Voided slabs

esacd.11.01

Voided slabs

Voided slabs give engineers a way to eliminate from a part of a floor slab concrete that has no structural function. Void formers in the middle of a flat slab eliminate 35% of the slabs self-weight.
With this module the engineer is able to adequately model, design and check a floor system made out of voided slabs. Focus is also laid on the optimization of the design and drafting process in order to make it as fast and economical as possible. The calculated reinforcement can also be sent to Allplan for further detailing.

Datasheet Scia Engineer

esacd.11.01

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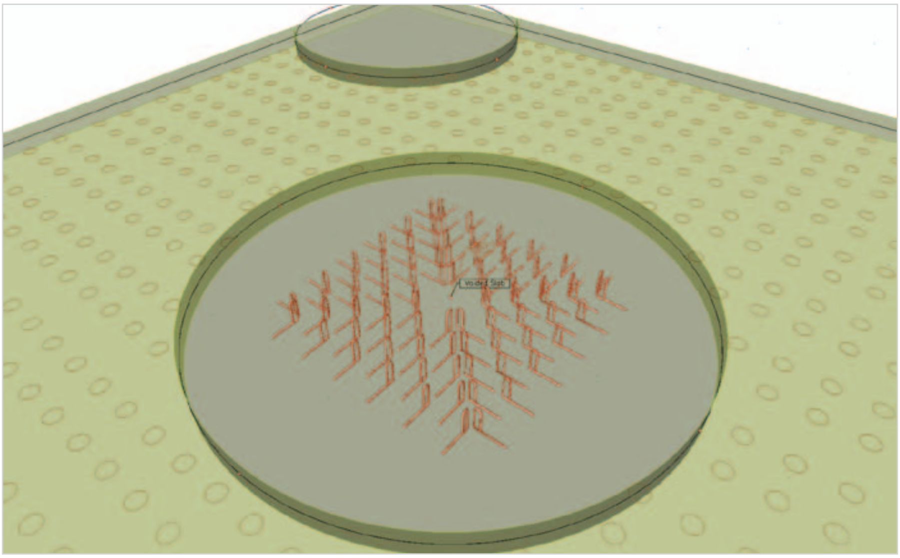
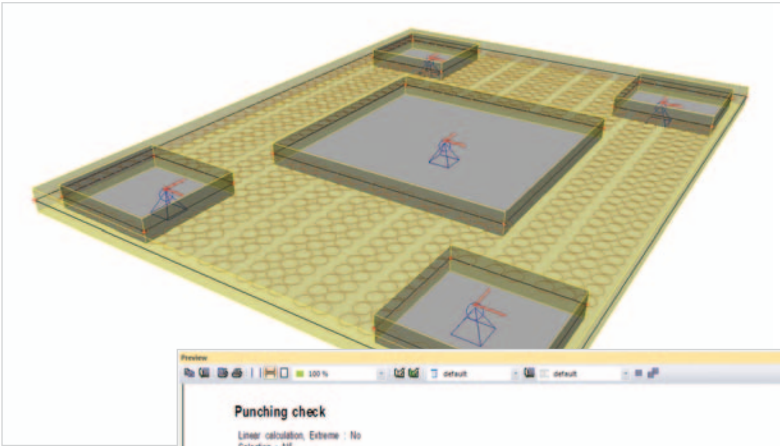
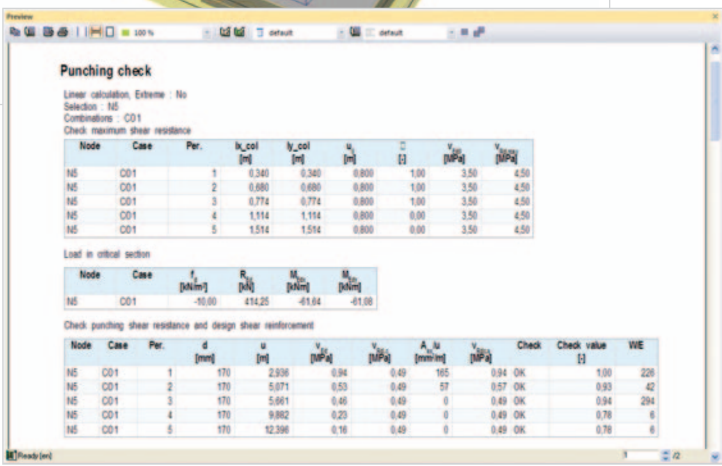
Voided slabs







Preview

100 % default default

Punching check

Linear calculation, Extreme : No
Selection : N5
Combinations : C01
Check maximum shear resistance

