# MasterSeries Webinar: Designing Steel Column Base Plate Connections

## Questions & Answers

**Date: Thurs, 5th March 2026**

**Time: 1:00 PM – 2:00 PM GMT**

**Q: How can a base plate be designed for a PFC (Parallel Flange Channel) column, and can the program design for compound members such as UC/UD in the minor axis?**

**A:** Base plate design for PFC columns or compound members in the minor axis is not currently supported in the *MasterKey: Connection Design* module. The module is designed for columns with symmetric cross-sections, such as:

- I and H sections
- Circular hollow sections (CHS)
- Rectangular hollow sections (RHS)
- Square hollow sections (SHS)

**Q: Can chemical anchors be used in base plate design?**

**A:** Not at the moment. However, this option will be reviewed for future implementation, as it is a commonly requested feature, including support for resin anchors.

**Q: Are baseplates checked according to TR34?**

**A:** Baseplates are currently designed according to the *Eurocode* and the relevant *British Standards*, following the rules of the *SCI Green Book*. TR34-specific checks are not implemented at this time.

**Q: Does the software make any allowance for the stiffness of the base plate? Eurocode is based upon a rigid plate – however it's not clear if the results obtained using the software take the rigidity of the plate into account.**

**A:** The program checks the strength of the connection components, including plate bending, anchor forces, and concrete bearing, to ensure the base plate has sufficient capacity.

However, connection stiffness is not calculated, and the base plate is not modelled as a flexible element. The design therefore focuses on component resistance checks rather than evaluating the rotational stiffness of the connection.

**Q: What is the workflow for designing a baseplate from a 3D model?**

**A:** The following workflow can be used to design a base plate connection within the 3D frame model:

1. Open the Steel Connection Design module.
2. Add a base plate from the Joint Template Library.
3. Select the node where the connection will be placed and import the frame results.
4. Review geometry, material grades, and imported forces.
5. Adjust design parameters to resolve any detailing issues.
6. Run the checks for all load cases to ensure the connection performs under every condition.

This workflow ensures that base plate connections are optimised, compliant with the Eurocode, and consistent across multiple columns when using connection groups.

**Q: Can baseplates subjected to column uplift be designed?**

**A:** Yes, the *MasterKey: Connection Design* module can design baseplates subjected to axial uplift. This functionality typically uses symmetrical bolt arrangements to resist tensile forces. Uplift is often a design consideration for columns in braced bays or to ensure stability during construction stages.

In integrated models linked to *MasterFrame*, the software automatically imports and designs for all load cases, including those producing uplift or tension. For standalone designs, users can manually define load cases with negative axial forces to account for these conditions.

**Q: How is the pry-out effect handled, and can it be analyzed in MasterSeries?**

**A:** The program performs the Concrete Pry-Out check even if foundation dimensions are not specified. However, when edge distances and concrete depth are defined, the exact capacity can be calculated, resulting in more accurate results. The pry-out check is carried out according to EN 1992-4, clause 7.2.2.4.

**Q: Is the additional bending moment on anchors due to grout considered in the design?**

**A:** Yes, the program designs the bolts as anchor bolts, including the additional moment caused by the lever arm between the concrete face and the base plate.

**Q: How can baseplates be designed when there is both uplift and shear? It seems there is no shear capacity when the column is in tension – is this correct?**

**A:** MasterSeries models the baseplate as a component-based moment connection with three zones:

1. **Tension zone** – holding-down bolts, concrete pull-out/breakout, washer/embedment effects
2. **Compression zone** – concrete bearing and plate bending
3. **Shear transfer** – friction, anchor bolts, and/or shear key

When bolts resist both tension and shear, their shear capacity is reduced according to Eurocode interaction rules.

