# CONSTRUCTION ESTIMATING ESTIMATING CONCEPTS QUICK-CARDS®

*A Unique Quick-Reference Guide*

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## ESTIMATING PREPERATION & QUANTITY TAKEOFF

### PREPARING A PRELIMINARY ESTIMATE

There are two methods to determine a preliminary estimate:

**Method 1:** Apply unit prices to the number of functional units.
Estimate Cost = Unit Price x Number of Functional Units

**Method 2:** Apply unit prices to different functional areas.
Estimate Cost = Unit Price x Functional Area

### ESTIMATING NEW CONSTRUCTION JOBS

There are two types of new construction jobs, plans-specs jobs and design-build jobs.

- Plans-specs jobs are projects with complete drawings and specs available. Use the plans and specs to estimate the job.
- Design-build jobs are projects with almost no drawings or specs available. Communicate with everyone involved (owners, architects, engineers, subtrades, suppliers, bonding, insurance) to get a better, more clear idea of the project.

### ESTIMATING RENOVATION JOBS

Renovation jobs have more uncertain factors than jobs that are new construction. To estimate a renovation job, visit the site and examine the current condition of the building. Follow the question list below to better gage the cost of the renovation project:

- Are old drawings or specs for the building available?
- Which contractor built the existing structure?
- Where are the existing utilities located?
- Is there readily accessible access to the utilities?
- Is the building poorly or well maintained?
- Are there any hazardous materials present in the building (asbestos, lead etc.)?
- Are there any unusual job conditions (ex. high ceilings, flooded basement, crawl space, occupant use)?
- Is there enough room to move tools, equipment and material around?
- Are existing fixtures, piping and equipment being relocated or removed?
- Are cutting and patching of existing surfaces included in the contract?
- Are there any dust control or noise abatement requirements?
- Will temporary shoring be required?
- Are there working hour restrictions?

### MEASUREMENTS

| Linear Measurements | | |
|---|---|---|
| 12 inches | 1 foot | ft. |
| 3 feet | 1 yard | yd. |
| 5½" yards | 1 rod | rd. |
| 40 rods | 1 furlong | fur. |
| 8 furlongs | 1 mile | mi. |

| Square Measurements | | |
|---|---|---|
| 144 square inches | 1 square foot | sq. ft. |
| 9 square feet | 1 square yard | sq. yd. |
| 30¼ square yards | 1 acre | sq. rd. |
| 160 square rods | 1 acre | A. |
| 640 acres | 1 square mile | sq. mi. |

**Acres**

An acre equals 4,840 sq. yd. or 43,560 sq. ft. In the form of a square, an acre is 208.71 yards on a side.

| | | |
|---|---|---|
| 1,728 cubic inches (cu. in.) | 1 cubic foot | cu. ft. |
| 27 cubic feet | 1 cubic yard | cu. yd. |
| 128 cubic feet | 1 cord | cd. |
| 24¾ cubic feet | 1 perch | P. |

| Volume: Cubic Yards | | |
|---|---|---|
| 1 cu. yd. | 27 cu. ft. | 46,656 cu. in. |

With water at its maximum density, 1 cubic foot weighs 62.427 lbs. and 1 gallon of pure water weighs 8.345 lbs.

For approximation: 1 cu. ft. of water is considered equal to 7½" gallons and 1 gallon weighs 8-1/3 lbs.

The British Imperial Gallon (both liquid and dry) contains 2777.274 cu. in = 16046 cu. ft., and is equivalent to the volume of 10 lbs. of pure water at 650 F.

### MEASURING BUILDING GROSS FLOOR AREA

Use the following steps to measure the Gross Floor Area:

**Step 1:** Go around the building perimeter and measure areas from the exterior wall corners.
**Step 2:** Find out how many individual floors the job has (basement, main floor, upper floors etc.)
**Step 3:** Subdivide each floor into smaller segments that are easier to measure.
**Step 4:** Break down the areas into common shapes, such as rectangles, squares, triangles, circles and semicircles.
**Step 5:** Calculate the area of each shape separately and total them to the area for each floor.
**Step 6:** Add the areas of each floor to get the total building gross area.

### TERM ALERT!

**Takeoff:** taking the information off the documents and translating it into a list of items with quantities.

### QUANTITY TAKEOFF PROCEDURE – 3 STEPS

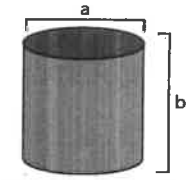
**Step 1:** Define takeoff scope.
- Study the plans and specs.
- Determine what needs to be taken off.

**Note:** If details are unclear in the plans and specs, ask the architect or owner for clarification.

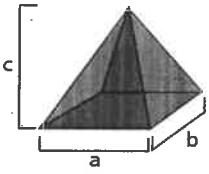
**Step 2:** Measure each item.
- Use the dimensions specified.
- Do not scale drawing, unless necessary.
- Mark the drawings for the items that were taken off as they are taken off.

**Step 3:** Record quantities.
- Make detailed reference as to which sheet the items were found in and where they exist in the building.
- Record the quantities with drawing number, detail number and grid reference.
- Keep different items separate.

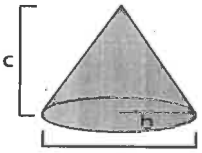
### VOLUMES




$V = 3.1416 \times a/2 \times a/2 \times b$
$= 0.7854 \times a^2 \times b$

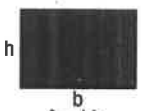



$V = 1/3 \times a \times b \times c$



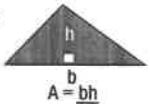

$V = 1.0472 \times b^2 \times c$
or $V = 0.3518 \times a^2 \times c$

### AREA FORMULAS

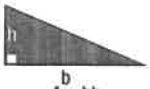



$A = bh$


$A = bh$

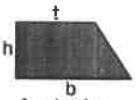



$A = \frac{bh}{2}$




$A = \frac{bh}{2}$


$A = s^2$




$A = \frac{t + b}{2} h$

$A = \pi r^2$ or $A = \frac{\pi d^2}{4}$

### INFO YOU MUST KNOW!

- Takeoffs are concerned solely with materials.
- Takeoffs don't include the cost of installation or placement of materials.

## ESTIMATING SITEWORK - DEMOLITION & EARTHWORK

### ESTIMATING DEMOLITION

The earthwork contractor can include site demolition in the quote, but they typically don't include interior selective demolition.

### ESTIMATING IN-PLACE, LOOSE & COMPACTED YARDS

To estimate earthwork, you will need to know the following 3 terms:

- **In-place yards:** the original volume of natural soils before disturbance; also called bank yards.
- **Loose yards:** the increased volume of loose soils after digging.
- **Compacted yards:** the decreased volume of soil after it is backfilled and compacted.

1.0 cubic yard (in-place yard)
= 1.2 cubic yard (loose yard)
= 0.85 compacted yard.

### ESTIMATING DEMOLITION CHECKLIST

Use the following checklist for demolition takeoff (with measurement units):

- ☐ Demolish existing building (sf or l/s)
- ☐ Remove trees (ea)
- ☐ Remove fence (lf)
- ☐ Saw cut (lf)
- ☐ Remove asphalt paving (sy or cy)
- ☐ Remove curb (lf or cy)
- ☐ Remove concrete slabs and sidewalks (sf)
- ☐ Demolish concrete foundation, column, beams and staircases (cy)
- ☐ Demolish floors, walls, ceilings and roofs with finishes (sf)
- ☐ Demolish structural steel columns, beams and joists (ea)
- ☐ Demolish doors, windows, millwork, specialty items (ea)
- ☐ Cutting and patching (l/s)
- ☐ Temporary fencing (lf)
- ☐ Temporary partitions (sf)
- ☐ Shoring and engineering (l/s)
- ☐ Hazardous material removal (l/s)
- ☐ Dumping (l/s, cy or tons)

### ESTIMATING EARTHWORK CHECKLIST

Use the following checklist for earthwork takeoff (with measurement units):

- ☐ Clear and grub (acres)
- ☐ Dewatering (l/s)
- ☐ Topsoil removal (cy)
- ☐ Excavation (cy)
- ☐ Rough grading (sy)
- ☐ Shoring or underpinning (l/s)
- ☐ Backfill (cy)
- ☐ Import fill (cy)
- ☐ Place and compact (cy)
- ☐ Soil stabilization (l/s)
- ☐ Building foundation excavation (cy)
- ☐ Mechanical and electrical excavation (cy)
- ☐ Building slab prep (cy)
- ☐ Haul away and disposal (cy)
- ☐ Soil testing (l/s)
- ☐ Jacking, boring and piling (lf)
- ☐ Support and protection (l/s)
- ☐ Silt fence or turbidity barrier (lf)

### COMMON UNIT ABBREVIATIONS

| Abbreviation | Meaning |
|---|---|
| bf | board feet |
| cf | cubic foot |
| cy | cubic yard |
| ea | each |
| ft | feet |
| lb | pound |
| lf | linear foot |
| l/s | lump sum |
| sf | square foot |
| sfca | square foot of contact area |
| sy | square yard |
| sq | square |

Unit abbreviation save time and help to clarify the meaning of takeoff quantities

# ESTIMATING SITEWORK – EARTHWORK (CONTINUED)

## CALCULATING SWELL

Swell is the soil volume increase resulting from excavation.

**Swell (%)** = (Loose Yards/In-place Yards – 1) x 100

**Load Factor** = In-place Yards/Loose Yards

## CALCULATING SHRINKAGE

Shrinkage is the soil volume decrease from fill compaction.

**Shrinkage (%)** = (1 – Compacted Yards/In-place Yards) x 100

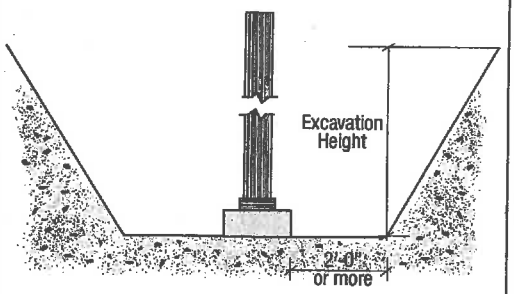
**Shrinkage Factor** = 1 – Shrinkage

## ESTIMATING STRIP FOOTING EXCAVATION

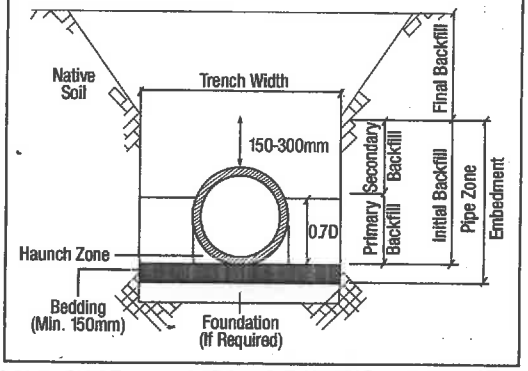
To account for workspace and the sloped excavation volume:

**Excavation Volume (net)** = (Footing Width + 2 x Workspace Width) x Excavation Height x Footing Length + Excavation Height x Excavation Slope x Excavation Height x Footing Length

## STRIP FOOTING EXCAVATION




## MECHANICAL/ELECTRICAL EXCAVATION




## ESTIMATING BULK EARTHWORK – GRID METHOD

**Step 1:** Visually study the site drawing to determine if it is a cut or fill.

**Step 2:** Pick the grid sizes and draw them on the plan.

**Step 3:** Use old and new contour lines to determine existing and proposed elevations at each corner of each grid.

**Step 4:** Calculate the volumes of cut or fill required for each grid.

**Step 5:** Add the grids together for total cut and fill volumes

**Note:** The result can be an import fill or export haul away.

## ESTIMATING BULK EARTHWORK – END AREA METHOD

Primarily used in long and narrow tract sites such as roadwork.