Node	Case	Per.	lx_col [m]	ly_col [m]	u [m]	[-]	v [MPa]	v [MPa]
N5	C01	1	0,340	0,340	0,800	1,00	3,50	4,50
N5	C01	2	0,680	0,680	0,800	1,00	3,50	4,50
N5	C01	3	0,774	0,774	0,800	1,00	3,50	4,50
N5	C01	4	1,114	1,114	0,800	0,00	3,50	4,50
N5	C01	5	1,514	1,514	0,800	0,00	3,50	4,50

Load in critical section

Node	Case	f [kN/m²]	R [kN]	M [kNm]	M [kNm]
N5	C01	-10,00	414,25	-61,64	-61,08

Check punching shear resistance and design shear reinforcement

Node	Case	Per.	d [mm]	u [m]	v [MPa]	v [MPa]	A_/u [mm²/m]	v [MPa]	Check	Check value [-]	WE
N5	C01	1	170	2,936	0,94	0,49	165	0,94	OK	1,00	226
N5	C01	2	170	5,071	0,53	0,49	57	0,57	OK	0,93	42
N5	C01	3	170	5,661	0,46	0,49	0	0,49	OK	0,94	294
N5	C01	4	170	9,882	0,23	0,49	0	0,49	OK	0,78	6
N5	C01	5	170	12,396	0,16	0,49	0	0,49	OK	0,78	6

Ready [en] 1 /2

Use of voided slabs is getting more and more attention in the market because of its numerous advantages.
The concept of a voided slab is very simple. Void plastic formers are placed between the upper and lower static reinforcement of a concrete slab. They replace concrete in zones where it has no structural benefit. Main benefits are:

- The floor weigh is up to 35% lower compared to solid slabs
- It is possible to create larger spans
- More open floor layout i.e. use of less columns.

The engineer can use generic features available in Scia Engineer such as loading, combinations, reviewing of results, checking of deformations. Above these generic features there are also more specific features available for voided slabs (design code: EC-EN) such as:

- Library with types of void formers,
- Automatic determination of voided slab zones,
- Adaptation of stiffness,
- Calculation of longitudinal and punching reinforcement.

Modelling of voided slabs

Modelling of voided slabs is based on the generic capabilities of Scia Engineer. The engineer creates a standard analysis model including loads, load cases, combinations, etc.
A typical set of load cases are:

1. Self weight panel + topping
2. Permanent load on the floor
3. Live load on the floor
4. Wind load effects from building sway.

The combinations for the calculation of the reinforcement and internal forces are standard Ultimate Limit State combinations and the Service Limit State combinations according to Eurocode.

Design of voided slabs

The design is executed in the same way as for solid composite slab. The reduced self weight and adapted stiffness are taken into account.
Void formers (Balls or Spheres) have to be left out in areas where the shear exceeds the reduced shear capacity of the voided slab. These areas are replaced by solid concrete. This occurs principally near columns and walls where shear forces are relatively high.

Punching checks are done as for a solid flat slab due to solid areas around columns.
The floor can be checked by standard Scia Engineer modules according to BS 8110 (esacd.02.09), EN 1992-1-1 (esacd.02.01) and EN 1992-1-2 (Fire) (esacd.07.01).
The voided slab customization is developed according to the Eurocode.

Void formers

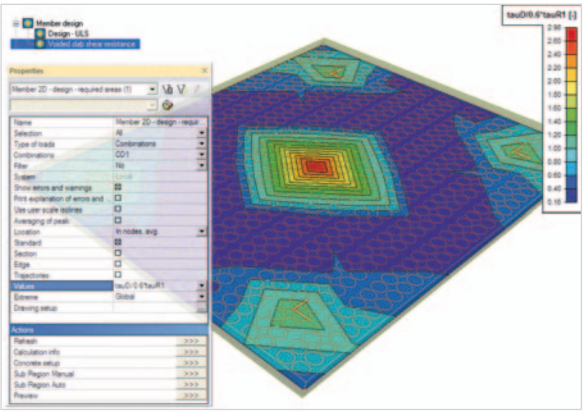
A predefined library of void formers is available in Scia Engineer.

