The Steel Member Design Modules include; Member Design for Axial Stress, Member Design for Combined Stress, Crane Gantry Girder Design & Plate Girder Design. These modules are predominantly used for checking and optimising steel members.

Prokon Steel Connection Design Modules are primarily used in conjunction with Frame Analysis.

After analysis, you can link to the design modules by simply clicking a connection or support node. With the click of your mouse – all information relating to the connection geometry and design loads will be exported to the connection design module.
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Strut is a Prokon steel member design module, which allows you to effortlessly design and optimise basic steel members subjected to axial stress, e.g. truss members. Strut considers only considers only axial forces during the design – any prevailing bending moments are ignored. This means that you should use the program for the design of trusses and truss-type sub structures of frames only, i.e. where members experience predominantly axial forces.

The steel member design modules primarily act as post-processors for the frame analysis and SUMO modules. Strut also has an interactive mode for quick design or checking of individual members without the need to first perform an analysis in SUMO of Frame.

When using the design module, you can set up design tasks. Each task lists the members to be designed, the design parameters such as effective length factors, and the design approach. You can save the design tasks to a file so that you can easily recall it later, e.g. after you have made changes to the model and need to check the design again.

There are two different design approaches available, depending on what the user would like to achieve, e.g. preliminary sizing or final design checks. The first option optimises elements for economy using mass as the criterion, i.e. the program selects the lightest section that would not fail, after you have selected the type of section to be used. The second option checks the sections that were specified in Frame or Sumo and is usually used in final design checks.

Key features:

- Considers only axial forces
- Interaction with Frame Analysis and Sumo
- Two different design approaches
Non-symmetrical sections, e.g. angles cannot be designed in Combine. Such members are typically used for constructing trusses or bracing frames and often have negligible bending moments, for such cases Strut (Member Design for Axial Stress) can be used.

**Combine Provides three different design approaches, depending on what you would like to achieve:**

- Select the lightest section to optimise elements for economy, using mass as criterion, i.e. the program selects the lightest section that would not fail, after you have selected the type of section that you would like to use.
- Evaluate the current sections that were specified in Frame or Sumo. This option is best suited for doing final design checks.
- You can also mark preferred sections in the section database and have Combine only choose sections optimised for economy marked as preferred sections

The design results for combine are generated on a Calcsheet with summary or in-depth design calculations for every member and graphs showing axial force and bending moment distribution along the length of the member.

When designing simple beams, the Member Design for Combined Stress module can use the analysis output from the Single Span Beam Analysis module.

### Key features:

- Considers a combination of stresses
- Interaction with Frame Analysis and Sumo
- Three different design approaches

Given the different design scope of the two programs, you may often use both modules to design different parts of the same structure, e.g. Member Design for Combined Stress to check the main framing elements and Member Design for Axial Stress to design the roof truss and cross bracing.

### CRANE GANTRY GIRDER DESIGN

**Design & optimise crane gantry girders**

The Crane Gantry Girder Design module can be used to swiftly design and optimise multi-span crane gantry girders with one or two cranes.

The program allows for continuously or simply supported girders. Multiple combinations of main beams and capping beams, including standard I-sections, plate girders and box girders are also supported. Crane beam calculates the envelopes for all the required design forces (including vertical loads and horizontal effects of the moving cranes), moments and deflections.
Modern mechanised manufacturing and automated welding techniques have simplified the production of plate girders greatly, boosting their popularity. PG is capable of designing I-shaped sections with identical or different top and bottom flanges. The program also allows you to vary the section properties along the length of the girder to model a tapered element. The program checks the behavior of girders under specified loading and gives guidance regarding bearing and intermediate stiffeners.

**Welded plate girders**
can often be effectively and economically used as flexural sections.

**PLATE GIRDER DESIGN**

**Design plate girder beams**

**Key features:**

- Multi-span girders
- Two cranes
- Calculates force envelopes

**PLATE GIRDER DESIGN**

**Design plate girder beams**

Modern mechanised manufacturing and automated welding techniques have simplified the production of plate girders greatly, boosting their popularity. PG is capable of designing I-shaped sections with identical or different top and bottom flanges. The program also allows you to vary the section properties along the length of the girder to model a tapered element. The program checks the behavior of girders under specified loading and gives guidance regarding bearing and intermediate stiffeners.

