BDU+ – Flush Beam

Contents

Basic Documentation – Overview

In addition to the individual program manuals, you will find basic explanations on the operation of the programs on our homepage www.frilo.com in the Campus-download-section.

Application options

This software allows you to analyse girders fitted flush to the surface of reinforced concrete ceilings in accordance with EC2. The girder can be an intermediate support or an end support of the reinforced concrete slab. It can be pinned or restrained, either on the left, on the right or on both sides.

The software application performs the following separate calculations:

- Required bending reinforcement
- Required shear reinforcement
- Required transverse reinforcement in the support area

Available standards

- DIN EN 1992:2012
- DIN EN 1992:2013
- DIN EN 1992:2015
- ÖNORM EN 1992:2011

Bases of design

The bases of calculation are provided by DIN EN 1992-1-1 and its National Annex or ÖNORM B 1992-1-1 and by Booklet 240 of the German Committee for Reinforced Concrete (DafStb).

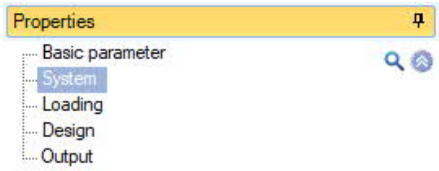
Data entry

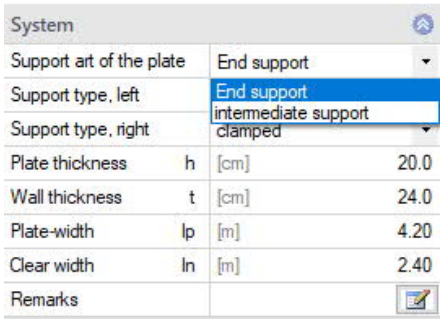
Basic parameters

Select the standard, the design situation (permanent/transient, accidental) and the material.

Structural system

Type of support	end support or intermediate support
Kind of support	restrained or pinned
h	plate thickness
t	wall thickness
lp	plate width
ln	clear width





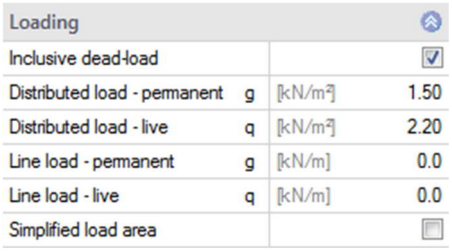
Loading

The loads are defined separately for g and q with their characteristic values.

You can define area loads and line loads.

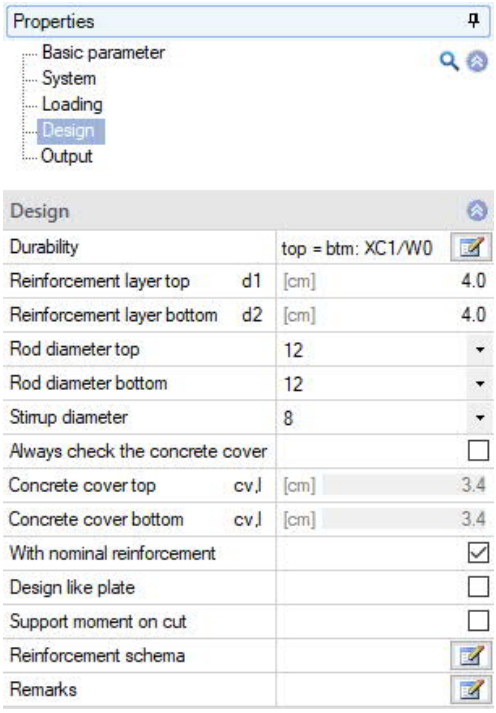
The options allow you to select whether simplified load areas or load areas calculated with a load propagation below 60 ° should be used.

You can optionally include self-weight or exclude it.



Design

Define first the Durability in a separate dialog.



...diameter	select the bar/stirrup diameter from a list.
Concrete cover top/bottom	indication of the location of the reinforcing steel
Design as a plate:	the default setting is the design of a beam as specified by the standard. When you check this option the shear reinforcement is designed as a plate.
Support moment in the support face	when you check this option, the support moment is determined at the edge of the support (in the support face). When the option is unchecked, the moment is calculated in the system axis and the moment curve is radiused.
Reinforcement scheme	presented on the graphic screen

The design of girders flush to the ceiling surface is performed in accordance with reference /3/ with a relation of the length of the missing support l to the slab thickness h of 7 < l/h < 15. For beams that satisfy the condition l/h < 7, constructive reinforcement is sufficient, under normal conditions, and additional verifications are not required. For beams where l/h > 15 and slabs where the support is discontinuous, additional verifications need to be performed.

