

7. COST CALCULATION

7.1 General

In Fig. 7.1.1, the part (tab) of the logical flowchart of EUCON[®] is presented for the calculation of the concrete production cost, as well as for the surcharges from the various protection measures against carbonation and chloride ingress. The tab contains:

- a field that the user introduces the **input data** as regards the *purchase cost of constituent materials* for concrete composition.
- a field that the user introduces the **input data** as regards the *other costs for concrete production, transportation and delivery*.
- a field that the user introduces the **input data** as regards the *additional cost of the protection measures, if any*.
- **calculation buttons**, for estimation of the total purchase cost of the constituents and the total concrete production cost.

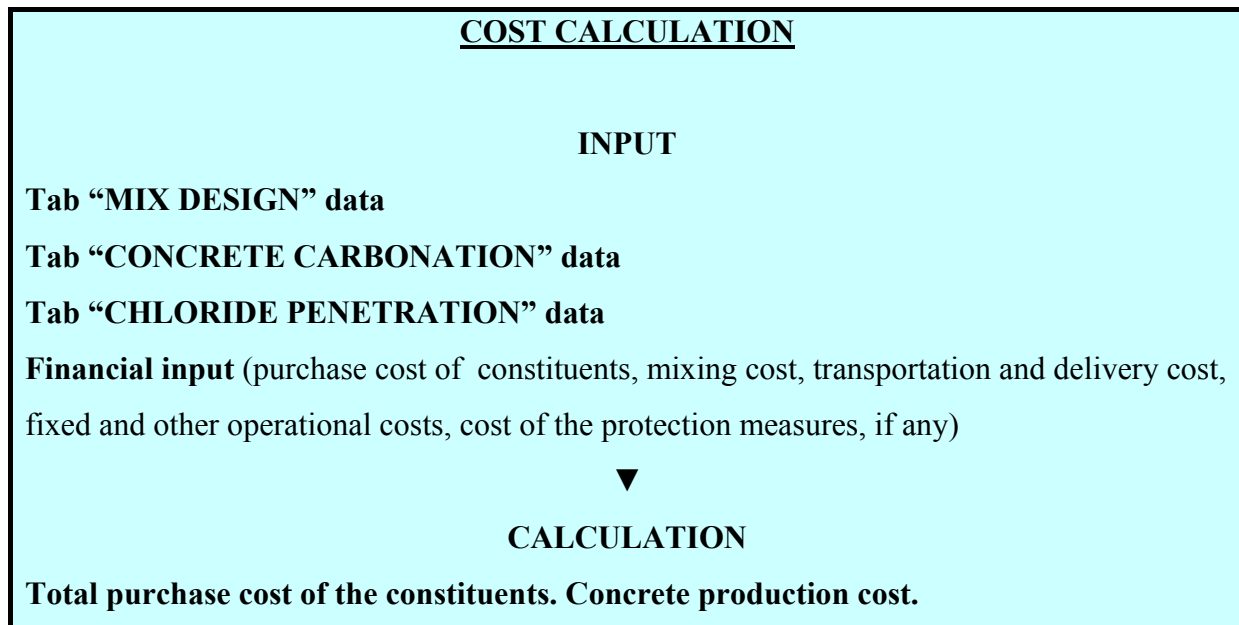


Figure 7.1.1 Logical diagram for computer calculation of concrete production cost.

A general view of this tab is given as Fig. 7.1.2. The user has to fill in the “white boxes” or to accept the default values, and then to press the calculation buttons in order to have an estimation of the concrete production cost, as well as of the surcharges from the various protection measures used. For the mathematical formulae used for these calculations and further questions, **please always advise the *Theoretical Background* [1], chapter 7**. In the sequence, each part of this tab is discussed in detail.

The screenshot displays the 'EUCON' software window with the 'COST CALCULATION' tab selected. The interface is organized into several sections:

- PURCHASE COST OF CONCRETE CONSTITUENTS:** This section contains input fields for various materials:
 - Cement value, UC: 0.085 €/kg
 - Type I additions value, UTI: 0.006 €/kg
 - Fly ash value, UF: 0.016 €/kg
 - Silica fume value, US: 0.16 €/kg
 - Aggregate value, UA: 0.0056 €/kg
 - Water value, UW: 0.0015 €/kg
 - Retarder value, UDR: 0.3 €/kg
 - Superplasticizer value, UDS: 0.7 €/kg
 A red checkmark is visible next to the 'Calculate' button. The result is: **Purchase cost of constituent materials for concrete composition, KP: 41.58 €/m3 concr.**
- CONCRETE PRODUCTION COST:** This section includes:
 - Mixing cost, KM: 1.75 €/m3 concr.
 - Transportation and delivery cost, KB: 3.5 €/m3 concr.
 - Fixed and other operational costs, KG: 3 €/m3 concr.
 A red checkmark is visible next to the 'Calculate' button. The result is: **Total production cost of concrete, KT: 49.83 €/m3 concrete**
- ADDITIONAL COSTS for CONCRETE PROTECTION:** This section contains two expandable areas:
 - Cement - lime mortar coating for additional protection against concrete carbonation:** For the required "cement/lime mortar coating" quality and quantity and the application technique used, **add** the respective cost: [] €/m² concrete or [] €/m³ concrete.
 - Corrosion inhibiting admixture for additional protection against corrosion:** For the required "corrosion inhibiting admixture" quality and quantity and the application technique used, **add** the respective cost: [] €/m² concrete or [] €/m³ concrete.

Figure 7.1.2 General view of the tab “COST CALCULATION” of the EUCON® program.