**Eurocode (EN 1993 + EN 1992-4)**

- Bolt shear resistance is reduced by Eurocode factors.
- EN 1992-4 includes explicit anchorage checks: shear with lever arm, pry-out, edge failure, and combined shear/tension interaction.
- With uplift, the remaining shear capacity can become very small if the bolt is close to pull-out capacity.
- Concrete anchorage often governs before bolt shear.

**Practical guidance**

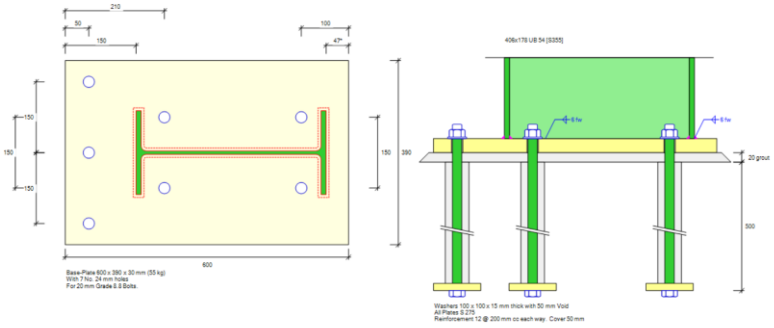
- Do not rely solely on bolts for shear if significant uplift exists.
- Consider increasing bolt number or size, edge distances, concrete strength, or providing a shear key.
- Eurocode anchorage provisions are stricter than historical practice, so careful design is required.

**Q: Can the model be exported to Revit?**

**A:** BIM links are available to third-party programs such as Revit, Tekla Structures, or via IFC. However, these links exchange only the frame model; connections are not included in the model exchange.

**Q: Can baseplates with unsymmetrical bolt arrangements be designed?**

**A:** Yes, baseplates can be positioned asymmetrically, and asymmetrical bolt arrangements can be used. Asymmetry is allowed about the major axis, while about the minor axis, the base plate connection must remain symmetrical. For clarity, an example of an asymmetrical configuration is provided below:



**Q: Will the software indicate when a shear key should be used in the connection, or is this the designer's responsibility?**

**A:** The decision to use a shear key is part of the designer's approach. However, the software will indicate if the current arrangement fails its shear checks.

**Q: Is there a way to create a group of base plate connections in MasterPort so that all connections are the same?**

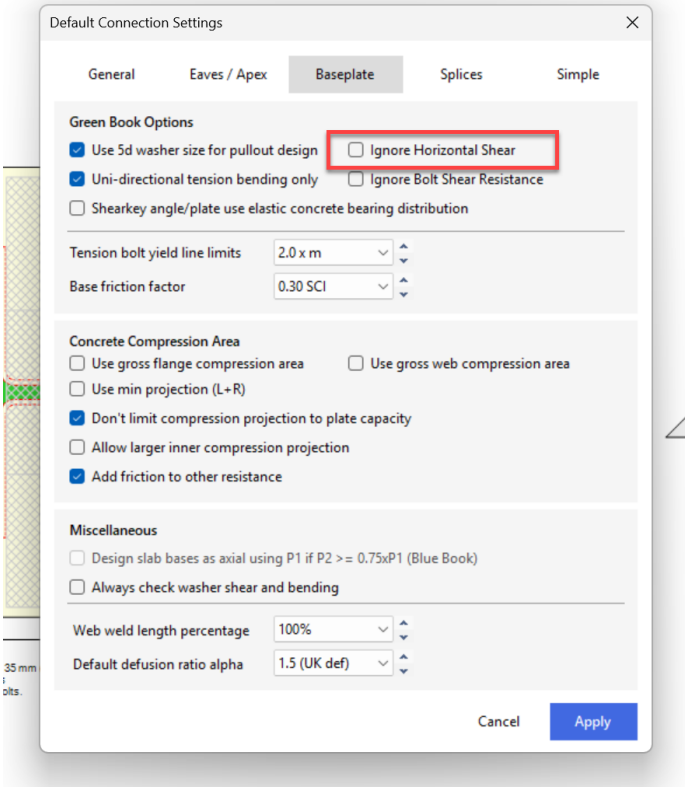
**A:** Yes, the Connection Design Group option is available within *MasterPort*, allowing multiple connections to be defined consistently.

