

User Manual

By CivilEngrTools.com

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1 Introduction

1.1 General

CET.SteelConnDesign is a **FREE**, cutting-edge steel connection design software that is built on the AISC 13th/14th/15th standards and powered by modern mathematical theories, offering users a powerful design solution. The software can run in 3 modes: **standalone**, integration with **FreeCAD** or integration with **Tekla**. **CET.SteelConnDesign** will also support **Revit** and **Blender** later.

The current version of **CET.SteelConnDesign** is tailored exclusively for Windows OS and is compatible solely with Imperial units. Notably, it is not an open-source program, though we willingly share the source code with our partners upon request.

The goal of **CET.SteelConnDesign** is not to generate profit but to empower designers by leveraging modern software and saving them time. While it is available for free, we encourage users to explore the enhanced features of our **Premium** service. For more information on accessing Premium benefits, please contact civilengrtools@gmail.com. Premium users can enjoy the following advantages:

- Efficiently process thousands of members with just one click. Our software can automatically identify Connection Setup types and design them with minimal user input (under development).
- Utilize **APIs** to customize connection checks or design all connections using specific bolt diameters or plate thickness (under development).
- Open and save project files in plain JSON format.
- Receive hot patches within 5 business days.
- Access feature requests and enhancements.
- Benefit from 24x7 email/video support.
- Attend in-person training sessions.
- Receive 10 developer hours for each Premium user, which can be used for custom connection development.

1.2 Why Choose CET.SteelConnDesign

Followings make **CET.SteelConnDesign** different from others:

1 Free to use: The standard version of **CET.SteelConnDesign** lets you explore unlimited connection types, loads, and materials for education, research, or commercial use.

2 Expertly designed: Our members, equipped with advanced degrees such as Masters and PhDs, possess profound expertise in Civil Engineering, Mathematics, and Computer programming. Led by a visionary with over two decades of industry experience, our team's strength extends to robust quality assurance and sales support.

3 User-friendly efficiency: Unlike competitors, **CET.SteelConnDesign** minimizes user inputs, automatically designing the most efficient connections.

4 Enhanced inspection: Enjoy a 3D interactive model created with **FreeCAD** and **Tekla**, allowing you to inspect connections more effectively.

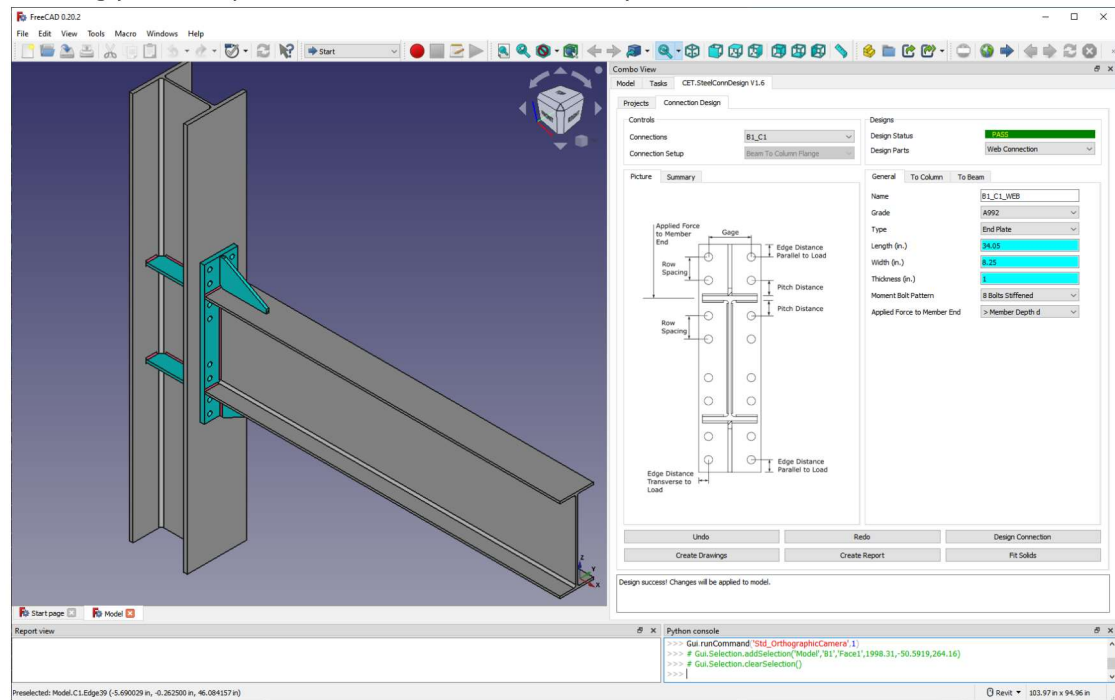


Figure 1.1 Inspection 3D Model in CET.SteelConnDesign with FreeCAD

5 Simple and powerful: The software's **Connection-Oriented** and efficient UI system lets you concentrate on specifying connection designs. Unique input fields accurately display user input and design results.

6 Detailed reports: Receive comprehensive connection design reports with user-friendly Latex equations, unit calculations, and detailed information.

Check column web compression buckling

$$\begin{aligned}
 h &= d - 2k \\
 &= 14.3 \text{ in.} - 2(1.46 \text{ in.}) \\
 &= 11.38 \text{ in.}
 \end{aligned}$$

$$\begin{aligned}
 \phi R_n &= \frac{\phi 24 t_{wc}^3 \sqrt{E F_{yc}}}{h} \\
 &= \frac{0.9(24)(0.525 \text{ in.})^3 \sqrt{(29000 \text{ ksi})(50 \text{ kips})}}{11.38 \text{ in.}} \\
 &= 330.7 \text{ kips}
 \end{aligned}$$

(AISC design guide 4 Equ 3.26)

Check column web local yielding

$$\begin{aligned}
 N &= t_f + 0.707(\text{weld size}) \\
 &= 0.522 \text{ in.} + (0.707)(0.25 \text{ in.}) \\
 &= 0.6987 \text{ in.}
 \end{aligned}$$

$$\begin{aligned}
 \phi R_n &= \phi [C_t(6k_c + 2t_p) + N] F_{yc} t_{wc} \\
 &= 1[1(6(1.46 \text{ in.}) + 2(1 \text{ in.})) + 0.69875 \text{ in.}](50 \text{ ksi})(0.525 \text{ in.}) \\
 &= 300.8 \text{ kips}
 \end{aligned}$$

(AISC design guide 4 Equ 3.24)

Check column web crippling

$$\begin{aligned}
 \phi R_n &= \phi 0.8 t_w^2 \left[1 + 3 \left(\frac{N}{d} \right) \left(\frac{t_w}{t_f} \right)^{1.5} \right] \sqrt{\frac{E F_{yw} t_f}{t_w}} \\
 &= 0.75(0.8)(0.525 \text{ in.})^2 \left[1 + 3 \left(\frac{0.69875 \text{ in.}}{14.3 \text{ in.}} \right) \left(\frac{0.525 \text{ in.}}{0.86 \text{ in.}} \right)^{1.5} \right] \sqrt{\frac{(29000 \text{ ksi})(50 \text{ ksi})(0.86 \text{ in.})}{0.525 \text{ in.}}} \\
 &= 272.7 \text{ kips}
 \end{aligned}$$

(AISC Equ. J10-4)

Figure 1.2 Detailed Connection Design Report Example

7 Automated 2D drawing generation: Our software now automatically generates connection drawings for users, complete with dimensions and annotations (with **FreeCAD** only).

1.3 Support

If you have any questions, feel free to reach out to us at **civilengrtools@gmail.com**. Premium users have the option to connect with our support team through Skype or Microsoft Teams.

1.4 Social Media

Youtube:

<https://www.youtube.com/@civilengrtools6051>

Facebook

<https://www.facebook.com/people/CivilStructural-Engineering-Tools/100083589511709/>

Linkedin

<https://www.linkedin.com/company/civilengrtools> (need login)

Twitter

<https://twitter.com/CivilEngrTools> (need login)

Reddit

<https://www.reddit.com/r/SteelConnDesign/>

Website

<https://civilengrtools.com/>

1.5 Join Us

We are a team of skilled engineers located in multiple places around the world. However, we need your help to promote our sales. As a sales representative, you can earn a percentage of premium subscriptions for each sale. Please reach out to us at **civilengrtools@gmail.com** if you have any questions or requests.

