

## 2.2.5. Cost estimating

### Overview of Estimation Methods

Cost estimating is essential for cost planning and budgeting and takes place in all stages of project development. Methods for cost estimation vary as the project evolves from the early stages of conception to the construction phase. In principle, as the project evolves, more information becomes available thus more accurate may be estimation and more precise may be estimation methods. Accordingly, estimation methods may be grouped as follows (expected precision is indicated between brackets):

- Estimation methods at the inception stage (30% to 50%);
- Design phase estimation methods (15% to 30%);
- Construction phase estimation methods (5% to 15%).

The fundamental difference between methods included in the first two classes and those included in the last class above is that the former depend on reliable historical cost data whereas the latter follow an analytical approach based on the costs of resources required for project completion. Moreover, the accuracy of estimation during the design phase increases as more information on the project is released by the design team. Table 1 below lists a few methods currently used in construction and classifies them according to the project phase for which they are appropriate. Note that the design phase is divided into three sections for three stages of design development.

Table 1: Estimating methods.

Classes of estimating	Estimating methods	Inception phase	Design phase	Construction phase
Guess estimating	"Blue sky" Cost comparison	■		
Single-rate approximate estimating	Cost per unit Floor area method Building volume method Storey enclosure method	■	■ ■ ■ ■	
Multiple-rate approx. estimating	Elemental cost plans Approximate quantities		■ ■ ■	
Analytical estimating	Unit rate estimating Operational estimating			■

Although guess-estimating may not be considered a methodology for estimating, it is sometimes useful for a preliminary educated guess on the approximate amount of investment required for the project.

**Single rate approximate estimating**

**Cost per unit**

The cost per unit is commonly used by national and international bodies such as education services, health services and office building investors at the inception stage of project development. It is adequate for preliminary estimating of some type of building facilities for which there is recent comparable unit data available. The total cost of the project will be given by:

Total cost = cost per unit x number of units.

Units to consider will be dependent of the type of building, for example, theatre seat, car park place, hotel bedroom, hospital bed space, etc. Obviously, for unit cost data to be reliable, it must come from a significant number of buildings of the same type, and ought to be updated to take into consideration cost depreciation over time. The method is very easy to use but may be rather imprecise even for the inception stage, for which a poor degree of precision is expected (say, 30% to 50%). For this reason, it is sometimes recommended that ranges of values instead of single values may be used for unit costs.

However, clients tend to use it very often for budgeting purposes. For example, if a client has a certain amount of money to spend in a facility, then it may be possible to consider the likely number of functional units to provide within the target cost available. Conversely, if the client decides to build up a hotel of 50 bedrooms, and historical data shows that for similar quality standard the cost of a bedroom is, say, between €15 000 and €20 000, then the client knows that the expected budget for the project ranges between €750 000 and €1 000 000.

### **Floor area method**

The floor area method is very popular in many European countries because of its simplicity. It is also adequate for preliminary estimating but obviously needs some more information from the project than the cost per unit method described above. The total cost of the project will be given by:

Total cost = cost per square meter x total project area.

In order to use the method, the building must be first measured by its internal dimensions at each floor level. No deductions are made for internal walls, ducts, lifts or stair cases. The costs of previous similar buildings are used to establish a sound cost per square meter that can be used for calculation of the total project cost by using the above expression.

Adjustments may be made to historical data for location and inflation. Subjective judgement may also be needed for establishing the adequate cost per square meter to use. For example, the standard of finishes, the shape of the building and the number of storeys may possibly unbalance average data collected from similar buildings.

In a more comprehensive version of the method, different types of floor areas and corresponding costs per square meter are taken into consideration. Table 2 depicts the breakdown of a dwelling, measured areas for each floor type and corresponding historical

costs per square meter. This requires more information on the project, obviously coming from a later stage of design than above, and implies the availability of historical data in a more detailed fashion than just a global figure per square meter as in the standard version of the method. But it can lead to much better results and avoid some subjective judgements. In a way, this variant of the cost per square meter method may be considered a multiple rate estimating and be included in the second class of Table 1.

Table 2: Dwelling project breakdown.

