Quantity Take-off

Required Information for Cost Estimate

- Detailed drawings
- Specifications
- Available site data
- Available resource data (labor, material & equipment)
- Government regulations
- Applicable owner requirements
**Quantity Take-off**

**Contract Documents**

- Contract agreement
- General conditions
- Special conditions
- Bills of quantities
- Drawings
- Specifications
- Plans
- Others (Change orders, Warranty,...)

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**Quantity Take-off**

**Quantity Take-off**

- Quantity takeoff is necessary to perform a cost estimate
- The quantity of material in a project can be accurately determined from the drawing
- The estimator must make a complete and thorough job analysis
- The unit cost of different materials should be obtained from material suppliers
- Cost of delivery and wastage should be included
- The material quantity takeoff is extremely important for cost estimating
Quantity Take-off

Quantity Take-off: Why?

- **Owner perspective:**
  - Initial (preliminary) estimate of the project costs at the different stages of the project
  - Preparing the BOQ as a requirement of the contract documents
  - Estimating the work done for issuing the contractor payments

- **Contractor perspective:**
  - Pricing different work items
  - Identifying the needed resources (Labor, Equipment, etc.)
  - Project schedule
  - Preparing invoices for work done
  - Subcontractors payments
  - Review and control of crews production rates
Quantity Take-off Table

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<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Unit Price</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(LE)</td>
<td>($)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(LE)</td>
<td>($)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(LE)</td>
<td>($)</td>
</tr>
</tbody>
</table>

**Bill of Quantity: Sample**

**Section (D) - Earth Work**

- Reference shall be made to section (3) of specifications.

- Excavation in any type of soil (except rock) including stripping, berming of gravel and native soil and transportation of water either to stormwater networks or for disposal during the subsoil foundation

- Excavation period (between completion of filling), showing the amount of excavation works, transportation of excavated material to dumping areas approved by the organization and compensation for excavation outside the green covered volume.

- Excavation rate per cubic metre:
  - $1000$
  - $50$
  - $0$

- Excavation rate per cubic metre:
  - $10$
  - $0$
### Quantity Take-off

**Bill of Quantity: Sample**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>Item 1</td>
<td>5.0</td>
<td>m</td>
</tr>
<tr>
<td>3-2</td>
<td>Item 2</td>
<td>450</td>
<td>m</td>
</tr>
</tbody>
</table>

**Priced Bill of Quantity: Sample**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Unit</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Item 1</td>
<td>1800</td>
<td>$15</td>
</tr>
<tr>
<td>2</td>
<td>Item 2</td>
<td>26360</td>
<td>$25</td>
</tr>
<tr>
<td>3</td>
<td>Item 3</td>
<td>770</td>
<td>$30</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Quantity Take-off</th>
<th>Statement for payment</th>
</tr>
</thead>
</table>

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**Quantity Take-off**

**Word order**
- Items in takeoff sheets are organized in the same construction sequence
- Order of items in the same chapter:
  - Items estimated in cubic meter \((m^3)\)
  - Items estimated in square meter \((m^2)\)
  - Items estimated in linear meter \((m)\)
  - Items estimated in numbers (unit)
  - Items estimated in weight (ton)
  - Items estimated in lump Sum (L.S.)

---

**Volume of some shapes**

- **A**<sub>1</sub>=Top Area
  \[ h \]
  \[
  Volume = \frac{1}{3}h(A + A_1 + \sqrt{A.A_1})
  \]

- **A**=Bottom Area
  \[
  Volume = \frac{1}{2}r_1h(r^2 + r_1^2 + r.r_1)
  \]

- **Volume = Area of Base×Height**

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### Quantity Take-off

#### Units of Measurements
- **Each (numbers):** Piles, doors, Windows, Precast concrete, etc.
- **Length (meter):** Windows sills, Pipes, Skirts, stair steps, etc.
- **Area (Square meter):** Flooring, painting, plastering, Brick walls (12 cm or less), etc.
- **Volume (Cubic meter):** Brick walls (>12 cm thick), Excavation, Backfilling, Reinforced Concrete, etc.
- **Weight (Ton):** Metallic works, Reinforcement steel, etc.
- **Lump Sum:** Some electrical and plumbing works, Manholes, etc.
- **Effort (Man-day):** Renting of equipment or labor, etc.