The effective widths in the span area, in the support area and for the shear design are determined as follows:

b_M	For interior supports	For slab end supports
b_M	$0.5 \cdot l_{eff}$	$0.25 \cdot l_{eff}$
b_{Ms}	$0.25 \cdot l_{eff}$	$0.125 \cdot l_{eff}$
b_Q	t + d	t + 0.5 * d

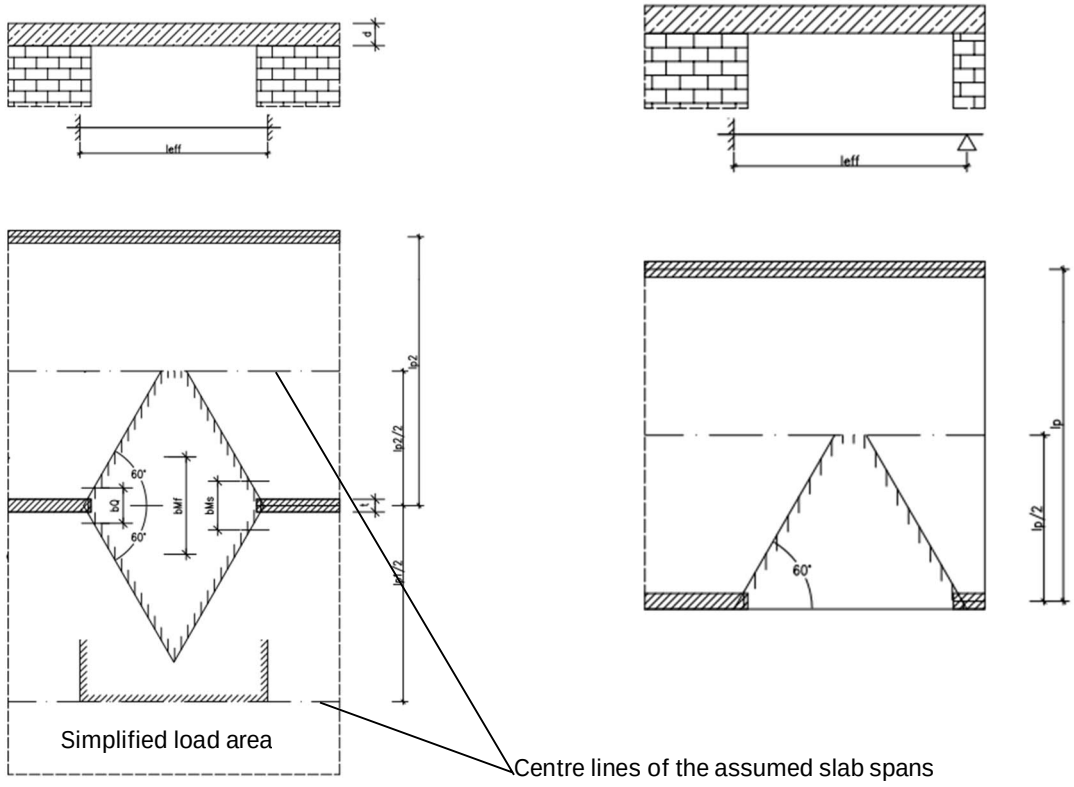
b_{Mf} effective width in the span area of the flush girder

b_{Mf} effective width in the support area of the flush girder

b_{Mf} effective width for the shear design of the flush girder

l_{eff} structural length. The structural length is determined by multiplying the clear width *ln* with the factor 1.05.

Effective widths and loaded areas



The loaded areas are determined by the 60° lines drawn from the theoretical support points and by the centre lines of the respective slab spans. Optionally, you can simplify the calculation by using the half of the slab support distance.

