Cold-formed steel design

esasd.15.01 **Cold-formed steel design according to EC-EN1993-1-3**

The steel design module Cold-formed steel design according to EC-EN1993-1-3 is an extension to the EC-EN module esasd.01.01 for steel code check and focuses on the design of cold formed profiles according to the European Standard EC-EN 1993. Both section checks and stability checks can be performed in the same way as for standard profiles.

Datasheet Scia Engineer

esasd.15.01

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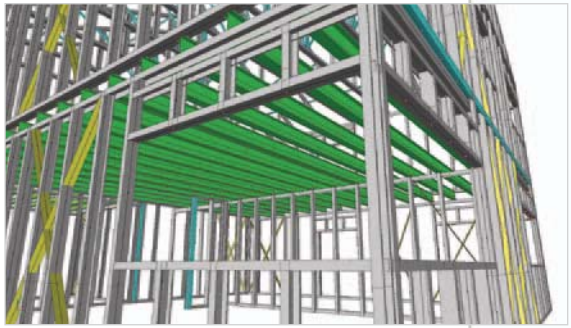
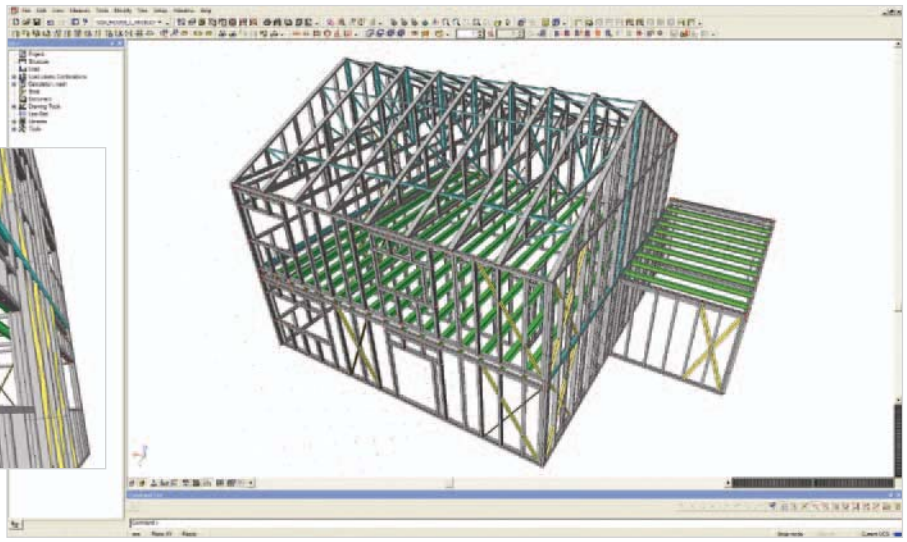
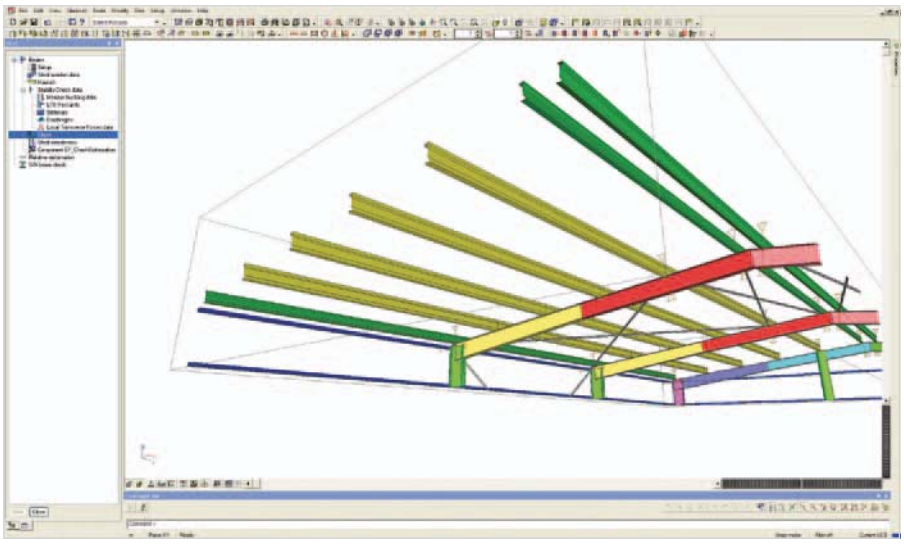
Cold-formed steel design according to EC-EN1993-1-3







Cold-formed steel members are made from structural quality sheet steel and are formed to the final shape either through press-braking blanks sheared from sheets or coils, or more commonly, by roll forming the steel through a series of dies. No heat is required to form the shapes (unlike for hot-rolled steel), which gives them the name “cold-formed steel”. Cold-formed steel members and other products are thinner, lighter, easier to produce, and typically cheaper than their hot-rolled counterparts. A variety of steel thickness is available to suit a wide range of structural and non-structural applications.

