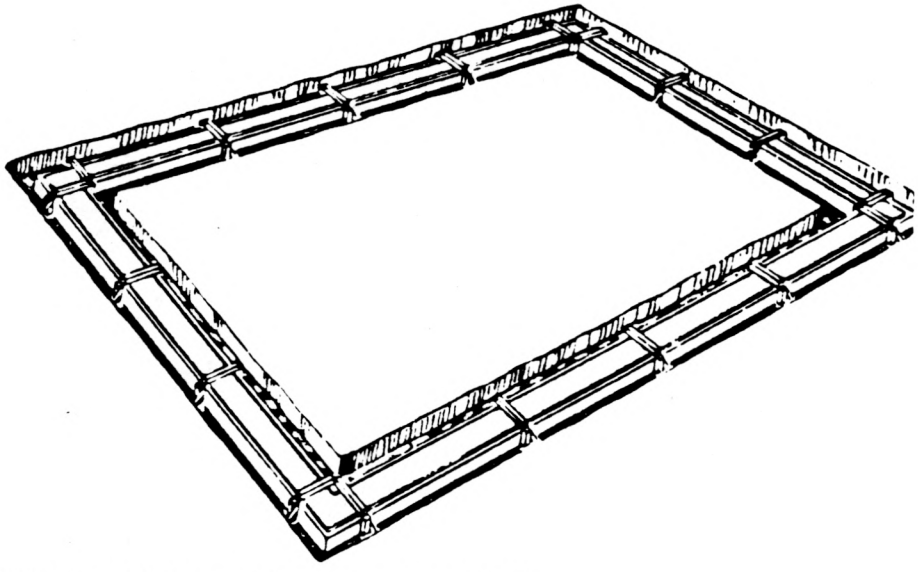
How much mortar?

For 100 square feet of brick wall surface				
Wall thickness	Number of bricks	Cubic feet of mortar	Mix by Volume 1:3	
			Masonry cement bags	Cubic feet of sand
3¾"	616	9	3	9
8"	1,232	21	7	21

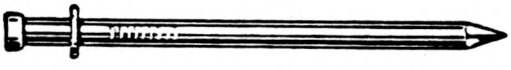
The mortar quantities in this table are approximations. They allow for roughly 20% waste for a 4 in. wall. 12% waste for an 8 in. wall. These allowances are conservative since waste can be higher than 50%, depending on the care and skill of the bricklayer. Table is based on standard building bricks - 2½ x 3¼ x 8 in. All mortar joints are assumed to be ½ in. thick. A 70-lb bag of masonry cement holds 1 cubic foot.

FIGURE 7

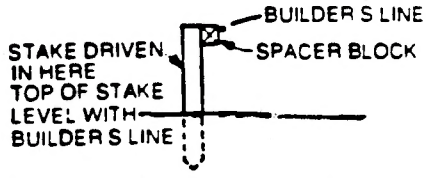
ESTIMATING THE FOOTING



19-7. A formed footing in which concrete has been placed

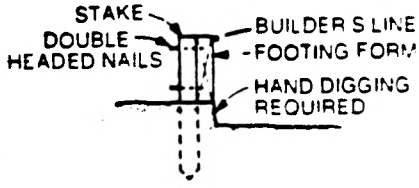


19-8. A duplex head nail is used when fabricating forms. This enables the forms to be securely nailed but allows the nail to be easily pulled when the forms are to be removed.



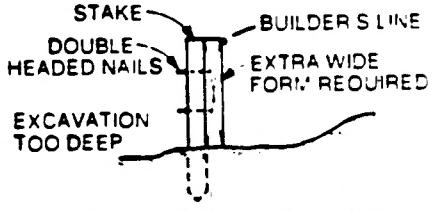
A SETTING FOOTING FORM STAKES

(a) Using a spacer block



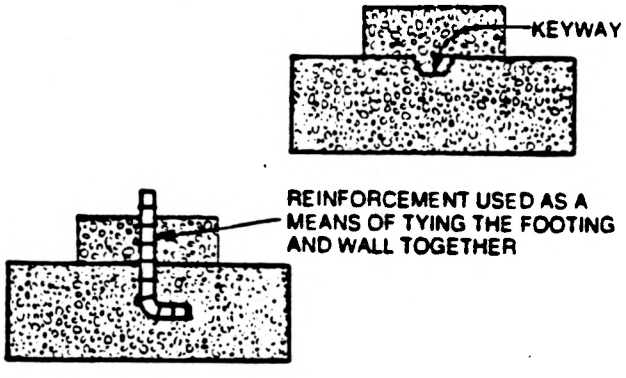
B BOTTOM OF EXCAVATION UNDERCUT

(b) Shallow excavation, hand digging required



C BOTTOM OF EXCAVATION CUT TOO DEEP

(c) Excavation is deeper than required, therefore forming must be the full depth



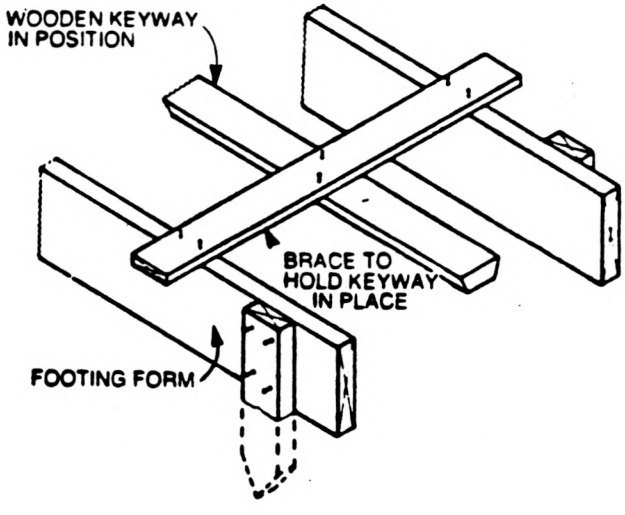
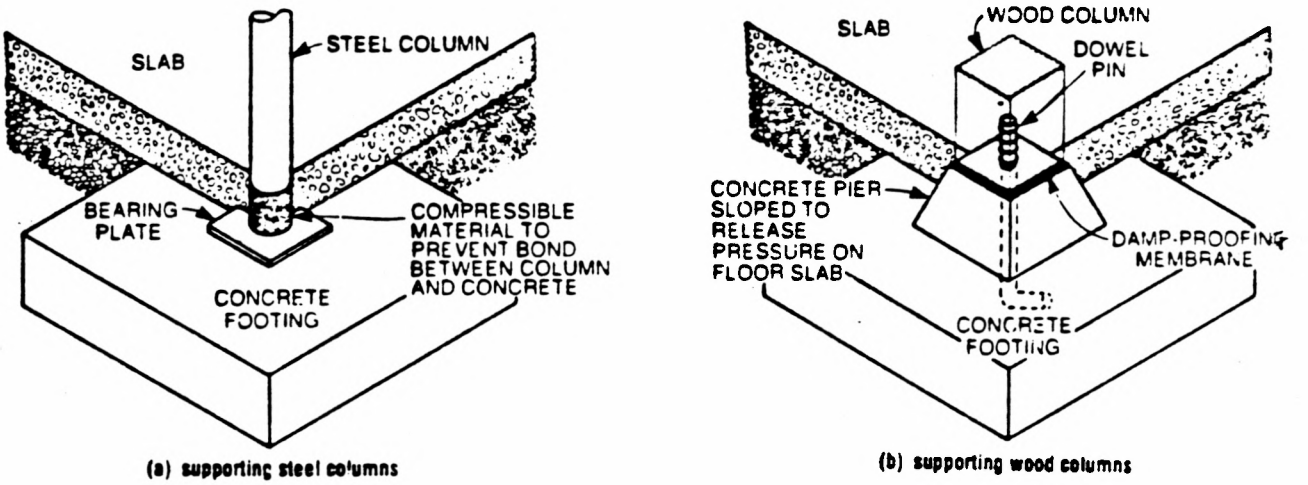
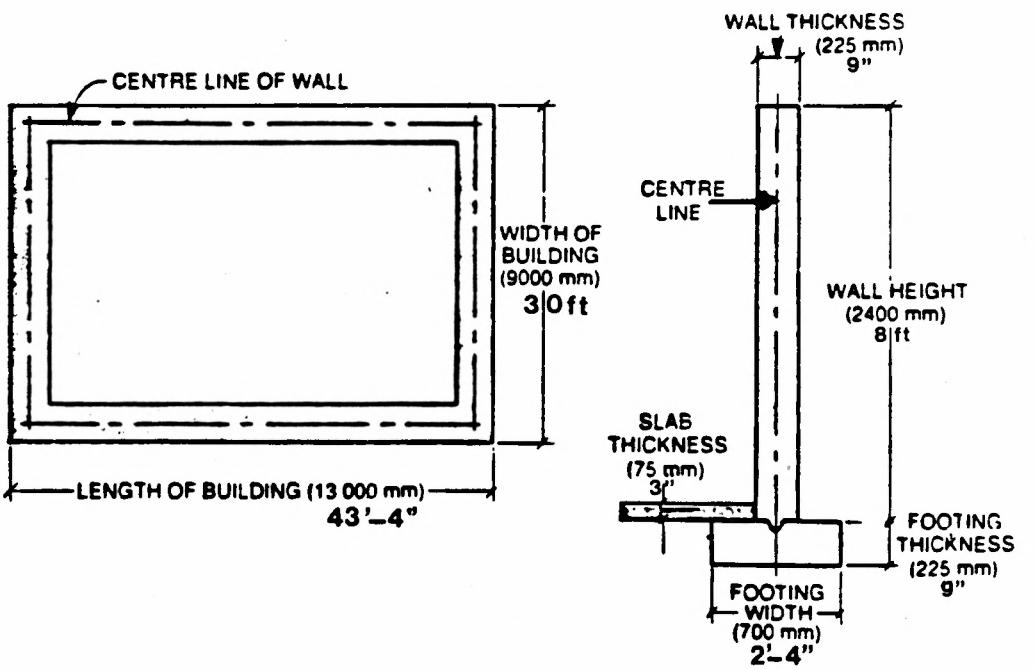


FIGURE 8

ESTIMATING THE FOOTING AND FOUNDATION WALL





To find the volume of concrete required in cubic metres we must first convert the dimensions given in millimetres to metres. The typical cross section drawing shows the size of interior post footings. From these dimensions, the volume of concrete needed for post footings can be calculated. This quantity is noted separately on the preliminary list, and will later be added to the quantity of concrete for the foundation wall footing when all similar materials are regrouped for costing.

If the dimensions are given in imperial measurement, find the volume in cubic yards. To convert the number of cubic yards to cubic metres, multiply by 0.76.

It is customary to add a percentage to the total for waste. We will be looking into this aspect of estimating later on and adjust our figures accordingly.

8.2.2 Reinforcing Bars

Reinforcing bars are identified by numbers, estimated in linear lengths and sold by mass (or weight). For example 16mm (5/8") bars are called no. 5 bars. Using the same basic lengths (between center lines) obtained for the footing, calculate the total length of reinforcing bars by multiplying each of these figures by 4 (2 rows of bars in each length of footing) and adding the result.

8.2.3 Anchor Bolts

The anchor bolts are usually spaced @ 1200mm (4'0") O.C. The distances are again taken from center line to center line.

If concrete block is used for the foundation wall, 16mm (5/8") diam. threaded, hook (or j) type anchor bolts are required to anchor the concrete block foundation wall to the footing. For interior posts footings, 16 mm (5/8") diam. threaded-j-type anchor bolts, 200 mm (8") long c/w nuts and washers are needed to anchor the steel posts to their footings.

8.2.4 Forms

Once the length of reinforcing bars required is calculated, the same figure can be applied to the length of form material required, based on the center line to center line method of measurement. Material used for footing formwork is usually

1. standard steel forms rented by the square metre (or square yard); or

2. made of 38 x 280 (2" x 12") wood joist stock that may be re-used for framing if of the required quality; or

3. 19mm (3/4") thick, tongue & groove planking material, using 235mm (5½") planks, (this option will require twice the length).

NOTE: If the soil is firm, there might not be any need for forms. It might be sufficient to pour the footings directly in a trench of the specified size.

8.3 Concrete Block Foundation Wall

The material specified for a foundation wall may be 240mm (10") concrete blocks or 200mm (8") poured concrete. First, we will estimate the quantities of materials for a concrete block foundation wall and the quantities for the poured concrete alternative will be estimated as a separate operation (see 8.4).

8.3.1 Concrete Blocks

The most common standard size block for foundation wall is 390 (L) x 190 (H) x 240mm (D) load bearing concrete blocks 16 (L) x 8 (H) x 10 in (D) Nominal. Figure 9 shows various types of concrete blocks.

Other materials used in conjunction with a block foundation wall are

1. mortar for joints;
2. reinforcing;
3. mortar fill for bottom & top rows of blocks;
4. anchor bolts & sill plate stock;
5. windows rough framing members;
6. dampproofing coating below grade; and
7. parging cement (full height of foundation wall with concrete blocks).

8.3.2 Basis for Estimating the Quantity of Concrete Blocks

Every $8m^2$ (86 sq. ft.) of wall surface will use 100 blocks of the dimensions listed in 8.3.1. Knowing this, the easiest way to calculate the total number of concrete blocks required is to:

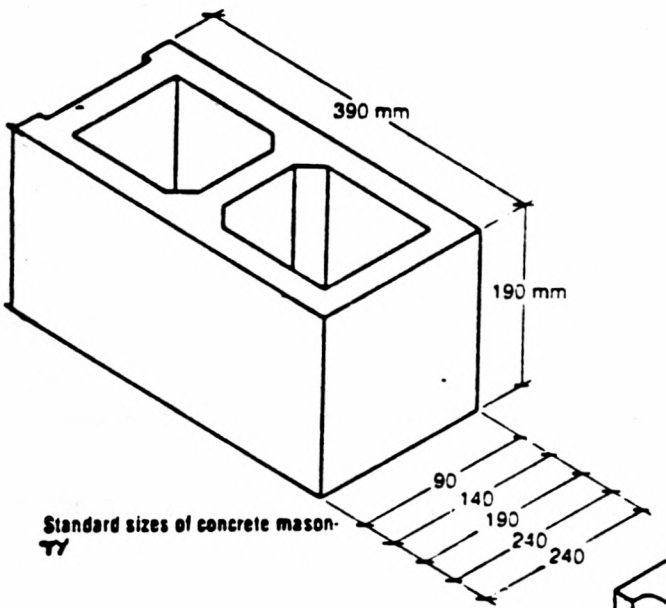
1. find out how many times $8m^2$ is contained in the total surface, then

2. multiply the answer x 100.

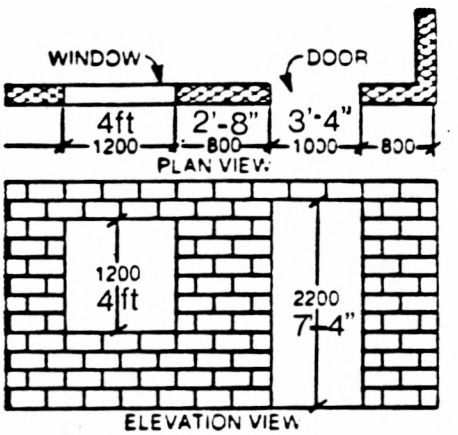
$$\frac{S}{86} \times 100 = \text{number of blocks}$$

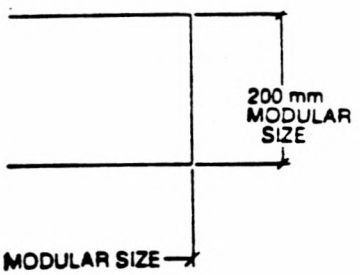
FIGURE 9

ESTIMATING CONCRETE BLOCKS

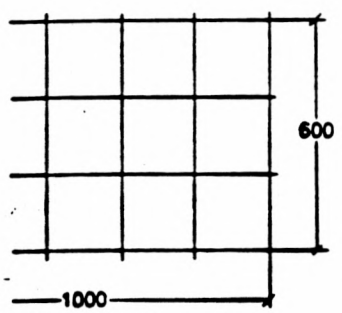


Standard sizes of concrete masonry

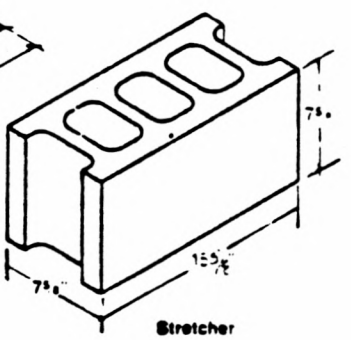


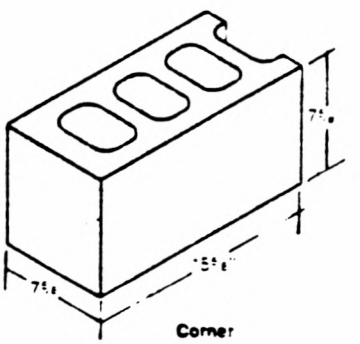


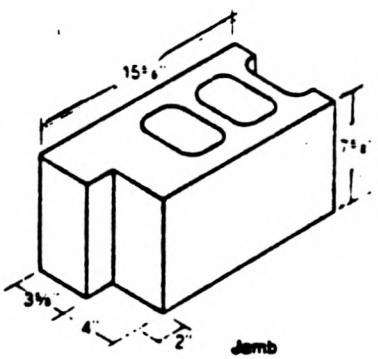
Typical metric block

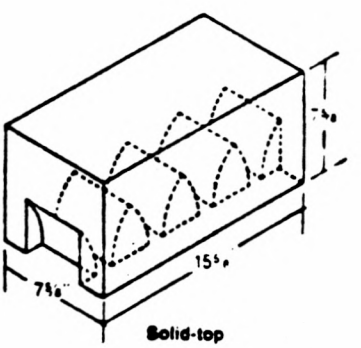


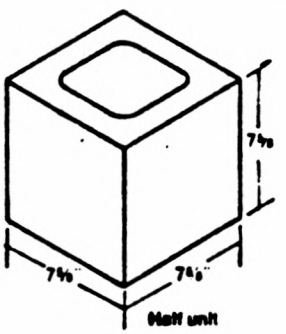
Typical modular panel

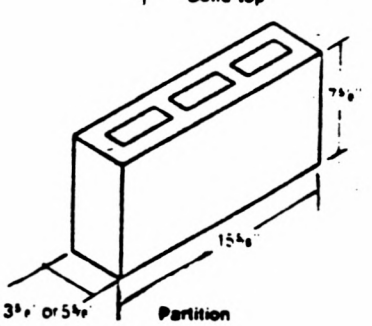












Mortar: Buy 175 lbs of masonry cement and 667 lbs. of *dry* sand for each 100 blocks.

Where S is equal to the total of all foundation wall surface areas.

Be sure to add blocks to take care of the foundation for the exterior stairs if required.

8.3.3 Mortar for concrete block foundation wall joints

100 concrete blocks 240mm wide (10 in) require 0.24 cubic metres (8.5 ft^3) of mortar. Calculate the amount of mortar required as follows:

$$\frac{0.24 \times \text{No. of blocks}}{100} = \text{cubic metres}$$

$$\frac{8.5 \times \text{No. of blocks}}{100} = \text{cubic feet}$$

8.3.4 Reinforcing

Sometimes "durowall" reinforcing is specified for every second course, continuous. Using the centerline to centerline method calculate the total wall length and multiply by the number of reinforced courses to get the amount of "durowall" reinforcing required (usually, at every second course).

8.3.5 Mortar Fill for Bottom and Top Rows of Concrete Blocks

The volume of mortar required to fill the top and bottom rows of a concrete block foundation wall is found by multiplying the total length (4 walls) by the block width by the block height by 2 and deducting 35% of the product to allow for the block webs.

(L x W x H x 2) - 35% = volume of mortar required to fill the top and bottom rows of a concrete block foundation wall.

8.3.6 Anchor Bolts and Wood Sill Plate

We will see from looking at a cross-section, that the anchor bolt spacing is the same as for bonding the concrete block wall to the wall footing. Referring back to section 8.2.3 on anchor bolts, we see that we will need the same number of anchor bolts for the sill plate as for tying the foundation wall to the footing. This time however the anchor bolts only need to be 200mm (8") long and they will be threaded and c/w nuts and washers.

8.3.7 The wood sill plate

We calculated the length of "Durowall" required by first measuring the total length of wall. The same total length of 38mm x 140mm (2" x 6") wood sill plate will be needed.

8.3.8 Basement Windows Rough Framing

Sufficient lengths of wood framing members (usually spruce) will be needed for the rough framing of the basement windows.

8.3.9 Dampproofing below grade

This is estimated in square metres or square feet. First find out the covering capacity of the dampproofing compound. This is usually indicated on the container. Knowing the covering capacity will allow you to determine the quantity of compound required for the total wall area to be dampproofed (length x height). Double the quantity as two coats are usually specified.

8.3.10 Parging

Parging is estimated in square metres or square yards. Note that parging for a block foundation wall is applied the full height of the wall and only above ground on a concrete wall. Coverage is also indicated on the parging cement bags. Always verify the thickness of parging specified.

8.4 Poured Concrete Foundation Wall

8.4.1 Formwork

The formwork for the concrete foundation wall is usually the most expensive single operation of house construction.

Formwork is usually estimated in square metres or square yards. This time we will double our total wall length to take care of both the exterior and the interior forms needed. We multiply this by the wall height to find the total wall area to be enclosed with forms.

If the foundation wall height does not exceed 2.4m (8' - 0") and ply panels are used, all we need is the wall length (4 walls) mutiplied x 2 and divided by the width of one panel. This will determine the number of panels required.

These sheets of plywood may be re-used as floor, wall or roof sheathing. If this is the case, the amount of plywood panels required for these operations can be reduced by the number of sheets of plywood available from the formwork.

If you are building other houses, you may want to keep those forms for these other jobs. New panels can be re-used for that purpose about 25 times or more if properly cleaned after each job and stored.