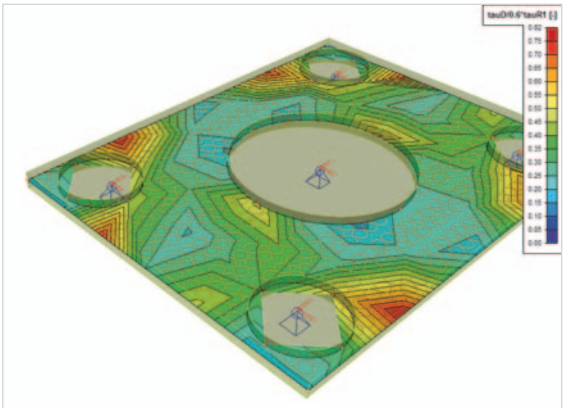
Determination of voided slab zones

The user is able to use common results, uz, Rz, Mx, My, Mxy, Vzx, Vzy, to analyze the floor. Especially for voided slabs a special function has

Highlights

- Full integration in Scia Engineer
- Link with Allplan for detailing
- Predefined libraries of void formers
- Respecting the new EC EN
- Made together with know-how coming directly from the market
- Automatic determination of zones in which voided slabs are not allowed
- Automatic adaptation of stiffness and self weight for voided/solid zones
- Practical rebars and shear reinforcement

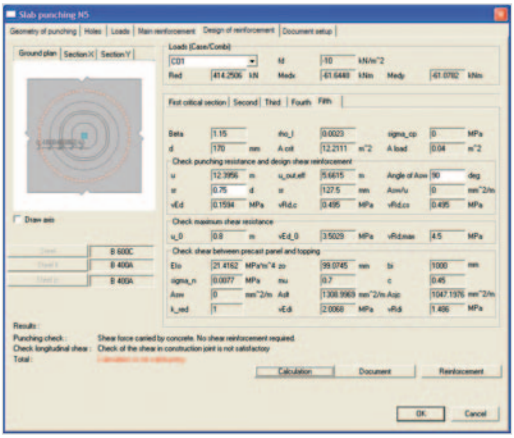




been developed in order to check the area for which the shear capacity of the floors with void formers is failing.

Scia Engineer will determine automatically in which regions voided slabs are not allowed. Subregions out of massive concrete will be created. Scia Engineer will do the adaptation of the self weight and stiffness in order to have the correct results.

These layouts can be exported to a DWG file or directly to Allplan. Afterwards the user can create a reasonable ball arrangement for manufacturing in e.g. Allplan.



Rebars

Also the longitudinal reinforcement in the slab can be designed in Scia Engineer (module esacd.02 is needed).

The user can use the existing module for design of reinforcement according to BS 8110 and/or EN 1992-1-1 for all reinforcement in all directions. The user can define the cover, the environmental class and the diameters of the reinforcement per side of the slab.

All reinforcement layers can be stored in an asf-file. This file format is used for export of reinforcement from Scia Engineer to Allplan.

Shear reinforcement

The standard punching shear check module (esacd.03) can be used for the check of punching shear above a support. This module is enhanced to check punching shear in voided slabs too.

The module checks the punching shear in all necessary perimeters and plots the reinforcement numerically.

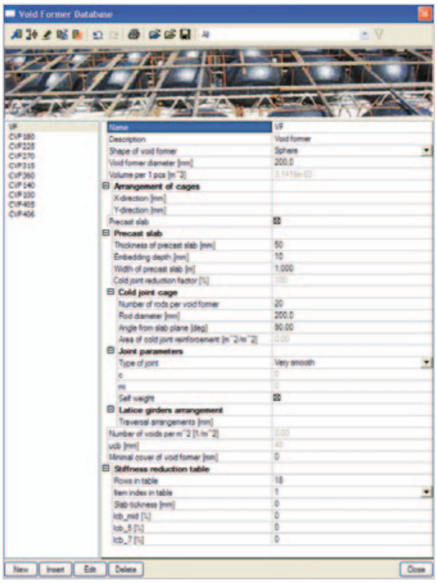
For voided slabs the theoretical shear reinforcement can be transformed to a practical arrangement using a set of practical links.
The arrangements of the punching reinforcement are a practical interpretation of EC2.

Advanced functionality

Additionally it is possible to override the designed reinforcement by a user-defined reinforcement. Complementary checks for horizontal shear at the interface between precast and site execution concrete are available.

According to the new EN code, clause 6.2.5, the check of the connection plane (interface) between the precast panel and topping can be performed.

The user is able to define the roughness of the top of the panel and the panel thickness for the check. The reinforcement contributing to horizontal shear resistance is punching shear reinforcement (first limit), lattice girder reinforcement (second limit) and lattice girder plus ball cage reinforcement beyond second limit i.e. in the voided area.
The output of all checks can be directed to the Scia Engineer Document.



Interoperability

Finally, the model including the reinforcement can be sent to Nemetschek Allplan for further detailing and finalization of the drawings incorporating automation that makes the total process very economical.