The steel design module according to EC-EN1993-1-3:2006 for the design of cold-formed steel members is integrated within the existing design of steel members according to Eurocode and is an extension to the standard steel code check (esasd.01.01).

This module covers the following:

- Determination of the initial shape;
- Calculation of the effective section properties including local and distortional buckling;
- ULS design checks;
- Special considerations for purlins restrained by sheeting.

Supported cross-section types

The following cross-section types are supported for the generation of initial shape and effective cross-section:

- Standard profile library cross-sections;
- Cold formed pair cross-sections;
- General thin walled sections;
- General sections with thin walled representation;
- Thin walled geometric sections;
- All other sections which support the centreline and do not have rounding.

Using the general cross-sections editor, it is possible to draw user-defined cross-sections with the integrated drawing tools or to import cross-sections from dxf- or dwg-files.

The average yield strength is supported as implemented in EN 1993-1-3. This option is editable in the case the fabrication type is set to cold formed. The choice between ‘Roll forming’ and ‘Other method’ will adapt the k factor as described in EN. In the design, the steel core thickness (excluding coating) is used instead of the total thickness of the cross-section. The metallic coating thickness is input by the user and the ‘core thickness’ is then calculated and displayed.

Determination of the Initial Shape

When a cold formed section is selected from the standard library or when it has been imported via the general cross-section utility, the initial shape of the cross-section is automatically calculated and divided to several parts and visualized. Supported element types (I (internal element), F (fixed element – no reduction is needed), SO (symmetrical outstand element), UO (unsymmetrical outstand element) and reinforcement types (RUO)) are automatically associated during this process.

Highlights

NEW

- Fully integrated cold formed checks in the standard Scia Engineer EN 1993 steel design environment, including mixed material structures
- Detailed analysis of the effective shape, including distortional buckling for edge stiffeners, double edge folds and internal stiffeners
- Advanced checks available as web crippling and shear in case of sections with stiffened webs
- Special purlin design checks including free flange geometry, advanced loading determination...
- Available for arbitrary cold formed sections, including the average yield strength and steel core thickness
- Implementation of the latest EN 1993-1-3:2006 (including the 2009 correction sheet)

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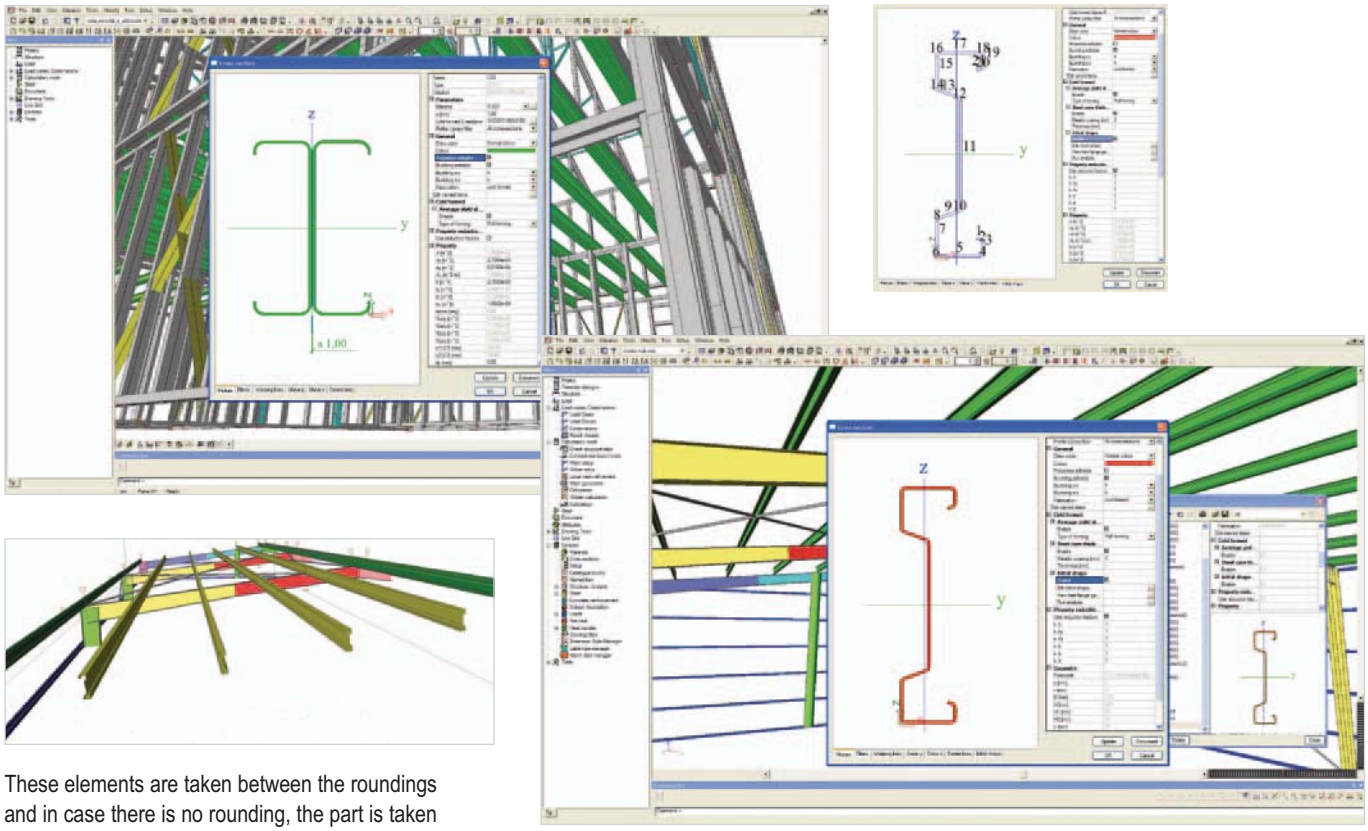