Similarly, the bracing material for the forms should be of a type and quality that will allow for their re-use as wall or partition framing members. In such a case, this would be noted as material already on hand for putting up the walls or partitions.

Using wood formwork, there are 2 options to choose from. These are illustrated in Figure 10.

a) Option No. 1: Uprights and double walers (using tie rods)

The spacing of uprights should be 600mm (2 ft) on center. That's 3 per panel and add 8 units for corners (interior and exterior).

The quantity of 2400mm (8 ft) long uprights required can be quickly estimated by using the number of 1200mm (4 ft) panels estimated for the forms, multiplying by 3 and adding 8 units.

The horizontal double walers are spaced 600mm (2 ft) on center vertically. In addition, top and bottom continuous single plates are recommended. The bottom plate is temporarily fixed to the top of the wall footing and the top plate is nailed to the top of the uprights. Remember to include material for both the interior and exterior forms.

The number of tie rods required may vary with certain factors such as special jobs and height of pouring, but for ordinary house construction, approximately 10 rods per form panel is required.

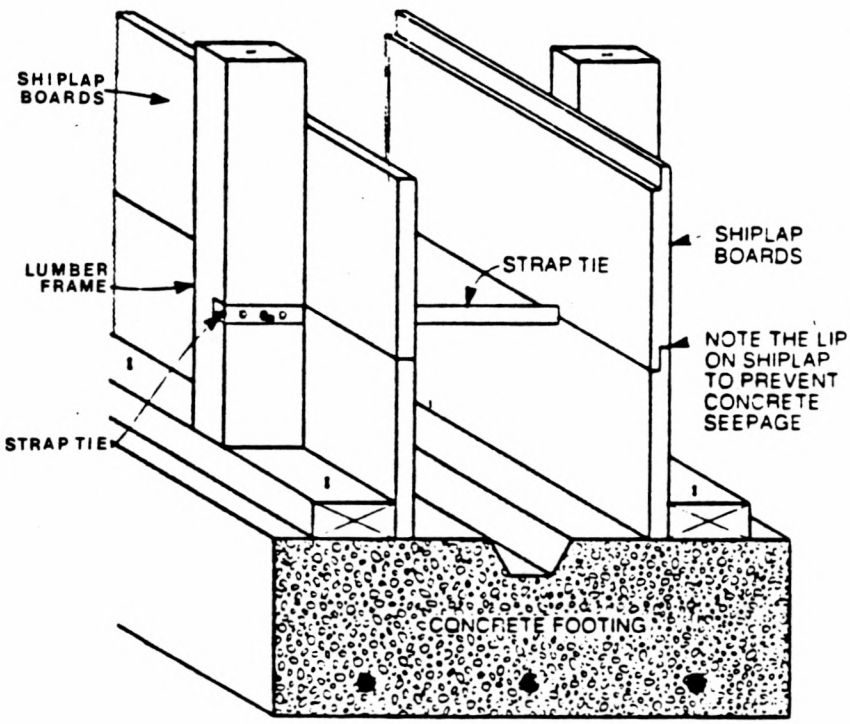
b) Option N° 2: Strap Ties

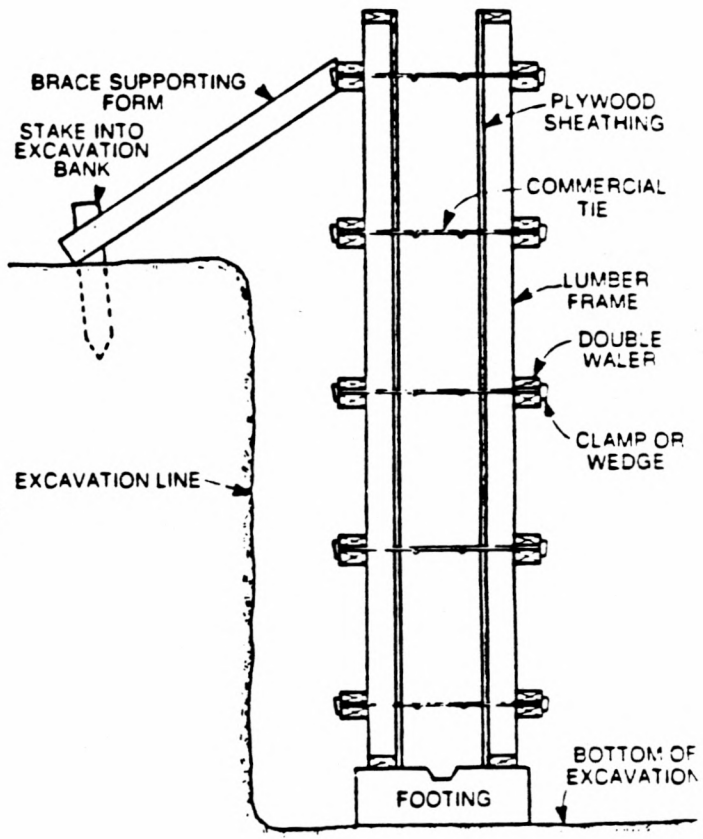
With the use of "Strap Ties" instead of tie rods the use of horizontal walers may be eliminated. This has the advantage of saving work but it may not represent much of a saving on materials because more 38 x 89 (2 x 4 in) studs will have to be bought for the partitions.

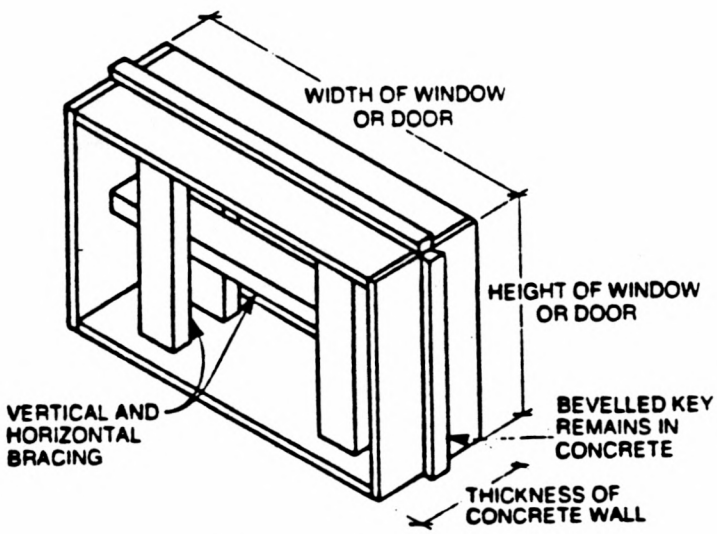
The two options should be compared for cost and convenience before deciding if tie rods or Strap Ties are going to be used. Formwork using strap ties requires only the vertical bracing plus one horizontal member temporarily nailed to the footing and one at the top.

FIGURE 10

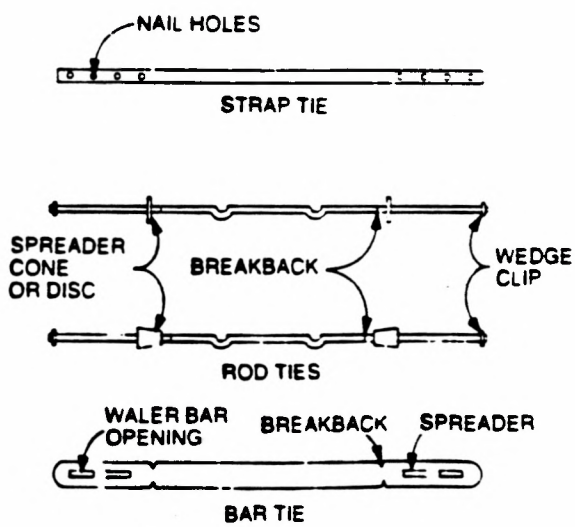
CONCRETE FORMWORK







Window and door rough backs



Concrete form ties

It is good practice to analyze the pros and cons of the various options in any building operation. Decide what is the most important factor to you. Is it the cost of the materials, of labour, of equipment or is it the time it will take to do the job?

8.5 Taking the Quantities of Concrete for the Foundation Wall

In taking the quantities for the concrete block foundation wall, the actual lengths of the four walls was used to calculate the total area. For the poured concrete option, the wall center lines may be used as for the footing to calculate the quantities required for both the concrete and the framework.

To find the volume of concrete required for a poured concrete foundation wall, multiply the total length (4 walls) by the height by the thickness or depth.

Note: To convert metres into yards, multiply by 1.09.

8.6 Interior Posts and Center Beam

The interior posts supporting the center beam may be concrete masonry, wood or (usually) steel telescoping or adjustable posts.

Steel posts are usually specified c/w (complete with) top and bottom welded steel plates.

The center beam may be steel or wood, usually laminated. The length of the center beam is usually the same as the distance between the interior faces of the two end walls plus a minimum of 200mm (8") or 100mm (4") bearing at each end.

8.7 Basement Floor Slab

8.7.1 Granular Bed

A 125mm (5") minimum of gravel or crushed stone compacted is required as the floor slab bed. Quantities are given in cubic metres or cubic yards.

8.7.2 50mm (2") Sand Blinding

This is a recommended "cushion" to fill in the gaps and provide a uniform and resilient surface on which the moisture barrier will be laid. Quantities are also given in cubic metres or cubic yards.

8.7.3 6 mil Polyethylene Moisture Barrier

The basement slab will be poured on the moisture barrier.

In measuring the quantity of polyethylene required provide for a 100mm (4") overlap at each joint. When installing the moisture barrier, take care not to puncture the film as any hole or gap will defeat its purpose as a moisture barrier.

Note: The moisture barrier may be installed over the concrete slab provided a raised floor is installed over it.

8.7.4 Perimeter Expansion Strip

This is usually required along the slab perimeter (between the slab edges and the foundation wall). It consists of a 12mm (½") premoulded expansion strip or as specified.

8.7.5 Basement Concrete Slab

Calculate the volume of concrete required by multiplying the area by the slab thickness.

8.7.6 Slab Reinforcing

For 150 x 150 - 4.8 (6" x 6" - 6) welded wire mesh, we need to estimate the quantity in square metres (or square yds). The area is the same as for the concrete slab area. The accepted substitute according to the code is number 3 bars spaced @ 600mm (2 ft.) both ways.

To find the number of bars required, proceed as follows: divide the slab length by the spacing of 600mm or (2 ft) and add one length. This will give you the number of bars required across the slab.

Then, divide the slab width by the spacing of 600mm (2 ft) and add one length. This will give you the number of bars required along the slab.

8.7.7 The Mechanical Troweling of the Basement Floor Slab

This is a requirement of some building codes. The cost of renting the equipment by the hour or the day should be recorded here.

This concludes the foundation work with the exception of basement windows, wall insulation and interior finish. These finishing operations usually take place at a later stage of construction.

Remember, this is a preliminary list of quantities. Any adjustment for wastage, breakage, etc. will be dealt with when preparing the final bill of materials.

9.0 FRAMING AND SHEATHING (including exterior Doors and Windows and Roofing)

9.1 Materials for Framing and Sheathing

This chapter explains taking the quantities of materials needed for framing and sheathing. This includes exterior doors, windows and roofing.

Please note that nails and screws - obviously needed during this stage of construction - are dealt with under a separate heading (Miscellaneous Metals, Ch. 18).

Table 9 contains a listing of the materials needed for this stage, and how each is measured and sold. Figure 11 illustrates the elements of a wood frame.

9.2 Floor Structure, Sheathing and Basement Stair

For all wood framing members, make a separate list on which you will inscribe (or list) in columns all the dimensions to be added for every different size of wood framing members called for, making sure you separate members of different sizes and species, e.g. spruce, pine, cedar, etc. (Separate what is different).

9.2.1 Floor Joists

First, find the floor joists span (or length in relation to end supports).

Add one foot to each length for overlapping at the beam.

Standard joist stock is sold in 3600mm (12') or 4800mm (16') lengths.

To this, add continuous headers which are used to close the spaces between the ends of the joists at outside walls.

Next, check to see if double joists are needed, such as under bearing partitions and around floor openings such as the stairwell and for basement window lintels. Add sufficient lengths of floor joist material to take care of these situations. Remember that there is no need for double joists under partitions when the roof structure consists of trusses.

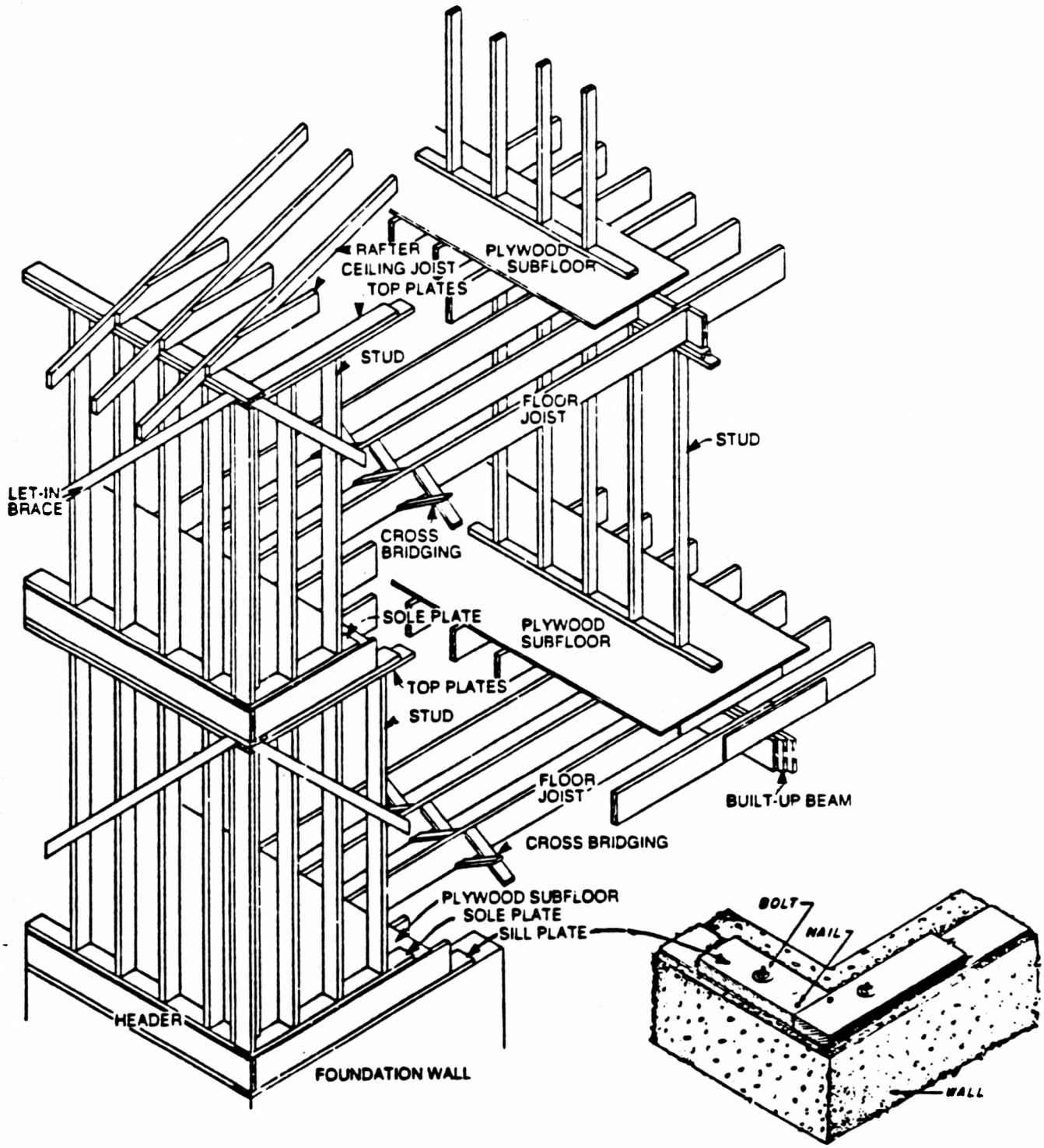
TABLE 9

MATERIALS FOR FRAMING AND SHEATHING

Material	How Measured	How Sold
Wood Framing Members	Linear metres or feet Unit of Standard Length	Linear Metres or feet Unit of Standard Length
Metal Joist Hangers	Each	Each
Plywood Sheathing Aspenite Sheathing	Square Metres or feet Each 1200 x 2400mm (4 x 8 ft) panel	Each (1200 x 2400mm (4 x 8 ft)panel)
Roof trusses	Each (for specified span & slope)	Each (for specified span & slope
Asphalt-felt paper	Square Metres (m^2) or Square yard (yd^2)	Roll [0.92(W) x 43.8m (L)] (1 x 43 yd^2) Coverage = 40m^2 (43 yd^2) per roll
Asphalt shingles	Square Metres (m^2) or Square yards (yd^2)	Bundle (21 shingles) Coverage = 3m^2 (3.6 yd^2) per bundle
Drip Strip (Sheet Metal)	Square Metres (m^2) or Square Feet (ft^2)	Square Metres (sqare feet) or Linear Metre (Lin. feet) of given width
Doors	Each	Each (prehung or with frame set with or without threshold)
Thresholds	Each	Each
Windows	Each	Each with Frame

FIGURE 11

WOOD FRAME ELEMENTS



Note that floor openings are not to be deducted and a percentage for waste will be added in the final list for estimating. At this point, check on your list for foundation wall footing formwork to see if joist stock material of the same size as your floor joists are called for and think about re-using them for the floor structure (if, of course they are of the proper lengths and quality). If so, they could be deducted from the total to be purchased for the floor framing and listed as being "on hand" for the floor framing operation. Think of the possibility of using excess lengths of joist material for cross-bracing. For that purpose it may be more economical to buy longer joists to start with.

9.2.2 Floor Sheathing

Usually plywood (or waferboard) forms the floor sheathing. A sheet of plywood (or waferboard) is 1.2m x 2.4 = 2.88m^2 (4 x 8 ft = 32 ft^2). The floor area divided by 2.88m^2 (32 ft^2) will give you the number of sheets required.

Here again, perhaps the plywood used for the foundation formwork can be re-used for the floor sheathing. If this is the case, the number of panels estimated for the foundation wall formwork could be simply said to be "on hand" for the floor sheathing, provided of course, you do not intend to keep the forms for use on other projects as is often the case. Details of floor framing may be found in Figure 12.

9.2.3 Basement Stair

Details of stairs may be found in Figure 13.

a) Stringers

To find the length of the stringers, we need to know the height from floor to floor and the number of steps and their width. The length will be the hypotenuse of the triangle formed by the length and height of the stair.

b) Treads

These may be hardwood such as birch or softwood such as pine or cedar. Cedar is preferable for exterior wood stairs.

c) Handrails

Handrails will be the same length as the stringers. Handrails may be purchased pre-shaped with metal brackets.

