SCIAENGINEER

SCIA Engineer 16 - USER SATISFACTION

Image Royal HaskoningDHV, Markthal - Rotterdam, The Netherlands, © Photo source: Ossip van Duivenbode

SCIA Engineer 16 as the major release of the year comes with a long list of enhancements, extensions and modifications that extend throughout the whole workflow of a typical user. Some of the new features and improvements are aimed at specialists focusing on a specific type of projects, others will impact the day-to-day practice of literally every structural engineer. Regardless of whether affecting initial modelling, precise analysis or code-complying design, all the new features share the same aim and purpose: **USER SATISFACTION**.
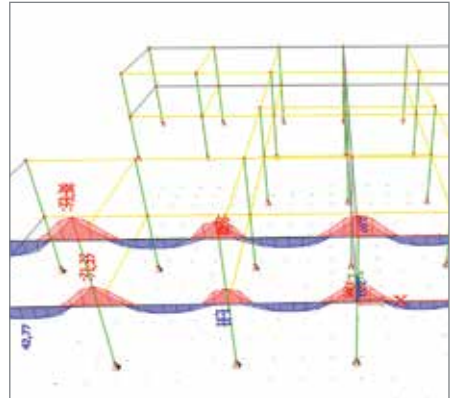
Reinforced Concrete Structures

Code-design of beams and columns

SCIA Engineer 16 now offers a comprehensive solution for design of reinforced concrete beams, columns and ribs. The Concrete 15 service has been extended by functions like:

- reduction of shear forces over the support,
- reduction of bending moments,
- new concrete setting related to reinforcement design,
- calculation of Xu (limit according to Dutch national annex),
- improvement in result visualisation,
- calculation of deflections based on the minimum beam stiffness,
- design and code-checks of ribbed slabs.

Moreover, thanks to the optimization of calculation algorithms the response of the concrete checks is now approximately three times faster than in the old Concrete service that was used up to version 14.

To support engineers in non-Eurocode countries, the prestressing library according to U.S. standards ASTM A416 and ASTM A910 has been implemented. The users are thus able to introduce strand-patterns and tendons with 3D geometry and calculate losses of prestressing.

Section Check

Section Check provides a versatile overview of a code-check in a section according to EC EN 1992-1-1. It allows engineers to perform design and checks in a specific section of a 1D concrete member. The tool has been first implemented in version 16 of SCIA Engineer.

The main benefit is that the user can perform directly a fast design and checks of a single concrete section. The user simply selects a section in the 3D model, quickly defines and/or edits the reinforcement and the results of the checks are immediately shown for the most critical ULS or SLS combination. Everything is fully integrated in the 3D model in a friendly GUI environment.

ECtools - ACI integration

SCIA Engineer 16 improves the integration of ECtools application in a common workflow used for the design of 1D members and shear walls according to ACI318-11 and ASCE 7-10. The tool has been integrated into the standard concrete service. The design of reinforcement can be made with respect of seismic procedures defined in the US standards. After successful design, the push-over analysis can be performed to obtain the push-over curve. The calculation report is send back to SCIA Engineer and, if required, to Engineering Report.

Steel Structures and Connections

Coupled Set AutoDesign

The Coupled Set AutoDesign is a new optimisation routine that works best for e.g., a user-defined set (catalogue) of steel (or other) profiles where several different dimensions can vary (height, width, thickness, etc.) in a range of discreet values and where some dimensions depend on another (i.e., sections of larger height are only produced with a limited range of thickness).

Scaffolding - Layher coupler

The scaffolding coupler library of SCIA Engineer has been extended with the Layer Allround LW type. Code-checks for scaffolding take into account all specific coefficients and design procedures for this particular coupler.