**Step 1:** Break down the site into stations at regular intervals.

**Step 2:** Take cross sections at each station. Draw a profile based on the elevation change.

**Step 3:** Calculate the cut and fill area for each cross section.

**Step 4:** Obtain the volume of earthwork between sections by taking the average of the end areas at each station (in square feet) multiplied by the distance between sections (in feet). Convert the result to cubic yards.

## ESTIMATING FOUNDATION BACKFILL

**For Strip Footing with Foundation Wall:**
Backfill Volume (net) = Excavation Volume – Footing Concrete - Wall Concrete

**For Isolated Pad Footing:**
Backfill Volume (net) = Excavation Volume – Pad Concrete

## ESTIMATING BASEMENT EXCAVATION

**Excavation Volume (net)** = (Building Area + Building Perimeter x Excavation Slope x Excavation Depth) x Excavation Depth

**Backfill Volume (net)** = Excavation Volume – Building Area x Excavation Depth

## ESTIMATING PAD FOOTING EXCAVATION

**If excavation is shallow and no slope is required, use the following:**
Excavation Volume (net) = (Pad Width + 2 x Workspace) x (Pad Length + 2 x Workspace) x Excavation Height

**If excavation is deep, then you need to account for both space and slopes:**
Excavation Volume (net) = (Pad Width + 2 x Workspace + Excavation Height x Excavation Slope) x (Pad Length + 2 x Work space + Excavation Height x Excavation Slope) x Excavation Height.

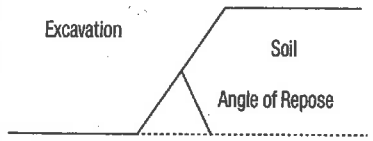
## ESTIMATING MECHANICAL/ELECTRICAL EXCAVATION

Underground mechanical pipes and electrical conduits require excavation of the earth, burial of the pipes/conduits and sand backfill.

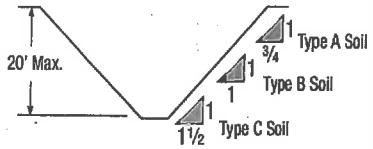
## CALCULATING EXCAVATION SLOPE

Excavation slopes are calculated by dividing horizontal distances by vertical distances.

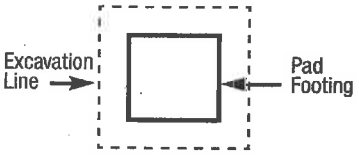
## EXCAVATION SLOPE




## SIMPLE SLOPE EXCAVATIONS




## PAD FOOTING EXCAVATION




## INFO YOU MUST KNOW!

Specialized computer software programs are typically used to calculate and draw 3-D graphs of the work to be done in the field, however it can be done manually too.

To manually calculate the volumes use either the grid method or the end area method.

## ALLOWABLE EXCAVATION SLOPES – OSHA

(For Max. Excavation Depth of 12 ft.)

| Soil Type | Height/Depth Ratio(H:V) | Slope Angle |
|---|---|---|
| Stable Rock | Vertical | 90° |
| Type A | ¾:1 | 53° |
| Type B | 1:1 | 45° |
| Type C | 1½:1 | 34° |
| Type A (short-term) | ½:1 | 63° |

# ESTIMATING SITE UTILITIES, PAVING, LANDSCAPE & IRRIGATION

## ESTIMATING SITE UTILITIES CHECKLIST

Use the following checklist for site utilities takeoff (with measurement units):

- ☐ Mobilization and demobilization (l/s)
- ☐ Surveying and as-builts (l/s)

**Storm Drainage**
- ☐ Excavation and backfill (cy)
- ☐ Manhole demolition (ea)
- ☐ Pipe demolition (lf)
- ☐ Manholes (ea)
- ☐ Catch basins (ea)
- ☐ Culverts (lf)
- ☐ Pipes (lf)
- ☐ Tie-ins (ea)
- ☐ Roof drain connection (ea)
- ☐ Foundation drain connection (ea)
- ☐ Sump pumps (ea)

**Sanitary Sewer**
- ☐ Excavation and backfill (cy)
- ☐ Open cut and repair (sy)
- ☐ Manholes (ea)
- ☐ Clean outs (ea)
- ☐ Pipes (lf)

**Sanitary Sewer (Cont.)**
- ☐ Septic tanks (ea)
- ☐ Grease traps (ea)
- ☐ Lift stations (ea)

**Water**
- ☐ Excavation and backfill (cy)
- ☐ Open cut and repair (sy)
- ☐ Pipes (lf)
- ☐ Fittings (ea)
- ☐ Backflow preventer (ea)
- ☐ Testing and balance (l/s)

**Fire Underground**
- ☐ Excavation and backfill (cy)
- ☐ Open cut and repair (sy)
- ☐ Pipes (lf)
- ☐ Fittings (ea)
- ☐ Fire Department Connection (FDC) (ea)
- ☐ Fire Hydrants (ea)

## ESTIMATING PAVING CHECKLIST

Use the following checklist for paving takeoff (with measurement units):

- ☐ Asphalt paving - including subbase, gravel and asphalt (sy)
- ☐ Curbs – including each type and curb base prep (lf)
- ☐ Parking bumpers (ea)
- ☐ Concrete driveway apron, handicap ramp or sidewalk (sf)
- ☐ Site signage – for traffic and parking control (ea)
- ☐ Line painting (ea or lf)

## ESTIMATING LANDSCAPING & IRRIGATION CHECKLIST

Use the following checklist for landscaping and irrigation takeoff (with measurement units):

**Soft Landscaping**
- ☐ Trees (ea)
- ☐ Shrubs (ea)
- ☐ Sod (sf)
- ☐ Seed (sf)
- ☐ Mulch (sf)
- ☐ Top soil (cy)
- ☐ Fertilizing (sf)
- ☐ Edgings (lf)
- ☐ Maintenance and warranty (l/s)

**Irrigation**
- ☐ Sleeves (lf)
- ☐ Pipes (lf)
- ☐ Fittings (ea)
- ☐ Sprinkler heads (ea)
- ☐ Planter drain (lf)

## COMMON UNIT ABBREVIATIONS

| Abbreviation | Meaning |
|---|---|
| bf | board feet |
| cf | cubic foot |
| cy | cubic yard |
| ea | each |
| ft | feet |
| lb | pound |
| lf | linear foot |
| l/s | lump sum |
| sf | square foot |
| sfca | square foot of contact area |
| sy | square yard |
| sq | square |

Unit abbreviation save time and help to clarify the meaning of takeoff quantities

# ESTIMATING CONCRETE

## ESTIMATING CONCRETE CHECKLIST

Use the following checklist for concrete takeoff (with measurement units):

- ☐ Formwork (sfca)
- ☐ Concrete (cy)
- ☐ Reinforcing (lb or ton)
- ☐ Curing and finishing (sf)
- ☐ Miscellaneous items

## ESTIMATING FORMWORK

Formwork is usually taken off by square feet of contact area (SFCA).

Miscellaneous formwork items

- ☐ Formwork hardware
- ☐ Keyway and inserts
- ☐ Form clamps and bracing
- ☐ Scaffolding and shoring
- ☐ Expansion joints
- ☐ Construction joints and bulkheads
- ☐ Form removal and cleaning
- ☐ Chamfer strip

**ESTIMATING FORMWORK IN BOARD FEET MEASURING UNITS**

| FORMWORK | FACTOR |
|---|---|
| Strip footing | 2.0 bf/sfca |
| Pad footing | 2.5 bf/sfca |
| Columns | 3.0 bf/sfca |
| Foundation wall | 2.5 bf/sfca |
| Wall over 12' high | 3.5 bf/sfca |
| Stair on grade | 2.5 bf/sfca |
| Stairs suspended | 6.0 bf/sfca |

**REINFORCING STEEL WEIGHT**

| BAR SIZE | WEIGHT (lb/ft) |
|---|---|
| #2 | 0.167 |
| #3 | 0.376 |
| #4 | 0.668 |
| #5 | 1.043 |
| #6 | 1.502 |
| #7 | 2.044 |
| #8 | 2.670 |
| #9 | 3.400 |
| #10 | 4.303 |

## ESTIMATING CONCRETE WALL

The wall takeoff starts with measuring wall lengths and heights figure out a wall area.

Use the following checklist for concrete walls takeoff (with measurement units):

- ☐ Formwork (sfca)
- ☐ Concrete (cy)
- ☐ Rebar (lb or ton)
- ☐ Rigid insulation (sf)
- ☐ Damp proofing (sf)
- ☐ Waterstop and keyway (lf)
- ☐ Control joint and chamfer strip (lf)
- ☐ Patching, rubbing and finishing, if exposed (sf)
- ☐ Excavation, backfill and compact (cy)

## ESTIMATING WALL FORMWORK FORMULA

**Formwork** = (Wall Length + Wall Thickness) x 2 x Wall Height

## ESTIMATING WALL CONCRETE FORMULA

**Concrete** = Wall Length x Wall Thickness x Wall Height

## ESTIMATING CONCRETE PAD FOOTINGS

Use the following checklist for concrete pad footings takeoff (with measurement units):

- ☐ Pad layout (l/s)
- ☐ Excavation (cy)
- ☐ Fine grading (sf)
- ☐ Formwork (sfca)
- ☐ Concrete (cy)
- ☐ Rebar (lb or ton)
- ☐ Embeds (ea)
- ☐ Backfill (cy)

## ESTIMATING CONCRETE PAD FORMWORK FORMULA

**Formwork** = Number of Pads x (Pad Length + Pad Width) x 2 x Pad Depth

## ESTIMATING CONCRETE PAD CONCRETE FORMULA

**Concrete** = Number of Pads x Pad Length x Pad Width x Pad Depth

## ESTIMATING CONCRETE SLABS

The takeoff of concrete slabs starts with measuring slab areas.