1.6 Investment Opportunities

We are an emerging startup with a promising future and are actively seeking investment opportunities. If you are interested in partnering with us, please do not hesitate to contact us.

1.7 Version History

Table 1 CET.SteelConnDesign Version History

Version Number	Notes
----------------	-------

V 1.9	Support beam web Angle connections and Tension/Compression axial forces
V 1.8	Support beam flange blocks (FreeCAD Only), extended single plate and stabilizer plate connection
V1.7	1 Support beam splice connections (non-moment connection) 2 Fix UI bugs like not being able to change design codes
V1.6	Support beam to beam web connections
V1.5	Support automated 2d drawing generation (FreeCAD only)
V1.4	Support beam to column, moment end plate connection
V1.3	Support beam to column, end plate connection
V1.2	Support column transverse stiffener in beam to column flange, moment connection
V1.1	Support beam to column flange, moment flange plate connection
V1.0	First Release: Beam to column single plate connection

1.8 Road Map

CET.SteelConnDesign is evolving gradually. In upcoming releases, we plan to introduce support for column splice connections, brace connections and others. **Eurocode** will be implemented soon (around 2026). We also will support CET.SteelConnDesign in Linux platform for FreeCAD. In the long term, our goals include:

- Expanded design codes support
- Integration of seismic design
- Implementation of **AI** for connection design
- Import IFC models

1.9 Legal Disclaimer:

When installing and using our software, users are assumed to agree with the terms outlined in the **License Agreement**.

2 Using Software

2.1 Download CET.SteelConnDsign

Please check github link for current version:

<https://github.com/CivilEngrTools/SteelConnDesign/releases>

Note: Source code is not provided. For collaboration opportunities, please reach out to civilengrtools@gmail.com.

2.2 Install CET.SteelConnDsign

Please check following video tutorial:

<https://www.youtube.com/watch?v=AF5v379huTA>

Note: CET.SteelConnDesign does not require administrator privileges to install.

2.3 Using CET.SteelConnDesign with FreeCAD

2.3.1 Download FreeCAD

Please use FreeCAD 0.20.2.

<https://github.com/FreeCAD/FreeCAD/releases/tag/0.20.2>

2.3.2 Setup FreeCAD for CET.SteelConnDesign

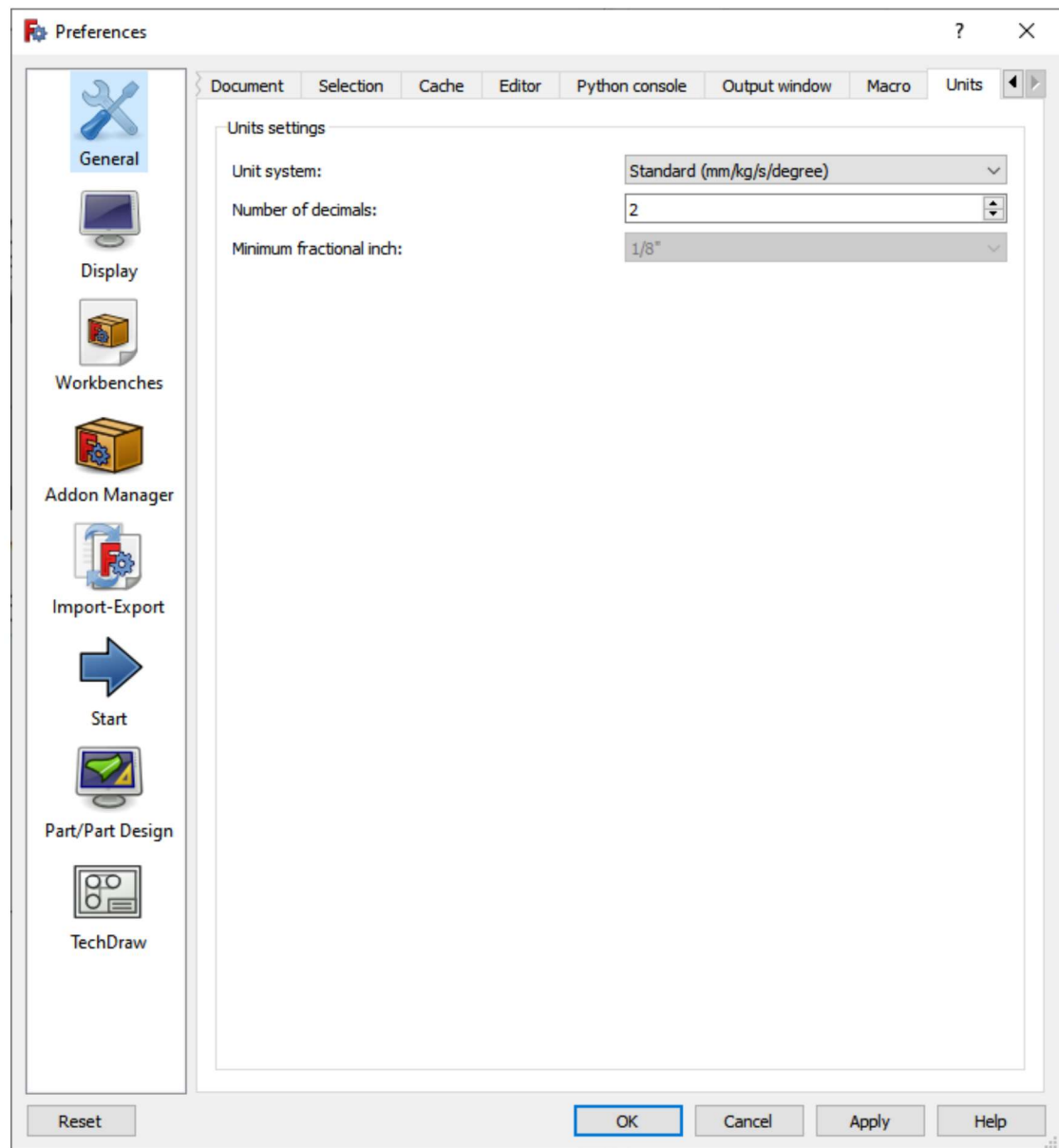


Figure 2.1 FreeCAD Setup, Units

- 1 Change "Unit system" to "US customary (in/lb)"
- 2 Change "Number of decimals" to 4