Unit warping stresses in the section library

A table of unit stresses (per fibre) the Cross-section Library has been extended with the values for unit warping and unit torsion.
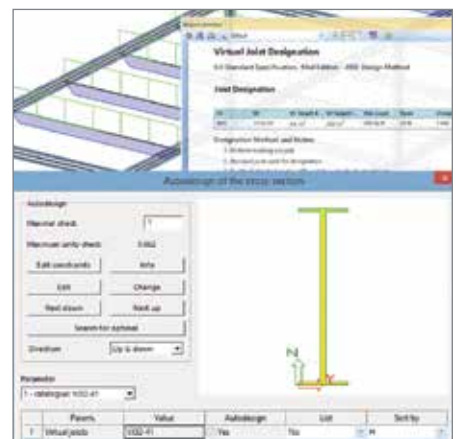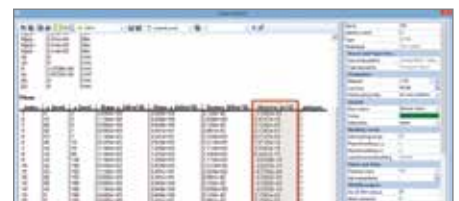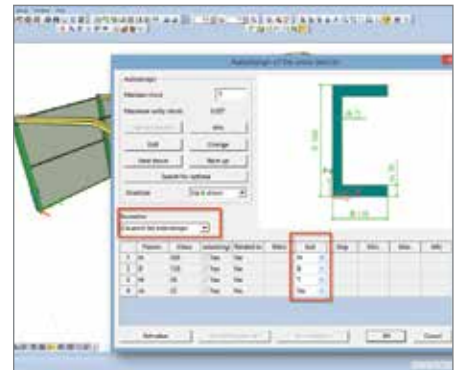
Steel connections enhancements

- A new summary output is now available alongside the brief and detailed reports.
- A new output for splice connections includes more details.
- The optimized internal architecture results in speed gains in connection checks.
- Calculations related to "Beam flange and web in compression" are faster and provide clearer output.
- Moment-stiff end-plate connection with four bolts per row are now theoretically better understood. In order to offer a safe verification technique for such connections, SCIA has synthesised the findings of several scientific publications. The implemented connection check is based on the component method and is in full agreement with EN 1993-1-8.
- The update of connection stiffness has been improved through several modifications and extensions of the algorithm.
- SCIA Engineer newly supports weak-axis bending moments and related shear forces.
- The Update Stiffness functionality in the design of steel connections has been updated.
- Steel connection design now supports weak-axis bending moments and related shear forces.

Virtual joist

The virtual joist functionality within SCIA Engineer delivers capabilities that span the gap between traditional design procedures used by engineers and detailed analysis done by manufacturers. As a result, users can optimize structures with complex geometry and loading conditions, while also providing joist designations that are in line with today's standards.

A typical scenario is:
- An initial member is selected from the virtual joist available in the profile library.
- The linear calculation and unity check are executed.
- AutoDesign can be optionally started to selects criteria for which the joist should be optimized: depth, weight, or moment of inertia.
- The model is updated based on the recommended optimal joist size and the analysis is repeated.
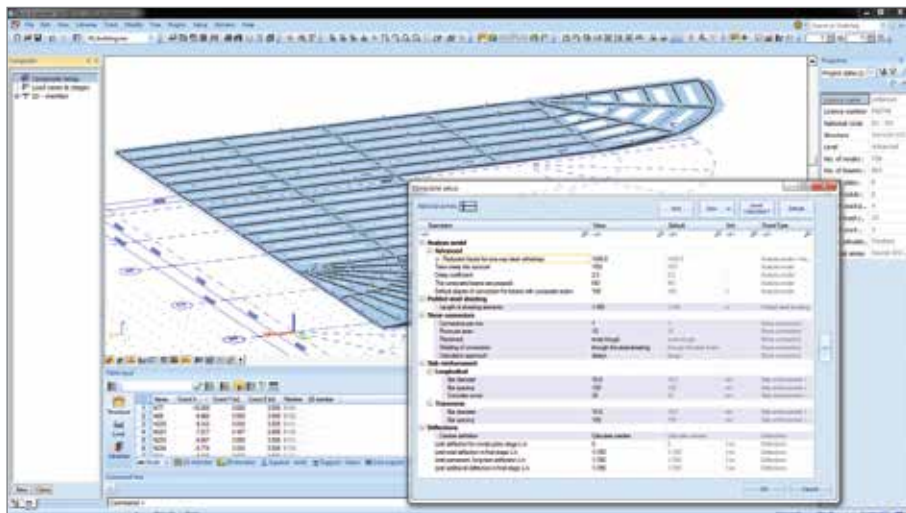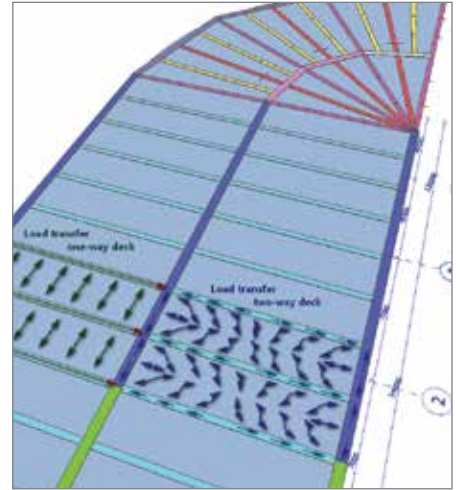- The required design method must be specified (ASD or LRFD).