FIGURE 12

FLOOR FRAMING

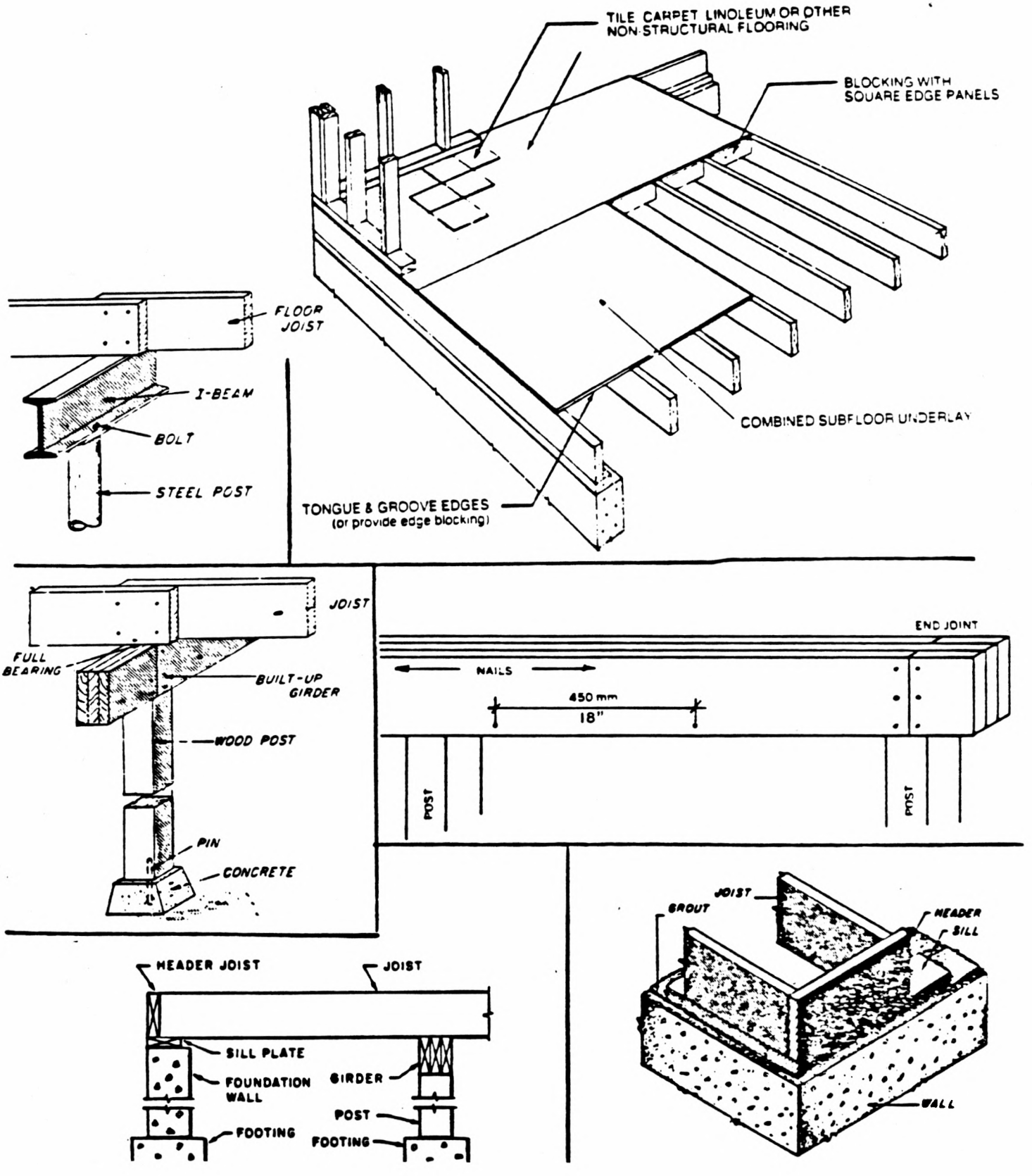
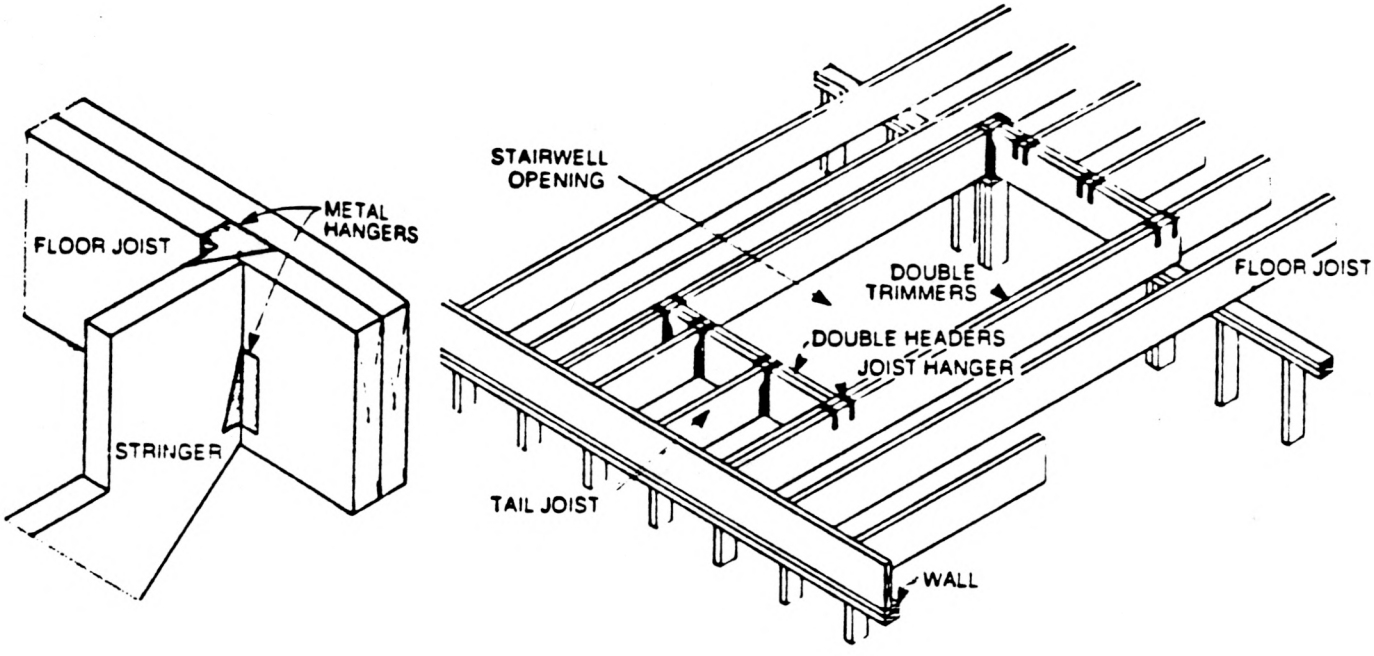
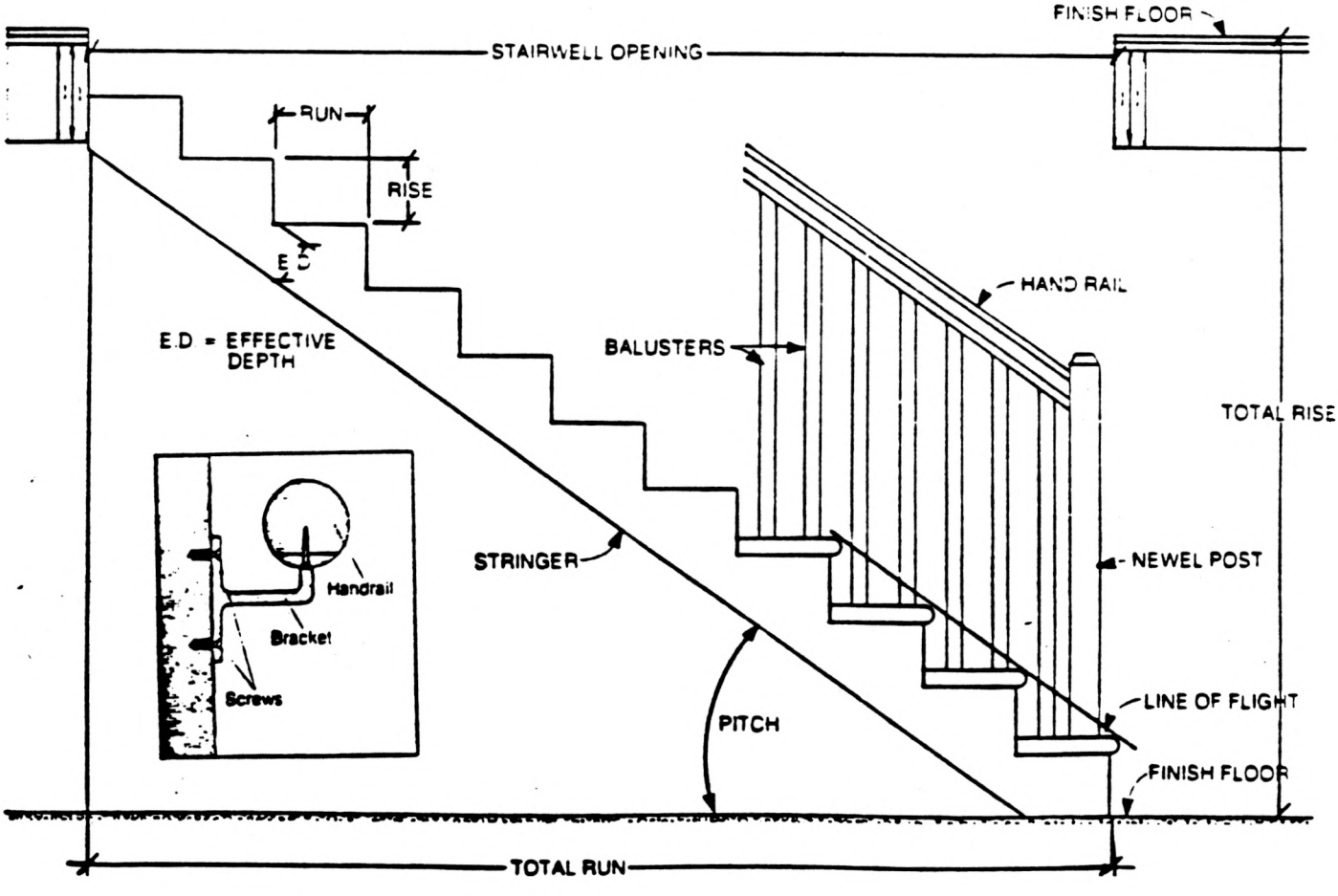


FIGURE 13

STAIRS





9.3 Exterior Wall Framing and Sheathing (and Asphalt/felt paper)

9.3.1 Wall Framing

In modern house construction, the wall framing is usually built of 38 x 140mm (2" x 6") stock placed at 600mm (24") O.C. without deducting for the wall openings. See Figure 14 for details.

The number of spaces will give you the number of wall studs. Then add 3 studs per corner or 12 studs. Then estimate the lengths required for the bottom and the top plates. The bottom plate is single and the top plate is always double. Girths are needed at mid-height. Therefore, the total length of 38 x 140mm (2" x 6") required for the wall plates (top and bottom) plus girths at mid-height will be 4 times the total exterior wall length.

We also require double studs on each side of every window and door opening as well as double members below window openings. If a plan calls for wall framing extension at the gable ends, sufficient material will be added including a single top plate along the roof edges.

9.3.2 The Lintels

Each length of lintel members can be determined. A note on the window schedule will usually tell us that the window dimensions are either outside of frame, stud opening or brick opening.

In determining the length of a lintel when the outside of frame dimension is given, add 89 mm (3½") for the lintel. The same principle applies for lintels over door openings. See Figure 15 for details.

REMEMBER THAT THE FIRST DIMENSION GIVEN IS ALWAYS THE WIDTH OF A WINDOW OR A DOOR.

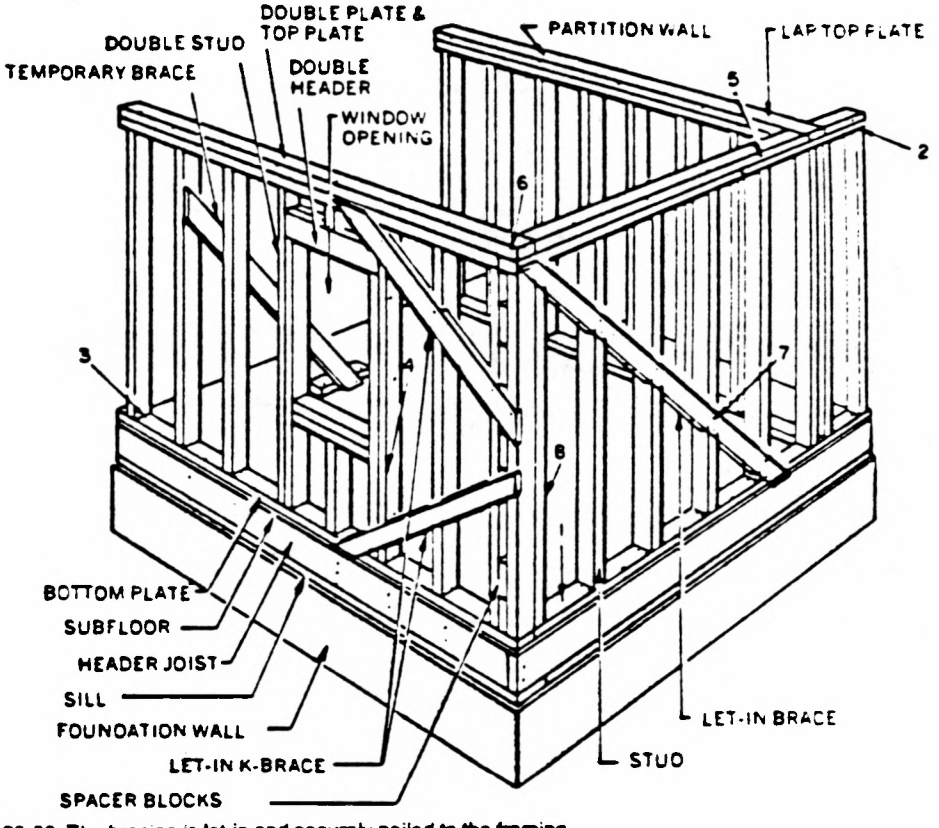
It's important to verify how many pieces you can get from standard lengths. Always verify to make sure that wastage of material is kept to a minimum.

Note: Most door and window manufacturers publish pictorial folders or manuals showing their standard products usually giving the item number as well as the outside dimensions (O.D.) for the frame, rough opening and brick opening.

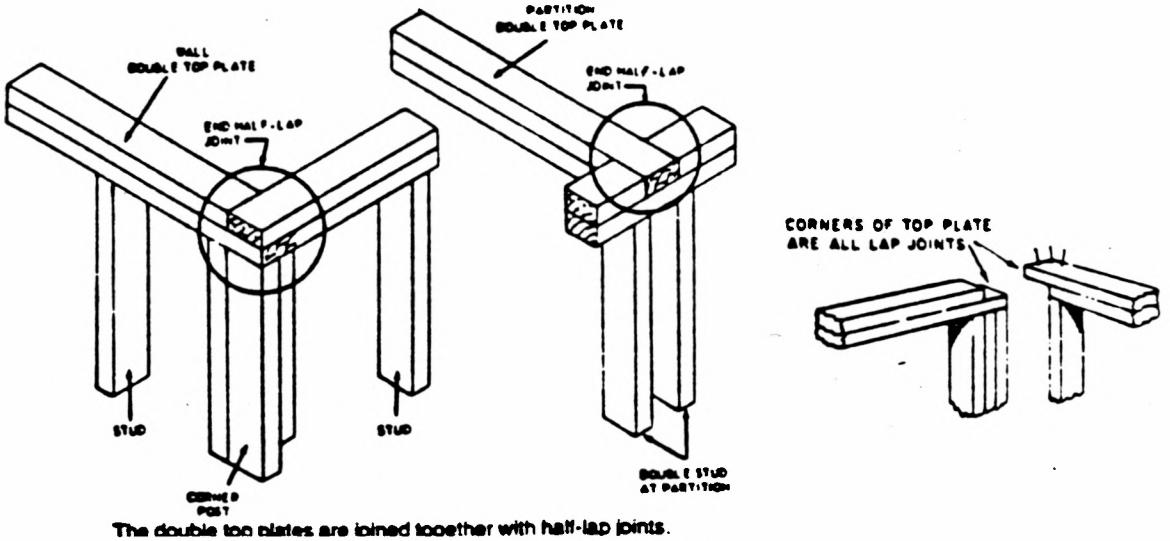
However, these standard dimensions are changed from time to time and it is advisable to verify them with the manufacturer or supplier before buying.

FIGURE 14

WALL FRAMING



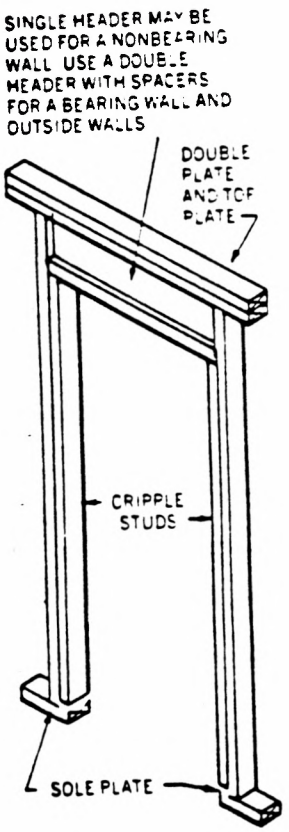
25-53. The bracing is let-in and securely nailed to the framing.

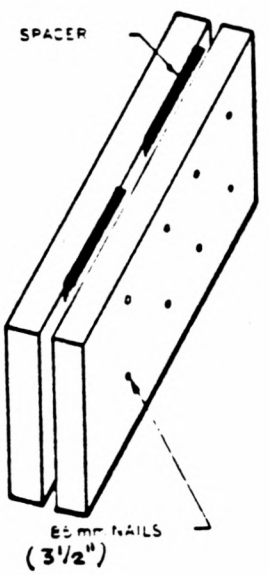


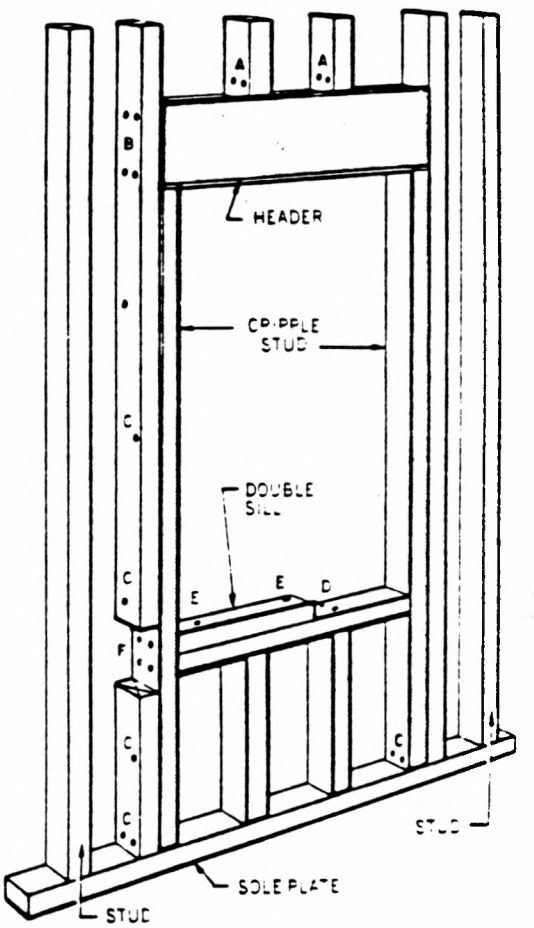
The double top plates are joined together with half-lap joints.

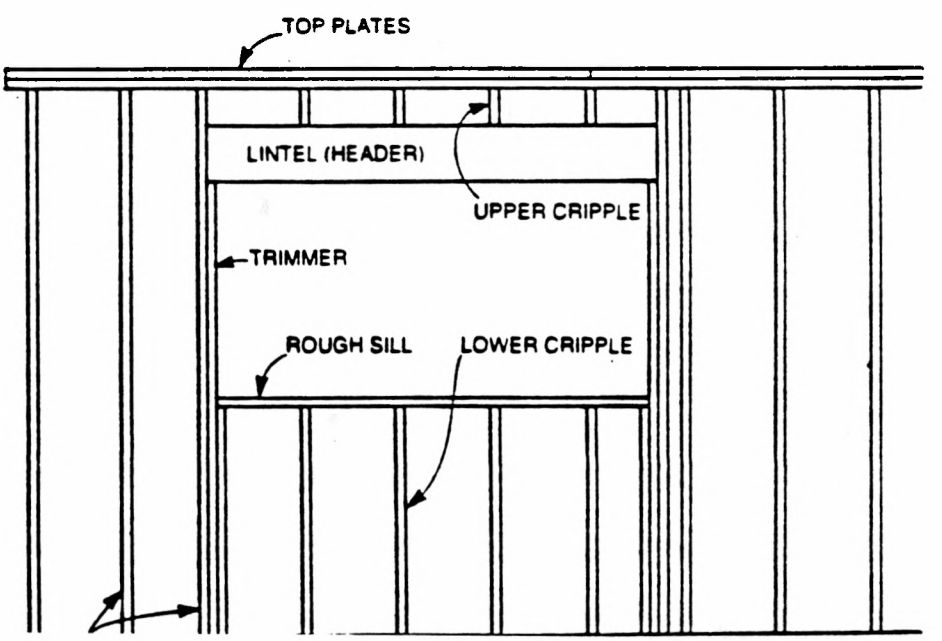
FIGURE 15

LINTELS









9.3.3 Exterior Wall Sheathing

Without deducting for the wall openings, we need to find the total wall surface (4 walls) and then, find how many 1200 x 2400mm (4' x 8') plywood sheets are needed to cover that surface. Or, to make it simpler, knowing that we will be using 2400mm (8 ft) long sheets and that this is the height of our exterior walls, we need only divide the total length (4 walls) by the width of a plywood sheet (1200mm or 4 ft.) to find the number of sheets required.

9.3.4 Asphalt/Felt Paper

Asphalt/Felt paper is sold in rolls 0.92m (3 ft) wide by 43.8m (144 ft.) long. One Roll will cover 40m^2 (43 yd^2).

Provide for a 100 mm (4") overlap at each joint.

Find out the total area to be covered and divide the area by 40m^2 (43 yd^2). This will give you the number of rolls of asphalt/felt paper required.

9.4 Roof Structure and Sheathing

9.4.1 Prefab Roof Trusses

Pre-fabricated wood "W" trusses @ 600mm (2 ft) on center is the most widely used roof structure system for modern house construction. The spacing may vary according to the design snow load allowable for various zones. The figures compiled represent 60% of the average ground snow loads recorded over many years.

If pre-fab trusses are not available in your locality and the cost of transportation would be prohibitive, the trusses can be built on site. Table 10 lists material required to build one truss. Figures 16 and 17 illustrate various roofing elements.

The number of trusses required is found by dividing the total length of the house by the recommended spacing for your zone and adding one truss. If gable wall framing is used, you will require 2 trusses less.

Trusses are ordered for a specific span (the distance between the end supports, out to out of frame). They are held in place with a ridge board until the roof sheathing holds them together.

TABLE 10

TRUSSES

2. Trusses of other types (metal gusset plates) may be used providing design configurations and support conditions are similar.