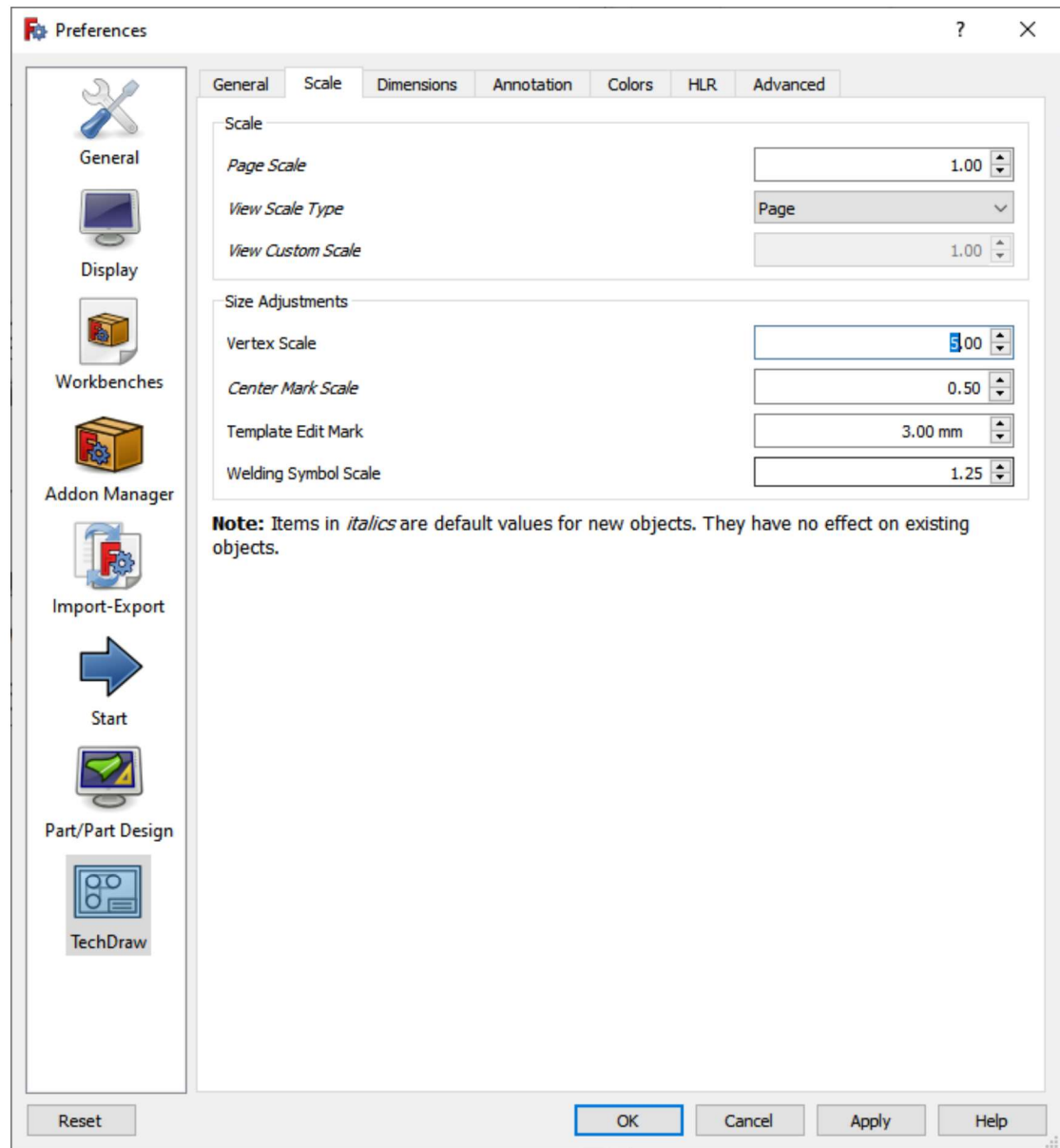


Figure 2.2 FreeCAD Setup, Scale

- 1 Change "Vertex Scale" to 3.0
- 2 change "Welding Symbol Scale" to 1.0

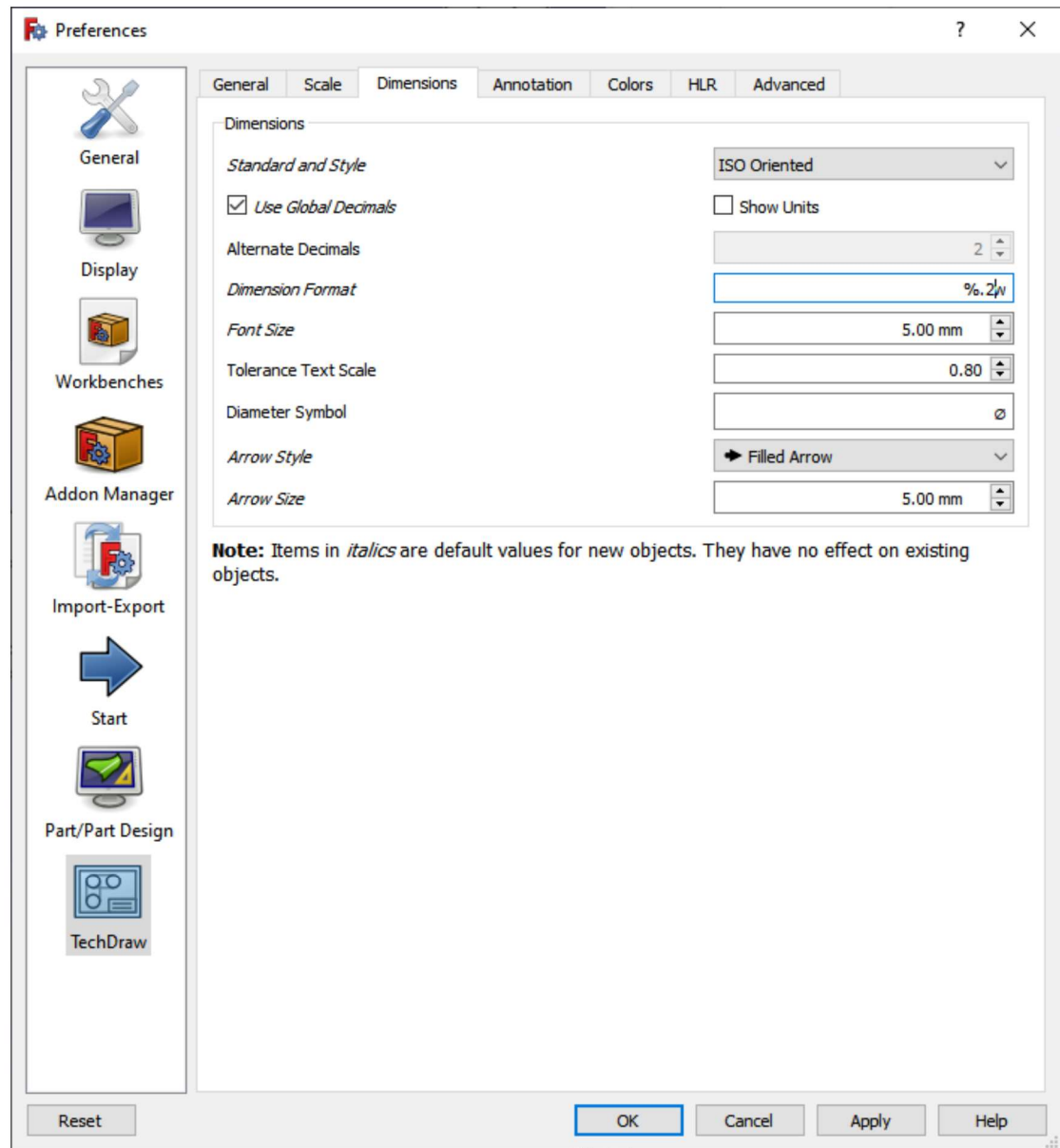


Figure 2.3 FreeCAD Setup, Dimension

- 1 Change "Dimension Format" to "%.4w"
- 2 Change "Arrow Size" to "2.5 mm"

2.4 Using CET.SteelConnDesign with Tekla

Please check our Youtube channel (<https://www.youtube.com/@civlengrtools6051/videos>) for details. Here are two important instructions:

1. Open Tekla before CET.SteelConnDesign.
2. Give each Tekla member a unique name like "B1" for beams or "C1" for columns. This helps CET.SteelConnDesign distinguish members and create connections.

2.5 User Interface

2.5.1 Shared UI for Integration With FreeCAD and Tekla

CET.SteelConnDesign features a unified UI system that operates consistently across both FreeCAD and Tekla. This means that most UI operations are the same whether you're using FreeCAD or Tekla. However, some functionalities are exclusive to FreeCAD and are not available in Tekla, such as the beam flange block operations.

2.5.2 Main User Interface

CET.SteelConnDesign features two primary tabs: the "Projects" tab, dedicated to projects, and the "Connection Design" tab, focused on managing connections. Refer to our YouTube channel, <https://www.youtube.com/@civilengrtools6051/videos>, for tutorial videos.