**Bi-Axial Bending Moment**

**Plate girders are normally used to resist high bending moments and/or vertical shear forces.**

The program correspondingly assumes that these effects would govern the design and does not explicitly perform the checks for bi-axial bending moment. The design output shows the complete interaction formulae, with the zero values for bending moments about the minor axis. If required, the output formulae can be manually adjusted to include bending about the minor axis.

**Buckling under Axial Compression**

The program assumes that the effect of axial compression is small and therefore uses the full moment capacity for bending about the major axis.

**No capacity reduction is made on account of buckling about the major axis.**
The analysis output can be viewed graphically or you can view the detailed design calculations. Diagrams of the following results are given:

• The deflected shape of the plate girder.
• Ultimate limit state bending moment diagram. The bending moment diagram is drawn on the tension face of the girder.
• Ultimate limit state shear force diagrams.
• Bending stresses at ultimate limit state.
  The stresses in the top and bottom flanges are shown in red and yellow respectively
• The shear stresses at ultimate limit state together with the shear capacity for various web stiffener spacing. The actual stresses are shown in red and the shear capacities in blue.

Key features:

• Model tapered sections
• Unsymmetrical I sections
• Graphical and detailed output

Prokon recently released a whole new Base Plate Design Module, which includes numerous new features.

BASEPL VER 2.6.05

This Column Base Design module designs rectangular column bases for stability and strength.

Base plates are rectangular in shape and columns can be hollow sections, I or H sections (universal columns and universal beams). The program performs calculations for stiffened as well as unstiffened base plates, and the plates can be attached to the concrete substrate with studs or bolts.

Although the new version is just as easy to use, Prokon has ensured that the transition to the new version is as easy as possible by making, the previous version of the Base Plate Module (Ver 2.6.05) still available to users.
The program designs rectangular concrete column bases subjected to vertical force and bi axial bending moment:

- **Stability:** The program also verifies the stability requirements for overturning and bearing pressure. Stability checks can be performed at ultimate limit state or using the working force method.

- **Strength:** The program designs the base at ultimate limit state for flexure and shear.

- **Optimisation:** You can use the program to optimise the dimensions of the base to yield the most economical design.

When completing you design the program allows you to generate Reinforcement bending schedules for the designed bases. You can open bending schedules in Padds or AutoPadds for further editing and printing.

The graphical design output shows the bending moment in the base plate, compressive or tensile forces in the bolts, and the distribution of the compressive stress under the plate in the concrete substrate (if bolted).

**BASEPL VER 2.6.05**

The new Baseplate Connection Design module allows you to design column baseplates subjected to axial force and bi-axial moment as well as shear and torsion.

**The program also gives you the option to make baseplates stiffened or unstiffened.**

One of the many major enhancements that was added in the new BasePl module was that it has the ability to design baseplates of any general shapes that supports steel columns of any general shape. Base plates can also bear directly on concrete or grout or can be supported on studs.

**The analysis of the new BasePl makes the following assumptions in the design procedure:**

- Transferring of the column forces to the base plate through an effective area, determined by the column geometry and the plate stiffeners (if any), between the base plate and the concrete.

- A plane is used to represent the strain across the effective area. The equilibrium point is determined iteratively to balance the internal forces with the applied axial load and biaxial bending.

- If the base plate bears on concrete or a grout layer, the program evaluates the bearing stress using the plane of strain and a parabolic stress-strain curve as per the relevant concrete design code.

- For each individual bolt, the program uses the plane of strain to determine its state of tension or compression.

- Where bolts work in tension or as studs in compression, the program checks the base plate’s resistance to the bending moment due to the bolt forces.

- Torsion transfers to the bolts as shear.
On completing the analysis, the program displays the resulting design forces and/or factors of safety for each of the load cases:

- Concrete bearing stress.
- Bolt tension or compression force.
- Bolt shear force.
- Base plate bending stress.
- Plain of strain

For a better understanding of the analysis the program, the strain diagram shows the effective bearing area used as well as the plane of strain used to find equilibrium.

The program also includes functionality to generate detailed drawings of the connection for editing and printing using Padds or other CAD systems.

