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Detailed Estimating-Introduction

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Outline

- Introduction
- Successful Construction Estimating
- The Detailed Estimating Procedure
- The stretch- out- Length concept (SOL)
- Site Work and Excavation

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Detailed Estimating-Introduction

Why unit price estimates are prepared, and how they are used?

- **Detailed estimates (unit price estimates) are done at end of the design phase.**
- **When it is prepared by project team (owners), it is called a fair cost estimate.**
- **When it is prepared by contractors and accepted by the owners, it is called bid estimates.**
- **Detailed estimates take weeks to prepare and involve many people from different disciplines.**

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Side-part - Successful Construction Estimating

Definition of a Construction Estimate

- **A construction estimate is a forecast of a project's "actual" cost.**
- **To arrive to "actual cost" is to visualize building the project through the estimating process.**
  - **Building the project in your mind's eye, or**
  - **Visualizing the process is fundamental to achieving realistic estimate totals.**
- **The estimating process consists of breaking a project down into logical components (e.g., excavate for spread footing, form up for spread footing, place concrete for spread footings) which are then:**

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Side-part - Successful Construction Estimating

Scoped
Quantified
priced

* Scoped:

- Unique dimensions, specified quality and construction methodology and potential problems and solutions.
- It is derived from design documents (plans and specifications) and the estimator's experience and construction background.
- Project site visits are encouraged for addressing such scoping issues at site access exit egress, storage capabilities, utilities locations, the extent of ongoing operations.

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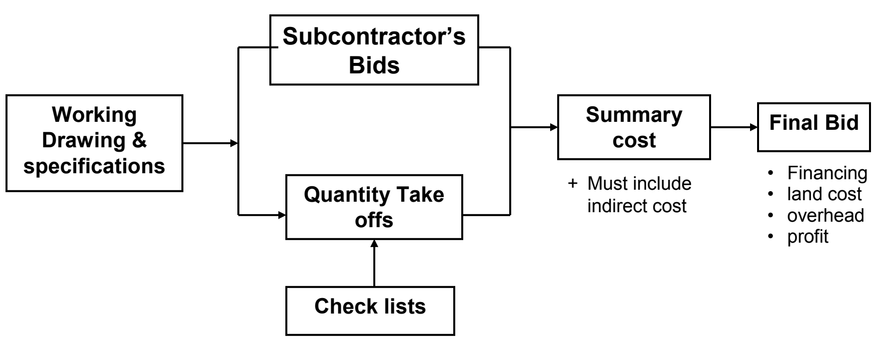
Side-part - Successful Construction Estimating

- Quantifying
  Packaging of project components' scope into unity that can be priced such as "cubic yards" of concrete pounds of reinforcing steel square foot of strip footing framework days of rental of a concrete bumper task.
- Pricing
  Applying market place labor, material, and equipment costing to the quantities (care should be taken to project location, quality and job specifies.
- Overhead and profit issues
  Contractors home office overhead profit, sale taxes, labor burden, bond contingency [represent % of total estimates].

The Detailed Estimating Procedure:

* Although the preparation of a construction estimate may involve a variety of approaches and varying degree of detail, there are five basic elements involved in the estimating procedure (and specially for direct costs of the project).

1) Working drawings and specifications (contract documents)
2) Subcontractors' bids
3) Quantity takeoffs
4) Checklists, and
5) A summary cost estimate



Organization Procedures

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The Detailed Estimating Procedure

1) Working drawings and specifications (contract documents)

* Working drawings and specifications are the main sources of information in the preparation of a detailed cost estimate for a project.
* Construction drawings usually include:
  - site plans
  - elevation
  - floor plans
  - foundation plans
  - structural framing plans, and
  - details and sections.
* Once they are received, they must be verified that a complete set is received.
* The drawings are numbered by discipline and specifications separated by trades.
* All the addenda also need to be tracked and verified.

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2) Sub-Contractors' Bids

* Before preparing an estimate, the general contractor must decide which construction activities are to be done by sub-contractors and which are to be done by its own work forces (In-house work).
* A contractor should contact there to sub-contractors (for completing bid) for each phase of the work which the contractor's workforce will not do.
* Sub-contractors usually furnish labors, materials, and equipment required to complete their phases of the work.