In locations where delivery problems, exist (air freight), trusses should be ordered in basic lumber as follows:

Material for one truss:

Sawn Timber:

Use	Size	No. of Pieces	Length
Top Chord	38 x 140 2" x 6"	2	4870 17
Bottom Chord	38 x 89 2" x 4"	2	4500 15
Web	38 x 89 2" x 4"	2	1060 4
Web	38 x 89 2" x 4"	2	2300 8

3. Nails:

185 common wire nails 76 [3"] long
1.3 kg [2.8#]
Note: 20% extra allowed

4. Gussets:
12 [½"] D.F. plywood 1 sheet
1200 x 2400 [4'-0" x 8'-0"]
Note: 20% waste allowed

FIGURE 16

ROOF TRUSSES

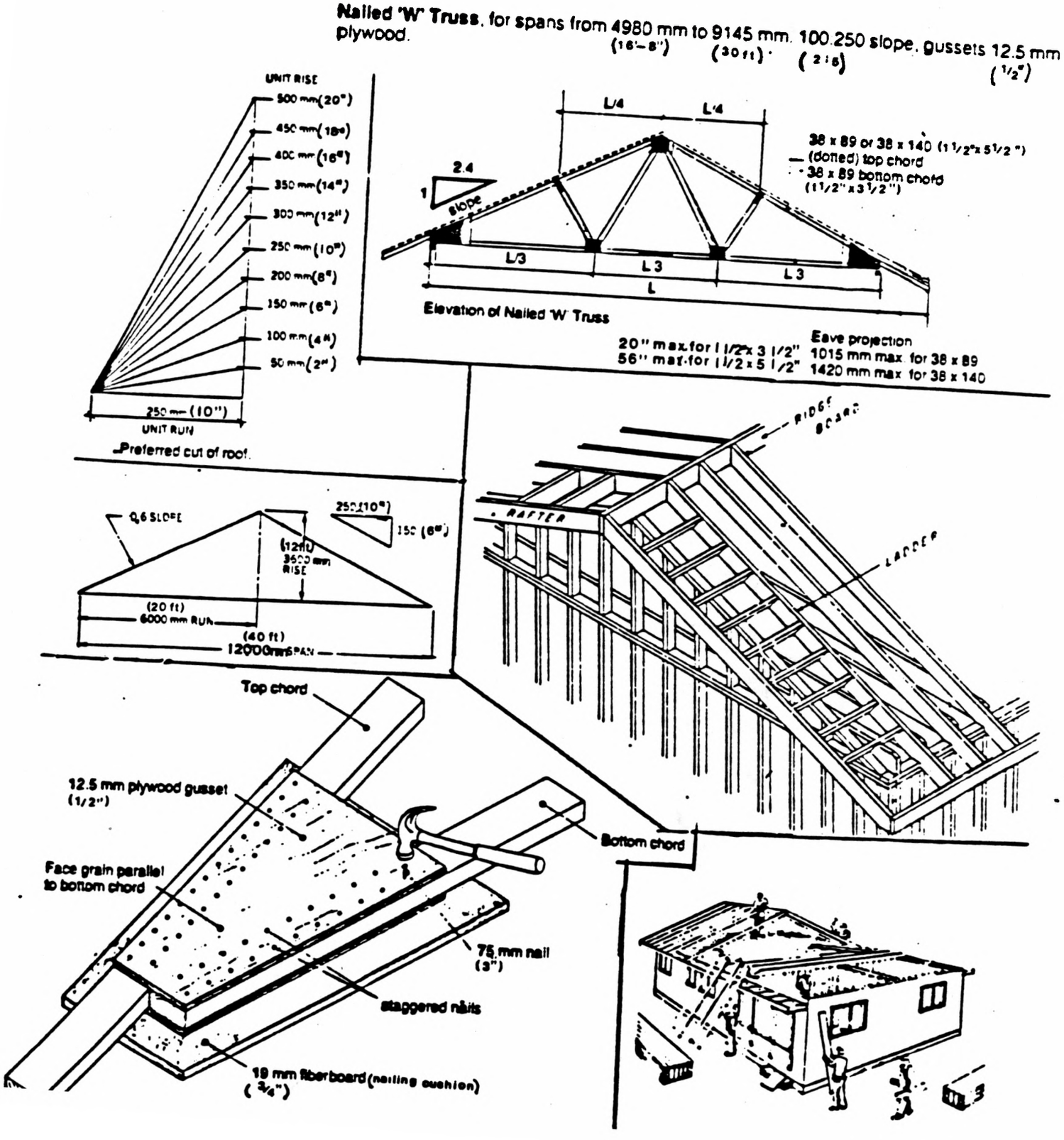
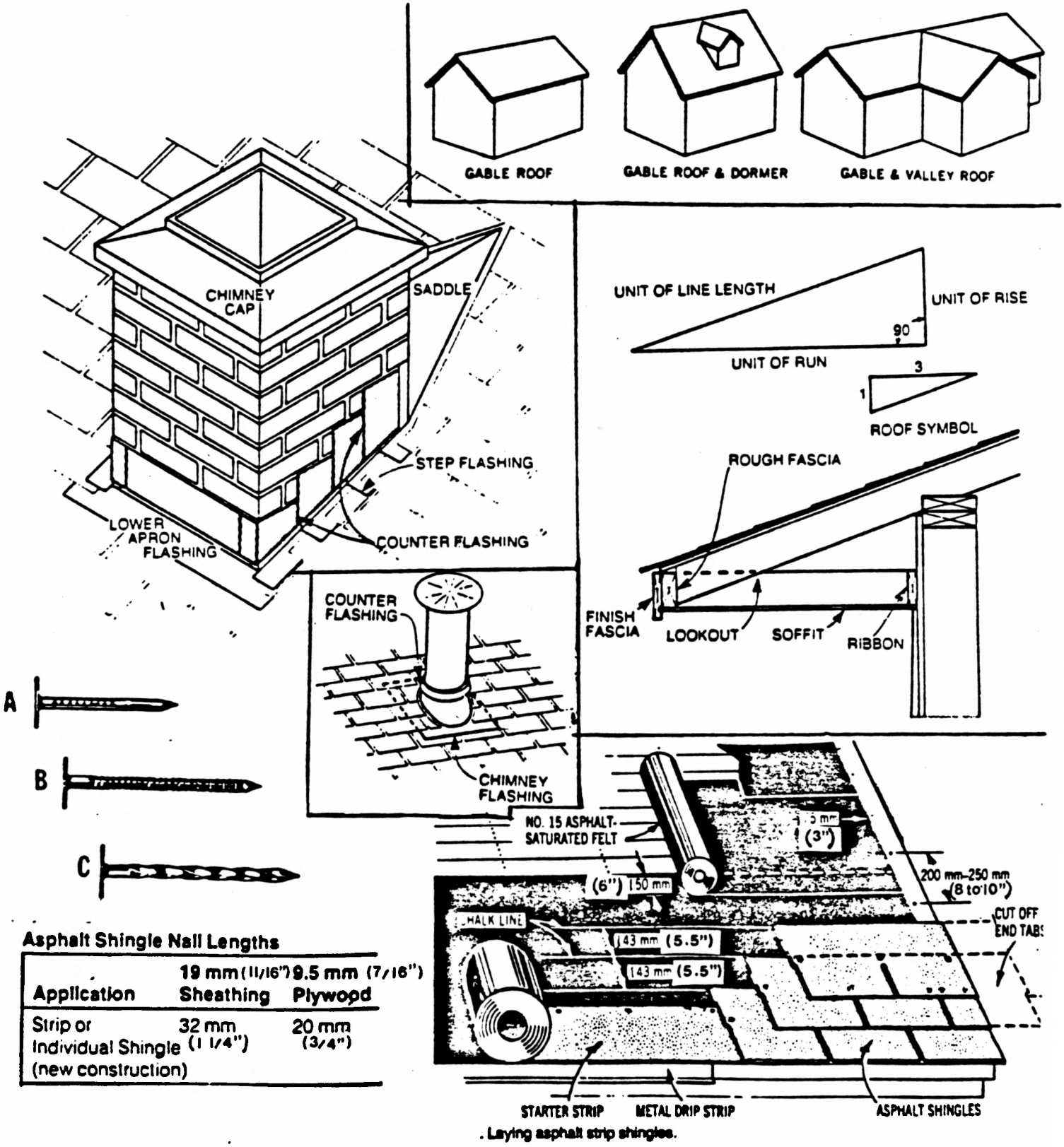


FIGURE 17

ROOF DETAILS



Asphalt Shingle Nail Lengths

Application	19 mm (11/16") Sheathing	9.5 mm (7/16") Plywood
Strip or Individual Shingle (new construction)	32 mm (1 1/4")	20 mm (3/4")

. Laying asphalt strip shingles.

9.4.2 Look-Outs and Eave Nailer

Usually, the two end trusses are lower to allow for the installation of look-outs which are butted against the second last truss at each end of the house and form the structure for the gable soffit.

In addition, there is a continuous nailer for the fascia board installed along the eaves.

9.4.3 Roof Sheathing

Calculate the surface area of a gable roof (if both roof halves are of equal size) in the following way.

First find the hypotenuse of the triangle formed by half the truss chord as the base and the height at the center line of the truss. Multiply the hypotenuse by the length of the roof; then multiply that figure by 2 (for both halves of the roof surface).

We know that a sheet of plywood is 1.2 x 2.4m = 2.88m^2 (4 x 8 ft = 32 ft^2). To find the number of plywood sheets required for roofing, divide the total area to be covered by 7.88m^2 (32 ft^2).

Be sure to specify the particular roof sheathing material you want, for example, standard, tongue and groove, etc.

9.4.5 Roofing

Once the roof sheathing is on, you don't want to leave it exposed for too long because of possible damage from rain. So normally the roofing operation will immediately follow the laying of the roof sheathing.

a) Asphalt Felt Paper

First, you will need asphalt felt paper which comes in rolls 0.914m (3 ft) wide and 43.8m (144 ft.) long. Each roll will cover 40m^2 (43 yd^2).

Provide for a 100mm (4") overlap at each joint, which leaves an actual covering of 0.814m (32") per strip of asphalt-felt paper on a 0.92m (3ft) wide roll.

b) Asphalt Shingles

They are sold in bundles each containing 21 shingles. One bundle will cover 3m^2 (3.6 yd^2). For an ordinary bungalow, 4 extra bundles will be needed for starter rows (one row of shingles installed upside down) and for the ridge cap.

Knowing that one bundle (21 shingles) will cover $3m^2$ ($3.6\ yd^2$) of roof surface the total number of bundles required is found by dividing the total surface to be covered by $3m^2$ ($3.6\ yd^2$). Then add 4 or 5 bundles as required.

c) Prefinished Metal Eave Flashing (or Drip Strip)

The drip strip is to be carried up 100mm (4") on the roof and form a 25mm (1") lip along the sheathing edges, using either aluminum or galvanized sheet steel. This is not a code requirement but it is recommended as an extra protection.

d) Bituminous Roofing Compound (or Roofing Cement)

This material will be needed to cement the joints between strips of asphalt-felt paper, and along the roof edges as well as for patching nail heads, etc.

In order to get familiar with the minimum code requirements and before transferring the total figures to the final list of materials, the subject of nails required is kept for last. An estimate of all the various types and sizes of nails, screws and other miscellaneous metals required may be made with the help of the appropriate tables of minimum requirements included in section 18.0 of this publication.

There are advantages in acquiring all the hardware in one purchase. Besides saving money it will be easier to calculate the amounts required after all our total quantities of the various materials have been compiled.

There are tables prepared to help us estimate the proper amounts of nails and screws needed for various activities and learning how to use those tables will help you prepare your estimate of quantities for various structural and finishing building operations.

9.5 Exterior Doors and Windows

9.5.1 Exterior doors and frames

Pre-hung units can be obtained. The cost may be higher but it might be worth considering because of the saving on time of installation and labour. Also, the necessary hardware is usually included.

Note the types, the sizes and other particulars such as

1. wood solid core;
2. plain or patterned;
3. glazed or unglazed;

4. metal insulated;
5. with or without storm doors;
6. with or without sidelight(s);
7. prehung or with separate frame set; or
8. with or without door knob*.

* Prehung doors can be obtained with or without door knobs; specify. If the hardware is a separate item, it should be covered under "HARDWARE".

Under Exterior Doors, write prehung units, the types, the sizes, with or without sidelights, with or without storm doors, left or right hand (or reverse), with or without thresholds, with or without hardware.

9.5.2 Windows

IN DIMENSIONING WINDOWS, THE WIDTH IS ALWAYS GIVEN FIRST.

First, find the glazing requirement for the zone you live in and the RSI value.

List the types, manufacturer, sizes and the number of units required of each type and size.

9.6 Interior Partition Framing

The material for the interior partitions is usually 38 x 89 (2 x 4").*

* Size of partition framing members should be according to code and/or local practice, probably 39 x 89 (2" x 4").

In estimating the quantity of partition studs, a general rule of thumb consists of counting one stud per 0.3m (1 foot) of partition without deducting for openings. First estimate the total lengths of partitions to be built of the same size stock and add 3 times the total length for the single top and bottom plates and the girths at mid-height.

DO NOT DEDUCT OPENINGS

10.0 PLUMBING

10.1 Codes, By-laws and Regulations

Before taking the quantities for the plumbing work, find out what the plumbing code, local by-laws and regulations stipulate concerning the installation of the plumbing system. In most regions, only a professional plumbing contractor is allowed to install the plumbing system. In any case, an inspection is mandatory to ensure that the system is installed according to the health and safety provisions of the plumbing code, by-laws and regulations.

If you have the expertise, by all means, consider installing the plumbing system, but keep in mind that the bottom line is that it must pass inspection. Having to re-install the plumbing system later could be a costly proposition.

10.2 Options for Measuring Plumbing Materials

Most contractors will provide a free estimate. However, if you are to do your own estimate shop around to have an idea of the basic costs and availability (locally) of the materials specified. If you decide to have an estimate made by a contractor, you will be in a better position to decide which of the two options to include in your bill of materials: sub-contracting or a detailed listing of all the materials required. Table 11 lists the materials needed for plumbing. Remember that you are preparing a complete list of all the materials required for the actual construction of your house, including an adequate water and drainage system that must meet the health and safety requirements.

Take time to investigate. Ask a material supplier. Visit house construction sites where a plumbing system is being installed. Use the phone for quotations and list the information gathered.

Keep in mind that a good quantity take-off will provide good reference material for future projects.

10.3 Method for Listing Materials

The following is a list of the usual plumbing materials needed in an ordinary house:

1. drainage and vent pipes;
2. drainage and vent pipe fittings;
3. water pipes;
4. water pipe fittings;
5. jointing material;

TABLE 11

MATERIALS FOR PLUMBING

MATERIAL	HOW MEASURED	HOW SOLD
Pipe	Linear metres or feet	Linear metres or feet
Pipe fitting	Each	Each
Valve	Each	Each
Jointing Material		
Solder		Spool
Paste		Can
Propane tank and accessories		Each
Teflon or rope		Spool
ABS or PVC cement		Can
Solvent		Can
Small brush		Each
Pipe Insulation (Jacket)	Linear metres or feet For given pipe diameter & thickness	Linear metres or feet (or precut lengths)
Fixtures & accessories	Each	Each

Consult manufacturer's catalogues such as "Crane" for accessories and details.

6. valves;
7. s.s. kitchen sink, faucet and accessories;
8. vanity sink, faucet and accessories;
9. w.c. and accessories;
10. bathtub and shower assembly;
11. laundry tub, faucet and accessories;
12. hot water tank and accessories;
13. sump pump;
14. floor drain; and
15. miscellaneous (strapping, brackets, pipe insulation, etc.).

For plumbing materials, use columnar sheets for the drainage system and for the water supply system. For the water supply system, list the materials for the cold water supply and the hot water supply separately.

In the pipe columns, list the various pipe sizes indicated on the drawings, making sure you don't mix the cold water lines with the hot water lines, then list the fittings and the accessories required. Use a different column for each type of fittings e.g. copper, A.B.S., P.V.C., C.P.V.C.

When you list the plumbing fixtures make sure you indicate the name of the fixture, and the make, model number, and colour. List together a sink and the faucet that goes with it, specifying whether it's 100 mm (4") or 200 mm (8") on center pipe connections to suit the fixture it applies to. Indicate the make, model number, finish, whether it is the mixing type, (with cold and hot water mixing tap) or separate taps with rigid or swivel type spout, etc.

Specify the type of trap, supply pipes, stops, sink brackets or supports, type of plugs on waste fitting, shower heads, etc. (see Crane catalogue for details). When listing accessories include the water tank's temperature and pressure relief valve and dielectric union on hot water line and check valve. Also, obtain information on sump pumps - connections to outside for discharge line to be carried away from foundation.

11.0 HEATING AND VENTILATION

11.1 Tradespeople Involved in Installation

Heating and ventilation work are usually performed by the same tradespeople. Heating generally involves duct work (gravity or forced air heating) and so does ventilation. If a hot water system is specified, plumbing is involved. An electrical heating system will be handled by the electrical trade. Always read the general notes on a plan first. The general notes form part of the specifications. They generally describe how a system is to be

installed. These notes will probably give some particular design temperature requirements for a particular zone. This information plus the specification will tell you what in detail and how to install. Table 12 lists the materials needed for heating and ventilation work.

11.2 The Chimney

If the chimney is a prefabricated insulated metal type, it is sold in sections with a special T-connection section to receive the smoke stack. The smokestack should be installed a minimum of 450mm (18") below the basement ceiling. In estimating the length (or height) required, allow for .9m (3 ft.) below the basement ceiling and .6m (2 ft.) above the roof ridge. In addition to the chimney sections, you will require a chimney cap, supporting strapping to secure the chimney to the floor framing members and a roof collar to provide the flashing material around the chimney at the roof surface. The list of materials should give the number and the type of sections required.

12.0 ELECTRICAL WORK

12.1 Meeting Codes and Regulations

An electrical installation for a house must meet the requirements of provincial or municipal statutes or, in the absence of such statutes, shall conform to the Canadian Electrical Code, Part I. Electricity is a source of essential energy which can be the cause of serious problems if the power carrying system is not installed properly or if the material used is not of the proper capacity and in good working condition. Unless you are a certified electrician, you would be well advised to leave the electrical installation to the experts. Things you would need to know include wire sizes, the right number of outlets per circuit permitted, connections to the entrance panels, proper grounding, adequate amperage and voltage, right fuse or breaker amperage, proper wire protection, etc. The bottom line is the health and safety of the house occupants. A wrong connection, a faulty installation, too small a wire size, improper use of the system can cause a fire, electrical shocks or severe burns to a novice attempting to hook up an electrical system or to those using it later.

Electrical inspectors are very strict about the installation of an electrical system and will not approve the connection of the electrical power unless the system is properly installed. It is recommended to have a specialist do the quantity estimates as well as the installation. However, it is helpful to know what materials we deal with.

TABLE 12

MATERIALS FOR HEATING AND VENTILATION

MATERIAL	HOW MEASURED	HOW SOLD
Furnace	Capacity in BTU per hour	Each
Heater	"	Each
Fuel storage tank	Capacity in litres (or gallons)	Each
Accessories	Each	Each
Ductwork		
Rigid duct	Width x height x length in metres (or feet) or diam. x length	Kilogram (kg) (or lbs)
Flexible duct	Diameter x length	Linear metres (m) or feet (ft)
Louvre	Width x height	Square metres (m^2) (or Square Feet (ft^2)
Air Filter	Width x height	Each
Fan	Capacity in litres/second (or gals/sec)	Each
Support brackets	1 every 1.2 metre (4 ft).	Each
Duct insulation (jacket)		Metres (m) (or feet (ft)
Internal Insulation		Square metres (m^2) (or Square feet (ft^2)

12.2 Estimating Quantities for Electrical Work

A house electrical system is usually composed of the following elements:

1. conductors (wires),
2. outlet boxes,
3. switches,
4. receptacles,
5. disconnect switch(es),
6. distribution panel,
7. breaker unit (or fusible unit),
8. main breaker switch,
9. grounding assembly,
10. incandescent fixtures,
11. fluorescent fixtures, and
12. miscellaneous (strapping, connectors, marrettes, wall plaques, etc.).

For estimating the quantities of materials for the electrical installation, use columnar sheets to list the various elements by order of importance.

After reading the specification to become familiar with the general provisions and the type and quality of the materials specified, examine the plans, schedules and general notes.

12.3 Outlets and Receptacles

Make note of the various types of symbols indicated on plans and find out what each one represents with the help of the legend and schedule (e.g. B= wall mounted outlet box for incandescent fixture, catalogue "Columbia" #9206, 3 required).

Note: In most contracts, a separate amount is allowed to cover the purchase of electrical fixtures which is actually one of the last additions to a construction project. The fixture makes and numbers are given here to guide the contractor or builder in providing the proper wiring, outlets and connections.

In preparing the final bill of materials, list the electrical fixtures separately, to be installed after the painting and other finishing touches are completed.

At this point, we are only concerned with the "roughing-in" or installation of the electrical systems up to and including the wall plugs, switches and ceiling and wall receptacles.

12.4 Conductors

Estimating the required lengths of conductors (or wires) demands a careful study of the plans and section because the routes that the wiring will follow are not governed by the shortest way from point A to point B but by the numerous obstacles such as doorways and other framing features which create a road block. Some wires will have to be taken up and over these obstacles in order to be directed to their destination, a junction box, a switch or a receptacle. Similarly, some wiring will have to be carried up a partition and along a ceiling in order to reach a ceiling outlet, with sufficient slack left to allow the electrician to make connections without having to "stretch" the wires. For these reasons, the estimator has to be generous about the length of conductors required.

12.5 Circuitry

The number of circuits and what each one will serve is usually found on the panel diagram. The circuit numbers and size of breakers should be indicated.

WARNING: Never attempt to "guess" the wire sizes. Qualified electricians use complicated tables to calculate the sizes of conductors required and no guess work is allowed here.

The basic wiring for a maximum 1200 w lighting circuit is either #12 or #14 wire with preference being given to #12 in all new house construction. Copper type conductors are also preferred over aluminum which are cheaper but require special treatment where the aluminum wires are connected to another metal and corrosion may occur. Although aluminum wire is accepted, it is not recommended.

Here again, strict rules apply. Never put yourself in a position where you will be forced to abandon or hire a qualified electrician to reinstall an electrical system that you already spent a considerable amount of money on.

13.0 INSULATION, AIR/VAPOUR BARRIER AND CEILING STRAPPING

13.1 Materials Required

Table 13 lists materials needed for insulation, air and vapor barriers and ceiling strapping. This includes rigid insulation and adhesive, batt insulation, polyethylene film and staples.

TABLE 13

MATERIALS FOR INSULATION, AIR/VAPOUR BARRIER, AND CEILING STRAPPING

Material	How Measured	How Sold
Rigid Insultation	Square Metres (m^2) or Square Feet (ft^2)	Square Metres (m^2) or Square Feet (ft^2) sheets of various thicknesses
Adhesive (for application of polystyrene moulded bead board to concrete or masonry)	Area to be covered (spot application)	4 litre (1 gal.) can covers 9.3m^2 (100 ft^2) average
Wool Insulation (Batts)	Area to be covered Coverage per bag is shown on page 125	Pieces of various sizes & thicknesses in bags - also mini rolls giving RSI Value & Coverage.
Air/Vapour Barrier polyethylene	Square Metres (m^2) or Square feet (ft^2)	Rolls: 93m^2 & 139.5m^2 (1000 & 1500 (ft^2) coverage
Staples for V/B application	1000 staples per 100 linear metre	Box of 1000 staples
Strapping	linear metres or feet	linear metres (feet) or unit of standard length.

* Staples will be included with Chapter 18 (Miscellaneous Metals).

13.2 Insulation

First check the minimum insulation requirements for the particular zone you live in (Energy Conservation Design zone). The right thickness of rigid or batt insulation required in your zone for foundation, wall and ceiling must be obtained.