CET.SteelConnDesign V1.6

Projects | Connection Design

General Settings

Design Codes: AISC 14th
Shape Database: AISC 14th
Design Method: LRFD
Company/Organization Name: CivilEngrTools.com
Designer: CET designer
Email: civilengrtools@gmail.com
Checker: TBD
Project Title: ent end plate connection design
Project NO.:
Date: 01/01/2022

FreeCAD Settings

Drawing Template: tes/A4_LandscapeTD.svg
Drawing Size (in. x in.): 11.69 x 8.27 (A4 Landscape)
Drawing Scale: 0.0833
Drawing Line Width (mm): 0.25
Drawing Dimension Line Width (mm): 0.15

Model Management

Model Name:
Model Provider: None
Load Project Save Project Save Prj. As New Project
Scan Model

Examples

Examples: None

Connection Management

Connection Setup: Beam To Column Flange
Beams:
Columns:
Connections:
Create Connection Delete Connection

Member Management

Name: C1
Type: Column
Start Coordinates, x, y, z (in.): 0, 0, 0
End Coordinates, x, y, z (in.): 0, 0, 120
Rotation (degree): 0
Members:
Create/Modify Member Delete Member

Reserved ... Save Settings Open Manual

Welcome to Steel Connection Design of CivilEngrTool

Figure 2.4 UI, Project Tab



Figure 2.5 UI, Connection Design Tab

2.5.3 Undo and Redo

In CET.SteelConnDesign, **Undo** and **Redo** functionalities are available exclusively within the "Connection Design" tab. It's important to note that Undo and Redo operations do not initiate any changes in the connection design itself.

2.5.4 Input Fields

The input fields in CET.SteelConnDesign exhibit three distinct statuses: user inputs, system-designed values, and fields with no inputs.

User Inputs

This is similar to other software. Our software will use the inputs for the connection design. Note that some fields have default values such as plate grades.

System-designed Values

In the case where a user does not input values, our software takes charge of designing the connection. The design results are then displayed in the input field, **highlighted** in a distinctive cyan color by intelligent algorithm. This unique feature not only allows users to easily review and verify the design outcomes but also provides the most efficient connection design. For example, under different shear forces, our software designs a beam to column flange, single plate connection as:

Table 2 Single Plate Design Results under Different Shear Forces

Shear Force (Kips)	Length (in)	Width (in)	Thickness (in)	Bolt Row	Bolt Dia. (in)	Ratio
10	5	3.5	0.25	2	0.75	0.71
20	5	4	0.375	2	0.875	0.88
30	8	3.5	0.375	3	0.75	0.86
40	11	3.5	0.3125	4	0.75	0.98
50	11.5	4	0.4375	4	0.875	0.88
60	11.5	4	0.5	4	0.875	0.92

Where ratio = shear force / min capacity

The screenshot shows a software interface with three tabs: 'General', 'To Beam', and 'To Column'. The 'To Beam' tab is active. The following fields are visible:

- Name: B1_C1_WEB
- Grade: A36
- Type: Single Plate
- Vertical Alignment: Top
- Horizontal Alignment: Left Side
- Length (in.): 11 (highlighted in cyan)
- Width (in.): 3.5 (highlighted in cyan)
- Thickness (in.): 0.3125 (highlighted in cyan)
- To Beam Top Dist. (in.): 1.5
- Plate Configuration: Conventional Configuration

Figure 2.6 System-designed Values Highlighted in a Cyan Color

Fields with no inputs

Certain fields, like the column transverse stiffener, may not necessitate user inputs and won't display results in specific situations. However, even if our system doesn't typically design a column transverse stiffener, providing input for parameters like stiffener thickness or clip length will prompt our system to generate the stiffener design for you.

Field	Left Screenshot Value	Right Screenshot Value
Name	C1_B1_COL_FLG_STIF	C1_B1_COL_FLG_STIF
Grade	A36	A36
Length (in.)		12.58
Width (in.)		3.8125
Thickness (in.)		0.625
Clip Length (in.)		1.5

Figure 2.7 User Input Clip Length Will Trigger the Column Transverse Stiffener Design

2.5.5 Switch Between Design Parts

CET.SteelConnDesign operates as a **Connection-Oriented** design software with a user interface focused on connections. The "Design Parts" dropdown facilitates efficient navigation between various members, connections or parts for the user. Additionally, selecting a different design part triggers the Picture panel to display the corresponding image with annotations, enhancing the user's understanding of the input fields.

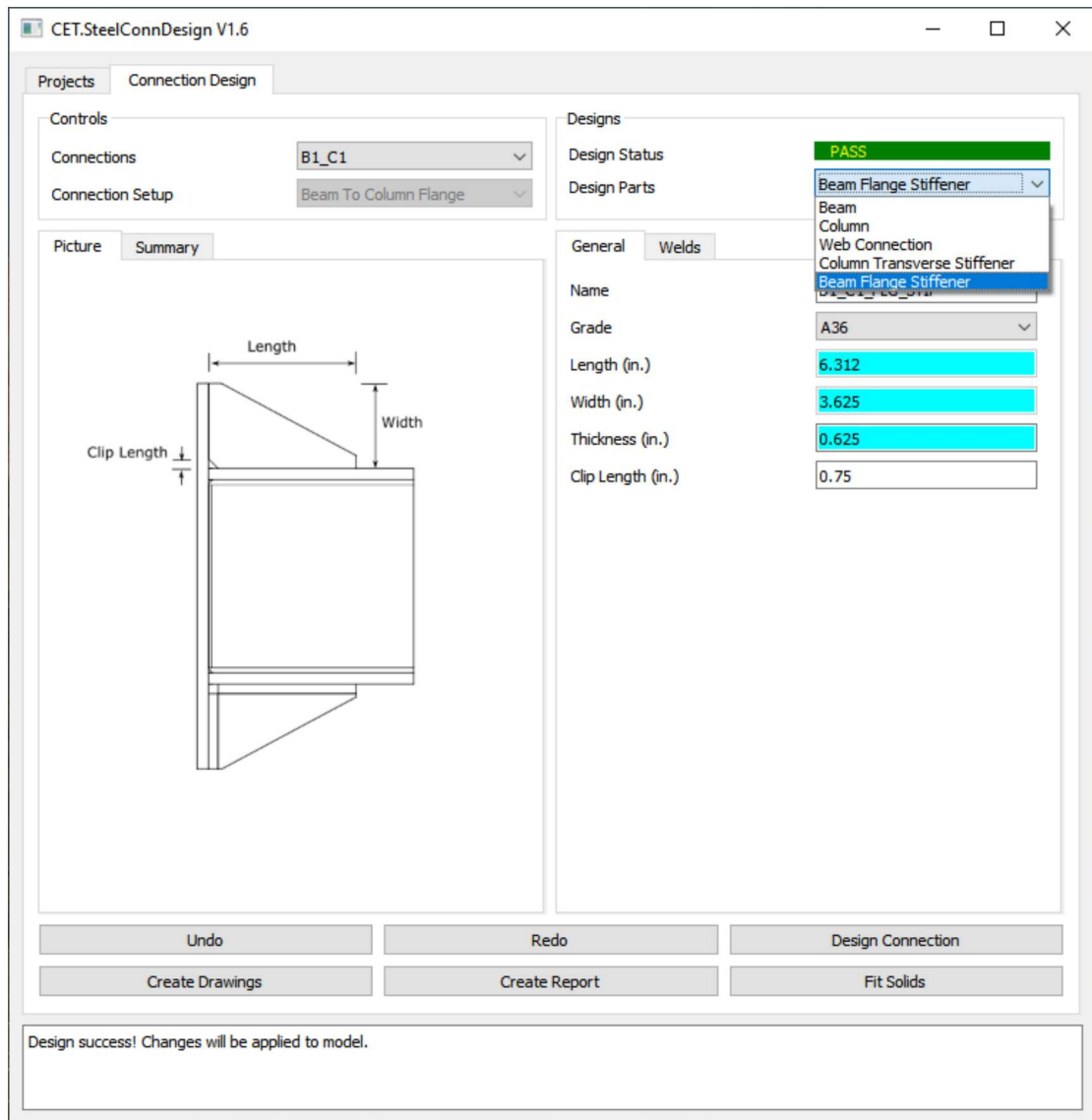


Figure 2.8 Switch Between Design Parts

3 Connection Design

3.1 Connection Setup

In the current version, our software offers support for four connection setups (in “Projects” tab): **Beam to Column Flange, Beam to Column Web, Beam to Beam Web and Beam Splice**. It's important to note that both beams and columns must be W Shapes. All three setups are designed to accommodate shear forces. However, not all setups are equipped to handle axial forces (tension and compression) and moments. Refer to the table below for a detailed overview:

Table 3 Forces, Moment and Connection Setup

Connection Setup	Shear Load	Axial Load	Moment
Beam to Column Flange	Yes	Yes	Yes
Beam to Column Web	Yes	Yes	No
Beam to Beam Web	Yes	No	No
Beam Splice	Yes	Yes	No

3.1.1 Beam To Column Flange/Web

At the beam web, three connection types are available: Angle, Single Plate, End Plate.