<b>Type of areas</b>	<b>Quantity (m<sup>2</sup>)</b>	<b>Cost/m<sup>2</sup> (€)</b>	<b>Total cost (€)</b>
Basement for car parking	1 100	350	385 000
Ground floor common access areas	350	400	140 000
Common floor areas	900	600	540 000
Apartment areas	4 000	740	2 960 000

In current construction practice, separate assessments are usually made for some works that, due to their great variety and cost, may significantly alter the total building cost appraisal. This is the case of foundations, external works, incoming services, drainage etc. Therefore, costs considered in Table 2 above do not include those works.

Parallel to the floor area method which is building specific, single rate estimating methods may be used for certain external works, especially in road and railway projects. The advantages and limitations of these methods are identical to those described above. Similarly, instead of using a single rate value, distinct rates for specific works may be adopted. Table 6.3 below shows an example of a municipal road project where the main works and rates are identified.

Table 3: Municipal road project breakdown.

<b>Type of works</b>	<b>Quantity</b> (m <sup>2</sup> )	<b>Cost/m<sup>2</sup></b> (€)	<b>Total cost</b> (€)
Land acquisition	70 000	7,5	525 000
Earth movements	95 000	3,2	304 000
Paving	60 000	30,0	1 800 000

Civil engineering works like earth supporting structures and bridges may be valued separately because the variability of associated costs is likely to distort the final cost appraisal.

### **Building volume method**

The building volume method is specific for building projects and aims to overcome the current criticism to the floor area method that does not take into account possible variations of the storey height. The building volume method became very popular in some European countries like in Germany and Switzerland, where building costs are often expressed in cubic meter prices. The total cost of the project will be given by:

Total cost = cost per cubic meter x total project volume.

In order to use the method, the building volume must be first assessed and explicit rules exist in some countries for that purpose. Buildings with distinct types of occupation should have corresponding volumes assessed separately, for example, car park areas, shopping areas and office areas in a commercial building. Specific works like excavations, foundations and external works ought to be assessed separately by using cost comparisons or approximate quantities, for example.

Costs per cubic meter may be difficult to find in countries where the method is not current. Actually, such costs depend on a number of variables, like building types, proportion of wall area per floor area, quality of finishes and so on.

### **Storey enclosure method**

When this method was suggested, it aimed at overcoming the problems detected in other single-rate estimating methods, by taking into account variations in plan shape and storey height. Unfortunately, the method was never totally adopted by construction professionals

because it requires much more calculations than other single-rate methods and because the rates needed cannot be directly extracted from historical data.

Basically, the utilisation of the method starts with the measurement of the building enclosure (comprising floors, external walls and roof areas). Each area is then multiplied by an appropriate weighting factor, thereby resulting the number of storey enclosure units. The following weighting factors are used:

- Floor areas, measured from the internal face of external walls: basements x 3; ground floor x 2; first floor x 2,15; second floor x 2,30 and add 0,15 for each successive floor.
- Roof areas, measured in its plan projection, to the extremities of eaves: roof x 1.
- External wall areas, measured on the external face of the walls: basement wall area x 2; above ground level (without any deduction for openings x 1.

The total cost of the project will be given by:

Total cost = unit cost rate x number of storey enclosure units

Additions should then be made for services, unusual foundations, external works and external services. Table 4 shows an example of calculation of the total cost of and five storey building by using the storey enclosure method.

Table 4: Example for the storey enclosure method.

<b>Type of areas</b>	<b>Quantity (m<sup>2</sup>)</b>	<b>Weighting factor</b>	<b>Storey enclosure units</b>
<b>Floor areas</b>			
Basement	200	3	600
Ground floor	250	2	500
First to fourth floor	160	9,5	1 520
Fifth floor	120	2,75	330
Roof area	160	1	160
<b>Wall areas</b>			
Basement	150	2	300
Ground floor to roof	740	1	740
<b>Storey enclosure units</b>			<b>4 150</b>

Allowing the cost per unit of €200, the cost of the building will be:

$$\text{Total cost} = 4\,150 \times 200 = \text{€}830\,000$$