Use the following checklist for concrete slabs takeoff (with measurement units):

- ☐ Granular base (sf or cy)
- ☐ Fine grading (sf)
- ☐ Formwork (sfca)
- ☐ Concrete (cy)
- ☐ Rebar (lb or ton) or mesh (sf or rolls)
- ☐ Poly vapor barrier (sf)
- ☐ Saw-cut control joint (lf)
- ☐ Curing and sealing (sf, gallon or pail)
- ☐ Hardener (sf, gallon or pail)
- ☐ Rigid insulation (sf or rolls)
- ☐ Finishing - trowel, broom (sf)
- ☐ Scaffolding and shoring for suspended slab formwork (l/s)

## ESTIMATING RECTANGLE SLAB ON GRADE FORMWORK

**Edge Formwork**= (Slab Length + Slab Width) x 2 x Slab Thickness

## ESTIMATING RECTANGLE SLAB ON GRADE CONCRETE

**Concrete** = Slab Length x Slab Width x Slab Thickness

## ESTIMATING CONCRETE REINFORCEMENT

Rebar is taken off by the linear foot and the number of pieces.

## ESTIMATING REBAR WEIGHT FORMULA - COMMERCIAL

**Bar Weight (lb)** = Number of bars (ea) x Bar Length (ft) x Unit Weight (lb/ft)

## ESTIMATING CONCRETE TIE BEAMS FORMULAS

**Side Formwork** = Beam Height x Beam Length x 2

**Bottom Formwork** = Beam Width x Beam Length

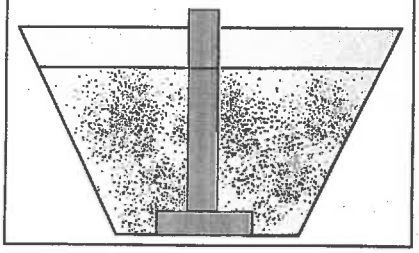
**Concrete** = Beam Height x Beam Width x Beam Length

## INFO YOU MUST

Concrete tie beams are more common in commercial and institutional projects.

To estimate concrete beams, look at the concrete beam formulas in this section.

## ESTIMATING CONCRETE STRIP FOOTING



## ESTIMATING CONCRETE STRIP FOOTING

The takeoff of strip footings starts with measuring their lengths.

Use the following checklist for concrete strip footing takeoff (with measurement units):

- ☐ Footing layout (l/s)
- ☐ Excavation (cy)
- ☐ Fine grading (sf)
- ☐ Formwork (sfca)
- ☐ Concrete (cy)
- ☐ Rebar (lb or ton)
- ☐ Embeds (ea)
- ☐ Backfill (cy)

## ESTIMATING STRIP FOOTING FORMWORK FORMULA

**Formwork** = (Footing Length + Footing Width) x Footing Height x 2

## ESTIMATING STRIP FOOTING CONCRETE FORMULA

**Concrete**= Footing Length x Footing Width x Footing Height

## ESTIMATING CONCRETE COLUMNS

- Concrete columns are vertical supporting structural members.
- They can be found in both residential, commercial and institutional projects to support parking facilities, exterior canopies and main roof decks.
- The takeoff starts with counting the number of columns according to their dimensions.

## ESTIMATING RECTANGLE COLUMN FORMULA

**Formwork** = Count of Columns x (Section Length + Section Width) x 2 x Column Height

**Concrete** = Count of Columns x Section Length x Section Width x Column Height

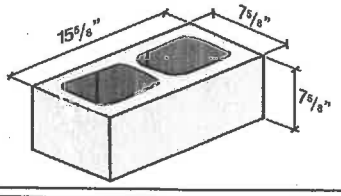
# ESTIMATING MASONRY

## ESTIMATING MASONRY CHECKLIST

Use the following checklist for masonry takeoff (with measurement units):

- ☐ Blocks (ea)
- ☐ Bricks (ea)
- ☐ Stone veneer (sf)
- ☐ Rebar (lb or ton)
- ☐ Cell fill concrete (cy)
- ☐ Mortar (bags)
- ☐ Sand (cy or ton)
- ☐ Scaffolding (sf)
- ☐ Wall bracing (sf or l/s)
- ☐ Control joint filler (lf)
- ☐ Joint reinforcement (lf)
- ☐ Flashing (lf)
- ☐ Wall tie (ea)
- ☐ Anchors (ea)
- ☐ Weep hole (ea)
- ☐ Bearing angles, channels or plates (ea or lf)
- ☐ Foam or rigid insulation (sf or bags)
- ☐ Firestopping (sf)
- ☐ Installing door frames (ea)
- ☐ Precast lintels and sills (lf or ea)
- ☐ Wall cleaning (sf)

## MASONRY BLOCK




## INFO YOU MUST KNOW!

When estimating masonry, remember that everything will be based on the quantity of blocks and bricks.

Use the tables in this section to determine the amount of blocks and/or bricks you'll need.

**BLOCKS & BRICKS**

| ITEM | QUANTITIES (Net) |
|---|---|
| Standard Block | 1.125 blocks per sf of wall area |
| Half Block | 2.25 blocks per sf of wall area |
| Face Brick Modular | 7.0 bricks per sf of wall area |
| Oversized Brick | 6.0 bricks per sf of wall area |
| Utility Brick | 3.0 bricks per sf of wall area |

**MORTAR**

| ITEM | QUANTITIES (Net) |
|---|---|
| Block | 3 bags per 100 block |
| Face Brick Modular | 7 bags per 1,000 brick |
| Oversized Brick | 8 bags per 1,000 brick |
| Utility Brick | 10 bags per 1,000 brick |

**SAND**

| ITEM | QUANTITIES (Net) |
|---|---|
| Sand | 1 cy per 7 bags mortar |

**CELL FILL CONCRETE (GROUT)**

| ITEM | QUANTITIES (Net) |
|---|---|
| 6 x 8 x 16 | 0.17 cf/block |
| 8 x 8 x 16 | 0.25 cf/block |
| 10 x 8 x 16 | 0.33 cf/block |
| 12 x 8 x 16 | 0.39 cf/block |
| 6 x 8 x 16 Bond Beam | 0.173 cf per lf |
| 8 x 8 x 16 Bond Beam | 0.22 cf per lf |
| 8 x 8 x 16 Deep Bond Beam | 0.46 cf per lf |
| 12 x 8 x 16 Bond Beam | 0.37 cf per lf |
| 12 x 8 x 16 Deep Bond Beam | 0.74 cf per lf |

# ESTIMATING ROUGH CARPENTRY & WOOD FRAMING

## LUMBER CONVERSION FACTORS

| NOMINAL SIZE (in x in) | ACTUAL SIZE (in x in) | BOARD FEET (bf) PER LINEAR FOOT (lf) OF LUMBER |
|---|---|---|
| 1 x 2 | ¾ x 1½ | 0.17 |
| 1 x 3 | ¾ x 2½ | 0.25 |
| 1 x 4 | ¾ x 3½ | 0.33 |
| 1 x 6 | ¾ x 5½ | 0.50 |
| 1 x 8 | ¾ x 7¼ | 0.67 |
| 1 x 10 | ¾ x 9¼ | 0.83 |
| 1 x 12 | ¾ x 11¼ | 1.00 |
| 2 x 2 | 1½ x 1½ | 0.33 |
| 2 x 3 | 1½ x 2½ | 0.50 |
| 2 x 4 | 1½ x 3½ | 0.67 |
| 2 x 6 | 1½ x 5½ | 1.00 |
| 2 x 8 | 1½ x 7¼ | 1.33 |
| 2 x 10 | 1½ x 9¼ | 1.67 |
| 2 x 12 | 1½ x 11¼ | 2.00 |
| 2 x 14 | 1½ x 13¼ | 2.33 |
| 4 x 4 | 3½ x 3½ | 1.33 |
| 6 x 6 | 5½ x 5½ | 3.00 |
| 8 x 8 | 7½ x 7½ | 5.33 |

## ESTIMATING DIMENSIONAL LUMBER

- Lumbers are measured by their length (lf) and converted to board feet (bf).
- Separate lumbers by different grades.
- For takeoff, make detailed notes for each item.

**Board Foot** = Lumber Pieces x Section Thickness x Section Width/12 x Length

## ESTIMATING PLYWOOD SHEETS

- Plywood is used as sheathing on floor, wall and roof.
- Plywood is measured by the area to be covered (sf) and converted to sheets (ea).
- Most common sheet size: 4' x 8'
- Note the plywood grades (CDX, OSB, fire rated) and thickness (½", 5/8", ¾") for pricing.

**Plywood Sheets** = Coverage Area/32

## ESTIMATING WALL STUDS FORMULA

**For wall stud spacing 12" or less**
Number of Wall Studs = Wall Length/Stud Spacing + 1

**For wall stud spacing greater than 12"**
Number of Wall Studs = Wall Length (ft) (one stud per one ft of wall)

Total Board Feet = Number of Wall Studs x Wall Height x Board Foot Conversion Factor

## ESTIMATING ROOF RAFTERS

- Roof slope is the ratio of rise over run
- Roof pitch is half of roof slope.

**Note:** When measuring run or rise, remember to include the eaves and overhand distance

**Roof Rafter Formulas**

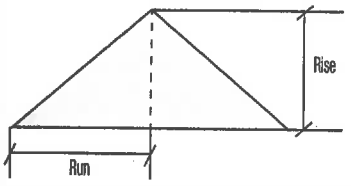
**Slope** = Rise/Run **Pitch** = Rise/Span **Span** = 2 x Run

**Total Run** = Run Distance + Eavehang Distance

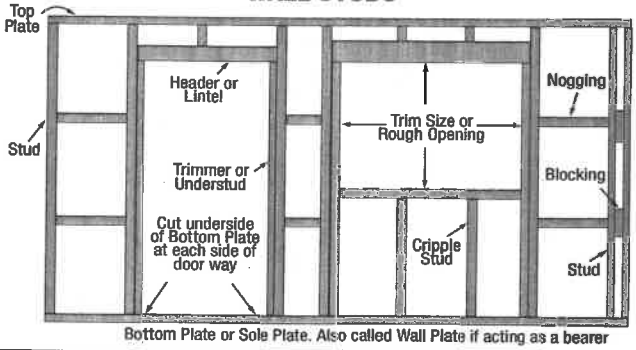
**Common Rafter Length** = Total Run x Multiplication Factor 1

**Hip/ Valley Rafter Length** = Total Run x Multiplication Factor 2

## ROOF SLOPE




## WALL STUDS




Bottom Plate or Sole Plate. Also called Wall Plate if acting as a bearer

## WALL FRAMING

| STUD SIZE | SPACING | BOARD FOOT (bf) PER SQUARE FOOT (sf) OF WALL |
|---|---|---|
| 2 x 4 | 12" | 1.27 |
| 2 x 4 | 16" | 1.17 |
| 2 x 4 | 20" | 1.10 |
| 2 x 4 | 24" | 1.07 |
| 2 x 4 | staggered | 1.69 |
| 2 x 6 | 16" | 1.51 |
| 2 x 6 | 20" | 1.44 |
| 2 x 6 | 24" | 1.38 |