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3) Quantity Take-offs:

* Quantity take off is the foundation of the estimate
* The goal of the quality take-off is to calculate every item of the project.
* Thus, it is important that working drawings and specifications be studied, and understood before start of take off quantities.

There will

1) provide a good understanding of the magnitude and the scale of the project.
2) Visualize how the project will be constructed

* The estimator looks at:
    - the material used
    - amount of repetition
    - structural system
    - electrical system

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* It is also important that analysis of the site is carried out (require visit to the site).
    - It will provide information about the conditions around the construction area.

      Fig. 6-1 A Site Analysis Form
    - Provide a checklist of the issues that should be known about the site
        - Composition of the soil will affect how easily it will be worked.
        - Access
        - Locate the nearest
            - Power
            - Water
            - Phone lines

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* Although there are a number of ways for a take-off to proceed, the construction sequence is usually the most logical. (quantity take off and scheduling process are inter-related)

For example:

1) After the site preparation and excavation activities have been estimated, concrete could be taken next. In the concrete section, the sequence could be:
   - pier footing
   - foundation pier
   - will footing
   - foundation wells
   - ground slab
   - steps
   - columns, beams, girders
   - supported slab
   - roof fill
   - floor finishing
   - rubbing and curbs

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The same procedure will be followed in the other selections as well.

2. Using a checklist (as will be explained later) to cover the itemized list of the activities involved in building that particular project.

3. Techniques that are utilized when accomplishing a quantity take off.

   During quantity take off:
   - mark nicely and in order.
   - be organized
   - use common sense
   - be consistent

* Use preprinted forms - Fig. 6-8
* List dimensions (width, length, height) in a consistent order.
* Verify the scale of drawings before using them as basis for measurement:
  - be alert for changes in scale - NTS (not to scale)
  - sometimes drawings have been photographically reduced.
* Mark drawings neatly and consistently as quantities are counted

  and put all the figures in the correct columns of the preprinted forms.
* Take advantage of:
  - repeated project elements such as multiple floors & elevators.
  - design symmetry (Fig. 6-9)
* Adjust for waste for quantities (Fig. 6-10)
* Include required items which are not included in the working drawings (from site visit) (Fig. 6-11) (shrink & swell)

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4. Checklists

* The purpose of a checklist is to remind the estimator to include every significant item performed in the construction process.
* Also, it will help the estimator to be organized which is a keg to prepare reliable estimates and avoiding mistakes.
* It involves breaking a project down into logical components which are then each:
  - scoped
  - quantified
  - priced
- Example a checklist for a single - family residence (Fig. 1.4) which may differ from other project.

  Through means the master format specifications which is divided into the Building Cost Data Book using 16 divisions as checklist Fig. 5-11 or Master format Figure (Page 5)

  (Fig. 0.2 as perish mark reference)

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5) Summary Sheet

* When the quantities have been determined, then prices, or unit costs must be applied in order to determine the total costs.

* Unit costs are made up of:

Direct (bare or unburden costs)

1. Materials or quantity take off - cubic yards, etc.
2. Labor - from historical records (productivity X wages)
3. Equipment
   - tool sheds
   - storage buildings
   - wood working
   - material handling machines

Indirect costs

1. Overhead (10-25% of direct costs)-Fig.6-17
   a) Job overhead - 4-10% of direct loss
   b) General overhead (home office 2-8% direct cost)

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2. Profit (cost to the owners)
   (6-15% of the total cost of the project)

* A summary cost estimate (Fig. 6-16)
  Include:
  - bids from sub-contractor
  - quantities take offs X unit prices for each item of the project in terms of direct costs
  - indirect costs
    - overhead
    - profit
    - contingency

* Unit costs are essential in the preparation of a valid final bid these should be selected with care and are available in terms of labor, materials and equipment costs.