3.1.2 Beam To Beam Web

Important points to consider:

1. Ensure that the main beam shares the same top elevation as the girder (other beam).
2. The main beam should not have a greater depth than the girder (other beam).
3. Do not support axial load or moment
4. Three connection types are available: Angle, Single Plate, End Plate.

3.1.3 Beam Splice

Important points to consider:

1. Ensure that the both beams shares the same top elevation.
2. Do not support moment
3. Only support Single Plate connection at beam web

3.2 General Connection Design

3.2.1 Input Forces and Moments

Our software supports the design of connections with Shear force, Moment, Tension axial force, and Compression axial force. For beam web connections, Shear force is required, and Moment, Tension, and Compression forces can also be applied if necessary.

For non-moment connections, if Tension or Compression forces are provided, the software will evaluate the interaction between Shear, Tension, and Compression forces. However, certain checks, such as block shear check, are not applicable when Compression force is present.

The screenshot displays the CET.SteelConnDesign V1.9 software window. The 'Connection Design' tab is active. On the left, the 'Controls' section shows 'Connections' set to 'B1_C1' and 'Connection Setup' set to 'Beam To Column Flange'. Below this is a 'Picture' tab with a diagram of a beam-to-column flange connection, showing a vertical column and a horizontal beam with a 'Setback' dimension indicated. The 'Summary' tab is also visible. On the right, the 'Designs' section shows 'Design Status' as 'PASS' and 'Design Parts' as 'Beam'. Below this is a 'General' section with various input fields: 'Name' (B1), 'Type' (BEAM), 'Grade' (A992), 'Section Type' (W-Shapes), 'Section Size' (W18X60), 'Shear Force (Kips)' (20), 'Moment (Kip-in)' (0), 'Tension Force (Kips)' (15), 'Compression Force (Kips)' (10), and 'Setback (in.)' (0.5). At the bottom, there are buttons for 'Undo', 'Redo', 'Design Connection', 'Create Drawings', 'Create Report', and 'Fit Solids'. A status bar at the very bottom indicates 'Design success! Changes will be applied to model.'

Figure 3.1 Input Forces and Moments

3.2.2 Bolt Design

Please see AISC Specification J3.

3.2.3 Weld Design

Please see AISC Specification J2.

3.2.4 Bolt Spacing and Edge Distance

Please see AISC Specification J3.

3.2.5 Connection Subject to Shear Force Only

For beam web connections like the single plate and end plate, they're designed to handle shear loads only. We'll check their capacities specifically for shear strength, ensuring they can withstand the applied shear forces.

- Bolt (AISC Specification J3)
- Bearing (AISC Specification J3.10)
- Shear Yielding (AISC Specification J4.2)
- Shear Rupture (AISC Specification J4.2)
- Block Shear (AISC Specification J4.3)
- Weld (AISC Specification J2)

3.2.6 Connection Subject to Shear Force and Axial Force

For beam web connections like the single plate and end plate, we're not only checking their capacity for shear loads but also considering the interaction with axial loads. This means making sure they can handle both shear and axial forces together. In addition to 3.2.4, followings will be checked:

- Tensile Yielding (for the axial load, AISC Specification J4.1)
- Tensile Rupture (for the axial load, AISC Specification J4.1)
- Block Shear (for the axial load, AISC Specification J4.3)
- Interaction of axial, flexural and shear yielding (AISC Specification H1)
- Interaction of axial, flexural and shear rupture (AISC Specification H1)
- Interaction of axial, flexural and block shear (AISC Specification H1)

Please note that bolts, bearing and welds will be check against the combined shear force and axial force.

3.2.7 Connection Subject to Shear Force, Axial Force and Moment

For the Beam to Column Flange setup, the resistance against moments is primarily handled by the connection to the beam flange, such as the beam flange plate connection. In the presence of axial load, the force on the beam flange (f) due to the axial force (P) and moment (M) is calculated using the formula:

$$f = \frac{M}{d} + \frac{P}{2}$$

Where d is the moment arm length.

Besides, he eccentricity of beam web bolt group will be ignored.

3.2.8 Connection Subject to Axial Force Only

For the beam-to-column flange connection with a moment, we'll check if the beam flange plate can handle axial force and the combined effect of axial force and moment.

- Bolt (AISC Specification J3)
- Bearing (AISC Specification J3.10)

- Tensile Yielding (for the axial load, AISC Specification J4.1)
- Tensile Rupture (for the axial load, AISC Specification J4.1)
- Block Shear (AISC Specification J4.3)
- Weld (AISC Specification J2)

3.3 Typical Connections

3.3.1 Beam Web

For beam web subject to the shear force, we will check

- Bearing (AISC Specification J3.10)
- Shear Yielding (AISC Specification G2)

Please be aware that the examination for shear yielding is in accordance with AISC Specification G2.

Furthermore, the evaluation of the coped beam web's strength will be conducted according to AISC Part 9. This assessment includes examinations for both flexural strength and flexural local buckling strength. Cope dimensions can be manually adjusted through the UI; however, the top and bottom cope dimensions will be the same in Tekla.

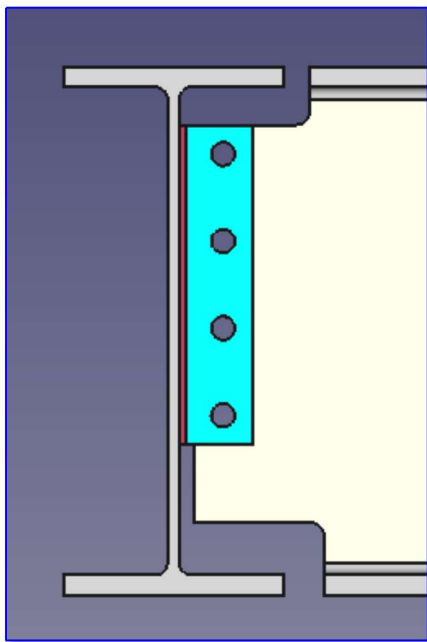


Figure 3.2 Beam Top and Bottom Copes in 3D Model

General	
Name	B2
Type	BEAM
Grade	A992
Section Type	W-Shapes
Section Size	W18X60
Shear Force (Kips)	40
Moment (Kip-in)	
Axial Force (Kips)	
Setback (in.)	0.5
Top Cope Length (in.)	4
Top Cope Depth (in.)	2
Top Cope Radius (in.)	0.5
Bottom Cope Length (in.)	4.5
Bottom Cope Depth (in.)	2.5
Bottom Cope Radius (in.)	0.5

Figure 3.3 Beam Top and Bottom Copes in UI

3.3.2 Beam Flange

For beam-to-column web connections, the beam flange block design is supported in CET.SteelConnDesign standalone version and in integration with FreeCAD. However, 2D detailing for beam flange blocks will be supported in a future version.