Key features:

- Shear and Torsion
- Baseplates and columns of any shape
- 3D Stress and strain Representation

Easily analyse connections that transmit shear, moment and axial force with Prokon’s moment connection design modules, Beam Column and Apex.

The modules only consider forces that are in the plane of the connection considered, i.e. vertical shear, axial compression or tension and in-plane moment. The program also allows you to design bolted or welded connections and beams can have haunches placed at any angle.

- **Beam Column**: Beam connected to flange of column.
- **Apex**: Symmetrical beam apex with end plates.
The two modules support all I and H-sections (universal columns and beams) in the Section Database. The program also includes an optimisation function which is available to assist you in determining a suitable layout, e.g. web plate stiffeners, bolt sizes and spacing. The design table lists all the variable dimensions and parameters of the connection. A value for any property in the table can be calculated using the Optimise function. Values of any individual property can also be fixed selectively to suite the user’s preferences:

The design output includes a calcsheet with full detailed design calculations. You can view the connections in 3D or 2D (e.g. elevation or plan) and save the pictures as CAD drawings.

Key features:
• Optimisation function
• Detailed design calculations
• View connections in 3D or 2D

The quick and easy to use Bolt Group and Weld Group, shear connection design modules, calculates the maximum resistance of bolt and weld groups respectively.

With these modules, you can also determine the smallest bolt or weld size that can be used to resist and in-plane force with arbitrary orientation. The Bolt Group program also considers both cases of single and double shear.

When determining the bolt forces and weld stresses, the programs give you the options to choose to use either a linear (polar moment) or non-linear (instantaneous centre of gyration) method of analysis. Two shear connection design modules are available:
• Bolt Group Design (bearing or friction grip connections)
• Weld Group Design (fillet welds)

To simplify the input of welds the Weld Group module provides you with a wizard to place welds around the outline of standard steel sections.

These Prokon steel member connection design modules are used primarily in conjunction with Frame Analysis and Sumo. After an analysis, you can link to the design modules by simply clicking a connection or support node with the click of your mouse.
All information relating to the connection geometry and design loads will be exported to the connection design module. However, you can easily use the connection design modules on their own as well, by entering geometry and design loads manually.

The Hollow Section Connection Design performs design checks on welded hollow section joints in lattice structures.

The connecting members transmit axial force and can be circular, square or rectangular hollow sections. The main chord can be I-sections or H-sections (Universal Beam or Universal Column). Supported connection layouts include K, T, N, X, and Y joints and combinations thereof. The program allows you to enter factored design forces (ULS) in the chord and braces.

All design calculations performed by the program are according to the recommendations given in Annex K of Eurocode 3 – 1992. The design checks are performed as prescribed in the code, including the following:

- Geometrical evaluation of the connection to ensure compliance with the design code.
- Plastification of the chord.
- Chord shear failure.
- Punching shear of hollow chord wall.

The program does not design the welds. The connection should normally be formed around the entire perimeter of each hollow sections by means of a butt weld, a fillet weld, or combinations of the two. After analysing and designing the connection the program displays the calculations on a Calcsheet and gives you the options for printing the design output or sending the data to your Calcpad.

Key features:
- Supports numerous connection layouts
- Detailed Calculations
- 3D Representation of Connection
Prokon’s simple connection design modules, Cleat, FinPlate and End-Plate, can analyse connections that transmit end shear and axial force.

The designed connections are considered simple connections that have negligible resistance to rotation and is thus incapable of transmitting significant moments at ultimate limit state.

Three modules are available for simple connection design (axial and shear forces only; no moment transfer):

- Double Angle Cleat Design
- Fin Plate Design
- End Plate Design

The modules make the following assumptions:

- The centre line of the beam and column are in the same plane.
- The connection transmits end shear only.
- Bolts have normal clearance holes.
- All bolts have threads in their shear planes.

The modules allow you to enter I or H-sections and orientations with the relevant design loads. The layout of the bolts on the connecting member is defined by entering their number and spacing. The program also provides automatic bolt sizing and spacing options to quickly get a workable bolt layout. To verify that you have defined the connection geometry as you intended, the program lets you view it from several angles either using dimensioned elevations or the 3D view.

After the analysis, you can view the design output on a Calcsheet with the complete design calculations.

**Key features:**

- Automatic bolt sizing and spacing
- View connection from several angles
- Complete calculations
FOR MORE INFO

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