NEMETSCHEK Scia

Scia Scaffolding

Scaffolding Structures Solutions

Scia Engineer

Scia Scaffolding

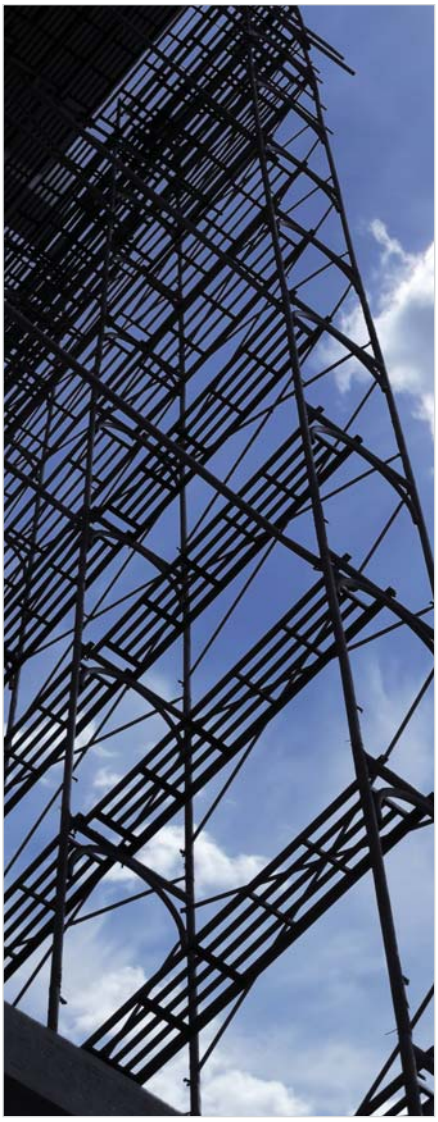
For centuries, scaffolding has merely been used as a means to facilitate the construction process. The calculation and design were only aimed at the structure itself, while the scaffold was just a means to attain the goal. In the present era, however, the analysis of the scaffold as a 'true' structure has strongly gained importance, among other things, due to numerous accidents caused by a faulty design.

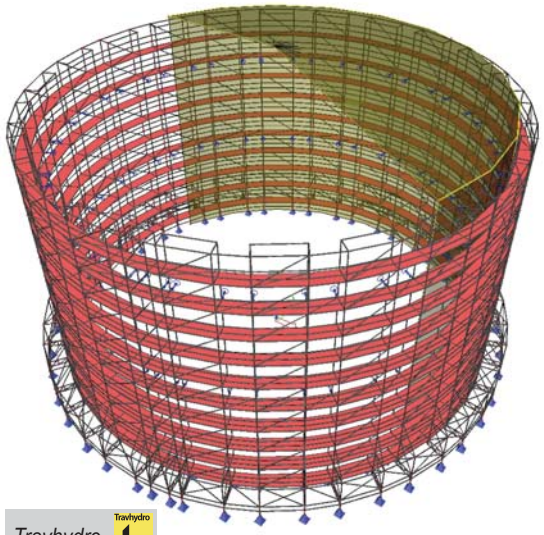
The engineers who design scaffolding face numerous challenges arising from the specifics of this type of structure.
Scaffolding is used to facilitate the **erection of structures**. It is often built on **flexible soil** or constructed **against a flexible construction**.

The present-day scaffold must be **in compliance with** the new **scaffold-design codes**. It must be **safe and reliable** to prevent the occurrence of an accident. The challenge is even bigger as **scaffolds contain a high degree of non-linearities (construction and couplers)** and **are prone to large deflections**.

And last, but not least, in order to beat the competitors the scaffold-design companies need an accurate and fast-and-easy-to-make **bill of material** to allow for the preparation of an exact **price quotation**.

Scaffolds are very often drawn with common CAD tools (e.g. DXF, DWG) that need **re-modelling in a structural engineering software**. Therefore it is important to have powerful tools available to build up the model and/or link it with the digital CAD-file. **Integrating structural engineering and a CAD model in one application** is definitely a better and more effective solution.