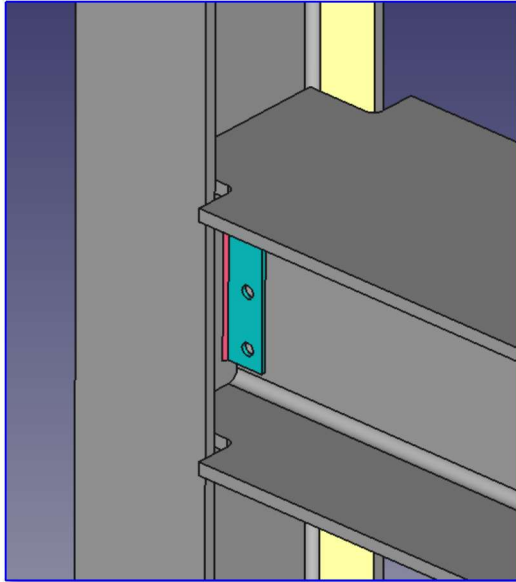


Figure 3.4 Beam Flange Blocks in 3D Model

General	
Name	B1
Type	BEAM
Grade	A992
Section Type	W-Shapes
Section Size	W14X90
Shear Force (Kips)	10
Moment (Kip-in)	
Axial Force (Kips)	0
Setback (in.)	0.5
Flange Block Length (in.)	4
Flange Block Width (in.)	2.5
Flange Block Radius (in.)	0.5

Figure 3.5 Beam Flange Blocks in UI

3.3.3 Angle Connection (Beam Web)

3.3.3.1 General

The **Angle** connection is more *complex* compared to **End Plate** or **Single Plate** connections. Currently, our software supports only **Angle** connections that are bolted to the beam web and bolted to either another beam or a column. Welded **Angle** connections will be available in a future version. Users can design either single-sided or double-sided angle connections, but double-sided connections are strongly recommended unless construction requirements specifically call for a single-sided connection. The UI for the angle connection:

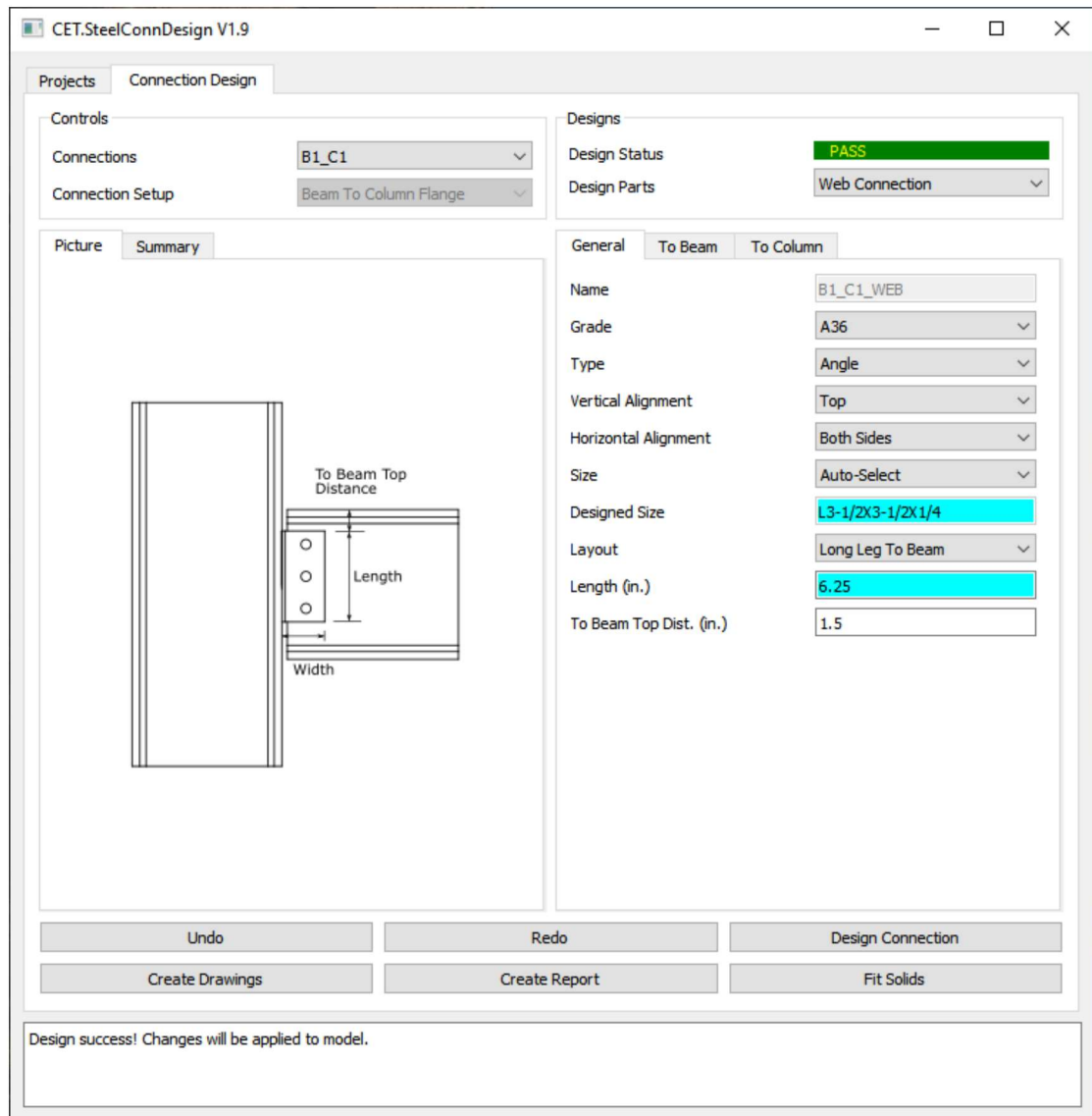


Figure 3.6 Angle Connection at Beam Web

3.3.3.2 Angle Size

CET.SteelConnDesign is one of the few software options that can automatically select an optimal angle size, significantly saving the designer's time. We highly recommend choosing 'Auto-select' in the 'Size' dropdown. However, users can still manually select their preferred angle size. When 'Auto-select' is enabled, the designed size will appear in cyan within the 'Designed Size' field. In future updates, the 'Size' and 'Designed Size' UI elements will be further streamlined for ease of use.

3.3.3.3 Bolt Eccentricity

According to AISC Steel Manual Part 10 (15th Edition, Page 10-9), for double-angle connections, eccentricity on the supported side can be ignored if there is only one vertical row of bolts through standard or short-slotted holes and the distance labeled 'a' (distance from angle face to bolt line) is 3 inches or less. In all other cases, eccentricity must be considered.

3.3.3.4 Bolt Location and Angle Gage

In single-sided angles, the term 'gage' refers to the distance from the angle toe to the bolt line, which differs from its meaning in double-sided angles. Please refer to the following figure for clarification.

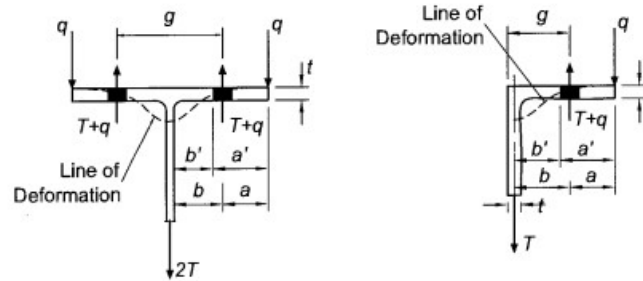


Figure 3.7 Angle Gages

When determining angle locations, our software references the following tables from the AISC Steel Manual:

- Table 1-7A, "Workable Gages in Angle Legs" (15th Edition, Page 1-52)
- Table 1-1, "W-Shapes" for workable gages (15th Edition, Page 1-12)
- Table 7-15, "Entering and Tightening Clearance" (15th Edition, Page 7-80)

If users manually input the gage value, only the workable gages for angles and W-shapes are validated.

It's important to note that larger bolt diameters, as specified in the 'Entering and Tightening Clearance' guidelines, increase the space requirements within angle legs. For angle connections, smaller bolt diameters, such as 5/8" or 3/4", are generally preferred to optimize fit and clearance.

3.3.4 End Plate Connection

Please check AISC Manual Part 10 for the Shear End-Plate connections.

3.3.5 Single Plate Connection

Please look at AISC Manual Part 10 for the Single-Plate connections. In our software, users can opt for either the "Conventional Configuration" or "Extended Configuration". The "Conventional Configuration" features a smaller bolt group eccentricity and may result in a smaller single plate, but it comes with certain limitations. On the other hand, the "Extended Configuration" is recommended when uncertain. Please check following references:

AISC 13th Page 10-101, AISC 14th Page 10-102 and AISC 15th Page 10-87

The screenshot shows the 'General' tab of a 'Single Plate' connection design. The 'Plate Configuration' dropdown menu is open, showing three options: 'Conventional Configuration', 'Extended Configuration', and 'Conventional Configuration'. The first two options are highlighted in blue, and the third option is highlighted in red.