Steel-Concrete Composite Structures

Design according to EN 1994

SCIA Engineer 16 features a comprehensive solution for the modelling, analysis and design of composite beam floor systems.

The new features added to the composite design module include:

- lateral-torsional buckling (LTB) checks according to EN 1994-1,
- comprehensive fire safety verification according to EN 1993-1-2 & EN 1994-1-2 for both the construction and final (exploitation) stages,
- simple and optionally filtered selection of a suitable decking from a catalogue of European, British and North American manufacturers,
- optional extension of the catalogue with user-input sheeting,
- increased torsional stiffness of the steel section due to the presence of the decking,
- diaphragms contribute to the overall load-bearing capacity,
- the finite element model takes into account the stiffness of the composite slab as well as the (partial) shear connection between steel beams and concrete slab,
- parasitic bending moments at the ends of, e.g., simple beams are avoided,
- all loads are first transferred to the secondary beams, which in turn transfer load to the primary beams as concentrated forces,
- stiffness in the weakened direction of the slab is compensated by increased stiffness of the beams in order to obtain a realistic behaviour of the floor as a whole,
- simplified approach for limitation of crack widths according to EN 1994-1-1, §7.4. 2 and §7.4. 3,
- evaluation of the contribution of variable loads to the final deflections obtained in the FEM calculations, which means that all required deflection checks can now be performed.
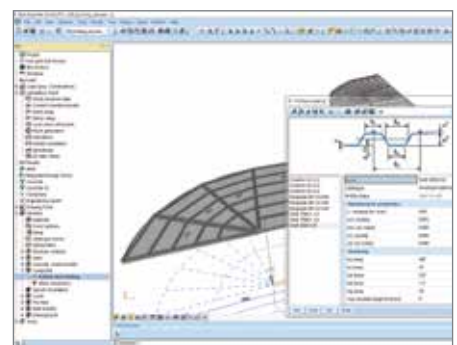
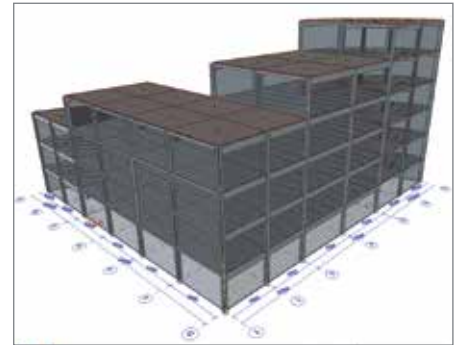### Design according to AISC 360-10

SCIA Engineer 16 offers also solution for the modelling, analysis and design of composite beam floor systems according to the U.S. codes.