## FLOOR/CEILING FRAMING

| STUD SIZE | SPACING | BOARD FOOT (bf) PER SQUARE FOOT (sf) OF WALL |
|---|---|---|
| 2 x 6 | 12" | 1.28 |
| 2 x 6 | 16" | 1.02 |
| 2 x 6 | 24" | 0.78 |
| 2 x 8 | 12" | 1.71 |
| 2 x 8 | 16" | 1.36 |
| 2 x 8 | 24" | 1.03 |
| 2 x 10 | 12" | 2.14 |
| 2 x 10 | 16" | 1.71 |
| 2 x 10 | 24" | 1.30 |
| 2 x 12 | 12" | 2.56 |
| 2 x 12 | 16" | 2.05 |
| 2 x 12 | 24" | 1.56 |

## ROOF RAFTERS - MULTIPLICATION FACTORS

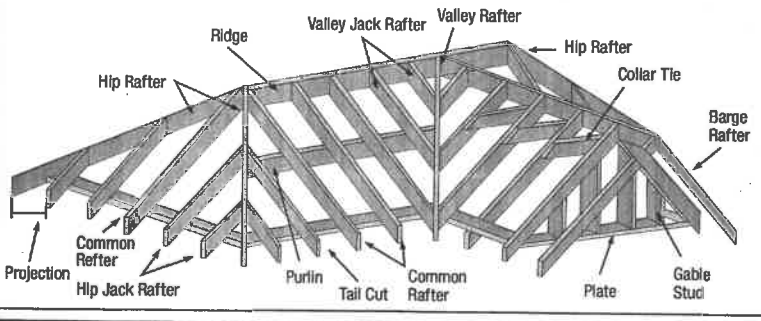
| ROOF PITCH | ROOF SLOPE | MULTIPLY LENGTH BY RUN BY: FOR COMMON RAFTER | MULTIPLY LENGTH BY RUN BY: FOR HIP/VALLEY RAFTER |
|---|---|---|---|
| 1/12 | 2 in 12 | 1.014 | 1.424 |
| 1/8 | 3 in 12 | 1.031 | 1.436 |
| 1/6 | 4 in 12 | 1.054 | 1.453 |
| 5/24 | 5 in 12 | 1.083 | 1.474 |
| 1/4 | 6 in 12 | 1.118 | 1.500 |
| 7/24 | 7 in 12 | 1.158 | 1.530 |
| 1/3 | 8 in 12 | 1.202 | 1.564 |
| 3/8 | 9 in 12 | 1.250 | 1.601 |
| 5/12 | 10 in 12 | 1.302 | 1.642 |
| 11/24 | 11 in 12 | 1.357 | 1.685 |
| 1/2 | 12 in 12 | 1.413 | 1.732 |
| 13/24 | 13 in 12 | 1.474 | 1.782 |
| 7/12 | 14 in 12 | 1.537 | 1.833 |
| 5/8 | 15 in 12 | 1.601 | 1.887 |
| 2/3 | 16 in 12 | 1.667 | 1.944 |
| 17/24 | 17 in 12 | 1.734 | 2.002 |
| 3/4 | 18 in 12 | 1.803 | 2.032 |
| 19/24 | 19 in 12 | 1.875 | 2.123 |
| 5/6 | 20 in 12 | 1.948 | 2.186 |
| 7/8 | 21 in 12 | 2.010 | 2.250 |
| 11/12 | 22 in 12 | 2.083 | 2.315 |
| 23/24 | 23 in 12 | 2.167 | 2.382 |
| Full | 24 in 12 | 2.240 | 2.450 |

## ESTIMATING ROOFING & SIDING CHECKLIST

Use the following checklist for roofing and siding takeoff (with measurement units):

- ☐ Flat roof (sf converted to sq)
- ☐ Sloped roof (sf converted to sq)
- ☐ Felts, sheathing paper and underlayment (sf)
- ☐ Roof insulation (sf)
- ☐ Vapor barrier (sf)
- ☐ Down sprouts and gutters (lf)
- ☐ Scuppers and roof drains (lf)
- ☐ Flashing, expansion joints and gravel stops (lf)
- ☐ Louvres and vents (lf or ea)
- ☐ Roof pavers (sf)
- ☐ Coping (lf)
- ☐ Ridge strips (lf)
- ☐ Fascias (lf)
- ☐ Reglets (lf)
- ☐ Sidings - including vinyl, wood and metal sidings (sf)
- ☐ Metal or vinyl soffits (sf)
- ☐ Parapet rain-lock panels (sf)
- ☐ Skylights (ea)
- ☐ Roof hatch with posts (ea)

## ROOF RAFTERS




## ESTIMATING FINISH CARPENTRY CHECKLIST

Use the following checklist for carpentry takeoff (with measurement units):

- ☐ Residential casework such as kitchen and bathroom cabinets (lf or ea)
- ☐ Solid surface countertops such as stone or granite (sf)
- ☐ Custom millwork including cabinets, shelving, stairs, railings (lf or ea)
- ☐ Wood trims (lf)
  - ☐ Exterior wood trims (lf)
  - ☐ Interior wood baseboards (lf)
  - ☐ Cornice trims (lf)
  - ☐ Crown molding (lf)
  - ☐ Window sills (lf)
  - ☐ Door and wall opening casings (lf)
- ☐ Corridor wood handrail (lf)
- ☐ Exterior vinyl soffit (sf)
- ☐ FRP panels (sf)
- ☐ Wood wall paneling or wainscot (sf)
- ☐ Labor-only package
  - ☐ Installation of doors, frames and hardware (ea)
  - ☐ Installation of vinyl windows (ea)
  - ☐ Installation of washroom accessories (ea)
  - ☐ Installation of mill work and FFE (ea)

# ESTIMATING STRUCTURAL STEEL

Use the following checklist for structural steel (with measurement units):

- ☐ Open web steel joists (lf converted to tons)
- ☐ Metal roof and floor decking (sf converted to tons)
- ☐ Structural steel shapes (lf or ea converted to lb, then tons)
- ☐ Anchor bolts and base plates (ea)
- ☐ Waste and connection (l/s)
- ☐ Metal canopy (ea or sf)
- ☐ Metal stairs (ea)
- ☐ Roof or elevator pit access ladder (ea)
- ☐ Elevator hoist or divider beams (ea)
- ☐ Metal gates and frames (ea)
- ☐ Embedded framing angle or plates (lf)
- ☐ Protective covers (ea)
- ☐ Support framing for hot water tanks, heaters, etc. (ea or lf)
- ☐ Handrail and guardrail at stairs, walls and balconies (ea or lf)
- ☐ Paint or prime (l/s, sf or lf)

# PRICING

## GENERAL GUIDELINES

**Step 1:** Finish takeoff first. Summarize the material quantities.
**Step 2:** Combine quantities for the same items and allow for reasonable waste.
**Step 3:** Transfer only to the total quantities to your pricing sheets.
**Step 4:** Pricing materials based on the quotes you received from the suppliers
**Step 5:** Pricing labor based on the adjusted productivity (man-hour) information.
**Step 6:** Add quotes from subcontractors or suppliers if necessary.
**Step 7:** Add indirect costs (ex. overhead, bond, insurance, permits).
**Step 8:** Allow costs for items that are not shown on drawings but required.
**Step 9:** Add owner's cash allowance for this portion of work.
**Step 10:** Allow contingencies due to problems in design and field construction.
**Step 11:** Add profits to get a total price.

## ESTIMATING LABOR COSTS – 5 STEPS

**Step 1:** Determine Worker-Hours per Unit.
Worker-hour per unit is how long it takes one person to do one unit of work.
**Step 2:** Estimate Total Worker-Hours.
Adjust historical worker-hours for the job at hand. Consider factors that can affect productivity, such as job size, overtime, crew, delays, weather, etc.
**Step 3:** Figure Labor Burden Rate.
Labor burdens are all the extras involved, such as fringe benefits in addition to the basic wage.
**Step 4:** Calculate Crew Rate.
First, for each member of the crew, take the basic wage and add labor burden to determine labor hourly rate. The crew rate will be the average of the team.
**Step 5:** Subtotal Labor Costs.
An estimate of your labor cost.

## INFO YOU MUST KNOW!

If you are a general contractor self-performing the work, then your costs for the portion of work should not be net. Include some profit and overhead in the price, like subcontractors do.

## ESTIMATING LABOR COSTS FORMULA

**Total Worker-Hours** = Quantity x Worker-hour/Unit
**Labor Hourly Rate** = Basic Wage x (1 + Labor Burden Rate)
**Total Labor Price** = Total Worker- Hours x Average Crew Hourly Rate

## ESTIMATING WORKER-HOUR PER UNIT FORMULA

**Total Worker-Hours** = Number of Working Crew Members x Hours Crew Worked
**Unit Worker-Hour for the Item** = Total Worker-Hours/Crew Output

## ESTIMATING LABOR BURDEN RATE FORMULA

**Labor Burden Rate** = Total Labor Burden/Total Basic Wages x 100%

## ESTIMATING EQUIPMENT OPERATOR RATE FORMULA

**Operator Rate** = Operator Basic Wage x (1 + Labor Burden Rate)

## ESTIMATING EQUIPMENT COSTS FORMULA

**Equipment Costs** = Equipment Hours x (Equipment Rate + Operator Rate)

## ESTIMATING MATERIAL COSTS FORMULA

**Material Price** = Quantity x Material Unit Price

# COST SUMMARY

## ESTIMATING HOME OFFICE OVERHEAD

Home office overhead costs is not directly tied to a specific job.
Home office overhead costs include:
- Owner's salary
- Office personnel salaries and benefits
- Vehicles not related to specific projects, with fuels and insurance.
- Office rent, utilities, furniture and supplies
- Business license & membership dues
- Marketing and advertising
- Loan interest
- Legal and auditing expenses
- Taxes and donations
- Bad accounts
- Overhead costs must be paid to remain in business.
- Office overhead varies annually.
- Office overhead is a cost not a profit.

## ESTIMATING PROFIT

Profit is estimated by applying a rate to the total cost.
Rate for small jobs: 20% to 30%
Rate for large jobs: 10% to 15%

## ESTIMATING HOME OFFICE OVERHEAD FORMULA

**Overhead** = Office Overhead Last Year/Construction Volume Last Year
**Office Overhead for Current Job** = Rate x Total Direct Costs for Current Job

## ESTIMATING BONDING COSTS

**Bid Bonds**
- Some bids require bid bonds to ensure that you will sign the contract if the job is awarded to you. If a bid bond is required, get the paperwork done on time.

**Performance and Payment Bonds**
- A performance bond is your guarantee to the owner that you will finish the job according to contract documents.
- A payment bond or labor and material bond, promises all labor and material supplied on the job will be paid for, protecting the owner from any claims.
- They are normally made out to 100% of the contract amount.
- The expense for payment and performance bonds is usually 1% to 3% of the total job costs.
- Payment and performance bond costs can be calculated by using a rate table from your surety company.