Figure 3.8 "Plate Configuration" Dropdown in Single Plate Connection Design

The screenshot shows the 'General' tab of a 'Single Plate' connection design. The 'Plate Shape' dropdown menu is open, showing three options: 'Normal', 'Normal', and 'Extended'. The first two options are highlighted in blue, and the third option is highlighted in red.

Figure 3.9 "Plate Shape" Dropdown in Single Plate Connection Design

Starting from version 1.8, a new field called "Plate Shape" has been added, with two options: "Normal" and "Extended." This field is only available for beam-to-column web connections. Please note the following:

- 1) An extended single plate will have a larger bolt group eccentricity and reduced bolt shear capacities. For example, a normal single plate with 5 rows of bolts has a bolt shear capacity of 74 kips, while an extended single plate with the same bolts has a bolt shear capacity of 45 kips, representing approximately a 40% decrease.
- 2) When "Extended" is selected for "Plate Shape," "Extended Configuration" must also be selected for "Plate Configuration." Otherwise, the connection will fail.

3.3.6 Moment End Plate Connection

Please see Design Guide 4: Extended End-Plate Moment Connections Seismic and Wind Applications.

Notes: User need to input correct moment loads. Axial load is not support for this connection.

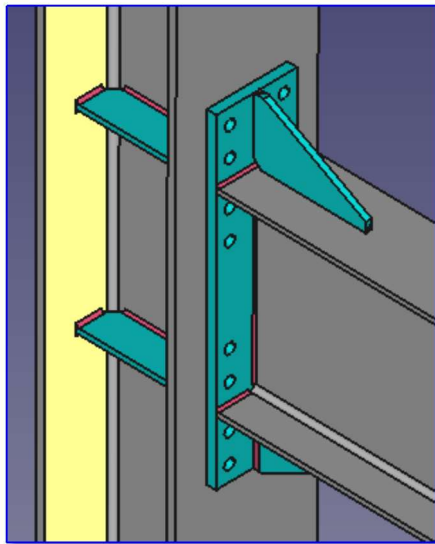


Figure 3.10 Moment End Plate in 3D Model

General	To Column	To Beam
Name	B1_C1_WEB	
Grade	A992	
Type	End Plate	
Length (in.)	34.05	
Width (in.)	8.25	
Thickness (in.)	1	
Moment Bolt Pattern	8 Bolts Stiffened	
Applied Force to Member End	4 Bolts 4 Bolts Stiffened 8 Bolts Stiffened	

Figure 3.11 Moment End Plate in UI

3.3.7 Column Transverse Stiffener

Please refer to AISC Design Guide 4: Extended End-Plate Moment Connections for Seismic and Wind Applications. It's important to note that our system designs column transverse stiffeners only when necessary, as the cost of these stiffeners is high. In some instances, changing the column size can eliminate the need for stiffeners, which is highly recommended.

Even if our system does not design these stiffeners automatically, users can still input values, such as the clip length. The system will then design the stiffeners and generate the corresponding drawings.

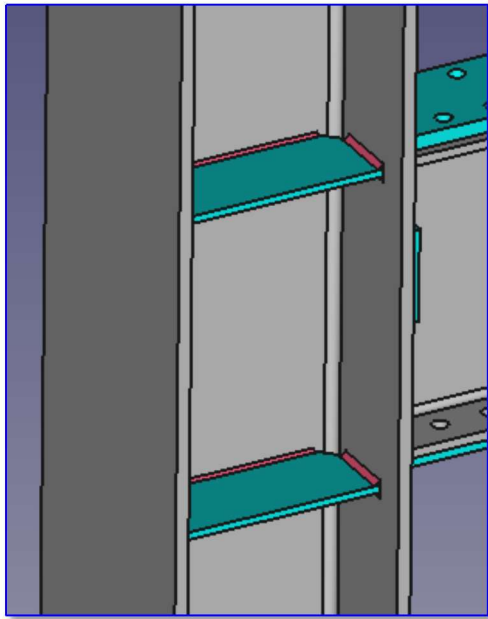


Figure 3.12 Column Transverse Stiffeners in 3D Model

General		Welds	
Name	C1_B1_COL_FLG_STIF		
Grade	A36		
Length (in.)	12.64		
Width (in.)	5		
Thickness (in.)	0.4375		
Clip Length (in.)	1.25		

Figure 3.13 Column Transverse Stiffeners in UI

3.3.8 Beam Flange Stiffener

Please check AISC Design Guide 4: Extended End-Plate Moment Connections Seismic and Wind Applications.

3.3.9 Stabilizer Plate

This feature is only available for beam-to-column web extended single plate connections. Currently, the presence of the stabilizer plate does not affect the bolt group eccentricity of the extended single plate. However, we may offer UI settings to allow for such changes in the future.

Similar to the column transverse stiffeners, users can enter values for the plates, and our system will create them even if they are not required.

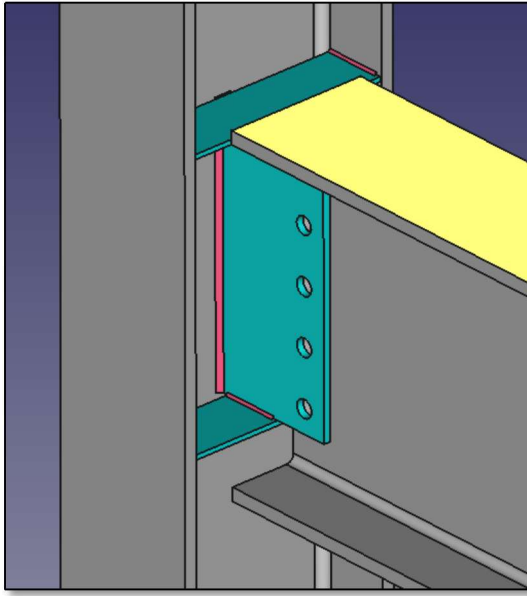


Figure 3.14 Stabilizer Plate in 3D Model

Designs	
Design Status	PASS
Design Parts	Stabilizer Plate

General	
Name	Conn1
Grade	A36
Length (in.)	10.92
Width (in.)	3.25
Thickness (in.)	0.25

Figure 3.15 Stabilizer Plate in UI

3.4 Notes For Standalone and Integration with FreeCAD

3.4.1 General

In a beam splice, the splice plates for the current beam and the splice plate can be designed separately based on different shear loads. However, both plates will share the same "To Center Line Transverse to Load" and number of bolt groups columns. User can adjust bolt diameter or edge distance for both plates.

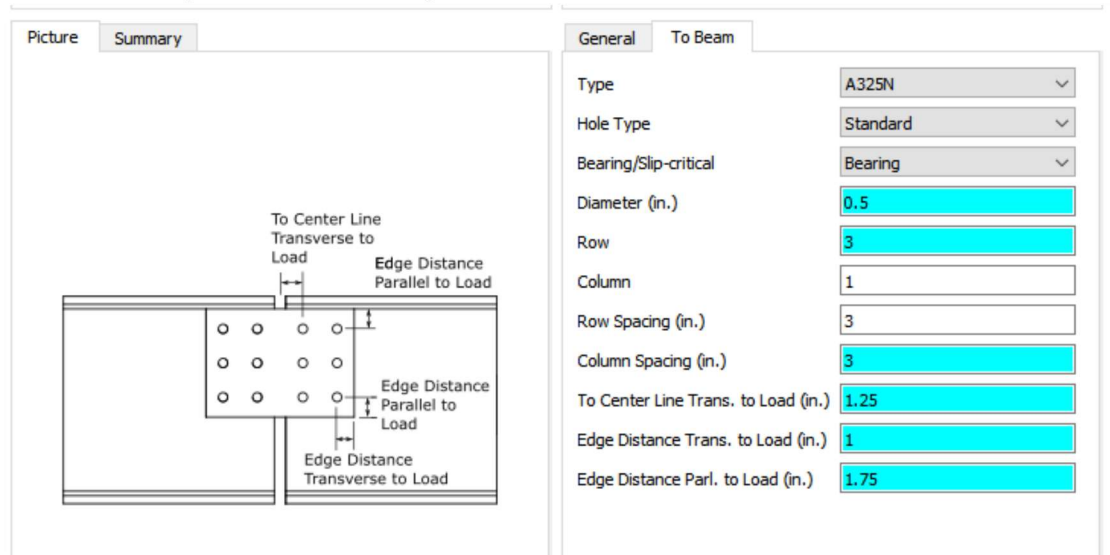


Figure 3.16 Inputs for Beam Splice Connection

3.5 Integration With Tekla and Known Issues

3.5.1 General

For a beam splice, the splice plate in the current beam and the splice plate in the opposite beam are symmetrical.