The new features added to the composite design module include:

- simple and optionally filtered selection of a suitable decking from a catalogue of European, British and North American manufacturers,
- optional extension of the catalogue with user-input sheeting,
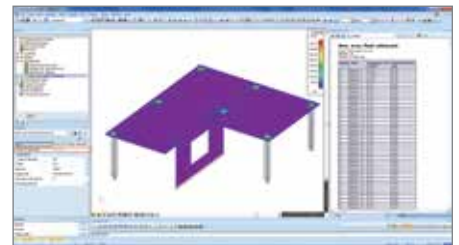- increased torsional stiffness of the steel section due to the presence of the decking,

- diaphragms contribute to the overall load-bearing capacity,
- the finite element model takes into account the stiffness of the composite slab as well as the (partial) shear connection between steel beams and concrete slab,
- parasitic bending moments at the ends of, e.g., simple beams are avoided,
- all loads are first transferred to the secondary beams, which in turn transfer load to the primary beams as concentrated forces,
- stiffness in the weakened direction of the slab is compensated by increased stiffness of the beams in order to obtain a realistic behaviour of the floor as a whole,
- AutoDesign optimizes the structure considering the following four limit states: ULS and SLS unity checks in the construction stage, ULS and SLS unity checks in the final stage.
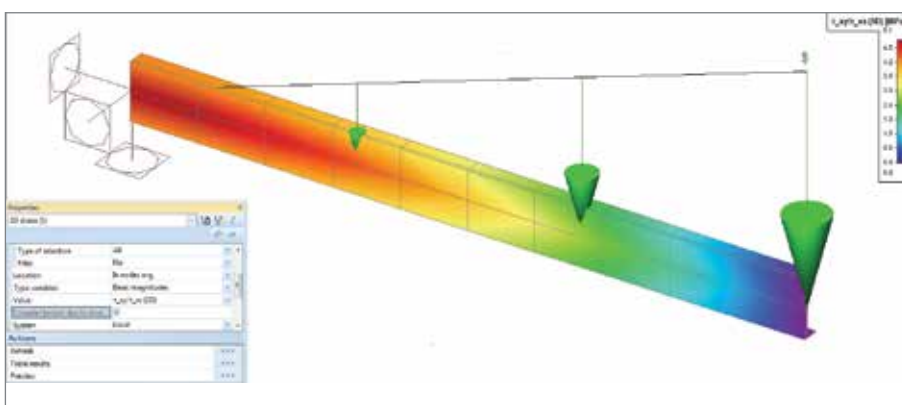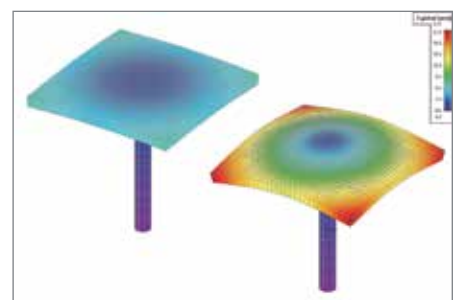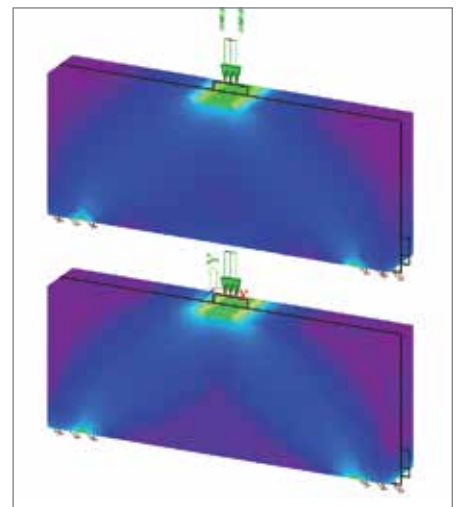

