

Benchmark 1: Concrete cover according EC2 clause 4.4

Project file: **EN2_Benchmark1.esa**

Scia Engineer Version 11.0.144

Introduction

This benchmark concerns *Example 4.1: Design the concrete cover of a reinforced concrete beam with exposure class XC1 of Eurocode 2 - WORKED EXAMPLES, The European Concrete Platform ASBL, May 2008.*

The concrete in use has resistance class C25/30.
Bottom longitudinal bars are 5 \varnothing 20; the stirrups are \varnothing 8 at 100 mm.

The max aggregate size is: $d_g = 20$ mm (< 32 mm).
The design working life of the structure is 50 years.
Normal quality control is put in place.

Reference Results

The reference gives following results:
From table 4.3N for exposure class XC1 and concrete resistance class C25/30, we see that Structural class S4 is used.

with
 $c_{\min,b} = 8$ mm

From table 4.4N we obtain:

$c_{\min,dur} = 15$ mm

Moreover:

$\Delta c_{dur,\gamma} = 0$

$\Delta c_{dur,st} = 0$

$\Delta c_{dur,add} = 0$

From relation (3.2):

$c_{\min} = \max(c_{\min,b}; c_{\min,dur} + \Delta c_{dur,\gamma} - \Delta c_{dur,st} - \Delta c_{dur,add}; 10 \text{ mm}) = \max(8; 15 + 0 - 0 - 0; 10 \text{ mm}) = 15 \text{ mm}$

Moreover:

$\Delta c_{dev} = 10$ mm

We obtain from relation (3.1)

$c_{nom} = c_{\min} + \Delta c_{dev} = 15 + 10 = 25$ mm

Next is calculated concrete cover for longitudinal reinforcement

$$c_{nom} = 30 \text{ mm}$$

The concrete cover for stirrups is “dominant”, because $25 + 8 = 33 \text{ mm}$. It is more than 30 mm from calculation of concrete cover for longitudinal reinforcement.

Scia Engineer Results

1. Concrete member data

| Beam type | Input for sides | Structural class | $c_{min,dur}$ [mm] | Δc_{dur} [mm] | $c_{min,b}$ [mm] | c_{min} [mm] | Δc_{dev} [mm] | c_{nom} [mm] |
|-----------|-----------------|------------------|-----------------------|--------------------------|---------------------|-------------------|--------------------------|-------------------|
| beam | * | S4 | 15 | 0 | 12 | 15 | 10 | 25 |

2. Concrete member data

| Beam type | Type | Material | Diameter [mm] | Number of cuts | Concrete cover [mm] |
|-----------|----------|----------|------------------|----------------|------------------------|
| beam | Lower | B 400A | 20,0 | | 25 |
| | Upper | B 400A | 20,0 | | 25 |
| | Stirrups | B 400A | 8,0 | 2 | |

3. Materials

| Name | Type | Stone diameter (d_g) [mm] |
|--------|----------|----------------------------------|
| C25/30 | Concrete | 20 |

Comments

- In Scia Engineer in design defaults is necessary to set correct exposure class on XC1 (default is XC3)
- In Scia Engineer in material library is necessary to set correct stone diameter on $d_g = 20 \text{ mm}$ for used concrete material (C25/30), default d_g is 32 mm.
- Results are equal to reference.
- $c_{min,b}$ calculated in Scia Engineer is 12 mm. It is correct because we have longitudinal reinforcement diameter 20 mm and shear diameter 8 mm. Subtract is 12 mm and it is bigger than diameter of shear so $c_{min,b} = 12 \text{ mm}$.