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### Quantity Take-off

#### Measuring units

<table>
<thead>
<tr>
<th>Cubic meter (m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used for items such as:</td>
</tr>
<tr>
<td>- Excavation</td>
</tr>
<tr>
<td>- Filling</td>
</tr>
<tr>
<td>- Concrete</td>
</tr>
<tr>
<td>- Masonry</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Square meter (m$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used for items such as:</td>
</tr>
<tr>
<td>- Masonry</td>
</tr>
<tr>
<td>- Plastering</td>
</tr>
<tr>
<td>- Flooring</td>
</tr>
<tr>
<td>- Painting</td>
</tr>
</tbody>
</table>
## Quantity Take-off

### Measuring units

**Linear meter (m)**
- Used for items such as:
  - Oil pipe lines
  - Sewage water pipe lines
  - Canals

**Number (unit)**
- Used for items such as:
  - Electric outlets
  - Doors and windows
  - Sanitary fixtures

### Lump sum (L.S.)
- Used for items such as:
  - Manholes
  - Lifts
- Item is subcontracted when the contractor does not have enough experience to construct it or there is an item which has a small quantities of many work items, such as manholes.
Quantity Take-off

Preparation for quantity take-off

- Check the availability of drawings
- Check the axis and dimensions
- Check building levels and link it to structural drawings.
- Check doors and windows model numbers
- Check ground water levels

Quantity Take-off

Preparation for quantity take-off

- Check architectural against structural drawings
- Check foundation design and foundation levels
- Check construction members dimension and reinforcement.
- Review the contract conditions and specifications
Quantity Take-off

1. Storage
   - Each Ton
   - $m^3$
   - 75%

2. Work items
   - 95%

Quantity Take-off

Earth Works

- Backfilling
- Excavation
- Soil Transportation
- Leveling

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Quantity Take-off

Excavation (Cubic meter)

- Quantities are calculated based on the dimensions of the foundation in plans.
- Prices differ based on the soil type, deep of excavation, ground water level, site location, shoring system, Equipment used, etc.

<table>
<thead>
<tr>
<th>GWT</th>
<th>2 m</th>
<th>2 m</th>
<th>0.5 m</th>
<th>0.5 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet soil (0.5 m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry soil (2 m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Quantity Take-off**

**Backfilling (Cubic meter)**

Backfilling = Excavation – volume of all works inside the excavated pit (footings, smells, column necks, brickwork, etc.) + amount above GL (or – amount below GL)

**Leveling and Soil Transportation**

- **Leveling:**
  - Area ($m^2$) if thickness less than 30 cm
  - Volume ($m^3$) if thickness more than 30 cm

- **Transportation:**
  - Transported soil = vol. of exc. – vol. of backfilling + additional soil at site
  - Add swelling factor based on the soil type: 5% sandy soil, 15% clayey soil and 25% for demolition material. (owner or contractor)
Quantity Take-off

Earth Works: Example

Quantity Take-off

Plain concrete

- Quantity of P.C footing = No. of footings for a specific model * length * width * depth

- Total quantity of P.C footings = summation of P.C footing models
**Quantity Take-off**

**Ground beams**
- Quantity of ground beam = No. of ground beams for a specific model * length * width * depth
- Total quantity of ground beams = summation of ground beam models

![Ground beam model](image)

**Concrete Works**
- Measured exactly, deduct all openings except spaces required for reinforcement, piping and pre-stressed concrete cables.
- Plain concrete (PC):
  - $m^2$ if thickness <20 cm
  - $m^3$ if thickness ≥20 cm
  - Average thickness (thickness) should be mentioned
- Reinforced concrete (RC):
  - All RC elements measured
  - Hollow block slabs measured by area ($m^2$).
  - Domes, cylindrical roofs and shells measured by the horizontal projection.
Quantity Take-off

Columns

- Quantity of columns = No. of columns for a specific model * length * width * height
- Total quantity of columns = summation of columns models