13.2.1 Basement Wall Insulation

The basement insulation is usually a minimum of 38mm (1½") to 50m (2") expanded polystyrene molded bead boards. This rigid insulation material should cover at least the upper part of basement wall interior from the underside of the floor sheathing above down to 600mm (2 ft) below grade. Quantities are estimated in square metres or square feet.

a) Adhesive to install polystyrene molded bead boards to concrete or concrete block foundation wall

This type of adhesive is usually spot applied either with a brush or caulking gun. Depending on the porosity of the wall surface (concrete blocks requiring more adhesive than concrete) a 4 litre (1 gal) can will cover from 4.6 to 14m^2 (50 to 150 ft^2) of wall (spot application). We can estimate an average of 9.3m^2 (100 ft^2) coverage with 4 litres (1 gal) of adhesive.

13.2.2 Framed Wall Insulation

Where mineral fibre or glass batt insulation is specified, first find the minimum insulation thickness required for your particular zone. This will give you the thickness of insulation batts required. Then find the wall area to be insulated. The total area is the length of 4 exterior walls multiplied by the height to be covered. However, exterior doors and window openings should be deducted from the total area in the case of batt insulation but 5% will be added when preparing the final bill of materials.

13.2.3 Ceiling Insulation

Again, the wool insulation thickness required at the ceiling (or attic space) is determined according to the energy conservation zone you live in.

Batt insulation is sold in bags and mini rolls.

Consult Table 14 for "R" value, size, quantity and coverage.

TABLE 14

BATT INSULATION COVERAGE

PRODUCT	"R" VALUE		SIZE		PIECES PER PACKAGE	AREA PER PACKAGE	
	Metric	Imperial	mm	in		m²	ft²
BATTS FRICTION FIT IN BAGS WOOD STUD CONSTRUCTION C.M.H.C. 5650	RSI-1.4	R-8	381 x 1219 x 70	15 x 48 x 2¾	28	15.00	140.0
			584 x 1219 x 70	23 x 48 x 2¾	28	19.93	215.0
	RSI-1.7	R-10	381 x 1219 x 89	15 x 48 x 3½	22	10.22	110.0
			584 x 1219 x 89	23 x 48 x 3½	22	15.65	168.7
	RSI-2.1	R-12	381 x 1219 x 89	15 x 48 x 3½	18	8.36	90.0
			584 x 1219 x 89	23 x 48 x 3½	18	12.81	138.0
	RSI-2.4	R-14	381 x 1206 x 89	15 x 47.5 x 3½	10	4.59	49.5
			584 x 1206 x 89	23 x 47.5 x 3½	10	7.04	75.9
	RSI-3.5	R-20	381 x 1219 x 152	15 x 48 x 6	10	4.64	50.0
			584 x 1219 x 152	23 x 48 x 6	10	7.12	76.8
	RSI-4.9	R-28	406 x 1219 x 216	16 x 48 x 8½	7	3.46	37.3
			610 x 1219 x 216	24 x 48 x 8½	7	5.21	56.0
	RSI-5.4	R-31	406 x 1219 x 286	16 x 48 x 11¼	6	2.97	32.0
			610 x 1219 x 286	24 x 48 x 11¼	6	4.46	48.0
	RSI-6.1	R-35	406 x 1219 x 305	16 x 48 x 12	6	2.97	32.0
			610 x 1219 x 305	24 x 48 x 12	6	4.46	48.0
	RSI-7.0	R-40	406 x 1219 x 318	16 x 48 x 12½	5	2.47	26.7
			610 x 1219 x 318	24 x 48 x 12½	5	3.72	40
ROLLS FRICTION FIT IN OVERWRAPS WOOD STUD CONSTRUCTION C.M.H.C. 5650	RSI-1.4	R-8	381 x 23 m x 70	15 x 75.5' x 2¾	1	8.75	94.39
			584 x 23 m x 70	23 x 75.5' x 2¾	1	13.43	144.71
	RSI-1.7	R-10	381 x 17 m x 89	15 x 55.8' x 3½	1	6.46	69.75
			584 x 17 m x 89	23 x 55.8' x 3½	1	9.53	102.95
	RSI-2.1	R-12	381 x 17 m x 89	15 x 55.8' x 3½	1	6.48	69.75
			584 x 17 m x 89	23 x 55.8' x 3½	1	9.93	106.95
BATTS FRICTION FIT IN BAGS FOR STEEL STUD CONSTRUCTION AND NOISE STOP BLANKET C.M.H.C. 5650	NOISE STOP BLANKET		406 x 1219 x 70	16 x 48 x 2¾	28	13.86	149.3
			610 x 1219 x 70	24 x 48 x 2¾	28	20.82	224.0
	RSI-1.4 STEEL STUD	R-8	406 x 1219 x 70	16 x 48 x 2¾	28	13.86	149.3
			610 x 1219 x 70	24 x 48 x 2¾	28	20.83	224.0
	RSI-1.7 STEEL STUD	R-10	406 x 1219 x 89	16 x 48 x 3½	22	10.89	117.3
			610 x 1219 x 89	24 x 48 x 3½	22	16.36	176.0
	RSI-2.1 STEEL STUD	R-12	406 x 1219 x 89	16 x 48 x 3½	18	8.91	96.0
			610 x 1219 x 89	24 x 48 x 3½	18	13.38	144.0
	RSI-2.4 STEEL STUD	R-14	406 x 1219 x 89	16 x 48 x 3½	10	4.95	53.3
			610 x 1219 x 89	24 x 48 x 3½	10	7.44	80.0
	RSI-2.6	R-15	406 x 1219 x 152	16 x 48 x 6	10	4.95	53.3
MINI-ROLLS FRICTION FIT IN OVERWRAPS: WOOD CONSTRUCTION C.M.H.C. 5650	RSI-1.4	R-8	381 x 12.2 m x 70	15 x 40' x 2¾	1	4.65	50
	RSI-1.7	R-10	381 x 9.75 m x 89	15 x 32' x 3½	1	3.71	40
	RSI-2.1	R-12	381 x 7.32 m x 89	15 x 24' x 3½	1	2.79	30
HEADER INSULATION	RSI-2.1	R-12	381 x 1219 x 89	15 x 48 x 3½	18	8.36	90
	RSI-3.5	R-20	381 x 1270 x 152	15 x 50 x 6	10	4.84	52.1

13.3 Air/Vapour Barrier

A 0.15 mm (6 mil) polyethylene air/vapour barrier is required on the warm side of the exterior walls and at the highest ceiling. The air/vapour barrier is measured in square metres (or square feet). It is sold in rolls of

1. 93 m^2 coverage (3m wide x 30m long)
   1000 sq. ft. coverage (10ft wide x 100ft long), and

2. 139.5 m^2 coverage (3m wide x 45m long)
   1500 sq. ft. coverage (10ft wide x 150ft. long).

Calculate the total area to be covered without deducting for openings. This will make up for the 100mm (4") min. overlap at each joint and 150mm (6") overlap at the wall and ceiling joints as well as returning of the material over framing members. The usual procedure is to cover all openings as we go and make triangular cuts along the diagonals of openings.

The air/vapour barrier is usually secured to the wall and ceiling framing members with a heavy duty stapler. The quantity of staples required is usually entered under Miscellaneous Metals.

13.4 Ceiling Strapping

Ceiling strapping is normally done in conjunction with the Air/Vapour Barrier installation at the ceiling. Strapping material usually consist of 19 x 89 (1" x 4") furring or strapping @ 400mm (16") on center. Strapping is sold in 2400mm (8ft) lengths.

Again, 5% for wastage will be added when transferring the totals to the final bill of materials.

13.5 Attic Access

At this point, the materials required for the access door to the attic (if applicable) should be considered. The insulation is usually sandwiched between 2 sheets of plywood and a flexible rubber or neoprene gasket normally provides a perimeter seal.

The framing for this item as well as the framing around the chimney does not have to be taken-off separately.

A sufficient percentage of framing wood is usually provided for these minor situations when estimating the quantities for the main framing requirements.

14.0 EXTERIOR WALL FINISH

14.1 Materials for Exterior Wall Finish

Various options may be given for the exterior wall finish. These are listed in Table 15.

Let's assume that pre-finished "Kolor-Lok" X - 90 and exterior grade plywood 12mm (½") with 38 x 38mm (2" x 2") wood battens at the two gable ends are the exterior finish materials required.

14.2 Pressed Board Siding (option #1)

Pressed (Masonite) board siding is sold under trade names such as "Kolor-Lok" and is typically prefinished with a durable plastic coating. It is available in 225mm (9") and 300mm (12") widths and lengths of 3.6m (12 ft). The 225mm (9") wide boards are used in this example.

The actual coverage of 225mm (9") wide pressed board siding is 190mm (7.5") in height per board.

Find out how many times 190mm (7.5") goes into the wall height and this will give you the number of rows required. Then, find the total board length needed by mutliplying the total length (4 walls) by the number of rows.

You can deduct the openings but 10% for waste will have to be added if you do. More wastage from cutting is to be expected with siding than with any other material.

In practice, you would not need to take off the quantities for a second option, unless you wish to compare the costs before deciding which of the 2 options best meet your requirements.

14.3 Strapping

You may need strapping along the eaves, at the top and bottom of exterior panels and vertically for both gable ends depending on the particular design.

14.4 Plywood Panelling and Battens

Make sure that sufficient material is included to take care of both gable ends.

The battens will be taken care of in 17.0 (Finish woodwork).

TABLE 15

MATERIALS FOR EXTERIOR WALL FINISH

Material	How Measured	How Sold
Horizontal Siding a) Pressed Board (e.g. Kolor-Lok) 225mm (9")	Area to be covered m^2 (ft^2)	Carton - 6 pieces x 4.8m (16 ft.) long-covering 6.7m^2 (72 $ft.^2$)
Pressed Board (e.g. Kolor-Lok) 300mm (12")	Area to be covered m^2 (ft^2)	Carton - 6 pieces x 4.8m (16 ft.) long-covering 8.9m^2 (96 $ft.^2$)
Metal corners	Unit	Unit
b) Aluminum	Area to be covered m^2 (ft^2)	Carton - 24 pieces x 3.8m (12'-6") long
Metal corners	Unit	Unit
Plywood	Area to be covered m^2 (ft^2)	Panel - 1200 x 2400mm (4'x 8') - coverage = 2.88m^2 (32 $ft.^2$) per panel
Battens	Linear metres or feet	Linear metres or feet
Face brick	*746 bricks per 9.3m^2 of wall area (100 ft^2)	Thousand bricks
Mortar	0.17m^3 (6 ft^3) of mortar per 9.3m^2 (100 ft^2 of brick wall	Bags of 31.5 kg (70 lbs)

*For standard modular bricks.
Quantity may vary depending on type of work.
Consult manufacturers of suppliers.

14.3.1 12mm (½") Exterior Grade Plywood Panels

Any dimension over 1200mm (4 ft.) is counted as a full panel. Exterior grade plywood panels (G1S) is usually required for exterior gable end panelling.

14.5 Aluminum Siding

Aluminum siding is measured the same as Kolor-lok siding. The horizontal lap siding is sold in cartons of 24 pieces 3.8m (12'-6") long with 200mm (8") "exposure" per row. Always verify with the supplier about the exact "exposure" of each board when installed.

The height to be covered is divided by that exposure to find the number of rows needed.

14.6 Face Brick

The most widely used estimating procedure to calculate the number of bricks required is the "wall area" method.

Before estimating the quantity of bricks required, we must first verify with the supplier to make sure of the sizes available.

Different localities may carry different sizes depending on the types of brick that are available or most popular in a particular region.

For the purpose of this publication, what is called the 100mm/4" standard modular brick is used. The dimensions are 190 x 90 x 57mm. In practice, one brick + one joint (both ways) is the basis of calculation. Therefore, using 10mm joints, the brick sizes for estimating purposes become 200 x 100 x 67mm. $9.3m^2$ ($100\ ft^2$) of wall area, 746 bricks and $0.173m^3$ or ($6.1\ ft^3$) of mortar are required.

NOTE: For other brick sizes, use the calculation tables usually supplied by manufacturers on request.

To the total, 5% should be added for waste and breakage when reporting the totals to the final bill of materials.

The amount of mortar required can be estimated using a simple rule of proportion. Knowing that $9.3m^2$ ($100\ ft^2$) of brick wall requires $0.173\ m^3$ ($6\ ft^3$) of mortar, the formula becomes:

$100\ ft^2$ requires $6\ ft^3$ of mortar therefore, $X\ ft^2$ will require

$$\frac{6 \times X}{100} \text{ of mortar}$$

Finish woodwork and trims are dealt within 17.0

15.0 INTERIOR WALL AND CEILING FINISH

15.1 Gypsum Plaster Board

The most common interior wall and ceiling finish is obviously gypsum plaster board which is available in various forms, sizes and finishes as follows:

1. Standard for painting,
2. 'SW' panel (has round tapered edges),
3. Fire Code - treated for fire resistance (15.9mm only),
4. 'Fire Code C' - treated for greater fire resistance 12.7 and 15.9mm (½ in. and 5/8 in.),
5. W/R - water resistant,
6. 'Foil-Backed' (foil acts as a vapor barrier or thermal insulation),

   NOTE: Foil-Backed should not be used as a base for tile or plastic coated hard boards

7. 'GPB' exterior ceiling panel 12.7mm (½ in.), and
8. 'Textone' (predecorated) panel 12.7mm (½ in.) with vinyl facing*.

   * Not recommended for ceiling

Other types are available for industrial applications.

Installation of gypsum board panels requires

1. type W screws with Philips head recess (Gyproc nails are not recommended by the manufacturer of gypsum plaster board),

2. joint compound and reinforcing tape, and

3. external cornerbead reinforcement.

These and other materials for interior and ceiling finish are found in Table 16.

15.2 Estimating Quantities of Gypsum Plaster Board Panels

In house construction 1200 x 2400mm (4' X 8') panels installed vertically are the most common. Gypsum plaster board panels can also be installed horizontally and are sold in various lengths on special order such as 3000 and 3600mm (10' and 12'). Floor to ceiling height is usually slightly more to accommodate the standard panels.

Usually, door and window openings are not deducted with the exception of large picture windows or large openings in partitions such as between living and dining rooms.

TABLE 16

MATERIALS FOR INTERIOR WALL AND CEILING FINISH

Material	How Measured	How Sold
Gypsum plaster board	Area to be covered	Sheet 1200x2400mm (4'x 8') - coverage 2.88m^2 (32 ft.^{2}) per panel
Joint compound (pre-mixed)	Area covered by 25 GPB requires 27 Kg (60 lbs) of joint compound (3 coats)	Box of 27 Kg (60 lbs)
Joint tape	Area covered by 25 GPB requires 91.4 m (100 yd) of joint tape	Roll of 75m (82 yd)
External Corner Reinforcement Beads	Number of exterior corners	2400mm (8 ft.) long strips 32 or 29mm (1.3 in or 1.2 in) flange)
GPB Screws	178 mm (7") ceiling *203 mm (8") wall along edges 300mm (12") o.c. at intermediate framing members	Kg (lbs)

* One method consist of using 2 screws close together at every 300 mm (12 in.) or so along the edges.

What we need to know is the total area to be finished. This generally includes the ceiling area (main floor only); the exterior wall area (including the basement wall); and both sides of partitions (main floor only).

15.3 The Ceiling Area

To save time, we can calculate the ceiling area as a whole by using the overall house dimensions (interior). Here is an example of the merits of keeping a "collection" sheet where the main dimensions are recorded for future use. At this stage, it is probable that the needed dimensions were already used.

15.4 The Exterior Wall Area

Separating what is different, we usually have two types of 12.7mm ($\frac{1}{2}$") gypsum plaster board panels, water resistant and standard.

15.4.1 Water-resistant Gypsum Plaster Boards

These are usually specified for basement walls (specially the laundry area) and ceramic tile backing in bathroom.

15.4.2 Standard Type Gypsum Plaster Board

This type is usually specified for main floor walls & partitions.

15.5 Basement Wall and Ceramic Tile Backing

The number of panels required can be estimated by dividing the total area by 2.88m^2 (32 ft^2), the area of one panel.

NOTE: Where ceramic tile is installed, the backing should be of a water-resistant type.

15.6 Main Floor Walls (interior face of outside wall)

The area on the outside of the walls was estimated for the ply sheathing. The area found may be used again for covering the interior face of the exterior wall. This is one method. Another method, which consists of taking each room separately can be used, if you prefer. However, using the figures that we already have will save time. The partition panelling may be estimated subsequently.

15.7 Partitions (Both Faces)

If the floor plan has a grid module it will help establish the lengths of partitions. Knowing that each square is 1200 mm (4 ft) each way facilitates the calculations. Any part of a partition that extends a grid square can readily be taken as extending so many feet probably 1/3, 1/4, 1/2 or 3/4 of 1200 mm (4 ft) just by looking at it.

NOTE: It is better to be slightly in excess of the actual length than to be short.

The total length of partitions - not deducting for openings - multiplied by 2 to take care of both sides of all partitions and divided by the width of a panel will give you the number of panels required.

When transferring the totals to the final bill of materials, all similar materials should be regrouped to allow you to assess the total quantities of each particular type of materials. At that time, a percentage for waste and breakage will be added.

NOTE: The quantity of gypsum board fasteners will be estimated in the section dealing with miscellaneous metals.

15.8 Joint Compound and Reinforcing Tape

There are various types of joint compound on the market including both ready-to-use mixtures and powder type. The powder type is mixed with water to form a paste. You must adhere strictly to proper proportioning of powder and water. The advantage of powder compounds is that it can be stored (dry) at any temperature. Premixed or ready-to-use mixtures require heated storage. They will deteriorate if exposed to repeated freeze/thaw cycles. Amongst the ready-mix compounds, the most versatile is the "all-purpose" type which is used directly from the container and can be used for 1st, 2nd and third coats.

The pre-mixed joint compound is sold in 27 kg (60 lb.) cartons.

One basis for estimating the quantity of joint compound required is 37kg (60 lb.) per 25 gypsum board panels.

Reinforcing tape is sold in rolls of either plain or perforated material. The perforated type is preferred. 25 gypsum board panels require 91.4m (100 yd) of reinforcing tape.

15.9 External Metal Corner Reinforcement

This is a galvanized steel corner reinforcement which is nailed or screwed to the framing through the gypsum panels. The flanges are covered with joint compound to form a smooth finished external corner. It is available in 2 sizes: 32 mm (1.3 in.), and 29 mm (1.2 in.).

See your list of usual tools for the essential equipment required for gypsum plaster board application.

16.0 INTERIOR DOORS

16.1 Types of Doors and Door Sets

Doors can be purchased either prehung or with separate frame sets. The cost of a prehung unit is slightly higher but the cost of installation is lower. Slab type hollow core doors are usually installed inside a house. They come with different types of finish or just plain plywood veneer for varnishing or painting.

If the installation time and labour is of concern it would probably pay-off to opt for prehung units. These can be obtained plain or pre-finished and with or without passage set or lockset (a lockset is required for a bathroom door).

16.2 Locksets and Doorsets

If doorsets or locksets are not included, these items should be covered under Hardware and Miscellaneous Metals. If purchased with separate frame sets, both the butts (or hinges) and the doorsets or locksets will be included in the hardware listing. Door finishing will be included with the chapter on caulking, weatherstripping, painting and ceramic tile. The unit is the basic measure for estimating doors.

Under the heading "INTERIOR DOORS" we will simply list each type of door giving the type, the size (width, height and thickness), and the number of units required for each type and size

NOTE: The special hardware for bi-fold doors usually comes with the door units. If purchased separately, the hardware would be listed under HARDWARE.

Bi-fold doors are often hung without frame which represents a good economy.

17.0 FINISH WOODWORK (Exterior and Interior)

17.1 Exterior Trim (Finish woodwork)

Usually the exterior finish woodwork includes the following:

1. perimeter sill,
2. door and window trim (normally included with Dashwood type of windows),
3. corner trim,
4. frieze band,
5. fascia board and soffit,
6. attic louvered vents,
7. flower box, and
8. battens (vertical joints - gable end panelling).

17.1.1 Perimeter Sill

From our "collection" sheet, we should already have the total house perimeter. This will be the total length of sill material required. The sill, if to be clad with a metal flashing can be of rough stock.

17.1.2 Door and Window Trim

Normally, Dashwood and similar windows are available with their own exterior trim. The unit cost of a window would include exterior window trim. However, the trim around the exterior doors may have to be estimated separately. We will assume that the windows will be supplied complete with exterior trim and we will estimate the quantity of door trim to match as required.

17.1.3 Corner Trim

Perhaps corner trim boards are specified. In this case the total number of boards required for the 4 corners will be estimated.

17.1.4 Frieze Band

If a frieze band is specified (usually exterior grade plywood, you may have to include the necessary nailer blocks at the top of the exterior wall.

The blocking consists of two continuous rows of 38 x 38 (2" x 2") stock.

17.1.5 Fascia and Soffit

Strapping for nailing the plywood soffit boards may be required. This applies to the front and rear elevations and along each of the gable end soffits.

1.5mm (3/8") exterior grade plywood normally forms the soffit finishing material. Aluminum soffits may be specified.

17.1.6 Attic Louvered Vents

For the purpose of your estimation, you may consider field-built wood louvered grille. The materials required may be:

1. 6m (20 ft.) of 38 x 38 (2" x 2") blocking,
2. 6m (20 ft.) of 38 x 140 (2" x 6") framing, or
3. 9m (30 ft.) of 19 x 89 (1" x 4") louvre material.

Pre-built units are also available.

17.1.7 Flower Box

The materials required are

1. some blocking which may be left over pieces of framing members,
2. some exterior grade plywood,
3. some gravel or crushed stone,
4. galvanized metal liner (see Miscellaneous Metals), and
5. galvanized steel straps (see Miscellaneous Metals).

17.1.8 Battens (Vertical Joints - Gable End Panelling)

These finishing materials require special attention since many small components are liable to slip our minds. After covering the bulk of the materials required however, we should have become more alert in depicting what is needed in order to provide a complete and accurate list of materials.