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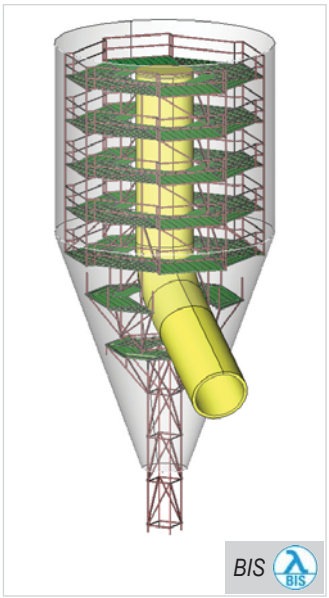

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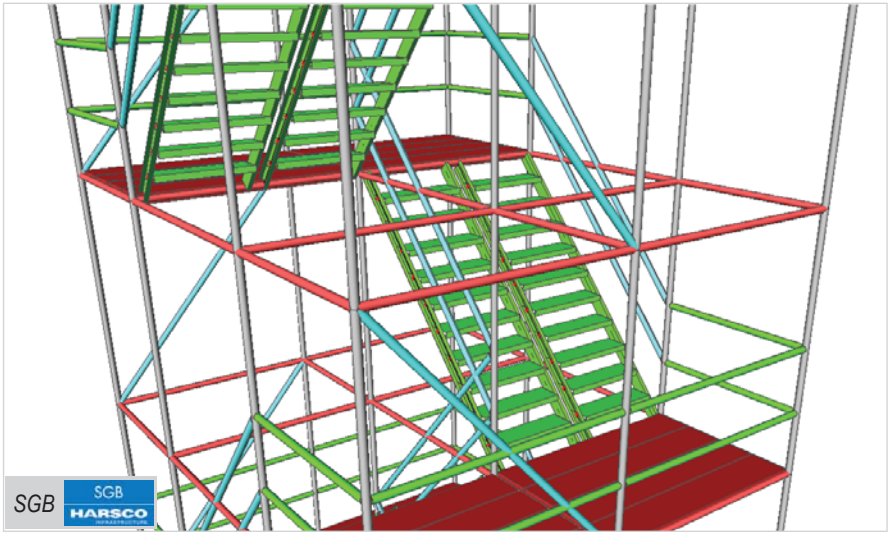


SGB

Scaffolding Structures Solutions

Scia Scaffolding is a tool for modelling, analysis and checking of virtually any type of scaffold: from modular systems over frame systems to tube and coupler scaffolds.

Modelling

The engineers either use the **standard modelling means** to create an accurate model of the analysed scaffold or they advantageously use the parameterisation capabilities integrated in the program and base their work on **tailor-made templates**. The **TrueAnalysis** technology makes it possible to keep in one model both the structural shape (for drawings) and analysis shape (for calculations and checks) of the scaffold.

In the **Standard Modelling** approach, all common modelling and manipulation functions of the generic Scia Engineer environment are available for the preparation of a model of the scaffold. If a 2D or 3D CAD model of the scaffold is available, this is directly imported as an analysis model.

Also an architectural model of the building for which the scaffold is being prepared is imported, which allows the user to model the scaffold next to the existing building.
In addition, all pre-prepared **User Blocks**, i.e. standardised or parametric blocks of geometry defined by the user (e.g. commonly used frame systems), are read into the model of the analysed scaffold.

As an alternative to direct modelling, **Scaffolding Templates** are suitable for engineers who regularly deal with the design of scaffolds. They prepare tailor-made templates for the types of scaffolds they have to handle. The advantage of using templates is that all common data (e.g. materials, cross-sections, stiffnesses, combinations, basic geometry, etc.) are defined just once – at the creation of the template. This way of working allows for a very fast input.

Any approach in Scia Scaffolding allows for an accurate modelling of the different scaffolding components including their appropriate specifics: **diagonals, couplers, metal floor boards, wooden planks, base jacks**, as well as the **connection between the ties and the façade**.

Analysis and check

The scaffold is designed for two specific conditions: **In Service** that is characterised by a high working load and only a minor wind loading and **Out of Service** that is characterised by an extreme wind loading and a small percentage of working load.

Integrated **Load Generators** enable the user to define the loading plane and the program automatically distributes the loading on all members within that plane. This is for example used for generation of wind loading on the scaffold.

The analysis includes standard **linear elastic analysis**, as well as advanced **second order analysis** for handling of the various specifics of scaffold structures as described by the codes: stability calculation for the determination of buckling shapes, non-linear functions for coupler stiffness, friction supports for base jacks, pressure-only supports for abutments, gap elements for margins between the pen and hole, etc.