Quantity Take-off

Slabs

- Solid slabs:
  - Quantity of slab = length * width * thickness

- Flat slab:
  - Quantity of slab = length * width * thickness

- Beams:
  - Quantity of beam = length * width * height
**Quantity Take-off**

**stairs**

- Quantity of stairs = inclined length * width * height + stair section area * stair width * No. of stairs

**Quantity Take-off**

**Brickworks Measurement**

- $m^2$ if thickness < 25 cm
- $m^3$ if thickness ≥25cm
- Deduct all openings
- Deduct half the area (volume) of arches
- Deduct all Concrete elements
- Facades are measured by area
- Separate item for each brick type

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**Quantity Take-off**

**Plastering**

- **Internal**
  - Engineering measurement by area (m²)
  - All openings are deducted
  - All openings sides are added
  - Inclined slabs are calculated based on their horizontal projection

- **External**
  - Measured by area (m²)
  - Deduct half the area of the openings ≥ 4 m²
  - Openings with areas <4 m² are kept without deduction
  - Cantilever slabs < 1 m projection not added
  - Add half the area of cantilever slabs ≥ 1 m

---

**Example**

```
   4.8m
  1έ  2δ  1έ

1έ

1έ  2δ

1έ

5.6m

1έ  2δ  1έ
```

- 1έ: 15 cm
- 7φ10/m
- 7φ12/m
- 2δ

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It is required to estimate the quantities of the following jobs:

- Excavation (كميات الحفر)
- Plain Concrete Footings (خرسانة القواعد العادية)
- Reinforced Concrete Footings (خرسانة القواعد المسلحة)
- Ground Beams concrete (خرسانة السطح)
- Backfilling (كميات الرمل)
- Columns concrete (خرسانة الأعمدة)
- Slab and beams Concrete (خرسانة البلاطات وكمرات السقف)
- Slab and beams Reinforcement (حديد تثبيت البلاطات وكمرات السقف)
### Quantity Take-off

**Example: Excavation**

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Unit</th>
<th>Number</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excavation</td>
<td>m³</td>
<td>4</td>
<td>1.6</td>
<td>1.6</td>
<td>1.2</td>
<td>12.288</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td>3.7</td>
<td>0.3</td>
<td>0.5</td>
<td>1.11</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td>2.9</td>
<td>0.3</td>
<td>0.5</td>
<td>0.87</td>
</tr>
</tbody>
</table>
**Quantity Take-off**

**Example: PC footings**

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Unit</th>
<th>Number</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>PC Concrete</td>
<td>m³</td>
<td>4</td>
<td>1.6</td>
<td>1.6</td>
<td>0.3</td>
<td>3.072</td>
</tr>
</tbody>
</table>

1.6 m

0.3 m

1.6 m

**Quantity Take-off**

**Example: RC footings**

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Unit</th>
<th>Number</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>RC Concrete</td>
<td>m³</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0.4</td>
<td>1.6</td>
</tr>
</tbody>
</table>

1.0 m

0.4 m

1.0 m
### Example: ground beams

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Unit</th>
<th>Number</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Ground Beams</td>
<td>m3</td>
<td>2</td>
<td>5.3</td>
<td>0.3</td>
<td>0.5</td>
<td>1.59</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>4.5</td>
<td>0.3</td>
<td>0.5</td>
<td></td>
<td>1.35</td>
</tr>
</tbody>
</table>

### Example: Backfilling

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Unit</th>
<th>Number</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
<th>Subtotal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excavation</td>
<td>m3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.27</td>
</tr>
<tr>
<td>2</td>
<td>PC Concrete</td>
<td>m3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.07</td>
</tr>
<tr>
<td>3</td>
<td>RC Concrete</td>
<td>m3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.60</td>
</tr>
<tr>
<td>4</td>
<td>Ground Beams</td>
<td>m3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.94</td>
</tr>
<tr>
<td>5</td>
<td>Total Concrete</td>
<td>m3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.61</td>
</tr>
<tr>
<td>5</td>
<td>Filling</td>
<td>m3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.66</td>
</tr>
</tbody>
</table>
### Quantity Take-off