At this point, it is a good idea to go through the elevations and details of your drawings to see if you have not forgotten any important part of the exterior finish woodwork and accessories.

It would be useful also to note all the miscellaneous metal components as you go and list them separately. These quantities will thus be available when estimating the miscellaneous metals.

17.2 Interior Woodwork

It includes all the interior finish carpentry work as follows:

1. kitchen cupboards,
2. closet shelving and accessories,
3. door and window architrave and trim, and
4. wall baseboard and special moulding.

17.2.1 Kitchen Cupboards

Kitchen cupboards are available as standard pre-built or custom-built units or they can be built on site.

Considering the materials, labour and construction time, it may be economical to resort to standard pre-built units.

If time and labour is not a major problem you may wish to have the kitchen cupboards built on-site. In any event, it is always worthwhile to compare both options before deciding. The finish woodwork operations are always time consuming and costly and estimating the quantities of such permanent features as kitchen cupboards requires great accuracy unless a global estimate at so much per meter or foot for costing is all that is required.

If you wish to prepare a complete estimate of the materials required, the quantities are to be listed for the toe-base, plywood or masonite for the drawer bottoms, plywood for drawers back and sides, plywood for doors, shelves, ends and countertop underlay, (the top may be a premoulded pre-finished standard unit which is sold by the linear foot), and hardware (which will be estimated with miscellaneous metals.

a) Toe Base

The toe base is usually constructed from 38 x 89mm (2" x 4") stock.

b) Drawer Bottoms

Drawer bottoms are usually made of 1/4" or 3/16" plywood.

c) Drawer Back and Sides

These are usually made of 1/2" plywood.

d) Doors, Shelf Backs, Ends and Countertop Underlay

Requiring 19mm ($\frac{3}{4}$") thick plywood are the doors, shelves, back and Ends, and counter top underlay.

You may also require a plastic laminate topping or ceramic tile.

NOTE: If a pre-moulded top is used, the total quantity of 19mm ($\frac{3}{4}$") plywood would be reduced accordingly.

Note that a range and refrigerator would not usually be included in contract (this is indicated by the note - N.I.C.).

The hardware will be listed under heading 18.0.

17.2.2 Closet Shelving and Accessories

Closet shelves are usually 19mm ($\frac{3}{4}$") plywood of required width.

Hanger rods or strips of the appropriate length are needed.

17.2.3 Door and Window Trim

For each regular hinged door (one side) 4.8m (16 ft.) of trim is usually required. The interior window trim can be estimated easily. Twice the width and twice the height will give the length of trim required for each window. Doors only have trim on 3 sides.

17.2.4 Wall Baseboard and Special Moulding

First ascertain that there is no wood baseboard required in the basement and in the bathroom which usually has a ceramic tile floor and dado finish.

All rooms on the main floor, except the bathroom require a baseboard.

Finish wood trim is a relatively expensive material. For this reason, quantities should be very carefully estimated. Rather than using "collected" gross figures, each wall requiring a baseboard should be measured as accurately as possible using the grid lines as a guide if provided.

When measuring the lengths of wall to estimate the quantity of baseboard required from the plan, don't forget that the baseboard is continuous under each window opening. Only the door openings are deducted.

Trim or mouldings of various types, shapes and sizes are available in different types of wood and even plastic material.

This concludes the interior finish woodwork. At this point, you should go through the plans, cross-section and details to make sure everything is covered on your preliminary list of materials concerning the Interior finish woodwork.

18.0 HARDWARE AND MISCELLANEOUS METALS (including Nails, Screws, etc.)

18.1 Reasons for Listing Hardware Separately

Why didn't we include the miscellaneous metal components and accessories with the activities they belong to, such as the nails required to secure the wall framing members?

In practice, this may be desirable, if you are familiar with the requirements of the codes regarding nailing of the various structural and sheathing members. The idea is to concentrate on the Building Code requirements and the use of the standard nailing charts designed to facilitate the task of choosing the right nails, the right sizes, the right spacings and methods of nailing various structural and finishing components. Section 9.23 of the National Building Code includes charts for various nail application. But always check your local code first.

Go through the Nailing, Fastening and Attachment tables in Sections 9.23 to 9.32 of the National Building Code. The purpose is to emphasize the importance of respecting the minimum safety requirements laid down in the code.

18.2 Hardware and Miscellaneous Metals Listings

Following on Tables 17, 18 and 19 are examples of lists of hardware and miscellaneous metals which you will require.

TABLE 17

HARDWARE AND MISCELLANEOUS METALS

ITEM	DIVISION 8 HARDWARE & MISCELLANEOUS METALS	UNIT OF ISSUE	QUANTITY	UNIT PRICE	TOTAL COST
		BROUGHT FORWARD			
1.	Lockset For 44 Exterior Wood Door 1 3/4"	Ea.	2		
2.	Latchsets [Both Sides]				
	a) 44 Exterior Storm Door 1 3/4"	Ea.	2		
3.	b) 34 Interior Wood Door 1 3/8"	Ea.	5		
4.	Privacy Set For 34 Interior Wood Door 1 3/8"	Ea.	1		
5.	Butts				
	a) 100 x 100 For 44 Ext. Wood Door 4" x 4" 1 3/4"	Pair	4		
6.	b) 75 x 75 For 34 Int. Wood Door 3" x 3" 1 3/8"	Pair	6		
7.	Tracks & Accessories For 34 Bi-Fold Door 1 3/8" [See Door Schedule For Sizes]	Set	3		
				CARRIED FORWARD	

TABLE 17 (Cont'd)

ITEM	DIVISION 8 HARDWARE & MISCELLANEOUS METALS (CONT'D)	UNIT OF ISSUE	QUANTITY	UNIT PRICE	TOTAL COST
	Nails				
1.	100 Common [Framing] 4"	kg lbs	7 15		
2.	82 Common [Framing] 3¼"	kg lbs	21 45		
3.	64 Common [Floor & Roof Sheathing] 2½"	kg lbs	53 117		
4.	50 Common [Wall Sheathing] 2"	kg lbs	14 30		
5.	25 Roof Shingle 1"	kg lbs	11 24		
6.	50 Elec. Galv. Annular Ring [Siding] 2"	kg lbs	8 16		
7.	31 Annular Blue Ringed [Drywall] 1¼"	kg lbs	19 42		
8.	64 Finishing 2½"	kg lbs	3 6		
9.	50 Finishing 2"	kg lbs	3 6		
10.	38 Finishing 1½"	kg lbs	0.6 1.5		
11.	100 Wood Screws 4" [#16]	Box	1		
12.	50 x 3 Galv. Steel Straps for Flower Box 2" x 1/8"	Ea.	7		

TABLE 17 (Con'td)

ITEM	DIVISION 8 HARDWARE & MISCELLANEOUS METALS (CONT'D)	UNIT OF ISSUE	QUANTITY	UNIT PRICE	TOTAL COST
13.	75 Dia. Adjustable Steel Post with Bearing Plates Top & Bottom 3"	Ea.	2		
14.	38 x 184 Joist Hangers 2" x 8"	Ea.	6		
15.	Fly Screen For Attic Vents	S.M. S.F.	1 12		
16.	50 Prefinished Metal Screened Vent 2" (SOFFIT)	L.M. L.F.	19 63		
17.	0.48 Ga. x 150 Prefinished Galv. St. Flashing to Roof Edge 26 Ga. x 6"	L.M. L.F.	47 154		
18.	0.48 Ga. x 150 Prefinished Galv. St. Drip Cap Flashing - Gable End 26 Ga. x 6"		16 54		
19.	0.79 Ga. x 700 Girth Galv. St. Flower Box Lining 22 Ga. x 2' - 4"	L.M. L.F	4 12		
20.	Staples For Air/Vapour Barrier	Box (5000)	1		
21.	0.48 Ga. x 400 Prefinished Galv. St. Flashing to Exterior Sill 26 Ga. x 16"	L.M. L.F.	40 132		

TABLE 18

FASTENINGS

NAILING FOR FRAMING				
Construction Detail	Minimum Length Nails, mm	Minimum Number or Maximum Spacing of Nails	Minimum Length of Nails, in.	Minimum Number or Maximum Spacing of Nails
Floor joist to plate—toe nail	82	2	3¼	2
Wood or metal strapping to underside of floor joists	57	2	2¼	2
Cross bridging to joists	57	2 each end	2¼	2 each end
Double header or trimmer joists	76	300 mm (o.c.)	3	12 in. (o.c.)
Floor joist to stud (balloon construction)	76	2	3	2
Ledger strip to wood beam	82	2 per joist	3¼	2 per joist
Joist to joist splice (see also Table 9.23.13.A.)	76	2 at each end	3	2 at each end
Tail joist to adjacent header joist	82	5	3¼	5
(end nailed) around openings	101	3	4	3
Each header joist to adjacent trimmer joist	82	5	3¼	5
(end nailed) around openings	101	3	4	3
Stud to wall plate (each end) toe nail	63	4	2½	4
or end nail	82	2	3¼	2
Doubled studs at openings, or studs at *partition* or wall intersections and corners	76	750 mm (o.c.)	3	30 in. o.c.
Doubled top wall plates	76	600 mm (o.c.)	3	24 in. o.c.
Bottom wall plate or sole plate to joists or blocking (exterior walls)[1]	82	400 mm (o.c.)	3¼	16 in. o.c.
Interior *partitions* to framing or subflooring	82	600 mm (o.c.)	3¼	24 in. o.c.
Horizontal member over openings in non-*loadbearing partitions*— each end	82	2	3¼	2
Lintels to studs	82	2 at each end	3¼	2 at each end
Ceiling joist to plate—toe nail each end	82	2	3¼	2
Roof rafter, roof truss or roof joist to plate—toe nail	82	3	3¼	3
Rafter plate to each ceiling joist	101	2	4	2
Rafter to joist (with ridge supported)	76	3	3	3
Rafter to joist (with ridge unsupported)	76	see Table 9.23.13.A.	3	see Table 9.23.13.A.
Gusset plate to each rafter at peak	57	4	2¼	4
Rafter to ridge board—toe nail	57	4	2¼	4
—end nail	82	3	3¼	3
Collar tie to rafter —each end	76	3	3	3
Collar tie lateral support to each collar tie	57	2	2¼	2
Jack rafter to hip or valley rafter	82	2	3¼	2
Roof strut to rafter	76	3	3	3
Roof strut to bearing *partition*—toe nail	82	2	3¼	2
38 mm by 140 mm or less plank decking to support	82	2	3¼	2
Plank decking wider than 38 mm by 140 mm to support	82	3	3¼	3
38 mm edge laid plank decking to support (toe nail)	76	1	3	1
38 mm edge laid plank to each other	76	450 mm (o.c.)	3	18 in. o.c.
Column 1	2	3	2	3

TABLE 18 (Cont'd)

Element	Minimum Length of Fasteners for Sheathing and Subfloor Attachment, mm				Min. No. or Max. Spacing of Fasteners
	Common or Spiral Nails	Ring Thread Nails	Roofing Nails	Staples	
Plywood or waferboard up to 10 mm thick	51	45	N/A	38	150 mm (o.c.) along edges and 300 mm (o.c.) along intermediate supports
Plywood or waferboard from 10 mm to 20 mm thick	51	45	N/A	51	
Plywood or waferboard over 20 mm thick	57	45	N/A	N/A	
Fibreboard sheathing up to 13 mm thick	N/A	N/A	44	38	
Gypsum sheathing up to 13 mm thick	N/A	N/A	44	N/A	
Board lumber 184 mm or less wide	51	N/A	N/A	51	2 per support
Board lumber more than 184 mm wide	51	N/A	N/A	51	3 per support
Column 1	2	3	4	5	6

Element	Minimum Length of Fasteners for Sheathing and Subfloor Attachment, in.				Min. No. or Max. Spacing of Fasteners
	Common or Spiral Nails	Ring Thread Nails	Roofing Nails	Staples	
Plywood or waferboard up to ⅜ in.* thick	2	1¾	N/A	1½	5⅞ in. (o.c.) along edges and 12 in. (o.c.) alon intermediate supports
Plywood or waferboard from ⅜ in.* to ¾ in.* thick	2	1¾	N/A	2	
Plywood or waferboard over ¾ in.* thick	2¼	2	N/A	N/A	
Fibreboard sheathing up to ½ in.* thick	N/A	N/A	1¾	1½	
Gypsum sheathing up to ½ in.* thick	N/A	N/A	1¾	N/A	
Board lumber 8 in.* or less wide	2	N/A	N/A	2	2 per support
Board lumber more than 8 in.* wide	2	N/A	N/A	2	3 per support
Column 1	2	3	4	5	6

RAFTER-TO-JOIST NAILING
(Minimum Number of Nails at least 76 mm long) (3 in. long)
(Unsupported Ridge)

Roof Slope	Rafter Spacing, mm	Rafter Spacing, in.	Rafter Tied to Every Joist						Rafter Tied to Joist Every 1.2 m					
			Building Width up to 8 m (up to 26 ft 3 in.)			*Building* Width up to 9.8 m (up to 32 ft 2 in.)			*Building* Width up to 8 m (up to 26 ft 3 in.)			*Building* Width up to 9.8 m (up to 32 ft 2 in.)		
			1 or less	1.5	2.0 or more	1 or less	1.5	2.0 or more	1 or less	1.5	2.0 or more	1 or less	1.5	2.0 or more
			21 or less	31	42 or more	21 or less	31	42 or more	21 or less	31	42 or more	21 or less	31	42 or more
1 in 3	400	16	4	5	6	5	7	8	11	—	—	—	—	—
	600	24	6	8	9	8	—	—	11	—	—	—	—	—
1 in 2.4	400	16	4	4	5	5	6	7	7	10	—	9	—	—
	600	24	5	7	8	7	9	11	7	10	—	—	—	—
1 in 2	400	16	4	4	4	4	4	5	6	8	9	8	—	—
	600	24	4	5	6	5	7	8	6	8	9	8	—	—
1 in 1.71	400	16	4	4	4	4	4	4	5	7	8	7	9	11
	600	24	4	4	5	5	6	7	5	7	8	7	9	11
1 in 1.33	400	16	4	4	4	4	4	4	4	5	6	5	6	7
	600	24	4	4	4	4	4	5	4	5	6	5	6	7
1 in 1	400	16	4	4	4	4	4	4	4	4	4	4	4	5
	600	24	4	4	4	4	4	4	4	4	4	4	4	5
Col. 1	2	2	3	4	5	6	7	8	9	10	11	12	13	14

Roof snow load ← in kN/m² ← in psf

TABLE 18 (Cont'd)

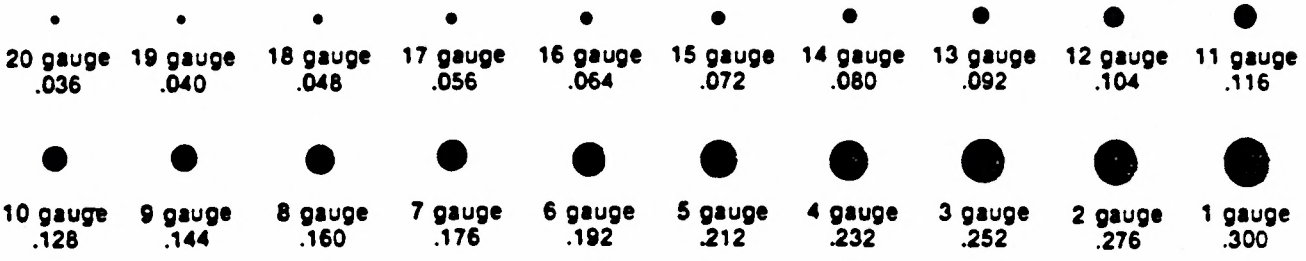
ATTACHMENT OF SIDING						
Type of Siding	Min. Nail or Staple Length, mm	Min. No. of Nails or Staples	Maximum Nail or Staple Spacing	Min. Nail or Staple Length, in.	Min. No. of Nails or Staples	Maximum Nail or Staple Spacing
Wood trim	51	—	600 mm (o.c.)	2	—	24 in. (o.c.)
Lumber siding or horizontal siding made from sheet material	51	—	600 mm (o.c.)	2	—	24 in. (o.c.)
Metal siding	38	—	600 mm (o.c.) (nailed to framing) 400 mm (o.c.) (nailed to sheathing only)	1½	—	24 in. (o.c.) (nailed to framing) 16 in. (o.c.) (nailed to sheathing only)
Handsplit wood shakes up to 200 mm in width	51	2	—	2	2	—
Handsplit wood shakes over 200 mm in width	51	3	—	2	3	—
Wood shingles and machine grooved shakes up to 200 mm in width	32	2	—	1¼	2	—
Wood shingles and machine grooved shakes over 200 mm in width	32	3	—	1¼	3	—
Asbestos-cement shingles	32	2	—	1¼	2	—
Panel or sheet type siding up to 7 mm thick	38	—	150 mm (o.c.) along edges	1½	—	5⅞ in. (o.c.) along edges
Panel or sheet type siding greater than 7 mm thickness	51	—	300 mm (o.c.) along intermediate supports	2	—	12 in. (o.c.) along intermediate supports
Column 1	2	3	4	2	3	4

NAILING OF WOOD STRIP FLOORING		
Finish Floor Thickness, mm	Minimum Length of Flooring Nails, mm	Maximum Spacing of Flooring Nails, mm
7.9	38[1]	200
11.1	51	300
19.0	57	400
25.4	63	400
31.7	70	600
38.1	83	600
Column 1	2	3
Finish Floor Thickness, in.	Minimum Length of Flooring Nails, in.	Maximum Spacing of Flooring Nails, in.
⅝	1½[1]	7⅞
¾	2	12
¾	2¼	16
1	2½	16
1¼	2¾	24
1½	3¼	24
Column 1	2	3

TABLE 19

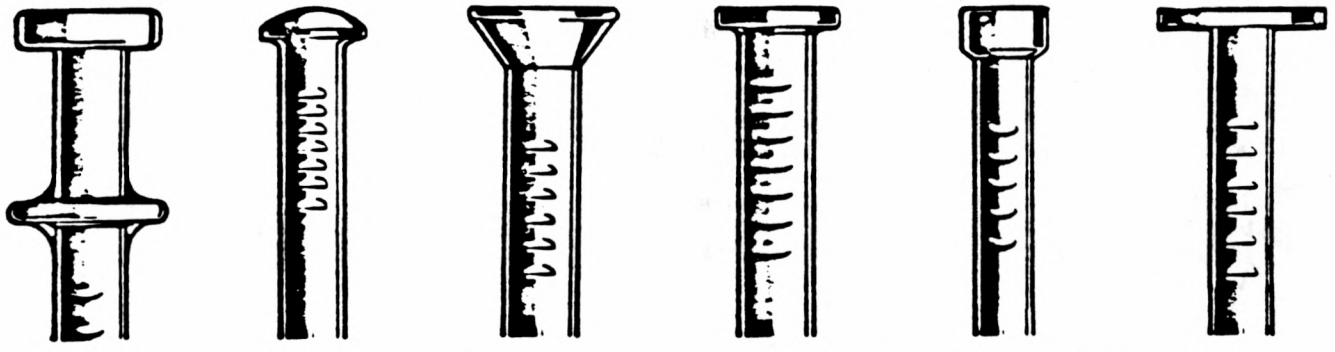
NAIL CLASSIFICATION

Nail wire gauges

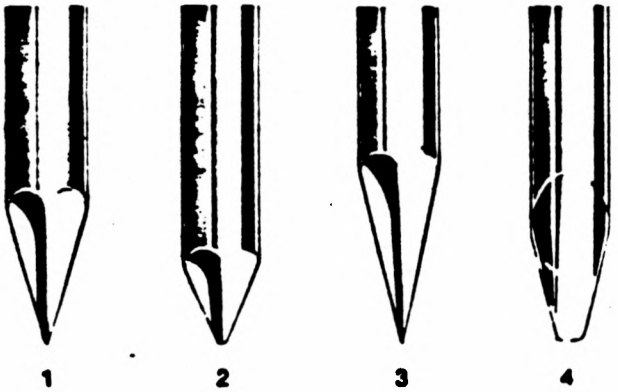


This table shows Imperial Standard Wire Gauge used for nails in Canada. The decimal equivalents will serve as a guide in selecting drill size for pre-drilled nail holes. These should be approximately 85 percent of the diameter of the nail used.

Head styles



Nail points



1 Diamond
The most popular point for nails used in general construction and other softwood applications.

2 Short diamond
Used for nailing hardwoods principally in making crates and boxes, laying hardwood floors and attaching hardwood trim. The blunt point breaks the fibres, reducing the possibility of splitting.

3 Long diamond
Recommended for use in other than hardwoods. Designed for fast driving, particularly in box making. A slight tap holds the nail steady. Then it can be driven home without holding.

4 Clinch
Its principal use is on nails to be clinched, as in box making. Also used on small nails which are driven in veneers. The clinch point should be at right angles to the grain of the wood.

TABLE 19 (Cont'd)

Bright and heat-treated Ardox machine quality pallet nails for machine driving (meet CWPCA specifications)
Flat heads
Diamond points

mm	Length inches	Gauge number	Overthread diameter	Approximate count per pound
50	2	0.138	0.138	127
63	2½	0.138	0.138	107
75	3	0.138	0.138	89
80	3¼	0.138	0.138	83
85	3½	0.138	0.138	78

Note: Stelco manufactures a wide range of machine quality nails. Both Ardox spiral and smooth shank for application on automatic nailing machines and pneumatic guns. We invite enquiries for machine quality nails to meet your specific nailing requirements.

Approximate count per pound table for nails

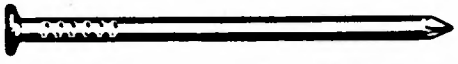
The count per pound figures in this table are approximate only. They may vary either way through changes in dimensions of the heads or points. Brads and no-head nails will run more to the pound than this table shows, and large or thick-headed nails will run less.

Reasonably accurate counts per pound have been given for the various types of nails in the tables listed on the preceding pages.