## ESTIMATING OTHER INDIRECT COSTS

Indirect costs, also known as soft costs, include:
- Land acquisition
- Architect and engineer design fees
- Construction interests
- Bank charges
- Legal fees
- Appraisal fees
- Accounting fees
- Building Permit costs
- Development cost charges
- Land survey
- Property taxes
- New home warranty
- Strata fees
- Marketing and sales

## ESTIMATING INSURANCE COSTS

**Major kinds of insurances:**
- Builder's Risk Insurance
- General Liability Insurance
- Worker's Compensation Insurance
- Some insurance can be estimated with home office overhead, such as Worker's Compensation Insurance.
- Some insurance can be estimated with jobsite overhead, such as automobile insurance.

## ESTIMATING JOB SITE OVERHEAD

- Jobsite overhead is the money directly related to the job.
- Includes the costs to run a jobsite office and the salaries for jobsite personnel.
- Jobsite overhead can amount to 20% to 40% of the total bid.

**Note:** Do not apply a percentage to cover overhead.

**Estimating Job Overhead Guidelines:**
- Define a list of jobsite overhead items.
- Decide how long it will take to finish the job.
- Share and discuss the duration of the job with your project managers or superintendents.
- Price each overhead item based on the job duration.

**Note:** The costs for some items are recurring on a regular basis throughout the job.
- Summarize all the costs to get a total jobsite overhead.

# QUOTES & BID ESTIMATE

## QUOTES

**Getting Quotes**
When requesting quotes:
- Request quotes from at least 3 suppliers.
- Attach a copy of your takeoff
- Specify as much additional information as possible.
- Furnish your specs and drawings for your supplier.

**Evaluating Quotes**
- When quotes come in, read them carefully to verify the following factors:
- Unit price
- Delivery charge
- Sales taxes
- Minimum order quantity
- Expected price escalation
- Storage cost or standby charges
- Discount rates
- Other items that are included with the purchase

## BID ESTIMATE WORKSHEETS

To estimate a bid, set up two estimate worksheets: bid workup sheet and bid recap sheet.

**Bid Workup Sheet**
- Shows the total bid price
- Summary of the total major cost categories, including material, labor and subcontractor
- Lists all trade components with their detailed costs
- Includes markups

**Bid Recap Sheet**
- Summarizes all direct and indirect costs.

## BID WORKUP FORMULAS

**Labor Subtotal** = Quantities x Labor Unit Price
**Material Subtotal** = Quantities x Material Unit Price
**Subcontractor Subtotal** = Quantities x Subcontractor Unit Price
**Item Subtotal** = Material Subtotal + Labor Subtotal + Subcontractor Subtotal

## BID RECAP FORMULAS

**Labor Subtotal:** The Sum of Labor Subtotal Column on the Bid Workup Sheet
**Material Subtotal:** The Sum of the Material Total Column on the Bid Workup Sheet
**Subcontractor Subtotal:** The Sum of Subcontractor Total Column on the Bid Workup Sheet
**Materials Sales Tax:** Material Total x Sales Tax Rate
**Labor Burden:** Labor Total x Labor Burden Rate
**Total Direct Costs:** Labor Total + Material Total + Subcontractor Total + Material Sales Tax + Labor Burden
**Total Indirect Cost:** Overhead + Bond + Insurance + Financing + Permit + Development Fees
**Profit:** (Total Direct Costs + Total Indirect Cost) x Profit Rate
**Bid Total:** Total Direct Cost + Total Indirect Cost + Profit

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# ESTIMATING FINISHES

## ESTIMATING FINISHES

**Commercial/Industrial Construction**
- In commercial and institutional projects, there will be detailed finish schedule.
- The finish schedule will show what finishes will go on walls, floors and ceilings, room by room.

**Residential Construction**
- In residential jobs, there will be rough guidelines as opposed to a detailed finish schedule.
- Create a room finish schedule based on the owner's requirements.
- Measure the area and perimeter of each listed room.

**Rectangular Room Formulas**

**Room Area** = Room Length x Room Width

**Room Perimeter** = Room Length + Room Width x 2

**Finish Area for Each Room**

**Floor Finish** = Room Area

**Floor Base** = Room Perimeter

**Wall Finish** = Room Perimeter x Ceiling Height (if same finish on all four walls)

**Ceiling Finish** = Room Area

Add up each room to get the total quantities for interior finishes.

## ESTIMATING FLOORING CHECKLIST

Use the following checklist for acoustical ceilings takeoff (with measurement units):
- ☐ Carpet, including wall carpet (sf or sy)
- ☐ Carpet tile (sf or sy)
- ☐ Resilient flooring (sf or sy)
- ☐ Vinyl composition tile (sf or sy)
- ☐ Rubber flooring (sf or sy)
- ☐ Terrazzo (sf or sy)
- ☐ Ceramic tile, including wall tile, exterior deck tile, fireplace tile surrounds and bull nose trims (sf or sy)
- ☐ Quarry or mosaic tile (sf or sy)
- ☐ Rubber tile (sf or sy)
- ☐ Marble or stone flooring (sf or sy)
- ☐ Laminate or hardwood flooring (sf or sy)
- ☐ Base (lf or y)
- ☐ Threshold (lf)
- ☐ Metal transition strips (lf)
- ☐ Epoxy grout (sf)
- ☐ Floor underlayment (sf)
- ☐ Flooring in elevators cabs (sf)
- ☐ Flooring on stairs (sf), treads (sf) and tactile warning strips (lf)

## ESTIMATING DOORS CHECKLIST

Perform a door count and verify the door schedule with actual plans to locate each door.

## ESTIMATING DRYWALL

**Commercial/industrial construction**
- In commercial/industrial construction, a drywall subtrade will install light-gauge metal framing and gypsum boards.

**Residential construction**
- In residential construction, a framer will install wood framing and a drywall contractor will install gypsum boards.

**Note:** Drywall quotes must be read carefully to see what they include. They can include insulation, vapor barrier, wood blocking, plywood sheathing.

## ESTIMATING ACOUSTICAL CEILINGS CHECKLIST

Check if the drywall contractor included acoustical ceilings in the quote.

**Use the following checklist for acoustical ceilings takeoff (with measurement units):**
- ☐ Ceiling tile (sf or ea)
- ☐ Insulation (sf)
- ☐ Suspension system (sf)
  - ☐ Main runner (lf)
  - ☐ Cross runner (lf)
  - ☐ Wall angle (lf)
  - ☐ Struts (lf)
  - ☐ Wire (ea)
  - ☐ Seismic post (ea)
  - ☐ Wall angle fasteners (ea)
  - ☐ Pop and grid fasteners (ea)
- ☐ Installing special lighting fixtures (ea)
- ☐ Metal strips (lf)

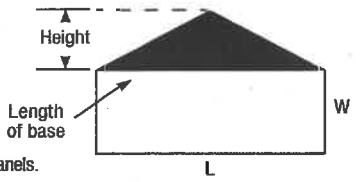
## ESTIMATING STOREFRONT & WINDOWS

**Commercial/Industrial Construction**
- In commercial/institutional projects, glass contractors will supply and install curtain walls, storefront doors and glazing.
- Look for a door schedule listing all aluminum doors, their sizes, details for jambs, heads and sills.
- Check plans and specifications for approved manufacturers and types of glass.

**Residential Construction**
- In residential projects, vinyl windows are quoted supply only, so you must add installation costs.
- Look for a windows schedule listing openings, window type and size, glazing, frame material and details, required accessories and hardware.

## NUMBER OF DRYWALL PANELS

$$\text{Number of Panels} = \frac{\text{Sq. Ft. (Area) of Surfaces to be Drywalled}}{32}$$




**Note:** Use this formula if using 4' x 8' Panels.

## ESTIMATING DRYWALL FORMULAS

The following formulas are based on 4 x 8 sheets.

**Wall Board Area** = Wall Length x Wall Height x Cover Sides x Board Layers

**Number of Drywall Boards (ea)** = Wall Board Area/32

## ESTIMATING EIFS/STUCCO

- For takeoff, go over all sides of building exteriors to measure the finish area.
- Check plans
- Include zigzag lines, because not all wall areas can be seen from exterior elevations.
- Check other locations where EIFS/stucco finishes are called for, such as ceilings, exterior soffits, canopy columns, under exterior balcony decks, roof and floor overhangs, roof parapets, retaining walls, dumpster walls, site features etc.
- Check the specs on stucco to find out the number and thickness of coats, mixes to be used and type of lath required.

**Note:** Check if the drywall contractor included EIFS/stucco finishes in his quote.

## ESTIMATING EIFS/STUCCO CHECKLIST

Use the following checklist for EIFS/Stucco takeoff (with measurement units):
- ☐ Lath, gypsum or metal (sy)
- ☐ Plaster (sy, cf or bags)
- ☐ EIFS (sf)
- ☐ Trims, moldings and shapes (lf or ea)
- ☐ GFRC columns (ea)

**Note:** Find out the number and thickness of stucco coats, mixes and type of lath.

## ESTIMATING PAINTING CHECKLIST

Both exterior and interior of the building should be checked for painting scope and reqs.

Use the following checklist for acoustical ceilings takeoff (with measurement units):
- ☐ Painting walls, including exterior cladding and interior partitions (sf)
- ☐ Painting ceilings, including covered and exposed areas (sf)
- ☐ Painting floor (sf)
- ☐ Painting columns and beams (sf or lf)
- ☐ Painting trims, moldings, cornices and baseboards (lf)
- ☐ Painting stairs (sf or lf)
- ☐ Painting doors (ea or sf)
- ☐ Painting cabinets (ea or sf)
- ☐ Structural steel priming or painting (ton or sf)
- ☐ Vinyl wall covering, including corner/bumper guards (sf)
- ☐ Painting exterior siding (sf)
- ☐ Painting downspouts and gutters (lf)
- ☐ Painting fences and railings (lf)
- ☐ Painting bollards (ea)
- ☐ Painting parking lines (lf) for exterior and interior parking spots
- ☐ Caulking (lf)
- ☐ Special waterproof coating to masonry or precast concrete walls (sf)

## ESTIMATING FURNISHINGS

- Furnishings estimating should not be neglected.
- Look at plans and specs to check if furnishings will be provided or are required.
- Don't assume the owner will provide furnishings. Always check with your client.

**Account for the following costs, when estimating furniture:**
- Material supply and shipping • Handling and assembly • Installation and cleaning

## ESTIMATING EQUIPMENT

- Equipment estimating should not be neglected.
- Even when equipment is supplied by the owner, you may still be responsible for related work such as equipment receiving, storage and installation.
- Residential appliances include: washer, dryer, refrigerator, dishwasher etc. (ea)
- Commercial/Industrial appliances include: parking control equipment, food service equipment, medical equipment, security and vault equipment, etc. (ea)

# ESTIMATING PLUMBING, HVAC & ELECTRICAL

## ESTIMATING PLUMBING

**Commercial/Industrial Construction**
- In commercial/industrial jobs, the plumbing or sprinkler contractor is only responsible for the work within a few feet of the building footprint. Anything beyond that boundary is picked up by the site servicing contractor.

**Residential Construction**
- In residential jobs, plumbers will likely perform all the work inside and outside of the building.