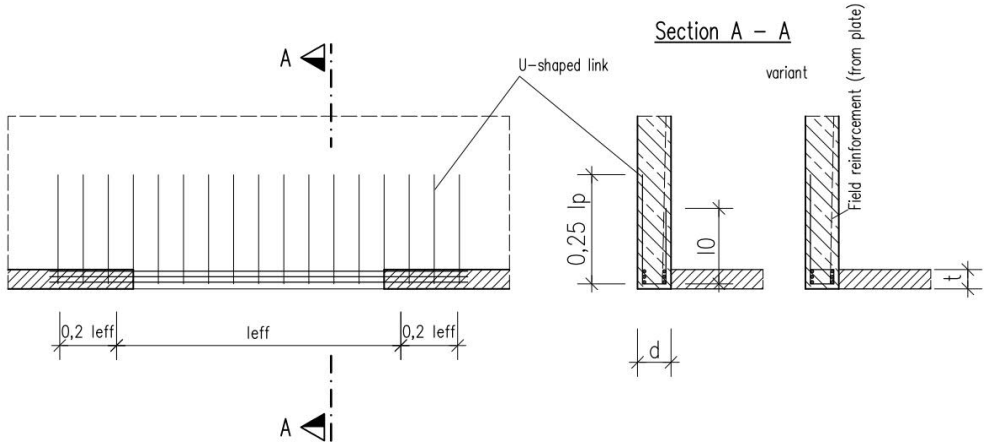
Additional reinforcement at the slab end support

The required transverse stirrup reinforcement is determined as follows:

req. as_{trans} = h[cm] / 10[cm^2/m] reinforcement ratio of 0.1 %

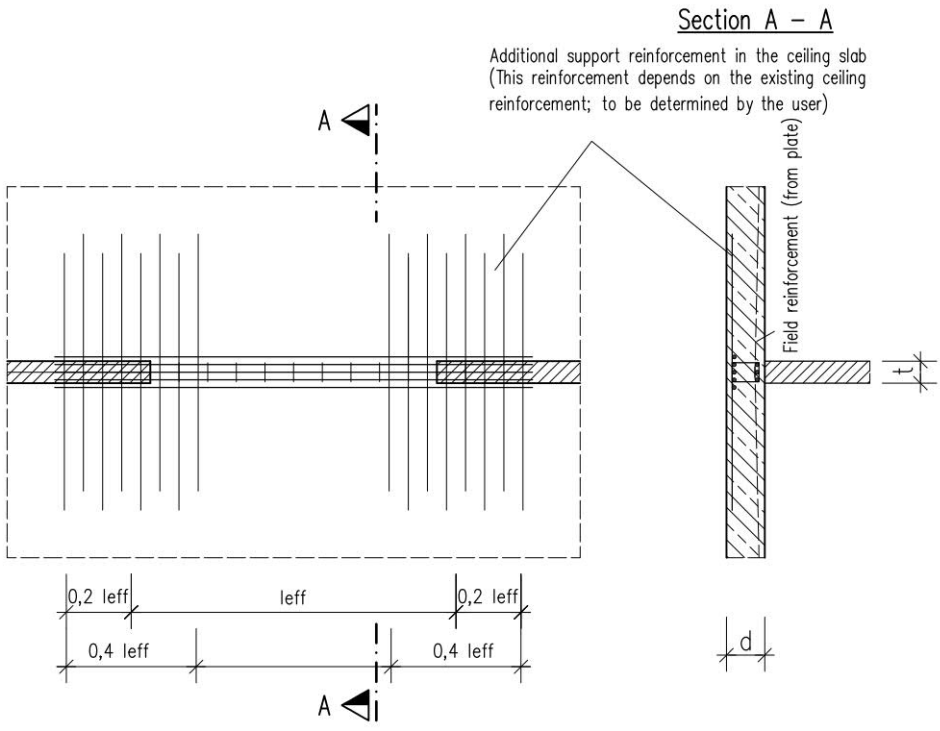
The transverse reinforcement is to be laid over the effective support distance plus 0.2 l_{eff}.

The existing span reinforcement transverse to the discontinuous support is to be installed up to the unsupported slab edge.



Additional reinforcement at the interior support

The span and support reinforcements are to be laid over the entire effective length. If the length exceeds l_{eff} > 10 d, the support reinforcement is to be increased linearly up to ≤ 15 d by 40 % in the area of 0.4 l_{eff}.



Output

You can optionally include durability in the output.

Description of the output: Output and printing

Reference literature

/1/ DIN EN 1992-1-1 / NA Amend.1:2012-06

/2/ ÖNORM B 1992-1-1:01/12/2011

/3/ Booklet 240 of the German Committee for Reinforced Concrete DAfStb