Ardox spiral common

mm	Length inches	Gauge number	Approximate count per pound
25	1	14	764
32	1¼	14	672
38	1½	13½	490
45	1¾	12½	316
50	2	12½	274
58	2¼	11½	203
63	2½	10½	143
75	3	9¾	92
80	3¼	9¾	88
85	3½	8	57
100	4	7	41
125	5	5	23
150	6	3	14.2

Common smooth shank



Length inches	Gauge number	Approximate count per pound
1	15	794
1¼	14	536
1½	13	322
1¾	12	229
2	11¾	167
2¼	11	141
2½	10	104
2¾	10	91
3	9	67
3¼	9	63
3½	7	47
4	6	25
4½	5	22
5	4	18
5½	3	13
6	2	9

Length inches / Gauge number	¼	⅜	½	⅝	¾	⅞	1	1¼	1½	1¾	2	2¼	2½
9	—	—	—	—	238	213	185	152	128	112	99	87	79
10	—	—	—	—	320	277	242	196	165	142	124	111	100
11	—	—	—	—	366	323	285	233	200	171	149	136	122
12	—	—	740	603	511	442	397	327	268	229	204	182	161
13	—	—	1017	802	688	590	503	412	348	297	260	232	209
14	—	—	1290	1037	833	741	667	536	459	308	350	312	278
15	—	—	1619	1316	1132	971	869	694	578	501	437	390	351
16	—	—	2142	1708	1414	1229	1099	872	739	635	653	496	452
17	—	3890	2700	2306	1904	1581	1409	1139	956	831	746	666	590
18	—	5072	3824	3130	2608	2248	1976	1590	1338	1150	996	890	820
19	9920	6860	5075	4132	3508	2816	2556	2096	1772	1590	1390	1205	1060
20	14050	9342	7164	5686	4795	4230	3596	2893	2412	2070	1810	1620	1450
21	17252	12000	8920	7232	6052	—	—	—	—	—	—	—	—

TABLE 19 (Cont'd)

Smooth shank

Length inches	Gauge number	Approximate count per pound
1	16	976
1¼	15	650
1½	14	427
1¾	14	355
2	13	251
2¼	13	214
2½	12	158
2¾	11	117
3	11	107
3¼	10	80
3½	10	74
4	9	48
5	8	33

Light roofing nails

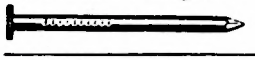
11 gauge Ardox spiral roofing nails, 7/16 inch head

Length inches	Gauge number	Approximate count per pound
1	11	265
1¼	11	223
1½	11	184
1¾	11	168
2	11	162

11 gauge smooth shank roofing nails, 7/16 inch head

Length inches	Gauge number	Approximate count per pound
¾	11	315
⅞	11	280
1	11	255
1¼	11	210
1½	11	180
1¾	11	150
2	11	138
2½	11	117
3	10½	82

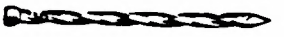
Red cedar shingle



Length inches	Gauge number	Approximate count per pound
1¼	14	432
1¾	14	247 count based on galvanized nails

Finishing nails

Ardox spiral



Length inches	Gauge number	Approximate count per pound
1¼	15	950
1½	14	609
1¾	13½	436
2	13	330
2¼	13	294
2½	12½	221
3	11½	131
3½	10½	121
4	9½	67

Ardox spiral octagonal (heat treated)
Finishing nails for attaching trim to masonry walls.

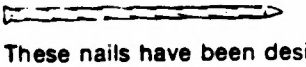
Length inches	Gauge number	Approximate count per pound
1¾	14	514

Smooth shank finishing

Length inches	Gauge number	Approximate count per pound
¾	18	2608
1	17	1444
1¼	16	856
1½	15	562
1¾	14	404
2	13	267
2¼	13	226
2½	12	162
3	11	109
3½	10	77
4	9	50

Coloured panel nails

Ardox spiral painted



These nails have been designed for attaching plywood or other prefinished paneling in recreation rooms, dens, etc. They are available in black, brown, tan, beige, blond, ivory and white, and are packed in 8 ounce visual packages. 12 packages per carton, 8 cartons per master carton of one colour.

Length inches	Gauge number	Approximate count per 8 ounce pkg.
⅞	15	500
1⅛	14½	300

TABLE 20

NAIL USAGE

FIXING PLYWOOD

A) FINISH WORK

PLY. THICKNESS	NAIL SIZE	NAIL TYPE	SCREW SIZE	SCREW TYPE
18.5 mm (3/4")	48 mm (2")	Finishing	38 mm (1 1/2")	No. 8
15.5 (5/8")	48 (2")	"	32 (1 1/4")	No. 8
12.5 (1/2")	40 (1 1/2")	"	32 (1 1/4")	No. 6
9.5 (3/8")	32 (1 1/4")	"	25 (1")	No. 6
6 (1/4")	19 (3/4")	"	19 (3/4")	No. 4

SPACING = 150 mm (6") apart for most work

B) SHEATHING (Ply. or particle board)

BOARD THICKNESS	NAIL SIZE	NAIL TYPE
up to 10 mm (7/16")	48 mm (2")	common or spiral
10 to 20 mm (7/16" to 7/8")	48	common or spiral
over 20 mm (7/8")	56 (2 1/4")	common or spiral

SPACING: EDGES = 150 mm (6") - INTERMEDIATE = 300 mm (12")

C) SUBFLOOR SHEATHING

PLY. THICKNESS	JOIST SPACING	NAIL SIZE	NAIL TYPE	NAIL SPACING EDGE	NAIL SPACING INTER.
12.5 to 15.5 mm (1/2" to 5/8")	300 mm (12")	56 mm (2 1/4")	common or sprial	150 (6")	300 (12")
12.5 to 15.5 mm (1/2" to 5/8")	400 mm (16")	56	"	150	300
18.5 mm	400 mm (16")	56	"	150	300
15.5 to 20.5 mm (5/8" to 7/8")	500 mm (20")	56	"	150	300
18.5 to 20.5 mm (3/4" to 7/8")	600 mm (24")	56	"	150	300
29 mm (1 1/8")	1200 mm (48")	65 (2 1/2")	"	150	150
32 mm (1 1/4")	1200 mm (48")	65	"	150	150

TABLE 20 (Cont'd)

FIBREBOARD SHEATHING (EXTERIOR)

Using 40 OR 48 mm (1 1/2" or 2") galvanized roofing nails:

Along edges = 75 mm (3") intermediate = 150 mm (6") O.C.

NAILING ROUGH LUMBER

BOTTOM WALL PLATE

2 x 85 mm (3 1/2") nails at each joist and corners. If along a joist or header: 2 x 85 mm (3 1/2") nails @ 600 mm (24") O.C.

DOUBLE TO WALL PLATE

1ST PLATE: 85 mm (3 1/2") nails to corner post and to each stud

2ND PLATE: 85 mm (3 1/2" nails @ 400 mm (16") o.c.

WALL STUDS

Ends nailed through plate: 2 x 85 mm (4") nails or, toe nailed: 4 x 65 mm (2 1/2") to the plate (2 each side of stud)

NOTE: corner posts are nailed together with 85 mm (3 1/2") nails

JACK STUDS TO LINTEL

Toe-nail with 4 x 65 mm (2 1/2") nails (2 each side)

OPENING STUD TO END OF LINTEL

4 x 85 mm (3 1/2") nails (each side of opening)

ALONG CRIPPLE STUD

75 mm (3") nails @ 400 mm (16") o.c.

ROUGH SILL TO CRIPPLE STUDS

2 x 85 mm (3 1/2") nails at each cripple stud

DOUBLE ROUGH SILL TO 1ST SILL

85 mm (3 1/2") nails @ 400 mm (16") o.c. (Staggered)

LINTEL (BUILT-UP WITH PLY SPACER)

85 mm (3 1/2") nails @ 400 mm (16") o.c. (Staggered) plus 2 at each end

BEAM AND GIRDER (Laminated)

Use 2 rows of 85 mm (3 1/2") nails spaced 400 mm (16") o.c.

TABLE 20 (Cont'd)

FRAMING FLOOR OPENING (double joists)

Use 5 x 85 mm (3-1/2"), or 3 x 100 mm (4") nails to secure end of joists (before placing the double joists). Nail latter to first joist.

CROSS-BRIDGING

2 x 56 mm (2 1/4") nails at top and bottom.

ESTIMATING THE QUANTITIES OF NAILS REQUIRED

Nails are sold by kilograms (or pounds) and the quantities estimated in kg per m^2

Example for Floor Framing Nail Requirements:

Size of Joists	Estimating Quantity of Nails
38 X 140 (2" X 6")	7.3 kg per m^2
38 X 184 (2" X 8")	5.8 kg per m^2
38 X 235 (2" X 10")	4.7 kg per m^2
38 X 286 (2" X 12")	3.7 kg per m^2

MISCELLANEOUS

ASPHALT SHINGLES:

4 nails per shingle
21 shingles per bundle
84 nails per bundle
0.15 to 0.19 kg of nails per bundle (depending on the nail size based on 11.5 mm nail head)

DOOR FRAMES:

85 mm (3 1/2") galv. casing nails placed 20 mm (7/8") from outer edges of casing and spaced 400 (16") o.c.

FIXING OF WOOD SIDING

a) Board and Batten
Board on Board
Clapboard
75 mm (3") galvanized siding nails

b) Channel Rustic
65 mm (2 1/2") galvanized siding nails

c) drop (T&G & Shiplap)
48 mm (2") galv. finish nails for T&G
65 mm (2 1/2") galv. siding nails for shiplap

d) bevel
48 mm (2") galv. siding nails

TABLE 20 (Cont'd)

e) Bungalow (plain or rabbeted edge)
65 mm (2 1/2") galv. siding nails

f) Log Cabin
75 mm (3") galv. casing nails
NOTE: Nail 38 mm (1 1/2") up from lower edge

g) Tongue and Groove (plain)
56 mm (2 1/4") galv. finish nails

NOTE: Nails should penetrate at least 38 mm (1 1/2") into the studs (if this is not possible, use threaded nails which have more holding power.

Roof trusses

(Represent 30% saving on Roof members and ceiling joists)

- No double plate needed on interior partitions
- Double joists under partitions not needed

'W' trusses maximum span = 9145 mm (30 ft.)

The lower the slope, the greater the stress (larger members needed) (King post trusses maximum span = 8000 mm (26 ft.)

Fastening devices

Self drilling
(flush and hanger rod type)

Self drilling - expansion

Standard drive pin
(Ramset fasterners)
Eye pin
(Ramset fasterners)

Flat head drive pin
(Ramset fasterners)

External threaded stud
(Ramset fasterners)

Utility head threaded stud
(Ramset fasterners)

Internal threaded stud
(Ramset fasterners)

Couplings
(Ramset fasterners)

Gemco anchor nail

Gemco anchor bolt

Gemco insulation hanger

Gemco pronged anchor

Gemco hanger support

ordinary wall anchors
Lagscrew shield
Plastic anchor
Nylon expansion anchor
Nylon drive anchor
Neoprene sleeve

TABLE 20 (Cont'd)

Ordering information

Imperial standard Wire Gauge is used for specifying nails In Canada

Nail sizes
Nails are specified as to length and gauge. Stelco's standard for wire nails is the Imperial Standard Wire Gauge conforming to CSA Standard B 111 'Wire Nails, Spikes and Staples'.

Nail ordering
Besides length and gauge, always specify type and finish when ordering Stelco nails. Head and point styles should be specified also for special and non-stock items. On the following pages a wide range of Stelco nail types, finishes, head and point styles is catalogued for your convenience. Examples: 2 inch x 12 gauge Ardox spiral common nails; 1 inch x 16 gauge blued lath nails.

Palletizing
Customers are requested, where possible, to order in full pallet quantities of a size and type. (See Table below.) Lesser quantities should be ordered in even fractions of the full pallet loads to assist palletizing and unloading in our warehouse, i.e. in multiples of 16 in the case of 50 lb cartons and in multiples of 10 all other packages.

Nail pallets
The following is the listing of standard pallet load quantities, according to size of carton or, in the case of packaged nails, of the master cartons. Pallets are expendable, non-returnable and come free of charge. Note: Part pallets are also available if required due to handling restrictions. Check with Stelco.

Bulk nails

Carton size	Weight Kg	Weight pounds	Per pallet	Total weight per pallet pounds	Kg
Carton #25	(11.25)	25	80	2000	(900)
Carton #50	(22.5)	50	64	3200	(1440)
Carton #50 — machine quality nails	"	50	48	2400	(1080)

Packaged nails

Package weight Kg	pounds	Packages per master carton	Weight Kg	pounds	Number of master cartons per pallet	Total weight per pallet pounds	Kg
(0.45)	1	50	(22.5)	50	40	2000	(900)
(2.25)	5	10	"	50	40	2000	"

19.0 CAULKING, WEATHERSTRIPPING, PAINT, CERAMIC TILES

19.1 Caulking

Caulking is required around windows, doors, seams, cracks and all joints requiring weatherproofing. This is an operation that can only be estimated accurately for the quantity required after all materials have been installed. The amount of caulking compound required greatly depends on various factors such as the tightness of the joints, the type of mouldings used, and other unforeseeable situations which can only be appreciated once the construction is completed. However, a fairly close estimate can be made by using the ratio of lineal meter (or foot) of joint to kg or imperial gallon of joint compound for given joint widths. Table 21 shows an example for a particular type of compound. Enquire with material suppliers for information on the various types and qualities of compound available. The life expectancy and coverage are usually indicated on the container.

19.2 Weatherstripping

Spring type, bronze or aluminum may be specified for the exterior doors. 9.6m (32 ft.) of bronze or aluminum, spring type weatherstripping material is required for the exterior doors. Modern windows are usually equipped with built-in weatherstripping material made of plastic, rubber or neoprene material. Proper insulation in the gap between the window frame and the rough framing may be the most important consideration for weatherproofing. If additional weatherstripping is required for the windows, it will probably have to wait until the windows are installed.

19.3 Painting

If contracted, the painting operation estimate may be prepared by the prospective contractor.

If you plan to do the work yourself, the following equipment and material will be required:

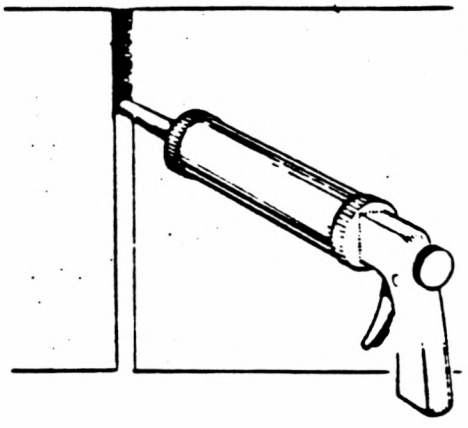
1. an extension ladder for the exterior,
2. one or two stepladder(s) for the interior,
3. plastic sheets to protect the floors,
4. paint brushes,
5. rollers and metal paint pan(s),
6. putty,
7. patching compound,
8. rolls of masking tape,
9. sanding paper,
10. paint as specified,

TABLE 21

EXAMPLE OF CAULKING COMPOUND
Characteristics and Coverage

CAULKING COMPOUND

Flintseal 510-21 is a superior utility caulking compound composed of asphalt, mineral fiber and fillers. Formulated to provide weather resistance, flexibility and ease of application. Dries to a tough, elastic, water resistant sealer. Complies with current revisions of CGSB-37-GP-5. Gun or tool consistency.



Used as a sealant and caulking for weatherproofing seams, joints, cracks, and general caulking requirements.

- Sash
- Flashings
- Soil Pipes
- Drains
- Down Spouts
- Eaves
- Stone Copings
- Parapet Walls
- Ventilators
- Skylights

- Surfaces must be sound, clean and dry, free from rust, loose paint, dust, dirt, grease, oil and frost.
- Flintseal 510-21 shall be pressed into the joint to obtain deep penetration.
- Crown sealant to ensure that water will not collect in the joint.

Apply by knife, trowel or gun.

- As a bedding compound @1/8" thick – 15 sq. ft. per gallon.
- Caulking compound – See Chart

Use Varsol, Shellsol, Turpolene or similar low hazard solvents for cleaning tools and equipment.

Ratio – Lineal Feet of Joint to Imp. Gallon of Material

JOINT	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
1/4	370	295	245	210	185	145	122	105	92
5/16		236	196	168	160	118	98	84	73
3/8			165	140	122	100	82	70	62
7/16				120	105	84	70	60	52
1/2					92	73	62	53	46
5/8						59	49	42	37
3/4							41	35	31
7/8								30	27
1									23

Up to 12 months in sealed containers.

CONTAINS FLAMMABLE SOLVENTS. DO NOT HEAT OVER FLAME AND NOT ABOVE 100°F. USE IN WELL VENTILATED AREAS. HARMFUL IF SWALLOWED.

11. paint thinner,
12. paint cleaner, and
13. cleaning rags

Refer to Table 22 for the various types of paint available and the recommended applications.

4.54 L (1 imp. gal.) will cover 46.5m^2 (500 $ft.^2$) of smooth surface wall or ceiling panelling and finish wood. Refer to the example of a list of quantities on the following page.

19.4 Ceramic Tile

Unglazed ceramic tiles are usually specified for the bathroom floor. Glazed ceramic tiles are specified for the bathroom walls (bath enclosure and dado).

The sizes are 50 x 50 x 3.2mm (2" x 2" x 1/8"). An example of the quantities are listed in Table 23 as well as the quantities of tile grout for both the floor and the walls.

The tools needed are

1. rounded-end plier-cutter,
2. a glass cutter, and
3. a sponge.

20.0 FLOOR COVERING (other than ceramic tiles)

20.1 Types of Flooring

With the exception of the bathroom floor, and sometimes kitchen and entrance halls, the main floor covering is either vinyl, vinyl-asbestos, rubber, linoleum or carpet. Sheet flooring material and tiles are available.

The floor area can be calculated as a whole using the house dimensions and deducting areas where the floor finish is ceramic tile, by taking each room separately and adding the areas of all rooms having a resilient type of floor covering. Remember that the floor covering is also required in the closets.

TABLE 22

PAINT

Choosing exterior paint

Tinted squares indicate best exterior coating. Latex dries quickly and is less likely to blister than an oil-base paint. Oil-base will adhere better during application, and it provides a seal that moisture cannot penetrate, but it is this that causes oil paint to blister if applied over damp wood or siding not protected on the inside by a vapor barrier.

● Dot indicates need for a prime coat over raw wood

	Exterior masonry paint — latex	House paint — latex	House paint — oil-base	Transparent sealer	Cement-base paint	Exterior clear finish	Aluminum paint — exterior	Wood stain	Roof coating	Roof cement	Asphalt emulsion	Trim paint	Awning paint	Spar varnish	Porch-and-deck enamel	Primer or undercoat	Metal primer	Latex types	Water-repellent preservatives
Wood siding			●															●	
Brick			●																
Concrete block	●		●																
Asbestos cement			●																
Stucco			●																
Natural wood siding and trim																			
Metal siding			●				●					●						●	
Wood-frame windows		●	●									●						●	
Steel windows		●	●				●					●						●	
Aluminum windows		●										●						●	
Shutters and other trim		●	●									●						●	
Canvas awnings																			
Wood-shingle roof																			
Metal roof		●	●															●	
Asphalt roofing paper																			
Wood porch floor																			
Concrete porch floor																			
Copper surfaces																			
Galvanized surfaces		●	●				●					●						●	
Iron surfaces		●	●				●					●						●	

TABLE 23

MATERIALS FOR PAINT AND CERAMIC TILE

	50 x 50 x 3.2 Ceramic Tile 2" x 2" x 1/8"				
	a) Bathroom Floors [Unglazed]	S.M. S.F.	2 20		
	b) Bathroom Walls [Glazed]	S.M. S.F.	14 145		
	Ceramic-Mosaic Grout				
	a) For Floor Tiles	kg lbs	2 4		
	b) For Wall Tiles	kg lbs	11 24		
	Adhesive				
	a) For Floor Tiles	L. Gal.	2.3 ½		
	b) For Wall Tiles	L.	13.6		
	300 x 300 x 2.3 Vinyl Asbestos Tile 12" x 12" x 0.87 Ga.	S.M. S.F.	59 635		
	Adhesive For V.A.T.	L. Gals.	23 5		
	Gypsum Plaster Joint Compound	kg lbs	97 214		
	Gypsum Plaster Joint Tape	L.M. L.F.	483 1,584		

TABLE 23 (Cont'd)

	Paint				
	Ext. Enamel 2 - Coats To Wood Trim	L. Gals.	23 5		
	Int. Enamel 2 - Coat To Wood Trim	L. Gal.s	19 4		
	Int. Latex 2 - Coat To Walls & Ceiling	L. Gals.	69 15		
	Int. Sealer 1 - Coat To Walls, Ceiling & Trim	L. Gals.	87 19		

20.2 Floor Tiles

Unless self-adhesive tiles are used, tile adhesive will be required. Installation information is printed on labels of adhesive containers. Floor covering adhesive is available in quart, gallon and 5 gallon container sizes (1.2 - 4.54 and 22.7 litres). Coverage is from 100 to 125 ft.^{2} per gallon, (9.3 to 11.6m^2 per 4 litres). A special notched trowel is used to spread the adhesive.

This concludes the quantity take-off and preparation of a preliminary list of materials for a house. The material quantity estimate that you will have developed will help you organize other housing projects by following the methods and procedures that provide a step by step record of every building activities and related materials.

END OF PART I

MATERIALS FOR HOUSE CONSTRUCTION

PART II

THE PREPARATION OF THE BILL OF MATERIALS

21.0 THE BILL OF MATERIALS

21.1 Summary of Part I

In part I, the subject of quantity take-off was covered.

It included

1. the methods and procedures used in taking the quantities from the blueprints,

2. the methods of measurement applicable to each type of material that usually forms part of house construction, and

3. the job conditions and the planning of a project in terms of general requirements.

The purpose of Part I was to present the various steps necessary to establish a preliminary list of quantities from a set of construction blueprints and specifications, following the usual building operations or activities.