**Q: Is additional material available from MasterSeries about base plate design using the software?**

**A:** The Learning Centre is currently being reviewed and updated. A completely new knowledge base will be released soon, providing comprehensive guidance on base plate design.

**Q: How are horizontal reactions from a portal frame handled when using a tie between columns? Should the load be ignored instead of using a shear key?**

**A:** There is an option in the *Default Settings* on the *Base Plate tab* to ignore horizontal shear forces. When this option is selected, the program will not perform shear checks. In this case, it is the designer's responsibility to address the shear forces.

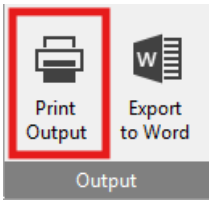


**Q: Are simple beam-over-column connections available in the library?**

**A:** Yes, a beam-over-column connection is available; however, it is designed as a moment-resisting connection.

**Q: How can the calculations be printed?**

**A:** Print options are available directly on the top toolbar. The calculation report can be sent to a physical printer or saved as a PDF. Additionally, it can be exported to a MS Word file. When printing, either all connections or selected connections can be printed, with or without the connection graphics.




**Q: Is it possible to take the pull-out force and check it with a resin fixing, as commonly used for smaller loads in the domestic sector?**

**A:** When tension is applied to the bolts, the program provides the force per bolt under the bolt pull-out check, which can be used to assess the suitability of resin fixings.

| | | | |
|---|---|---|---|
| $F_{t,Rd}=2 \cdot M_{pl,1}/m_x$ | 2•57375.0 / 38.5 | 2984.4 kN | OK |
| **Step 3: Bolt Pullout** | | | |
| **Washer Embedment** | | | |
| Min Embedment Fn(Ft, Void, $F_{cd}$) | 104.5, 50,18.13 | 20.5 mm | |
| Actual Embedment | (150 - 50)/2 | 50.0 mm | OK |
| **Washer Size** | | | |
| Washer Thickness tk >= 0.8•Ø | 20 >= 0.8•20 (16 >> 15mm SCI P207/95 T.6.3) | 15.0 mm | OK |
| Washer width Lap >= 5•Ø | 150 >= 5•20 | 100.0 mm | OK |
| **Bolt Pullout EN 1992-4 - 7.2.1** | | | |
| Concrete | Cracked | | |
| **Individual Cone** | | | |
| Force per Bolt | | 104.51 kN | |
| Bolt to concrete edge conditions | All edges distances > = 1.5 $h_{ef}$ | | |
| $N0_{Rk,c}=k1 \cdot \sqrt{(F_{ck})} \cdot h_{ef}^{1.5}$ | $8.9 \cdot \sqrt{(32)} \cdot 380^{1.5}$ | 372.94 kN | |
| $N_{Rd,c}=N0_{Rk,c} \cdot \psi_{s,n} \cdot \psi_{re,n} \cdot \psi_{ec,n} \cdot \psi_{m,n} / \gamma_{Mc}$ | 372.9•1•1•1•1.31/1.5 | 325.28 kN | |
| Bolt force $N_{Ed}$ <$N_{Rd,c}$ | 104.5/325.3 | 0.321 | OK |

**Q: Can the cone shape of holding-down bolts be defined in the software?**

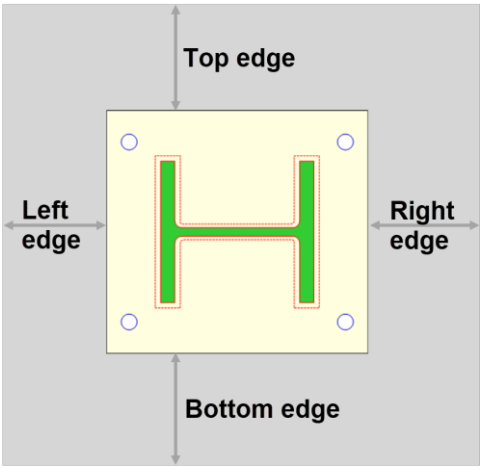
**A:** No, Eurocode does not provide for a user-selectable cone angle, unlike older UK practice. This means that engineers cannot adjust or tune the cone angle when designing according to Eurocode.