## ESTIMATING PLUMBING – QUANTITY TAKEOFF PROCEDURES

**Step 1:** Count each type of fixture and equipment for each floor or section of the building. Total them separately.

**Step 2:** Start with the largest size in the pipe line, follow along the main, check off and note the number of valves and tees for that size, as well as the size and number of risers.

**Step 3:** Mark the point where the size of the line changes.

**Step 4:** Return back down the same line, check and takeoff the number of fittings.

**Step 5:** Start again from the beginning, measure the footage of pipe and round off to the nearest 10 ft. then mark the line to indicate you have completed the takeoff.

**Step 6:** Follow the same procedure for each size of pipe; continue to the end of the main or riser. Then work from the end of the main, return back down the line and take off the branches: valves, fittings and pipes to the last outlet.

**Step 7:** Recheck the length of the risers for distance between floors from architectural plans.

**Step 8:** Carefully check the drawings for unmarked pipelines to ensure that nothing has been missed.

**Step 9:** Total all quantities for each different system independently.

## ESTIMATING HVAC

- Some mechanical contractors will quote HVAC, plumbing and/or fire sprinklers as a total package.
- Carefully read their quotes to see what's included.

## ESTIMATING ELECTRICAL – TAKEOFF SEQUENCE

- Lighting fixtures and lamps
- Wiring devices
- Conduits, connectors and wire
- Boxes and covers
- Service and distribution (one-line diagram)
- Special systems
- Site electrical
- Equipment hook up
- Miscellaneous materials and installation

# PROJECT MANAGEMENT SCHEDULING RESIDENTIAL & COMMERCIAL

QUICK-CARDS® *A Unique Quick-Reference Guide*

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## PROJECT MANAGEMENT & SCHEDULING – INTRODUCTION

### INFO YOU MUST KNOW!

Planning and scheduling are two terms that are often thought of as synonymous, but they are not.

- Scheduling is just one part of planning. It is the determination of the timing and sequence of operations.

### PROJECT MANAGER & SCHEDULER

- The responsibility of maintaining the schedule must be given to the project manager superintendent and forepersons.
- An effective project manager coordinates the work of various trades and ensures that each activity is started and completed on time.
- The schedule should include all code-required inspections at specified points during construction– such as foundations, framing, plumbing, electrical, final inspection and client walk-though. If any inspection is over-looked, the next phase of work can be delayed.
- The scheduler must ensure that all materials are available when they are needed, by ordering well in advance.
- The scheduler must give all vendors and subcontractors sufficient advance notice.
- Provide important schedule information and regular updates to suppliers, employees, subcontractors, lenders and customers.

### PROJECT SCHEDULER – 3 TYPES OF KNOWLEDGE

A scheduler must have 3 types of knowledge:

- Knowledge of computer software
- Knowledge of principles of scheduling and project control
- Knowledge of specific technical field of the project.

### MANAGING PROJECT COMMUNICATION – 4 PROCESSES

1. **Communication Planning.** Determine who needs what information, how frequently they need it and how it will be given to them.
2. **Information Distribution.** The process of making needed information available to those who need it in a timely manner.
3. **Performance Reporting.** Collecting and distributing information on progress; this includes measuring progress, reporting status and forecasting future results.
4. **Administrative Closure.** This includes gathering information and generating and disseminating information about a phase or final project closeout.

### JOB SCHEDULE

- Match the type of scheduling tool to the job at hand.
- Smaller jobs may only need a simple bar chart and activity list.
- Larger, more complex projects, may need computerized systems.
- A schedule must:
  - List each activity
  - Estimate time needed for each activity.
  - Specify the who, what, where & when for each task.
  - Include start-up activities that must be completed before construction begins, such as drawings and permits, utility hookups, on-site sanitary facilities and locating lot corners.
- Scheduling a project requires an understanding of all the individual units of work required.
- See Activity Lists section of this Quick-Card.

## MASTER ACTIVITY LISTS FOR RESIDENTIAL & COMMERCIAL JOBS

### MASTER ACTIVITY LISTS

The master activity lists shown here can help improve your accuracy and reduce the time required to produce a schedule. These lists contain all the typical activities in residential and commercial projects. Grouping activities by project phase (as shown here) helps organize them into a usable list.

### ACTIVITY LIST FOR RESIDENTIAL JOBS

**PROJECT START UP**
- Obtain a permit
- Obtain approved drawings
- Obtain plot of site
- Temp. power and water
- Builder's Risk Insurance
- Surveyor locates corners

**OWNER ACTIVITIES**
- Select plumbing fixtures
- Select light fixtures
- Select HVAC system
- Select paint
- Select cabinets

**INITIAL SITEWORK**
- Clear and grade site

**FOUNDATION PHASE**
- Set batter boards
- Dig footings
- Set grade stakes
- Footing inspection
- Pour piers and footings

**SLAB PREP WORK**
- Fine grade sub-base
- Set batter boards
- Place wire mesh
- Set grade stakes
- Set UG pipe and conduit

**PLACE SLAB**
- Place and finish concrete
- Cure concrete

**WOOD FRAME PHASE**
- Order framing material
- Deliver framing material
- Erect floor framing, walls and sheathing
- Deliver roof trusses
- Install roof framing
- Complete rough framing
- Check plumb and square
- Check door openings
- Install wall insulation
- Framing inspection
- Clean up waste material

**UTILITY ROUGH-IN**
- Deliver tubs and showers
- Plumbing top-out
- Plumbing inspection
- HVAC and elect rough-in
- Electrical inspection

**FRAME CLOSE-IN PHASE**
- Install sheathing and exterior wood items

**EXTERIOR MASONRY**
- Order brick
- Deliver brick
- Install veneer and chimney

**ROOFING ITEMS**
- Install shingles, install flashing and felt

**FINISH PHASE**
- Interior wall material
- Wall finish items
- Paint interior walls
- Paint exterior walls
- Deliver wallpaper
- Hang wallpaper
- Paint or stain interior trim
- Paint or stain doors
- Paint touch-up

**INTERIOR WOOD TRIM**
- Deliver interior trim
- Install interior trim
- Install shelving and rods
- Install interior doors

**FINISH FLOORING**
- Install ceramic tile
- Install other hard tile
- Install vinyl tile
- Install carpet

**INSTALL MISC. ITEMS**
- Insulate attic
- Order cabinets
- Deliver cabinets
- Install cabinets
- Install bathroom accessories
- Order appliances
- Deliver and set appliances
- Install brick
- Install stove
- Install compactor
- Install washer/dryer
- Install range hood

**FINISH UTILITIES**
- Plumbing trim-out
- HVAC trim-out
- Deliver HVAC equipment
- Set grills and thermostat
- Start up and test equipment

**ELECTRICAL TRIM-OUT**
- Hook up main power
- Check and test system
- Final electrical inspection

**CUSTOM ITEMS**
- Install fireplace items
- Install outside decks
- Install hot tubs
- Install alarm systems
- Install telephone wiring
- Install TV wiring

**FINISH SITEWORK**
- Grade driveway and walks
- Install concrete driveway
- Form and place sidewalks
- Site landscaping

**CLOSE-OUT PHASE**
- Disconnect temporary utilities
- Clean house
- Final inspection

### ACTIVITY LIST FOR COMMERCIAL JOBS

**PROJECT START UP**
- Obtain a permit
- Obtain approved drawings
- Obtain plot of site
- Temporary power and water
- Builder's Risk Insurance

**INITIAL SITEWORK**
- Clear and grade site
- Surveyor locates corners of lot & building

**EARTHWORK**
- Excavation basement
- Backfill

**FOUNDATION PHASE**
- Piles and caissons
- Set rebars and wire mesh
- Spread and continue footings
- Column pedestals
- Grade beams
- Fdn inspection

**SLAB PREP WORK**
- Fine grade sub-base
- Set batter boards
- Place rebar and wire mesh
- Set grade stakes
- Place UG pipe and conduit

**MASONRY**
- Rebars
- Basement walls

**PLACE SLABS**
- Place and finish concrete
- Cure concrete

**STEEL FRAME PHASE**
- Order framing material
- Deliver framing material
- Erect cols, floors & wall framing
- Deliver roof-framing materials
- Install roof framing
- Check plumb and square

**MISC. IRON & PARTITIONS**
- Steel bar joists & decking
- Place floor slabs
- Install interior walls
- Install door frames
- Install wall insulation
- Framing inspection
- Clean up waste material

**UTILITY ROUGH-IN**
- Deliver plumbing fixtures
- Plumbing top out
- Rough in HVAC & electrical
- Install fire sprinkler system
- Electrical inspection

**FRAME CLOSE-IN PHASE**
- Install exterior curtain walls
- Install exterior windows

**ROOFING ITEMS**
- Install roofing
- Install sheetmetal
- Install roof drains

**FIREPROOFING PHASE**
- Fireproof steel columns
- Fireproof steel beams

**FINISH PHASE**
- Wall finish items
- Lath and plaster
- Paint interior walls
- Paint or stain doors
- Paint touch-up

**INTERIOR WOOD TRIM**
- Install interior trim
- Install interior doors

**FINISH FLOORING**
- Install ceramic tile
- Install other hard tile
- Install vinyl tile
- Install carpet
- Install wood flooring
- Install misc. items
- Install restroom items

**FINISH UTILITIES**
- Plumbing trim-out
- HVAC trim-out
- Set grills and thermostat
- Start up and test equipment
- Fire sprinkler system
- Electrical trim-out
- Hook up main power
- Check and test system
- Final electrical inspection

**CUSTOM ITEMS**
- Install fire alarm system
- Install telephone wiring
- Install TV wiring
- Elevator and electrical stairs
- Metal toilet stalls

**FINISH SITEWORK**
- Storm & sanitary sewers
- Grade driveway and walks
- Install concrete driveway
- Form and place sidewalks
- Site landscape

**CLOSE-OUT PHASE**
- Disconnect temporary utilities
- Clean building site
- Final inspection

# BAR CHARTS

## BAR CHARTS

- A bar chart shows the sequential relationship between various activities and how they fit together in a project.
- The chart indicates the date of the beginning and the date of completion of each unit of operation.
- Activities that will be performed to accomplish the job are listed in the left column.
- The time required to perform each step is indicated in the columns to the right of the left column.
- These steps are listed in sequence for each element of work.

**The Bar Chart provides the scheduler a simple means of:**

- Determining overall time required to complete the work through the use of a logical method.
- Determining the earliest time an activity can start and the latest time an activity can be completed without delaying the project completion.
- Determining the leeway, or free float, available for scheduling an activity.
- Reviewing each phase of the job in detail to make sure that the items such as special material and equipment are covered.
- Coordinating requirement between crafts.
- Comparing alternate methods for performing the job.

## BAR CHARTS – FREE FLOAT & TOTAL FLOAT

- Free-float is the amount of time any activity can be delayed without adversely affecting the early start of any following activity. In other words, it's the difference between the earliest possible finish of a given activity and the early start of the following.
- Total float is the amount of time that an activity can be delayed without affecting the overall project completion.