Analysis & Results

New analysis options and capabilities

- The general plasticity module, which includes Von Mises yield condition, has been extended with new types: Tresca yield condition, Mohr-Coulomb condition, and Drucker-Prager yield condition.
- New parameters in the Solver setup increase the stability of non-linear analysis, allow the user to neglect masses in a specific direction and choose a preferable method for time history analysis.
- The option to specify the thickness of lose layer at contact level improves the stability of the Soil-in calculation.
- Triangular elements are now used for the analysis of membranes, if necessary. The algorithm automatically selects the best suitable type of the element.
- A new possibility for seismic calculation has been implemented - Equivalent Lateral Forces (ELF). It is the most well known method for the seismic analysis of structures. Although it is quite conservative, its simplicity makes it very popular for seismic design.
- The automatic mesh refinement now considers not only one, but a user-defined group of load cases.
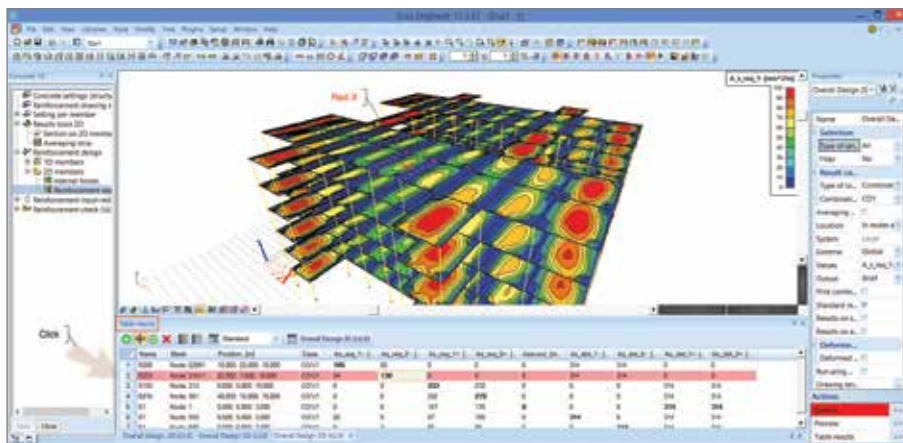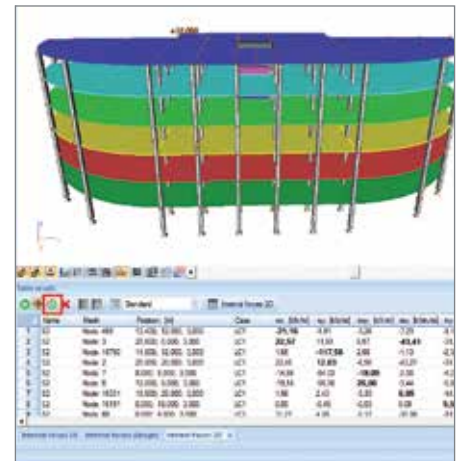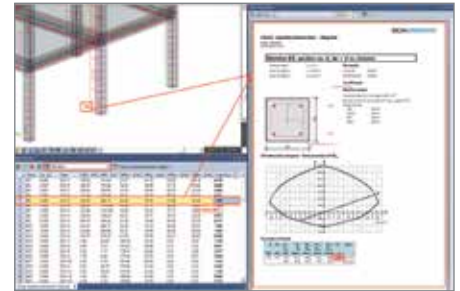

Evaluation of results

- The 3D stress has been extended with 2D strains. It is now possible to see and evaluate basic total strain, principal total strain, basic plastic strain, and principal plastic strain.
- The display of 3D stress results now also handles the situation when the load is not applied in the shear centre but in the centroid. For uniaxial symmetric cross-sections (mostly steel sections C,U) the position of the shear centre differs from the location of the centroid and this eccentricity causes additional torsional moment.
- The evaluation of results for Open Checks or checks in the Concrete 15 tree can be simplified and sped up via a generation of a single linear combination derived from the envelope combination for a selected type of extreme.

SCIA Engineer 16 - USER SATISFACTION

Table Results

- A Red "X" mark shown on the FE mesh of the model helps locate the position of a particular Table Results value in the model.
- Refresh of the results in Table Results can be sped up via option Load result.
- Table Results can be opened via a newly added Action button directly from the Property window.
- A new option makes it possible to reduce the total size of the project, e.g. when sharing it with a colleague via Internet.
- If any Table Results tab becomes invalid, it can be quickly regenerated using a new Regenerate current tab button.
- When performing a check of a concrete member (using the Concrete 15 service), a detailed check can be invoked by double-clicking on the required row in Table Results.
- Clicking on a row in Table Results selects (and highlights) the corresponding entity in the graphical window. This feature also applies to the Concrete 15 service only.
- The validity status of the results for a particular tab is notified in the bottom left corner of the table.