These elements are taken between the roundings and in case there is no rounding, the part is taken between the crossing points of the centre lines.
The generated initial shape can be viewed and modified by the user.

The initial shapes can be checked manually, before being applied to the model, for compression and bending according to both local axes.

Effective shape

For the initial shapes within Scia Engineer, the elements are determined between the roundings. For the calculation of the effective width, however, the notional width is used. This is specified in EN 1993-1-3 art 5.1 and figure 5.1 pp 19. The effective width based on the notional width is recalculated again to determine the effective width of the element in Scia Engineer.

For the definition of the compression and bending stresses the code does not require use of iterations, stiffener iteration and overall cross-section iteration, but these can be selected optionally in the steel setup of Scia Engineer.

The effective width of Internal Compression Elements and Outstand Compression Elements is calculated according to EN 1993-1-5 art.4.4. The procedure for determining the effective width/thickness of plane elements with edge stiffeners is given in EN 1993-1-3 art.5.5.3.2 and art.5.5.3.1. The procedure for determining the effective width/thickness of elements with intermediate stiffeners is given in EN 1993-1-3 art.5.5.3.3 and art.5.5.3.1. The obtained effective sections can be displayed graphically.

Section and stability checks

The general Scia Engineer steel code check can be run, including AutoDesign and Single Check.
Additional information can be defined on the steel member to specify the boundary conditions:

- Member buckling data;
- LTB restraints;
- Stiffeners;
- Diaphragms.

Diaphragms are used in the same way as currently implemented in Scia Engineer. Bow imperfection for LTBII and the national annex parameters are supported as well.

Section Checks

In contrast to EN1993-1-1, there is no classification for cold formed sections according to EN1993-1-3.
Since the checks depend on effective properties calculated in the cross-section manager, the cold formed EC-EN checks are not valid for haunches and arbitrary members or for members which do not have the initial shape. In such cases the default EN 1993-1-1 code check will be executed.
The following section checks are executed: Axial Tension, Axial Compression, Bending Moment, Shear Force, Torsional Moment, Local Transverse Forces, Combined Tension and Bending, Combined Compression and Bending, Combined Shear, Axial Force and Bending Moment, Combined Bending and Local Transverse Force.

Stability Checks

The following stability checks are performed: Flexural Buckling, Torsional and Torsional-Flexural Buckling, Lateral-Torsional Buckling (LTB is done completely according to EN 1993-1-1. For the calculation of the elastic critical force, the cubic equation algorithm is used), Bending and Axial Compression, Bending and Axial Tension, Combined Bending and Tension check.

For the calculation of bending and axial compression, EN 1993-1-3 allows two possibilities, so the user can choose:

- EN 1993-1-1 interaction according to article 6.3.3 (the cold–formed sections will be seen as class 3 or 4.);
- Alternative method according to EN 1993-1-3 article 6.2.5(2).

Purlin design

For the cross-sections that meet all requirements of Chapter 10, the reduced default checks are executed. This means that not all default checks will be executed and that the special purlin checks according to Chapter 10 will be performed (Diaphragm on the compression side, Diaphragm on the tension side, Definition of the free flange geometry, Determination of the equivalent lateral load, Determination of the lateral bending moment, Determination of the distance between anti-sag bars, Determination of the lateral spring stiffness, Buckling resistance of the free Flange).