The stretch - out - Length concept (SOL)

* In the process of making take-offs of length, areas, and volumes, the stretch-out length concept may be used to a good advantage by an estimator:

- for computing concrete volumes
- reinforcement lengths
- masonry units
- many other items

* The SOL is the length of the center line of any strip of + thickness which bounds the perimeter of a building foundation

SOL = Po - 4t

Po = length of the outside perimeter

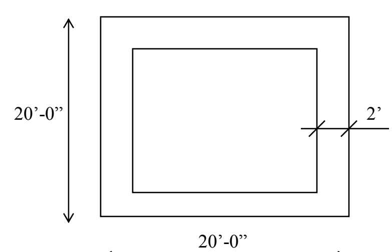
t = thickness of width of a given strip

(No matter of # of corners or offsets which are 90-degree turns it will give excess calculation).

The stretch - out - Length concept (SOL)

Example 1

Find out the areas of the strip in the shown figure:



A- two rectangles

2X20 + 2X16 = 144 SF

B- SOL = Po - 4t

= 4 x 20 - 4 (2)

= 72 LF

Area = SOL x 6

= 72 LFX2LF = 144SF

Useful when there are many corners and offset, such as

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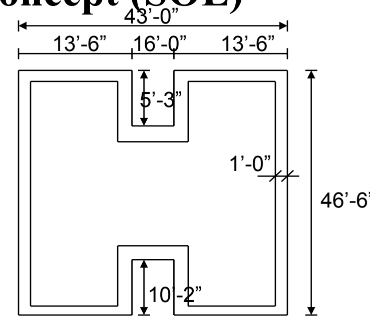
The stretch - out - Length concept (SOL)



Example 2

SOL = Po - 46

Po = (46-6")x2 + 43'-0"(2)+ (5'3" + 10'-2") (2)

= 209.83 ft.

SOL = 209.83 - (4x1)

= 205.83 ft.

Area = 205.83 x 1 = 205.83 sf

If the volume of concrete required for the wall, Assume depth of the wall 8ft., the volume

Volume = area of the top of the wall x depth of the wall

= 205.83 ft^2 x 8ft. = 1646.64 CF

= 61 Cy

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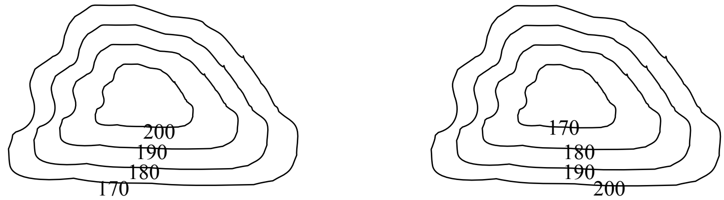
1) Site Work and Excavation

General:

(1) **The estimator must be familiar with the site before making estimating to be familiar with many factors involved in the excavation such as:**
   1) **type of soil - specially nature of the soil at various depth by taking boring and test holes.**
   2) **water conditions etc.**

Site cleaning and grading

* **Unevenness of land is shown by contours established by the surveyor.**
* **These contours show the elevation and vertical distance above the sear or bench mark, and are the same all along a contour line.**



Hill **Depression**

Site Contours

- * The site plan is used by the estimator to compute the amount of cut and fill involved.
- * One way to calculate the amount of cut and fill is called the borrow pit method.
- \- This method required grid lines to be drawn lengthy over the site plan.
- \- These grids are drawn to scale, and their intersections site are plotted for elevation.
- \- These elevations at the intersections are determined by inter-polating between contour lines on the site plan.

Example:- <u>Fig. 2-2</u> Site Plan with Contours

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Top soil, Earth work, and Excavation

* Sometimes it is necessary to strip and store the loam or top soil covering the area to be graded, in this case
  - The volume of cut or fill has to be adjusted to compensate for this
* Some of the top soil may be stock piled for later use.
* The cost of excavating the material will be difficult to determine and it depends on:
  - type of soil
  - water encountered
  - pumping required
  - bracing of banks
  - length of haul
  - disposal of the excavated material

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* Bulk or mass excavation for basements and other large areas below grade is determined after site - clearing operation is estimated.

  Volume of bulk excavation = depth

  The excavation line around the building will have to beset back to allow for form work and the sloping of the cut.

