



Introduction

In this document the approval for the product Bole® according ETA-13/0076 (dated 12 march 2013) is evaluated for use in Denmark. The approval is based on the general version of Eurocode 2 and without change applicable in for instance Germany and Holland. This evaluation shows the relevant articles in the Danish national application document which might lead to differences and how these differences effect the statical calculation for the product Bole®.

Relevant differences between DS/EN1992-1-1 and EN1992-1-1

The ETA-13/0076 Annexes 12 & 13 describes the process to determine the punching shear resistance using the product Schöck Bole®. The method is implemented in the Eurocode2 based on EN1992-1-1 article 6.4.5(5).

When we follow the steps in the designing process, some formulas refer to the Eurocode, other values are based on testing and can be used without change, but of course the required material properties must be guaranteed. Relevant differences our found in two sections of Eurocode 2: 2.4.2.4(1) material properties and 6.4.3 Punching shear calculation.

Annex 12, first paragraph:

Punch is checked on the outer control perimeter $1,5 \times d$ from the outer dowel. According DS/EN1992-1-1: 6.4.5(4) this check may be performed at $2,0 \times d$. The standard values of EN1992 will be used to be sure that the performed tests are assuring the required safety level. This leads to conservative answers and is therefore safe.

Formula A3:

The applied value for γ_c in this formula is 1,5. According DS/EN1992-1-1 tabel 2.1NA this value is 1,45. The standard value of EN1992 = 1,5 will be used to be sure that the performed tests are assuring the required safety level. This leads to conservative answers and is therefore safe. The used value for $v_{min} = (0,0525/1,5) \cdot k^{3/2} \cdot f_{ck}^{1/2}$. According DS/EN1992-1-1:6.2.2(1): $v_{min} = (0,051/1,45) \cdot k^{3/2} \cdot f_{ck}^{1/2}$ which results in the same answer.

Formula A7:

The applied safety factor $\gamma_s=1,15$. In DS/EN1992-1-1 tabel 2.1NA a value of $1,2 \times \gamma_3$ is prescribed. As the materials for Bole® are under continuous factory production control, the values of γ_3 may be set to 0,95. This means that the factor $\gamma_s=0,95 \times 1,20 = 1,15$ resulting in the used values and comprehensive with the performed tests.

Conclusions

The national parameters used in Denmark equal the applied values or are more favourable. Therefor calculations performed with the Schöck Bole-software guarantee the required safety level a can be used without any change. The reinforcement surrounding the dowels must meet both the requirement in ETA-13/0076 and the requirements in DS/EN1992-1-1.