7.2 Purchase cost of concrete constituents

All the following costs represent the value of the concrete constituent materials as they delivered in the ready mix plant or the place where the concrete is manufactured (including transportation to the plant premises).

Cement value, UC:	Introduce the value of cement per weight unit. UNITS: €/kg DEFAULT VALUE: 0.085 €/kg (CEM I)
Type I additions value, UTI:	Introduce the value of Type I additions (filler aggregates and/or pigments), if any, per weight unit. UNITS: €/kg DEFAULT VALUE: 0.006 €/kg (filler aggregate)
Fly ash value, UF:	Introduce the value of fly ash (Type II addition), if any, per weight unit. UNITS: €/kg DEFAULT VALUE: 0.016 €/kg
Silica fume value, US:	Introduce the value of silica fume (Type II addition), if any, per weight unit. UNITS: €/kg DEFAULT VALUE: 0.160 €/kg
Aggregate value, UA:	Introduce the value of aggregates per weight unit. UNITS: €/kg DEFAULT VALUE: 0.0044 €/kg
Water value, UW:	Introduce the value of water per weight unit. UNITS: €/kg DEFAULT VALUE: 0.0015 €/kg
Admixture value, UDi:	Introduce the value of the each specific admixture used, per weight unit of the admixture as delivered. UNITS: €/kg DEFAULT VALUE: 0.30 €/kg (for retarder), 0.75 €/kg (for accelerator), 0.70 €/kg (for air-entraining), 0.42 €/kg (for plasticizer), 0.70 €/kg (for superplasticizer), 1.00 €/kg (for other admixture:

	corrosion inhibitor)
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Click on the “**Calculate**” button to estimate the purchase cost of the constituent materials.

Calculation

Purchase cost of constituent materials for concrete composition, KP:	<p>This cost is estimated from the equation:</p> $KP = C.UC + TI.UTI + F.UF + S.US + A.UA + WA.UW + \Sigma(UDi \cdot dosage\ i / 100 \cdot C)$ <p>(The admixture i dosage is the kg admixt./100 kg cement)</p> <p>UNITS: €/m³ concrete</p>
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7.3 Concrete production cost

Mixing cost, KM:	<p>Introduce the cost of material mixing and preparation of the fresh concrete.</p> <p>UNITS: €/m³ concrete</p> <p>DEFAULT VALUE: 1.75 €/m³ (includes energy, labour, maintenance)</p>
Transportation and delivery cost, KB:	<p>Introduce the cost of transportation and delivery of the fresh concrete.</p> <p>UNITS: €/m³ concrete</p> <p>DEFAULT VALUE: 3.50 €/m³ (includes fuels, labour, maintenance)</p>
Fixed and other operational costs, KG:	<p>Introduce the fixed cost of purchase and establishment of equipment for concrete production, transportation and delivery (depreciation values), other labour and administration costs and general operational costs.</p> <p>UNITS: €/m³ concrete</p> <p>DEFAULT VALUE: 3.00 €/m³ (includes fuels, labour, maintenance)</p>

Click on the “**Calculate**” button to estimate the total production cost of concrete.

Calculation

Total production	This total cost is estimated from the equation:
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cost of concrete,	$KT = KP + KM + KB + KG$
KT:	UNITS: €/m ³ concrete

7.4 Additional costs for concrete protection

If additional protection measures are applied to reduce or eliminate the **concrete carbonation**, they have to be taken into account in the cost considerations. Two general protection measures may be applied, as given in the “Concrete Carbonation” tab: *waterproof sealants* or *cement – lime mortar coatings*. If they have been used, then the following will appear:

- Waterproof sealant for additional protection against concrete carbonation

For the required “waterproof sealant” quality and quantity and the application technique used, **add** the respective cost: _____ €/m² concrete or _____ €/m³ concrete.

- Cement – lime mortar coating for additional protection against concrete carbonation

For the required “cement/lime mortar coating” quality and quantity and the application technique used, **add** the respective cost: _____ €/m² concrete or _____ €/m³ concrete.

If additional protection measures are applied to reduce or eliminate the **chloride penetration and/or the steel corrosion**, they have to be taken into account in the cost considerations. Several protection measures may be applied, as given in the “Chloride Penetration” tab. If they have been used, then the following will appear:

- Corrosion inhibiting admixture for additional protection against corrosion

For the required “corrosion inhibiting admixture” quality and quantity and the application technique used, **add** the respective cost: _____ €/m² concrete or _____ €/m³ concrete.

- Corrosion-resistant stainless steel reinforcing bars or epoxy-coated conventional bars

For the required “specific reinforced bar” quality, **add** the surcharges in cost: _____ €/m³ concrete.

- Cathodic protection of the reinforcement for additional protection against corrosion

For the required materials and “cathodic protection” used, **add** the surcharges in cost: _____ €/m³ concrete.

● *Impregnation technique for additional protection against chlorides and corrosion*

For the required materials and “impregnation technique” used, **add** the respective cost: _____ €/m² concrete or _____ €/m³ concrete.

● *Protective coating for additional protection against chlorides and corrosion*

For the required “protective coating” quality and quantity and the application technique used, **add** the respective cost: _____ €/m² concrete or _____ €/m³ concrete.

7.5 Final optimization and reporting _____

By obtaining the above final estimation for the *concrete production cost and any other additional costs* as regards concrete protection against carbonation, chlorides and corrosion, you may:

- **accept the cost results, as well as and the previous strength and durability results, and terminate the design procedure.**
- **Otherwise, you may change any input data mainly from the tab “MIX DESIGN” or other tabs where specific protection measures are proposed, in order to correct the output results of this tab, until final acceptance.**

By using the separate actions such as **Reports** or **Exit**, the user may create a report file or, finally, exit.