  - The sloping of the cut depends on:
    type of the soil
    depth of the cut
    presence of the water
  - For undisturbed soil and no water present
    slope used for banks Horizontal/Vertical
    = 1:1 for sand and gravel
    1:2 for ordinary clay
    1:3-4 for stiff clay
  - Sometimes it is not possible to slope the banks and in this case - use sheet and brace the banks to prevent cave-ins

Swellage and Shrinkage

* In computing the cubic volume of an excavation or backfill provision should be made of swellage and shrinkage.

- Swell - increase in volume
- Shrink - decrease in volume by compaction (Fig. 6-11).

Material	Swellage factor	Compact	Shrinkage
Sand & gravel	1.10 - 1.18	(1.12)	0.95
Loam	1.15 - 1.25	(1.25)	0.90
Dense clay	1.20 - 1.35	(1.27)	0.90
Solid rock	1.40 - 1.60		

Actual amount of earthwork = volume of undisturbed soil X swellage factor

Example:

If an undisturbed volume of loam soil measures 80ft. X 100 ft. and has a depth of 8ft., then its volume, cy, would be

$$\text{Volume} = \frac{80 \times 100 \times 8}{27} = 2370 \text{ cy}$$

The actual volume of loam soil would be 1.20 times that amount

$$\text{Volume} = 1.20 \times 2370 = 2844 \text{ cy}$$

* The 474-CY increase in volume is due to the swellage of the loam soil during the process of excavation.

Utility and Drainage Trenches:

* Other than bulk or mass excavation, there are other excavation items need hard or special equipment for excavation, such items:
- utility trenches
- footings
- drainage trenches
- pits
- other special items

* The cost for excavation for such items are more expensive than bulk or mass excavation.

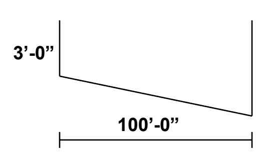
* In determining the volume of the soil to be hauled away, swellage factors should be used.

Drainage Trenches:

* Various types of drainage systems are required to remove sub-surface water.

* Since drainage trenches, such as sewer trenches, must have a slope, the computation of the depth of the trenches is based on an average depth.

Minimum slope 6in. Per 100 linear feet (LF)



Calculation of Excavation Volume:

If a slope 1/4" per foot : 25" for 100 ft.

2.08 ft. for 100 ft.

Average depth = 2.08/2 ft. = 1.04 ft.

Undisturbed Volume = (3'-0 + 1.04)ft. x width x length / 27

= (2.08/2 + 3.0) x 2.0 x 100/27 = 29.9 cy

Volume = Swellage factor x undisturbed volume

= 29.9 x 1.30 = 38.9 cy

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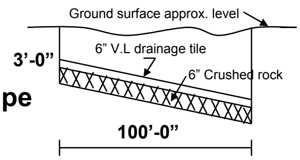
Back Fill



1) Determine the volume of the 6-in diameter pipe
2) Volume of the 6-in layoff crushed rock
3) Take the sum of these volumes from the computed excavation volume.
4) Applying a shrinkage factor for the particular soil type.

Assume the computed factor for the dense clay is 0.90

1. Volume of the 6-in diameter pipe = IIr^2 x L = 3.1416xCo.25)^{2}x100
   = 19.6 CF
2. Volume of 6 in. of crushed rock = 0.5 x 2.0 x 100 = 100 CF
   Total volumes = 19.6 + 100 = 119.6 CF
   = 4.4 cy
3. Volume of backfill required = Net Volume / Computed factor
   = (29.9 - 4.4)1.3/0.9 = 36.83

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Roads, Parking, and Walks:

* Consider sub-grade preparation
  - sub-drains
  - soil stabilization
  - sub-base course
  - base courses) tonnage unit is used
  - prime costs) and bought
  - asphalt paving needed)

  Concrete curbs and gutters is based on units of 100 linear feet.

Fences & Landscaping

* Estimate for fence is bound on - per linear foot of fence.
* Landscaping is usually subcontracted or quantity take off is required area of seeding, fertilizing, # of trees etc.