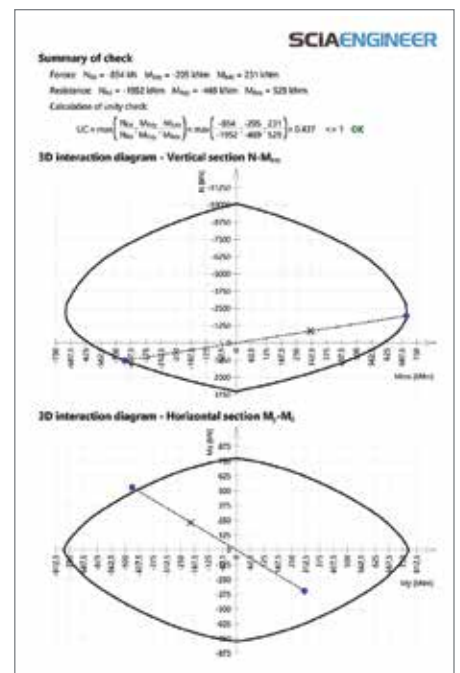## Improvements for day-to-day work

Engineering Report

Engineering Report, the primary tool for the preparation of comprehensive and clear documents about the performed analysis and design, has been also extended by several new features and optimised for higher performance. In the first place we must mention the optimised memory consumption. Engineering Report is now capable of:

- importing A0 drawing in 600 DPI quality.
- processing high number of generated images in one block,
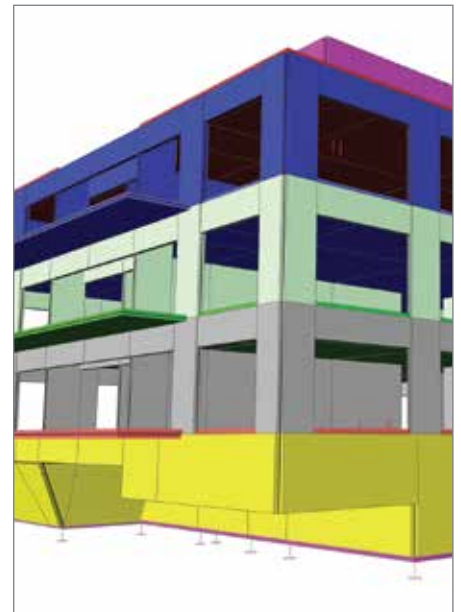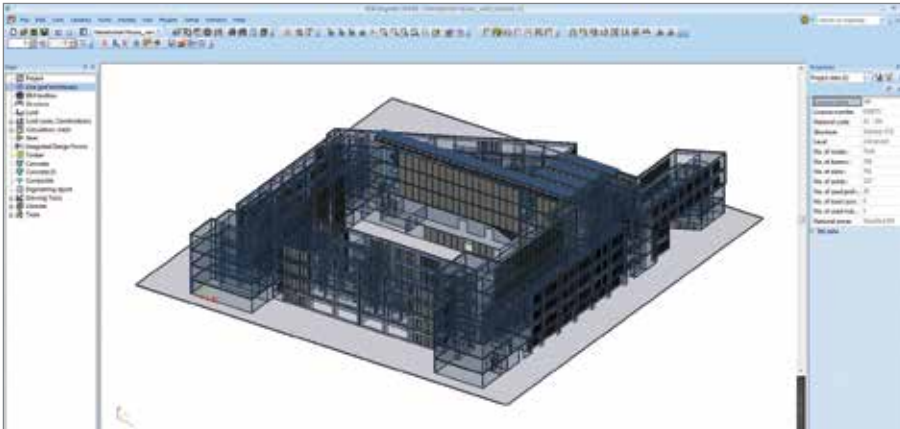- effective reading of ECtools calculation reports.