This part deals with the preparation of a final Bill of Materials which can be used for estimating the costs of construction. It is done by transferring the information gathered onto a standard form used by estimators to prepare the Bill of Materials for the purpose of costing the job. Costing itself uses another method which consists of regrouping the materials under each trade or discipline.

21.2 Parts of a Bill of Materials

The Bill of Materials is a more detailed and organized version of the material listing developed from the quantity take-off. In other words, the final Bill of Materials is a document that is prepared in such a way that an estimator can readily identify all the materials pertaining to each particular trade involved in a building project. The estimator can also put a price tag against each group of elements or activities, including the labour involved, the equipment needed, the sub-contracted activities, the contingencies, overhead, etc. in order to arrive at the total cost of a construction project.

The first step in preparing a bill of materials is to list the Job Name and the Headings that will be used to identify and regroup all similar materials according to the various trades involved. There is, of course, more than one way of finalizing a list of materials for costing.

However, the trade method is preferred by most estimators because it provides each discipline with the full range of materials, labour and equipment needed, in a logical sequence. In other words, the Framing Carpenter (for example) does not have to look through every page. The page title will indicate that all that will be required by his trade is listed subsequently under the heading: "ROUGH CARPENTRY".

When completed, however, the Bill of Materials does not necessarily eliminate the preliminary listing developed from the quantity take-off. All your take-off lists and collection sheets should be kept in a folder for future reference. These work documents will be useful during construction and for organizing future projects.

21.3 Purpose of the Final Bill of Materials

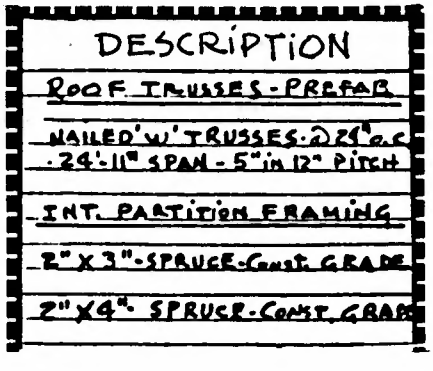
The final Bill of Materials will be used to estimate the costs, to purchase the materials, to organize the labour, to rent or buy the necessary equipment and to call for sub-contractors bids if need be. The Bill of Materials will also constitute a complete financial record of the job.

As can be appreciated, the whole exercise, starting with the quantity take-off, through the preparation of a preliminary list of materials, to the final Bill of Materials will allow you to be well prepared for the smooth execution of a house project.

21.4 Methods of Preparing a Bill of Materials

A - With your preliminary list of quantities at hand, first enter the complete material description in the far left hand column. Be specific in order to avoid misinterpretation. Show WHAT, and WHERE.

Example:



B - Next, proceed with the addition of the figures: Length, Width and Height or the number of units, followed by the total quantities.

The next two columns are for deductions and/or additions as applicable. For example, window openings may have to be deducted from the area of a wall. Also, a certain percentage for waste or breakage may have to be added. These percentages may vary with the size of job but the following are considered adequate for the construction of an ordinary house:

1.	wood framing member	-	10%
2.	plywood panelling	-	5%
3.	ceiling strapping	-	5%
4.	shiplap siding	-	10%
5.	masonry units	-	5%
6.	concrete	-	5%
7.	mortar	-	15%
8.	Batt insulation	-	5%
9.	gypsum plaster board	-	10%
10.	nails, screws, staples	-	10%

DESCRIPTION	PCS.	DIMENSION L	W	H	DDT. Quantity	ADD Quantity
ROOF TRUSSES - PREFAB						
NAILED W/ TRUSSES @ 24" o.c. - 24'-11" SPAN - 5" IN 12" PITCH	15					
INT. PARTITION FRAMING						
2" X 3" - SPRUCE - Const. GRADE	117	BFT				+10%
2" X 4" - SPRUCE - Const. GRADE	17	BFT.				+10%
PLYWOOD SHEATHING.						
5/8" - T & G - FOR FLOOR SHEATHING	23	BFT	4FT			+10%
1/2" - EXT. WALL SHEATHING	36	BFT	4FT			+10%
1/2" - T & G - FOR ROOF SHEATHING	31	BFT	4FT			+10%
ASPHALT/FELT PAPER - #15						
OVER EXT. WALL SHEATHING						
OVER ROOF SHEATHING						
LOOK-OUTS & EAVE NAILER	TOTAL					
2" X 4" - SPRUCE						
SOFFIT BOARD NAILER						
1" X 4" - SPRUCE STRAPPING						

C - Follows the net quantity column which is, of course, to enter the new total after deductions and/or additions. The net quantity is the actual quantity of a material after the necessary percentage for waste or breakage (or the fudge factor) has been added.

	PCS.	DIMENSION L	W	H	DDT. Quantity	ADD Quantity	NET Quantity	
ROOF TRUSSES - PREFAB.								
NAILED W/ TRUSSES @ 24" o.c. - 24'-11" SPAN - 5" in 12" PITCH	15						15	UNITS
INT. PARTITION FRAMING								
2" X 3" - SPRUCE - Const. GRADE	117	8Ft				+10%	129	UNITS
2" X 4" - SPRUCE - Const. GRADE	17	8Ft.				+10%	19	UNITS
PLYWOOD SHEATHING.								
5/8" - T & G - FOR FLOOR SHEATHING	23	8Ft	4Ft			+10%	26	UNITS
1/2" - EXT. WALL SHEATHING	36	8Ft	4Ft			+10%	40	UNITS
1/2" - T & G - FOR ROOF SHEATHING	31	8Ft	4Ft			+10%	35	UNITS
ASPHALT/FELT PAPER - #15								
OVER EXT. WALL SHEATHING							24	Rolls
OVER ROOF SHEATHING							3	Rolls
TOTAL							6	Rolls
LOOK-OUTS & EAVE NAILER								
2" X 4" - SPRUCE							400	L.Ft
SOFFIT BOARD NAILER								
1" X 4" - SPRUCE STRAPPING							320	L.Ft

D - Next comes the LABOUR requirements. First the Unit Cost or wages of each individual involved in putting in place the work described in the first column. Then, the total cost for all labour engaged in the work described is entered.

	PCS.	DIMENSION L	W	H	DDT. Quantity	ADD Quantity	NET Quantity		LABOUR unit cost	total cost
ROOF TRUSSES - PREFAB										
NAILED W/ TRUSSES @ 24" o.c. 24'-11" SPAN - 5" in 12" PITCH	15						15	UNITS		
INT. PARTITION FRAMING										
2" X 3" - SPRUCE - Const. GRADE	117	8 FT				+10%	129	UNITS		
2" X 4" - SPRUCE - Const. GRADE	17	8 FT.				+10%	19	UNITS		
PLYWOOD SHEATHING.										
5/8" - T & G - FOR FLOOR SHEATHING	23	8 FT	4 FT			+10%	26	UNITS		
1/2" - EXT. WALL SHEATHING	36	8 FT	4 FT			+10%	40	UNITS		
1/2" - T & G - FOR ROOF SHEATHING	31	8 FT	4 FT			+10%	35	UNITS		
ASPHALT/FELT PAPER - #15										
OVER EXT. WALL SHEATHING							24	Rolls		
OVER ROOF SHEATHING							3	Rolls		
TOTAL							6	Rolls		
LOOK-OUTS & EAVE NAILER							400	L.Ft		
2" X 4" - SPRUCE										
SOFFIT BOARD NAILER							320	L.Ft		
1" X 4" - SPRUCE STRAPPING										

E - Follows the MATERIAL column in which the unit cost will be shown first then the total cost for each type of material described in the first column.

	PCS.	DIMENSION L	W	H	DDT. Quantity	ADD Quantity	NET Quantity		LABOUR unit cost	LABOUR total cost	MATERIAL unit cost	MATERIAL total cost
ROOF TRUSSES - PREFAB												
NAILED W/ TRUSSES @ 24" o.c. 24'-11" SPAN - 5" in 12" PITCH	15						15	Units				
INT. PARTITION FRAMING												
2" X 3" - SPRUCE - Const. GRADE	117	8 Ft				+10%	129	Units				
2" X 4" - SPRUCE - Const. GRADE	17	8 Ft.				+10%	19	Units				
PLYWOOD SHEATHING												
5/8" T&G - FOR FLOOR SHEATHING	23	8 Ft	4 Ft			+10%	26	Units				
1/2" - EXT. WALL SHEATHING	36	8 Ft	4 Ft			+10%	40	Units				
1/2" T&G - FOR ROOF SHEATHING	31	8 Ft	4 Ft			+10%	35	Units				
ASPHALT/FELT PAPER - #15												
OVER EXT. WALL SHEATHING							24	Rolls				
OVER ROOF SHEATHING							3	Rolls				
TOTAL												
LOOK-OUTS & EAVE NAILER							6	Rolls				
2" X 4" - SPRUCE							900	L.Ft				
SOFFIT BOARD NAILER												
1" X 4" - SPRUCE STRAPPING							320	L.Ft				

F - The following sub-trade column is for the parts of the house construction process that will be sub-contracted. Again, enter the unit cost first. It could be for renting a piece of equipment (with or without an operator), perhaps by an hourly rate, per day or per other basic arrangement. Then, the total cost of the particular sub-contract for the described job will be entered. These figures are to be according to an accepted bid or whatever arrangement has been made.

At this point, the estimator will probably contact building material suppliers, contractors, builders and other sources of information before deciding on acceptable estimates of costs. The estimator will also inquire about transportation costs, delivery dates and obtain other pertinent information.

	PCS.	DIMENSION L	W	H	DDT. Quantity	ADD Quantity	NET Quantity		LABOUR unit cost	LABOUR total cost	MATERIAL unit cost	MATERIAL total cost	SUB TRADE unit cost	SUB TRADE total cost
ROOF TRUSSES - PREFAB														
NAILED W/ TRUSSES @ 24" o.c. - 24'-11" SPAN - 5" in 12" PITCH	15						15	UNITS						
INT. PARTITION FRAMING														
2" X 3" - SPRUCE - Const. GRADE	117	8 Ft				+10%	129	UNITS						
2" X 4" - SPRUCE - CONST. GRADE	17	8 Ft.				+10%	19	UNITS						
PLYWOOD SHEATHING:														
5/8" - T & G - FOR FLOOR SHEATHING	23	8 Ft	4 Ft			+10%	26	UNITS						
1/2" - EXT. WALL SHEATHING	36	8 Ft	4 Ft			+10%	40	UNITS						
1/2" - T & G - FOR ROOF SHEATHING	31	8 Ft	4 Ft			+10%	35	UNITS						
ASPHALT/FELT PAPER - #15														
OVER EXT. WALL SHEATHING							24	Rolls						
OVER ROOF SHEATHING							3	Rolls						
TOTAL LOOK-OUTS & EAVE NAILER							6	Rolls						
2" X 4" - SPRUCE							400	L.Ft						
SOFFIT BOARD NAILER														
1" X 4" - SPRUCE STRAPPING							370	L.Ft						

G - Finally, the total cost will be entered in the far right column. This will include Labour and Material, Transportation, etc. It will also include sub-trade costs if applicable.

CODE _____

DATE _____

JOB Rural House C2

TRADE Rough Carpentry

PAGE 5 of 15

	PCS.	DIMENSION L	W	H	DDT. Quantity	ADD Quantity	NET Quantity		LABOUR unit cost	LABOUR total cost	MATERIAL unit cost	MATERIAL total cost	SUB TRADE unit cost	SUB TRADE total cost	Total cost
ROOF TRUSSES - PREFAB															
NAILED W/ TRUSSES @ 24" o.c. 24'-11" SPAN - 5" IN 12" PITCH	15						15	UNITS							
INT. PARTITION FRAMING															
2" X 3" - SPRUCE - Const. GRADE	117	8Ft				+10%	129	UNITS							
2" X 4" - SPRUCE - Const. GRADE	17	8Ft.				+10%	19	UNITS							
PLYWOOD SHEATHING															
5/8" - T&G - FOR FLOOR SHEATHING	23	8Ft	4Ft			+10%	26	UNITS							
1/2" - EXT. WALL SHEATHING	36	8Ft	4Ft			+10%	40	UNITS							
1/2" - T&G - FOR ROOF SHEATHING	31	8Ft	4Ft			+10%	35	UNITS							
ASPHALT/FELT PAPER - #15															
OVER EXT. WALL SHEATHING															
OVER ROOF SHEATHING							24	Rolls							
LOOK-OUTS & EAVE NAILER TOTAL							3 6	Rolls Rolls							
2" X 4" - SPRUCE							400	L.Ft							
SOFFIT BOARD NAILER															
1" X 4" - SPRUCE STRAPPING							370	L.Ft							

21.5 Importance of a Complete and Accurate Bill of Materials

As can be appreciated, a good estimate will depend greatly on the accuracy and completeness of the quantity take-off. When establishing a list of quantities, keep in mind that you are providing the estimator with all the necessary data about the sizes and the quantities of materials as well as any information needed to obtain a realistic estimation of the total cost of a project.

22.0 SUMMARY OF COST ESTIMATING AND CONCLUSIONS

22.1 Cost Estimating

Cost estimating is a specialty requiring a good knowledge of many other aspects of project administration which cannot be covered in this publication. Other publications and courses are available on this specialized subject. Therefore, we will only review some of the main aspects of cost estimating to better understand the importance of an accurate and complete take-off listing and the Bill of Materials.

To arrive at a realistic estimation of the cost of house construction, certain factors and conditions that could affect the costs and the distribution of labour have to be taken into consideration.

There are factors of time and market conditions to consider, such as the availability and the delivery of the materials. Market fluctuations or the material cost variables have to be considered. Certain costs may have changed by the time you are ready to build.

The labour element is the most difficult to estimate because it implies a knowledge of the time required for the execution of the various activities as well as the factors that may affect the organization and the execution of a project.

22.2 Conclusion

What is achieved by establishing the material listing from the specifications and the blueprints is what will allow the estimator to proceed with the estimation of the costs of every element to arrive at the total cost of the project.

What is important to remember is that the Bill of Materials will not only allow you to be well prepared for the execution of a project but, when completed, will constitute a precise and complete record which will help you organize future projects.

When you build your own house, it is important to keep control of all the expenditures. To be able to say to others that the expenses incurred in the construction of your house, were less than expected because you have kept a precise record of all the expenses, is a claim that can only be made if you have gone through the proper preparation.

The ability to read blueprints and establish your own Bill of Materials will allow you to proceed with the execution of a house project with much less expenses, worries and delays because you will have a good understanding of the overall requirements as well as of each step of the process. Once you have gone through the exercise for one project, the planning, organizing and execution of future projects will be greatly facilitated.

23.0 REFERENCES

Canada Mortgage and Housing Corporation. 1985. Canadian Wood Frame House Construction. Ottawa. (NHA 5031M 05/85).

_____ 1986. Energy Efficient Housing Construction. Ottawa. (NHA 5488 03/86).

_____ 1987. A Glossary of House-Building and Site Development Terms. Ottawa. (NHA 1165 01/87).

Canadian Institute of Quantity Surveyors. 1985. Methods of Measurement of Construction Work. CIQS Publishers.

Canadian Wood Council. 1978. Metric Manual for Wood Products. (10M78-09).

Cannon, K.F. and Hatley, S.G. 1982. Building Construction Technology. McGraw-Hill Ryerson. Toronto.

Helyar, F.W. 1978. Construction Cost Estimating. McGraw Hill Ryerson. Toronto.

National Research Council of Canada. 1976. Manual on Metric Building Drawing Practice. Ottawa. (NRCC 15234).

_____ 1985. National Building Code of Canada, Part 9. Ottawa. (NRCC 23174).

Building in metric

CONVERSION TABLES "APPENDIX A"

When renovating or adding to a house, it is best to work within one system of measurement consistently. Because almost all houses in Canada are built to imperial standards, the drawings and specifications in *Home Improvements Manual* follow that system.

Nonetheless, metrication is becoming gradually accepted in Canada, and many building products are now sold with metric labels. In most instances, such products have only been "soft converted"—that is, their label (not their size) has changed. "Hard conversion," which will come into effect eventually, means that traditional imperial standards (such as for bricks and pipes) will be replaced by "rational" metric equivalents. These equivalents will be within a few millimetres of their imperial counterparts.

The charts below will help you convert measurements and guide you into "thinking metric" for the future.

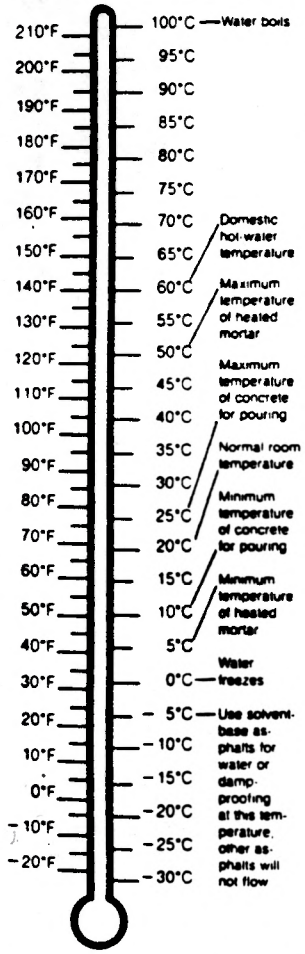
Metric to imperial conversion factors

To change	Into	Multiply by
Cubic metres (m^3)	Cubic feet	35.31
Cubic metres	Cubic yards	1.307
Degrees Celsius (°C)	Degrees Fahrenheit	(1.8 × °C) + 32
Kilograms (kg)	Pounds	2.20
Kilopascals (kPa)	Pounds per square inch	0.145
Litres (L)	Imperial quarts	0.88
Litres	Imperial gallons	0.21
Litres	U.S. quarts	1.06
Litres	U.S. gallons	0.264
Metres (m)	Feet	3.28
Metres	Yards	1.09
Millimetres (mm)	Inches	0.039
Square metres (m^2)	Square feet	10.76
Square metres	Square yards	1.195
Tonnes (t)	Tons	1.10

Imperial to metric conversion factors

To change	Into	Multiply by
Cubic feet	Cubic metres	0.028
Cubic yards	Cubic metres	0.76
Degrees Fahrenheit	Degrees Celsius	(°F − 32) × 0.555
Feet	Metres	0.30
Gallons (imperial)	Litres	4.54
Gallons (U.S.)	Litres	3.78
Inches	Millimetres	25.40
Pounds	Kilograms	0.45
Pounds per square inch	Kilopascals	6.88
Quarts (imperial)	Litres	1.14
Quarts (U.S.)	Litres	0.95
Square feet	Square metres	0.093
Square yards	Square metres	0.836
Tons	Tonnes	0.91
Yards	Metres	0.914

Fahrenheit/Celsius



Metric conversion—how it works

The metric system is founded on internationally accepted SI units (SI stands for *Système international d'unités*). It is a decimal system, which means that it is based on multiples of 10. This greatly simplifies multiplying, dividing, and converting from one metric unit of measure to another.

The basic unit of *length* is the metre (m). It is divided into 100 centimetres (cm) or 1,000 millimetres (mm); 1,000 metres make a kilometre (km). The unit of *volume* is the litre (L), which is defined as 1,000 cubic centimetres (cm^3). One cubic centimetre at maximum density weighs 1 gram (g), which is the basic metric unit of mass (weight).

The Celsius temperature scale defines 0°C as the freezing point of water, 100°C as the boiling point of water.

Decimal multiples and sub-multiples of SI units are expressed by simply adding prefixes to the unit names, as in kilometre or millilitre.

Multiplication factor	Prefix	Symbol	Meaning
1 000 000 = 10^6	mega	M	one million times
1 000 = 10^3	kilo	k	one thousand times
100 = 10^2	hecto	h*	one hundred times
10 = 10	deca	da*	ten times
0.1 = 10^{-1}	deci	d*	one tenth of
0.01 = 10^{-2}	centi	c*	one hundredth of
0.001 = 10^{-3}	milli	m	one thousandth of
0.000 001 = 10^{-6}	micro	μ	one millionth of

*Hecto, deca, deci, and centi are mostly used in science, rarely in everyday language, except for hectolitre and centimetre.

Metric costs

Price per square metre	Price per square yard	Price per cubic metre	Price per cubic yard	Price per litre	Price per quart	Price per litre	Price per gallon
$ 0.10	$ 0.08	$ 0.10	$ 0.08	$ 0.10	$ 0.11	$ 0.10	$ 0.46
0.20	0.17	0.20	0.15	0.20	0.23	0.20	0.91
0.30	0.25	0.30	0.23	0.30	0.34	0.30	1.36
0.40	0.33	0.40	0.31	0.40	0.46	0.40	1.82
0.50	0.42	0.50	0.38	0.50	0.57	0.50	2.27
0.60	0.50	0.60	0.46	0.60	0.68	0.60	2.73
0.70	0.59	0.70	0.54	0.70	0.80	0.70	3.18
0.80	0.67	0.80	0.61	0.80	0.91	0.80	3.64
0.90	0.75	0.90	0.69	0.90	1.02	0.90	4.09
1.00	0.84	1.00	0.77	1.00	1.14	1.00	4.55
1.10	0.92	1.10	0.84	1.10	1.25	1.10	5.00
1.20	1.00	1.20	0.92	1.20	1.36	1.20	5.46
1.30	1.09	1.30	0.99	1.30	1.48	1.30	5.91
1.40	1.17	1.40	1.07	1.40	1.59	1.40	6.37
1.50	1.25	1.50	1.15	1.50	1.71	1.50	6.82
1.60	1.34	1.60	1.22	1.60	1.82	1.60	7.27
1.70	1.42	1.70	1.30	1.70	1.93	1.70	7.73
1.80	1.51	1.80	1.38	1.80	2.05	1.80	8.18
1.90	1.59	1.90	1.45	1.90	2.16	1.90	8.64
2.00	1.68	2.00	1.54	2.00	2.28	2.00	9.10
5.00	4.20	5.00	3.85	5.00	5.70	5.00	22.75
10.00	8.40	10.00	7.70	10.00	11.40	10.00	45.50