**Example: Columns**

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Unit</th>
<th>Number</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Columns Concrete</td>
<td>m3</td>
<td>4</td>
<td>0.3</td>
<td>0.3</td>
<td>3</td>
<td>1.08</td>
</tr>
</tbody>
</table>

| Example: Slabs and beams |

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Unit</th>
<th>Number</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Slab &amp; Beams</td>
<td>m3</td>
<td>2</td>
<td>5.3</td>
<td>0.3</td>
<td>0.5</td>
<td>1.59</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>4.5</td>
<td>0.3</td>
<td>0.5</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>5</td>
<td>4.2</td>
<td>0.15</td>
<td>3.15</td>
</tr>
</tbody>
</table>
### Example: Summary sheet

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Unit</th>
<th>Number</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excavation</td>
<td>m3</td>
<td>15.27</td>
<td></td>
<td></td>
<td></td>
<td>14.27</td>
</tr>
<tr>
<td>2</td>
<td>PC Concrete</td>
<td>m3</td>
<td>3.07</td>
<td></td>
<td></td>
<td></td>
<td>3.07</td>
</tr>
<tr>
<td>3</td>
<td>RC Concrete</td>
<td>m3</td>
<td>1.60</td>
<td></td>
<td></td>
<td></td>
<td>1.60</td>
</tr>
<tr>
<td>4</td>
<td>Ground Beams</td>
<td>m3</td>
<td>2.94</td>
<td></td>
<td></td>
<td></td>
<td>2.94</td>
</tr>
<tr>
<td>5</td>
<td>Filling</td>
<td>m3</td>
<td>6.66</td>
<td></td>
<td></td>
<td></td>
<td>6.66</td>
</tr>
<tr>
<td>6</td>
<td>Columns Concrete</td>
<td>m3</td>
<td>1.08</td>
<td></td>
<td></td>
<td></td>
<td>1.08</td>
</tr>
<tr>
<td>7</td>
<td>Slab &amp; Beams</td>
<td>m3</td>
<td>6.09</td>
<td></td>
<td></td>
<td></td>
<td>6.09</td>
</tr>
<tr>
<td></td>
<td><strong>Total Concrete</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>14.78</strong></td>
</tr>
</tbody>
</table>

### Example: Reinforcement

2φ16 علوية + 4φ16 علوية و دائرية دل و أسطوانات D2.5
0.3m x 0.5m
قطع الكرات ك 24,1

30cm
2.5cm ↔ 2.5cm
25cm
50cm 45cm

7φ10/m
7φ12/m
## Quantity Take-off

**Example: Reinforcement**

<table>
<thead>
<tr>
<th>Unit (kg)</th>
<th>No. of bars</th>
<th>Length</th>
<th>Total length</th>
<th>Unit Weight</th>
<th>Total Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 upper (beams)</td>
<td>4</td>
<td>4.8</td>
<td>19.2</td>
<td>1.63</td>
<td>31.296</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>5.6</td>
<td>22.4</td>
<td>1.63</td>
<td>36.512</td>
</tr>
<tr>
<td>16 lower (beams)</td>
<td>8</td>
<td>4.8</td>
<td>38.4</td>
<td>1.63</td>
<td>62.592</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>5.6</td>
<td>44.8</td>
<td>1.63</td>
<td>73.024</td>
</tr>
<tr>
<td>10 long (Slab)</td>
<td>34</td>
<td>5.6</td>
<td>190.4</td>
<td>0.63</td>
<td>119.952</td>
</tr>
<tr>
<td>12 short (Slab)</td>
<td>40</td>
<td>4.8</td>
<td>192</td>
<td>0.92</td>
<td>176.640</td>
</tr>
<tr>
<td>8 stirrup (beams)</td>
<td>60</td>
<td>1.55</td>
<td>93</td>
<td>0.41</td>
<td>38.130</td>
</tr>
<tr>
<td></td>
<td>51</td>
<td>1.55</td>
<td>79.05</td>
<td>0.41</td>
<td>32.411</td>
</tr>
<tr>
<td><strong>Total Steel</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>570.557</strong></td>
</tr>
</tbody>
</table>