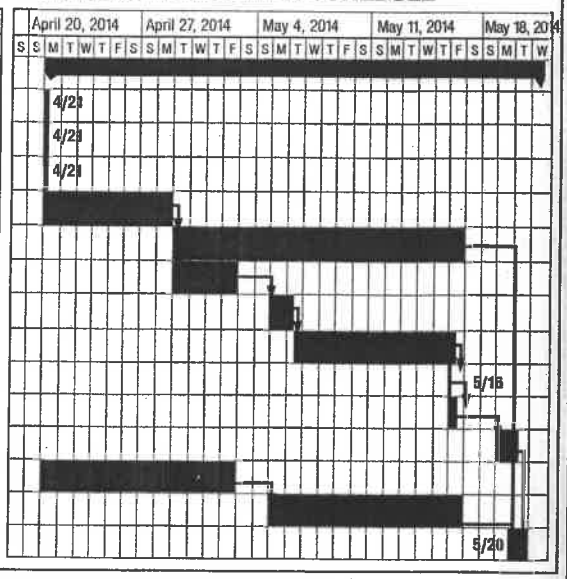
## INFO YOU MUST KNOW!

- Lead-times can range from less than an hour to several months.
- Missed start-up times are the most damaging to planning and project management.

## BAR CHART SCHEDULING – RESIDENTIAL PRE-CONSTRUCTION SCHEDULE

Bar Chart Scheduling Table

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | Pre-Construction Prep | 22.5 days | Mon 04/21/14 | Wed 5/21/14 |
| 2 | Obtain Zoning info/covenants | 0 days | Mon 04/21/14 | Mon 04/21/14 |
| 3 | Supply lot sale agreement | 0 days | Mon 04/21/14 | Mon 04/21/14 |
| 4 | Supply house plans | 0 days | Mon 04/21/14 | Mon 04/21/14 |
| 5 | Engineering Structural/Soils | 6 days | Mon 04/21/14 | Mon 4/28/14 |
| 6 | Apply for building permit | 14 days | Tue 4/29/14 | Fri 5/16/14 |
| 7 | Create Construction bid docs | 4 days | Tue 4/29/14 | Fri 5/2/14 |
| 8 | Dist. construction docs for bids | 1.5 days | Tue 5/6/14 | Tue 5/6/14 |
| 9 | Bidding period | 8 days | Tue 5/6/14 | Fri 5/16/14 |
| 10 | Bid deadline | 0 days | Fri 5/16/14 | Fri 5/16/14 |
| 11 | Notify winning bidders | 4 hrs. | Fri 5/16/14 | Fri 5/16/14 |
| 12 | Sign subcontractor agreements | 1.5 days | Mon 5/19/14 | Tue 5/20/14 |
| 13 | Secure long-term financing | 10 days | Mon 4/21/14 | Fri 5/2/14 |
| 14 | Secure construction loan | 10 days | Mon 5/5/14 | Fri 5/16/14 |
| 15 | Begin Construction on site | 1 day | Tue 5/20/14 | Wed 5/21/14 |



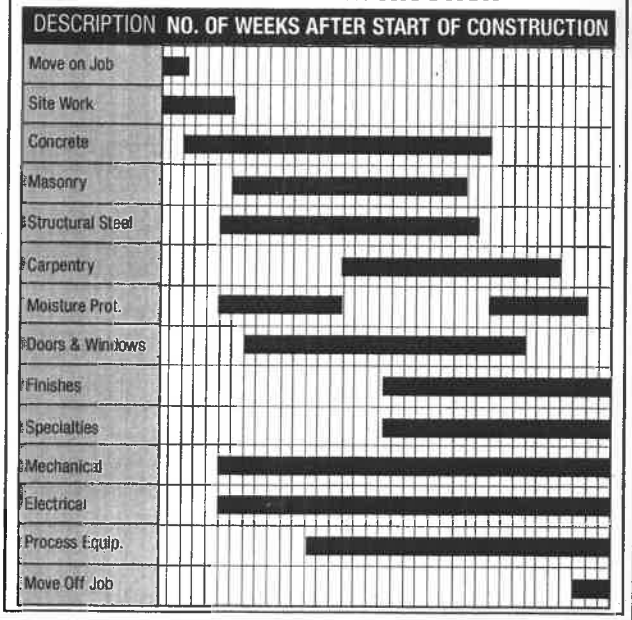

## ADVANTAGES OF BAR CHARTS

- It's simple. No complicated calculations are involved.
- Easy to prepare. Can be prepared anywhere with just a pencil and paper.
- Easy to understand. No technical or mathematical background needed.
- Time-scaled. The length of a bar representing an activity is proportional to its duration.
- Great for general planning
- Can serve as a basis for other, more complex schedules, like the Critical Path Method.

## DISADVANTAGES OF BAR CHARTS

- Lack of logical representation. Does not answer the "why" of an activity's start date.
- Does not show the complex interdependence of activities in a project. Ex. some activities happen simultaneously.
- Size and complexity of project interferes with the simplicity of bar charts if the project is long or complex. However, bar charts can still be used in long and/or complex projects if used to:
  - show a subset of the work activities to maintain the simplicity of the bar chart.
  - show summary bars to maintain the simplicity of the bar chart.

## BAR CHART SCHEDULING – COMMERCIAL CONSTRUCTION




# ARROW DIAGRAM

## READING ARROW DIAGRAMS

- Arrow diagrams incorporate data from the bar chart and use arrows to link the activities.
- The tail of each arrow represents the start of the element; the head represents the finish.
- The length of the longest path through the diagram equals the total path required to complete the project.
- Shorter paths include arrows that indicate activities that may be performed simultaneously.
- Every element on the longest path is critical. Delay in one of these activities delays the project.
- An element on a shorter path is non-critical.
- Relationships among the activities are positioned in terms of precedence. Most activities have predecessor activities (activities that must be completed before the given activity can begin).
- Subsequent activities are those items that cannot begin until some prior activity is completed.
- Understanding the relationships between activities can provide greater flexibility and help better manage a schedule.

## PROJECT PLANNING

- A project is initially planned without factoring time or availability of resources.
- Project planning consists of analyzing the project, breaking it into working elements and arranging these elements in an Arrow Diagram.
- The arrow diagram becomes the working model of the project.

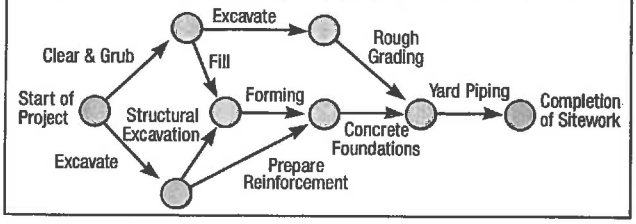
## ADVANTAGES OF ARROW DIAGRAMS

- Shows logical representation.
- Better than bar charts at representing large and complicated projects.

## DISADVANTAGES OF ARROW DIAGRAMS

- Not time-scaled
- Requires knowledge of how arrow diagrams work to produce them and understand them.

## ARROW DIAGRAM FOR TYPICAL SITEWORK




## STRUCTURING ARROW DIAGRAMS

To structure an arrow diagram, the scheduler must analyze each activity and determine:

- What activity must immediately precede this element?
- What activity must immediately follow this element?
- What other activity, if any can be done simultaneously with this element?

## INFO YOU MUST KNOW!

- The length of the arrow has no relation to the time it takes to do the job.
- All arrows may be about the same length, even though they represent jobs that take varying lengths of time.

# CRITICAL PATH METHOD

## CRITICAL PATH METHOD (CPM)

- The Critical Path Method or Critical Path Analysis is a mathematically based algorithm for scheduling a project.
- Commonly used with any project with interdependent activities.
- Calculates the longest path of planned activities to the end of the project.
- Calculates earliest and latest that each activity can start and finish without extending the project completion time.
- Determines "critical" activities (on the longest path)
- Prioritizes activities for the effective management and to shorten the planned critical path of a project by:
  - Pruning critical path activities
  - "Fast tracking" (performing more activities in parallel)
  - "Crashing the critical path" (shortening the durations of critical path activities by adding resources)
- On complex, long duration projects, a computer can process the date of the critical path system.
- In this method, final completion dates are continuously corrected as actual time is recorded.

**Note:** Maintenance of the chart can be a full-time job in itself, as there will be many changes on the job before it is finalized.

## CPM REQUIREMENTS

The essential technique for using CPM is to construct a model of the project that includes the following:

- A list of all activities required to complete the project (Work Breakdown Structure).
- The time (duration) that each activity will take to complete.
- The dependencies between the activities.

## CONSTRUCTION DELAYS

- Delayed completion, extended overhead and loss of productivity require a chronology of the job, CPM is useful in providing this.
- Delays result in losses and litigation.

## READING CRITICAL PATH METHOD (CPM)

- The encircled letters indicate each unit of operation, activity or decision listed on the Bar Chart.
- The number between the circled tasks, nodes, indicates the estimated time for that activity.
- Numbers are usually given in units of days or weeks required to complete that activity.
- By adding the total elapsed time along each path, the longest path can be determined.
- The longest path is called the Critical Path.
- Any delay in the Critical Path would delay the entire project.

## BASIC GROUND RULES FOR CPM

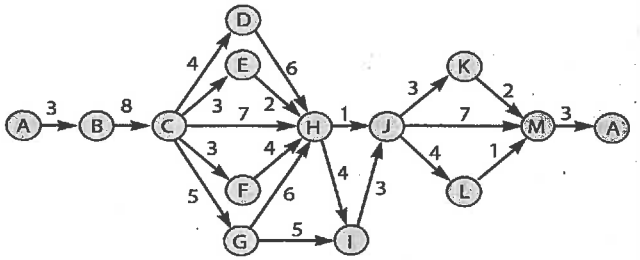
The basic ground rules of CPM are:

- Planning and scheduling are separate operations.
- Planning always comes first.
- The CPM and PERT systems are meant to maintain an optimum construction schedule.
- The CPM and PERT systems illustrate how changes or delays on any specific activity can cause an overall delay in the project.

## CPM – SUPPLEMENTAL STEPS

1. Review and analyze the schedule
   - Review the logic and make sure that every activity has the correct predecessor.
   - Common errors to look for: wrong, missing or redundant relationship and logic loops.
2. Implement the schedule
   - Choose start and finish dates within the range of the calculated dates.
3. Monitor and control the schedule
   - Compare the baseline with what has actually been done.
   - Analyze any deviation (variance) from the baseline and take corrective actions.
4. Revise the database and record feedback
   - This is a continuous process.
   - Document project in a well-organized, easy to retrieve manner.
   - Record unusual events
   - Explain adjustments

## TYPICAL CRITICAL PATH METHOD (CPM) DIAGRAM




Circled letters represent events or completion of activity. Numbers between circles are estimated time periods for the completion of the activities.