After the calculation, the scaffold is checked for both the **Ultimate Limit State** and **Serviceability Limit State**.

Tubes and other sections are checked according **EN-codes for steel and aluminium**.

Specific checks for (steel) tubes and couplers are integrated according **EN 12810-12811**.

Scia Scaffolding design flow

Nemetschek Scia has developed the Scia Scaffolding design flow, which is illustrated in the next diagram; it matches the BIM philosophy for integrating the complete process in one environment.

Using the generic modeller environment of Scia Engineer, an intelligent 3D model of the scaffold is created in the first phase.

From this 3D model, both 2D and 3D drawings and sections are automatically generated.

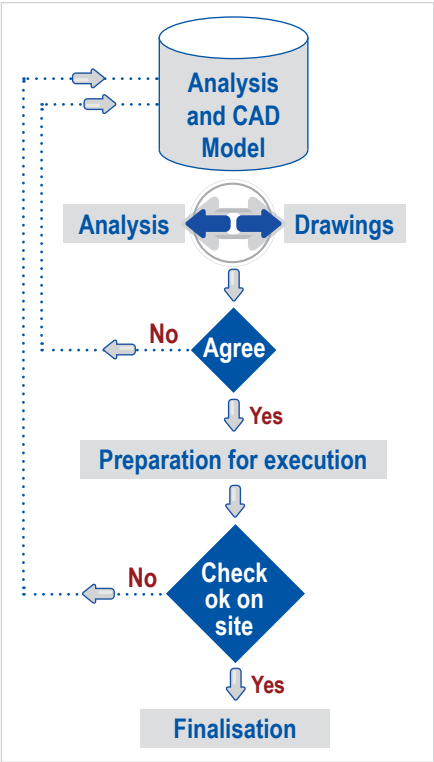
The engineer then refines this model by adding loads, supports, etc. After this, the analysis and checks are executed according to the appropriate codes (for steel and aluminium, as well as specific checks for tubes and couplers)

After the analysis, the same model is used to prepare the Bill of Material, which is required for the preparation of the execution. The amount of material is directly extracted from the intelligent model of the scaffolding.

It is obvious that this methodology provides a clear advantage in time savings and cost reduction of the scaffolding process.

CSS	Material	Unit mass [kg/m]	Length [m]	Mass [kg]	Surface [m²]	Unit volume mass [kg/m³]	Volume [mm³]
Standard - RO48.3X3.2	S 235	3,6	77,000	273,8	11,930	7850,0	3,4881e+07
Ledger - RO48.3X3.2	S 235	3,6	99,590	354,1	15,430	7850,0	4,5114e+07
Guardrail - RO48.3X3.2	S 235	3,6	75,180	267,3	11,648	7850,0	3,4057e+07
Bracing - RO48.3X2.3	S 235	2,6	22,301	58,1	3,435	7850,0	7,4041e+06
Floor 0,32 - RECT (40; 320)	Floor 0,32	8,2	93,150	763,8	67,068	640,6	1,1923e+09
Toeboard - RECT (150; 20)	Toeboard	2,3	37,590	87,2	12,781	773,3	1,1277e+08
Tube - RO48.3X3.2	S 235	3,6	5,270	18,7	0,816	7850,0	2,3873e+06
GT Chord - RO48.3X3.2	S 235	3,6	20,000	71,1	3,099	7850,0	9,0600e+06
GT Diagonal - SHSCF25/25/2.5	S 235	1,6	18,420	30,2	1,769	7850,0	3,8498e+06

	A	B	C	D	E	F	G	H	I
1	Bill of material								
2	CSS	Material	Unit mass	Length	Mass	Surface	Unit volume mass	Volume	Quantities
3			[kg/m]	[m]	[kg]	[m 2]	[kg/m 3]	[mm 3]	#
4	Ledger 1.09 - RO48.3X3.2	S 235	3,6	25,07	89,2	3,884	7850	1,14E+07	23
5	Ledger 2.07 - RO48.3X3.2	S 235	3,6	74,52	265	11,545	7850	3,38E+07	36



Scia Scaffolding Benefits

The innovative technologies like **Parametric Modelling, Template Analysis** and **TrueAnalysis**, together with advanced analysis options covering different types of non-linearity enable the engineer to perform real Computer-Aided-Engineering in the field of scaffolding design.

Completeness

Exact, fast and full engineering solution covering the report and the drawings as well as the bill of material.