**Q: Can different steel grades be defined for the baseplate and the holding-down washer plates?**

A: The program allows a steel grade to be specified for the column cross-section and a separate grade for all plates in the connection. However, it is not possible to define a separate steel grade specifically for the washer plates.

**Q: Do the concrete edges defined (top, bottom, left, right) correspond to the plan view image, i.e., is "top" at the top of the screen?**

**A:** Yes, the edge names correspond to the top view of the connection. In this view, the left edge is on the left, the right edge is on the right, and so on. Edge distances are measured from the edge of the base plate.




**Q: Are serviceability checks for bolt slip included in the brief?**

**A:** For some connection types, the program can perform checks related to bolt slip. However, this is not currently available for base plate connections.

**Q: Can baseplates be designed with bending and shear in both the major and minor axes?**

**A:** The program designs connections according to Eurocode and British Standards, following the guidance of the SCI Green Book. These documents do not provide rules for base plate design with bending about both the major and minor axes.

Therefore, the MasterSeries Connection Design module does not support minor-axis bending in base plate connections. Bending about the major axis can be designed, while shear forces in both the major and minor axes can be handled.

**Q: Can reinforcement improve the concrete capacity for shear and uplift?**

**A:** Several reinforcement-related options are available under the Concrete section of the Property Tree. Their effects depend on the specific design checks being carried out.

**Pull-out (tension) behaviour**

Top reinforcement does not automatically increase the pull-out cone resistance. Under *EN 1992-4*, supplementary reinforcement must be specifically arranged to tie the breakout body if reinforcement is to be considered in tension.

MasterSeries provides an option to indicate that supplementary pull-out reinforcement is present. However:

- The design of this reinforcement is not carried out by the program and must be detailed by the designer.
- When this option is enabled, MasterSeries does not check the concrete pull-out resistance and instead provides the note: "*User-designed concrete vertical reinforcement provided – concrete pullout not checked*.

**Shear behaviour**

Options are also available to specify side reinforcement and supplementary edge reinforcement, which can improve the concrete shear capacity.

When supplementary edge reinforcement is indicated:

- The program does not check edge shear failure
- The designer is responsible for providing suitable reinforcement
- The reinforcement itself is not designed or checked by the program

**Q: When a shear key is used, why is there an option to ignore bolts and friction?**

**A:** The choice of which components resist horizontal shear is left to the designer's engineering judgement. The options to *Ignore Bolts* or *Ignore Friction* when a shear key is defined allow the designer to control the horizontal load path according to their design approach.

These options are provided for several reasons:

- **Load path control:** A shear key (such as a stub section, plate, or angle) transfers horizontal shear directly into the foundation through bearing against the concrete. By ignoring bolts or friction, the shear key can be sized to resist the full horizontal force independently
- **Conservative design assumptions:** Anchor bolts are typically installed in clearance holes and may not engage simultaneously or share the load equally. For this reason, many engineers prefer not to rely on bolt shear resistance when a dedicated shear key is provided
- **Uncertainty in load sharing:** There is no strict industry consensus on the exact distribution of horizontal forces between bolts, friction, and shear keys. The software provides these options so the engineer can select the primary resistance mechanism rather than relying on uncertain load sharing
- **High shear scenarios:** In cases of high horizontal shear where friction and bolts do not provide sufficient capacity, the shear key is often designed as the primary load transfer mechanism