## CPM PREPARATION – 4 STEPS

Preparation for a CPM project includes the following 4 steps:

**1. Determine the work activity**

- Restrict the number of activities for the simplicity of the project schedule
- Break the project down into small activities
- Factors considered in breaking down the project into individual activities:
  - Nature of work/homogeneity
  - Location/floor
  - Size/duration
  - Time Chronology
  - Responsibility
  - Phase

**2. Determine the duration of activities.** In most construction projects, durations are calculated in workdays, usually a 5-day workweek.

Duration = Total quantity / Crew productivity

**3. Determine logical relationships**

- A logical relationship exists between two activities, when the start (or finish) of one activity physically depends on the finish (or start) of another activity.
- The order of activities is determined by logical relationships. However, sometimes some activities are put before the others because of resource constraint (restriction).
- A resource constraint (or restriction) is when you can theoretically do two tasks at the same time, but you schedule one as a predecessor of the other because of resource (labor, equipment) limitation.

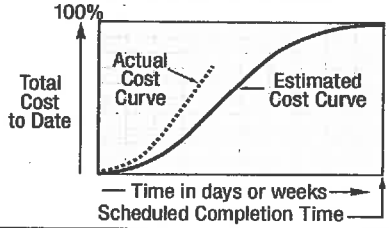
**4. Draw the logic network and perform the CPM calculations**

- The logic network and CPM can be done by hand however, there are computer programs that can accurately perform these calculations and give you the calculated finish date of the project, the critical path and the available float for all non-critical activities.

**Note:** If you use a computer program to make the calculations, check the input and the output. Don't solely rely on the computer program for the CPM.

# COST S-CURVE & BELL CURVE

## COST S-CURVE CHART




## PROJECT ESTIMATING & S-CURVE

- Projects that are accurately estimated and completely managed follow a similar S-curve.
- The value of using this curve is that at half-way or three quarters through the project, it becomes clear whether the project is on track or heading for a loss. Corrective measures can be taken, and losses avoided or minimized.
- Ideally, the curve ends in the estimated total cost and time.

**Note:** If the curve ends at a total lower cost, the contractor makes more profit.
If the curve ends at a higher total cost, there is less profit, or worse, a loss.

## S-CURVE

- S-curves are an important project management tool.
- S-curves allow the progress of a project to be tracked visually over time, and form a historical record of what has happened to date.
- Analyses of S-curves allow project managers to quickly identify project growth, slippage and potential problems that could adversely impact the project if no remedial action is taken.
- The S-curve shows, at any moment in time, the accumulated costs of the materials, subcontracts, labor and many other important aspects of the job.
- The chart consists of the summation of costs in dollars throughout the progress of work on a daily, weekly or monthly basis.
- The vertical scale of the chart is measured in dollars, employee-hours, or units of materials, in which the upper limit is the total estimated cost, employee-hours or material.
- The horizontal scale of the chart is measured in time.

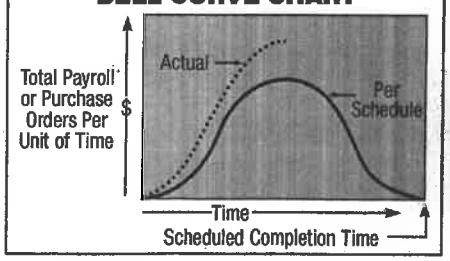
## S-CURVE PATTERN

- The first part of the curve rises at a gradual incline during the start-up period.
- As the job progresses and efficiency improves, the curve becomes steeper at a steady rate.
- Near the end of the project, the curve flattens again as fewer persons are employed and fewer/smaller material purchases are made.

## BELL CURVE

- The bell curve is similar to the S-curve, except it shows the cost of material, subcontract or labor per week or per month.
- The bell curve normally grows slowly at the beginning of the job, increases during the bulk of the work and slows down at the end of the project.
- When actual spending varies from the bell curve, it's a warning that the job is running into trouble.
- The labor-power loading curve on a construction site over the duration of the construction schedule is typically an asymmetrical bell curve.

## BELL CURVE CHART



# MANAGING COSTS, TIPS & SUMMARY

## INFO YOU MUST KNOW!

- Regularly comparing "actual" vs. "estimated" costs is important in keeping any job on track and profitable.
- Such costs comparisons are possible only when you have a schedule, necessary resources and corresponding timeframes.

## ESTIMATED VS. ACTUAL COSTS

**Estimated Costs**

- Estimated cost are quantitative assessments of the likely costs of the resources required to complete project activities.

  **Note:** Estimated costs may be presented in summary or in detail.
- Cost estimates are generally expressed in units of currency (dollars) in order to facilitate comparisons both within and across projects. Other units such as hours or days may be used.

  **Note:** In some cases, estimates are provided using multiple units of measure to facilitate appropriate management control.

**Actual Costs**

- The actual cost (AC) of a project represents the true total and final costs accrued during the process of completing all work during the pre-determined period of time allocated for all schedule activities as well as for all work breakdown structured components.
- Actual costs are primarily made up of a number of specific items including, but not limited to, cost in direct labor hours, direct costs alone, and also all costs including indirect costs.

  **Note:** Actual costs should be thoroughly itemized in detail throughout the project.

## RESOURCE ALLOCATING & LEVELING

- Cost/Resource allocation (or loading): Resources in this context include: labor, equipment and materials.
- Cost loading is assigning the appropriate cost (or budget) to each activity.
- When the cost of all activities are added up, the total should be equal to the project's budget.
- Resource allocation, means assigning the right amount of resources to each activity at the right time.
- The objective of this step is to load each activity with the amount of resources it requires and calculate its budget.

## RULES & TIPS FOR PLANNING

- All tasks must have markers that enable everyone to tell that the work is actually complete.
- Avoid micro planning.
- Construct the schedule on paper first.
- You must know both cost and schedule to know where your project actually is.
- The overall shutdown time is usually critical in jobs that require a lengthy period of down-time.
- There is nothing more damaging to planning and project management than missed start-up times.
- Remember that some activities are independent of others but some must happen simultaneously.

## PROJECT MANAGER/ SCHEDULER – SUMMARY

The successful project manager/scheduler should be prepared to do the following:

- Be able to read plans and measure them accurately.
- Possess a fair knowledge of arithmetic, together with the knowledge of English and metric systems.
- Be able to visualize (draw a mental picture) of the building from the plans.
- Have an intimate knowledge of the job conditions, most practical methods of handling materials and labor on the job.
- Have the knowledge and ability to assemble materials into workable units.
- Possess an intimate knowledge of labor performances and operations and convert them into dollars and cents.
- Avoid labor disputes caused by inadvertent violation of labor union contracts.

  Work by certain trades may be different in various states.
- The successful project manager should foresee cost over-run on the project by creating and monitoring the S-curve and Bell Curve charts.

# GLOSSARY

**A/E:** Architect/Engineer, usually the designer of the project hired by the Owner.

**Activities:** tasks/work done workers or subcontractors.

**Arrow Diagram:** Flow chart with arrows and event nodes.

**As-Built Plans:** approved plans, which show all revisions and changes.

**BOCA:** Building Officials and Code Administrators International, Inc.

**Building Permit:** Authorization required by local government for new buildings or major alteration

**Calendar Days:** Actual days of the week in place of working days.

**Certification of Occupancy:** Official notification by building department that job is complete.

**Change of Scope:** revision to original contract

**Change order:** written revisions to contract

**Civil Engineer:** a professional registered in the state to practice in the field of civil works.

**Class A:** General Engineering Contractor who builds civil works like roads, bridges and dams, usually hired by the governmental agency.

**Class B:** General Building Contractor, who builds residential, commercial and industrial structures, usually hired by the owner.

**Class C:** Specialty Contractor includes Plumbing, Electrical, HVAC, etc. Usually hired by the General Building Contractor.

**Cleanup:** Housekeeping done by subcontractors after work.

**Composite crew:** a building team made up of laborers, journeymen and foremen for certain trades.

**Contingency:** An event that may occur affecting cost or time.

**CPM:** Critical Path Method

**Craft:** A trade occupation requiring skill and training

**Direct Cost:** costs of all permanently installed materials and equipment and the labor required.

**Drawings:** Plans & specifications prepared by architect/ engineer and approved by building department.

**Dummy Arrow:** Line without time or work, indicates only a sequence of restraints without activity.

**Early start:** work beginning before scheduled time

**Earthwork:** Excavation, fill, compaction and grading

**Electronic Surveying:** Field measurements made by electronic or laser instruments.

**Event Numbering:** Identification of an activity

**Events:** See activities

**Extras:** Cost in excess of that given in contract

**Float or free time:** amount of time any given activity can be delayed.

**Foundations:** concrete or masonry work that supports building or structure.

**General Conditions:** See indirect costs

**General contractor:** One who contracts for the construction of an entire building.

**Grading:** Modification of ground to conform to plans

**Grub:** to remove tree roots

**HVAC:** Heating-Ventilating Air Conditioning

**ICBO:** International Conference of Building Officials

**ICC:** International Code Council

**Incidental Time Items:** Start-up and wind down time, supervisory instructions, maintenance and clean-up work area during and end of shift, tool box meetings, unloading and transporting materials getting tools and equipment.

**Indirect Costs:** All costs other than direct costs that do not become a permanent part of the project.

**Indirect Field Costs:** See indirect cost

**Inspections:** required inspections by local codes

**Job overhead:** see indirect costs

**Lead-time:** amount of time required between ordering and delivery of material or equipment

**Main account:** sitework, concrete, masonry, misc. steel, rough and finish carpentry, moisture protection, doors and windows, finishes, specialties, mechanical and electrical.

**Employee-hour:** labor time expended per person per hour

**Pavement:** concrete or asphalt slab

**Permits:** government authorization for construction, plumbing, electrical work, etc.

**PERT:** Program Evaluation and review technique

**Plumbing:** work connected with water and wastewater

**Portmortem:** an evaluation and documentation of entire project from initial through completion, or completions vs. schedule and cost vs. estimate.

**Project Closeout Activities:** Disconnecting temporary electrical and water services and removing signs

**Reinforcement:** Steel bars and wire mesh used in concrete or masonry.

**Rough plumbing:** concealed plumbing

**Standard Labor Cost:** Cost per employee-hour according to US Dept. Labor.

**Standard Unit Employee-hours:** time required for performing work under site conditions, familiarity and skill with work, proper supervision, adequate supply of workers, unobstructed access, temperatures between 40° and 85°, 40-hour week and 8 hour days.

**Standard Unit Subcontract Price:** Work done on a subcontract basis.

**Start-up activities:** obtaining permits, on-site sanitary facilities, lot survey, temporary electricity & water supply.

**Surveying and Layout:** Field measurement made by construction surveyor to locate foundations, set grades and establish property corners.

**Testing:** field test of soil and materials required by building Department.

**Time phasing:** time required for selecting contractors by negotiation or bidding or time for executing work.

**Total Float:** Amount of time an activity can be delayed without adversely affecting overall time.

**Unit Material Cost:** cost for each bd-ft of lumber, cy of concrete, sf of paving.

**Work Elements or Work Accounts:** activities, subdivisions of each main

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