Versatility

General or company tailor-made solution with the latter being simple to use by technicians and requiring a short training period.

Safety

Assessment in compliance with EN 12810-12811, EN 1993 (steel) and EN 1999 (aluminium).

Profitability

Fast, accurate and safe design to persuade contractors and win more tenders.

Integration

Integration in standard CAE software (used by more than 5.000 companies worldwide), which makes it also possible to take into account the interaction between the scaffold and the structure itself.

Customisation

User-prepared tailor-made parametric libraries and templates increasing the overall productivity. The libraries and templates contain standard (parametric) construction blocks, coupling elements, company style for reports and drawings.

Openness

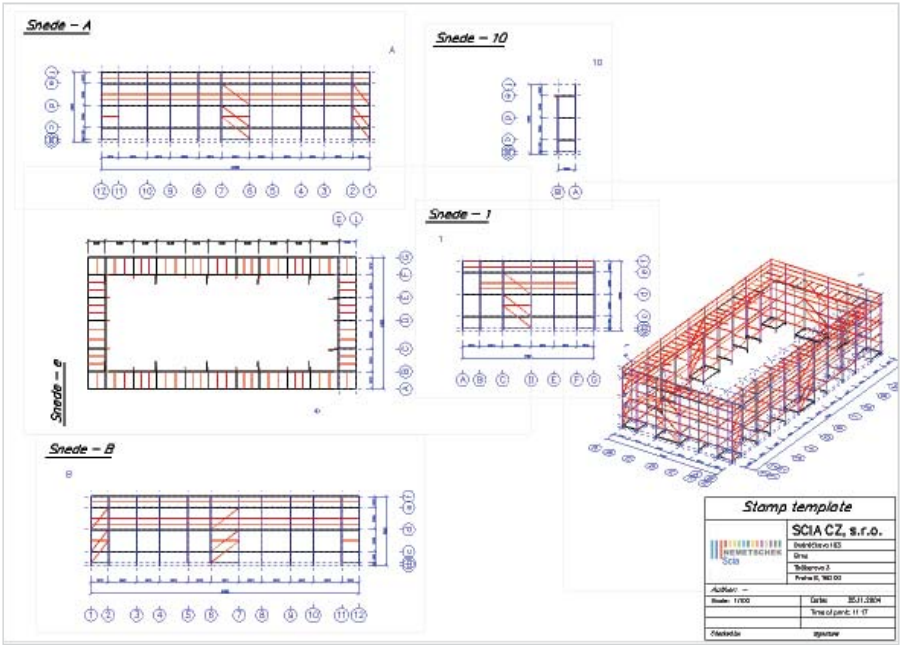
Reports are exportable to commonly used formats for further elaboration: RTF (Word), MS Excel©, PDF (also 3D).
Drawings are exportable to widely accepted formats: DWG, DXF (even with X-Ref link), VRML ...
Graphical export to intelligent object-based formats: Revit Structure©, Tekla Structures©, IFC, XML ...

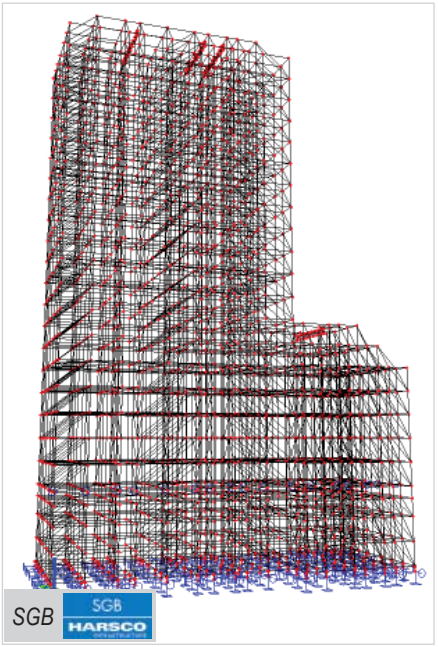
Time saving

Since the same model is used for both drawings and calculations, there is no loss in time and all previously defined data are directly available. Any changes invoked in any design stage are made only once and they generate an automatic update of the analysis, the drawings and the bill of material.

All-In-One

BIM technology with the “All-In-One” solution in a single model: import from CAD, integrated modeller, analytical model, calculation, checks, export to CAD, export to MS Excel ©.





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