Other improvements include:

- improvement in importing PDF files and external images to Engineering Report,
- extensions in table picture generator,
- export of Engineering Reportto MS Excel without formatting,
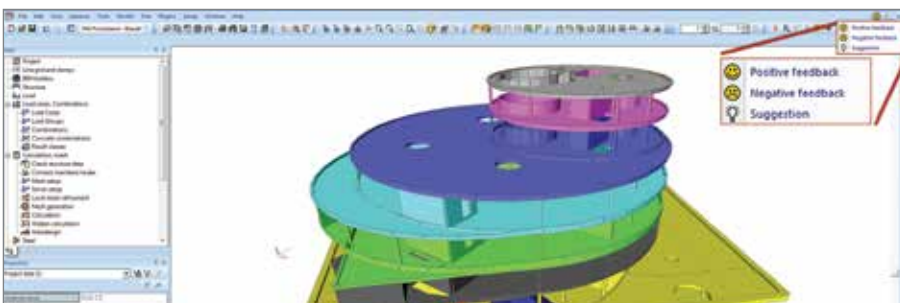- sorting in ChapterMaker according to the order in the database manager (library).

Import / export

- The old interface with Allplan is substituted by new one based on IFC file format. File > Export > Allplan (.ifc) produces the IFC file optimized for Allplan.
- SCIA Engineer is now compatible with the Tekla Structures 2016.
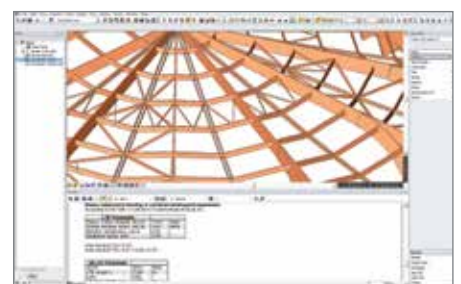

Miscellaneous improvements

- The SCIA Engineer Web-Help Search function can now be accessed directly from the SCIA Engineer application window.
- An Apply bottom has been added to the View parameters settings dialogue. The adjusted view parameters can be immediately checked without closing the settings dialogue.
- In the Project settings dialogue the redundant options have been removed. Moreover, the construction type and model type options now display an illustrative icon to make the dialogue more intuitive.
- Items listed in system libraries (e.g. library of manufactured profiled sheeting) can now be filtered using user-spedified criteria.
- The users can provide their feedback via a single click on a smiley icon on the top of the SCIA Engineer application window.
- User-input tolerances during alignment process control whether openings that are located close to edges of 2D members are aligned or not. This option has been added to tackle various special situations.

Other material design

Timber and aluminium design extensions

- Timber and aluminium materials have been added to the IBC code-checks.

SCIA Engineer 16 - USER SATISFACTION

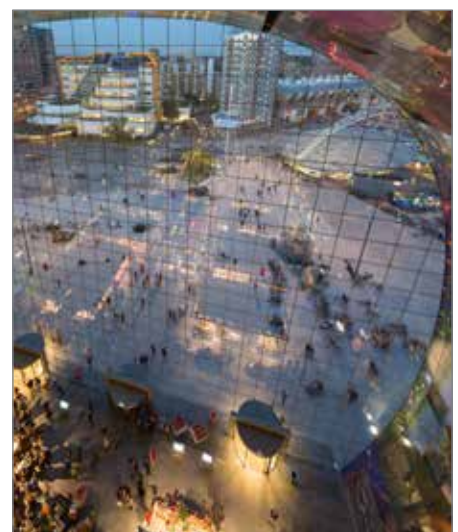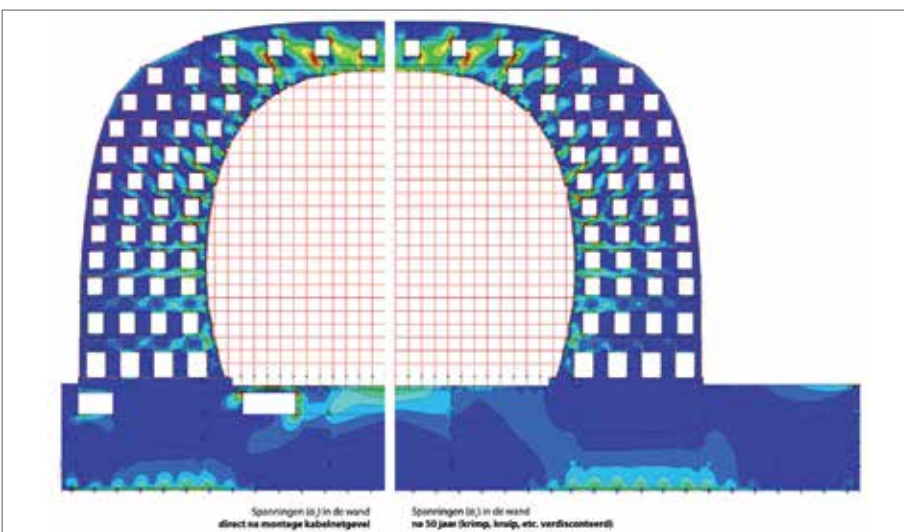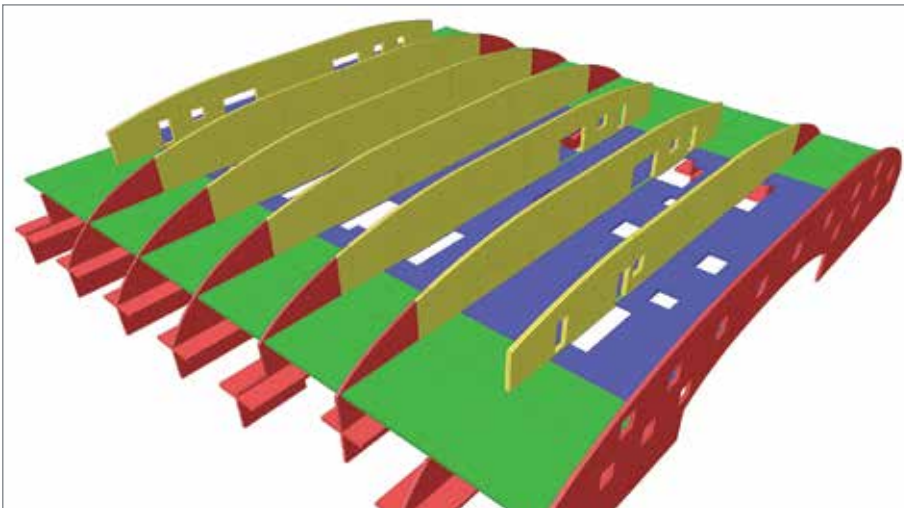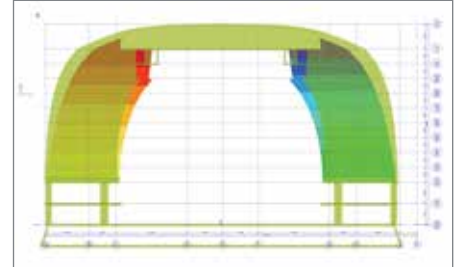## Signature project - User project of the release

It has already become a tradition that with every release we present one of the outstanding projects designed by SCIA Engineer users. It is always a very difficult task to pick just one project from all those marvellous, exceptional works.

For SCIA Engineer 16 we selected one of the winning projects from our User Contest 2015 competition - a residential and office building combined with a market hall built in central Rotterdam, the Netherlands. It is the first covered market hall in the Netherlands enveloped in apartments and enclosed by cable net façades. Just watch the screen next time you start SCIA Engineer and the building will emerge in front of you.

Royal HaskoningDHV, Markthal - Rotterdam, The Netherlands
© Photo source: Ossip van Duivenbode

If you would like to learn more about this extraordinary project, visit
www.scia.net/en/markthal or browse the User Contest book **http://books.scia.net/UC2015**

Interested in SCIA Engineer 16? Please, contact your dealer.

This article summarises all improvements and extensions implemented in
SCIA Engineer 15.1, SCIA Engineer 15.2, SCIA Engineer 15.3 and SCIA Engineer 16.

www.scia.net