3.5.2 Known Issues

1 When selecting the "Right Side" plate configuration for a **Beam Splice** connection in Tekla, two plates will be displayed. Despite this, the design and calculations are correct. Therefore, in Tekla connection 77, under the "Parameters" tab, users should adjust the plate side to the right side.

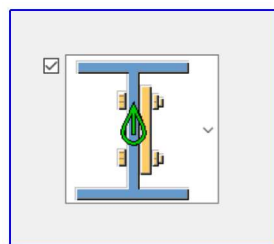


Figure 3.17 Tekla Plate Side for Beam Splice Connection

2 In **Beam Splice** connections for flange plate design, if the hole type is selected as "Long Slot Hole Parallel to Load" or "Short Slot Hole Parallel to Load" in Tekla Connection 77, the

vertical dimension in the "Primary bolts" section under the "Top flange bolts" tab may be incorrect. To resolve this, copy the value from the "Secondary bolts" section and overwrite the incorrect value.

3 In **Beam Splice** connections for flange plate design, if the hole type is selected as "Long Slot Hole Parallel to Load" or "Short Slot Hole Parallel to Load" in Tekla Connection 77, the "Tolerance" value may be incorrect. To fix this, copy the value from the "Bottom flange bolts" tab and overwrite the incorrect value.

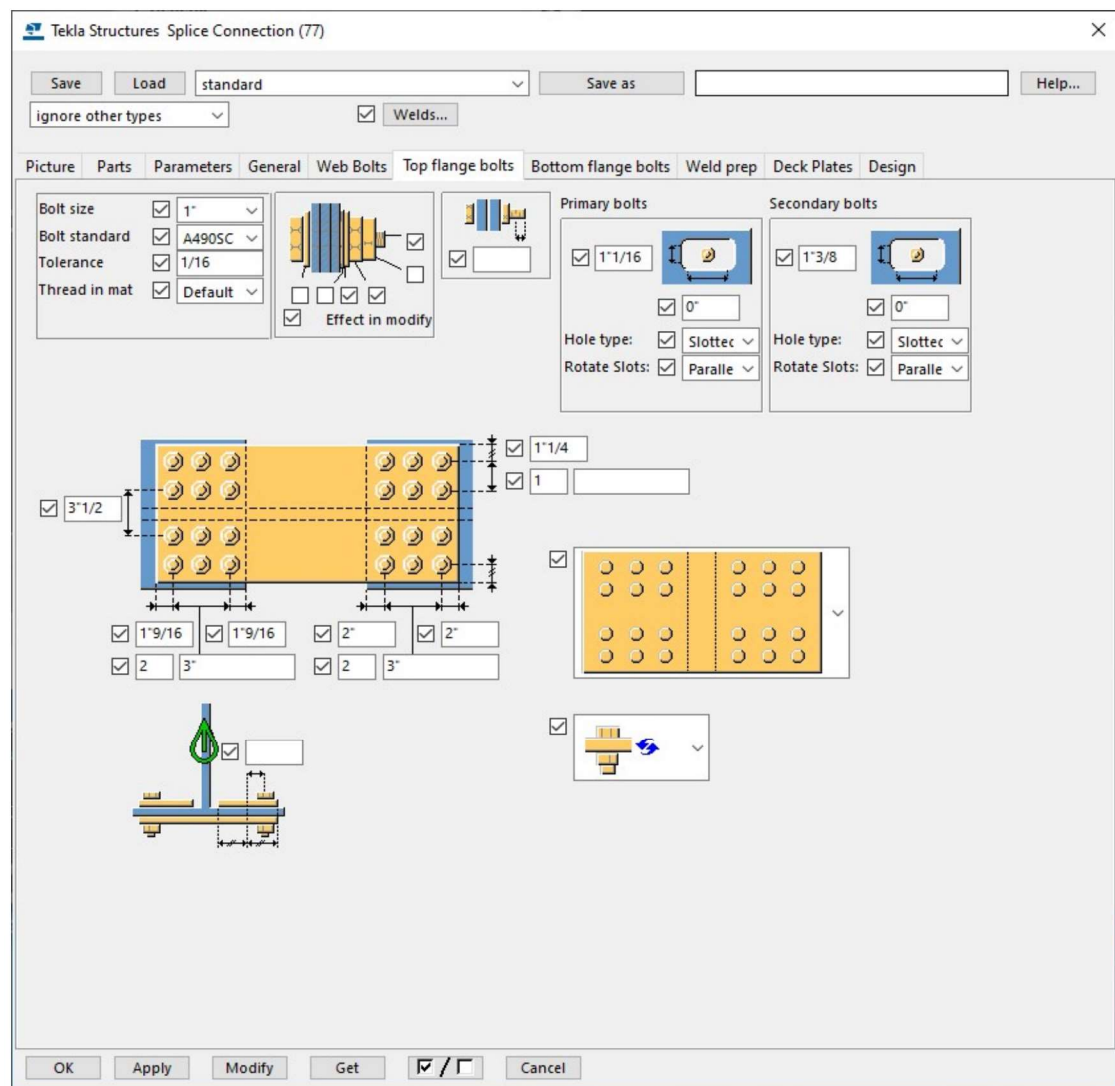


Figure 3.18 Flange Bolt Inputs in Tekla

4 For **Beam to Column Web**, extended single plate connections with a stabilizer plate, the welds between the stabilizer plate and the single plate are missing. Users need to manually add these two welds.

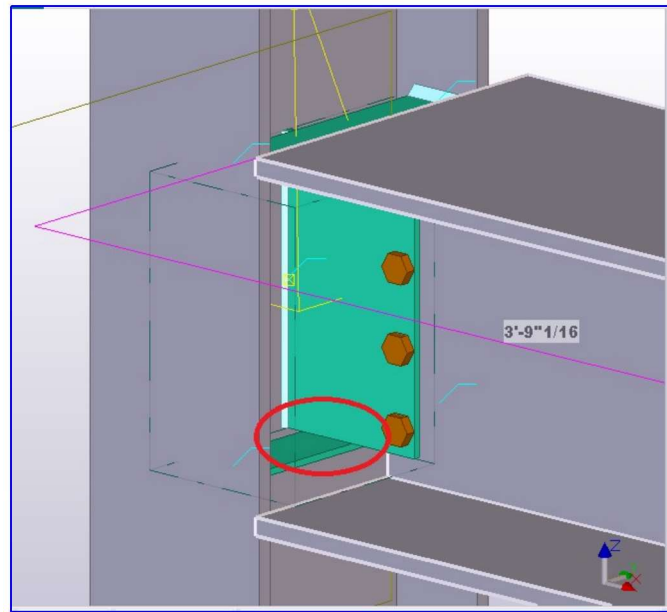


Figure 3.19 Missing Welds between the Stabilizer Plate and the Single Plate

4 Report and Drawings

4.1 Detailed Connection Design Report

Your design reports in CET.SteelConnDesign have distinct characteristics that set them apart in the market:

1 Connection Geometry and Strength Limitations:

Comprehensive checks on connection geometry limitations and strength constraints ensure a thorough assessment.

2 Real Connection Sketches with Dimensions (Only for FreeCAD):

Integration with FreeCAD allows for the presentation of authentic connection sketches accompanied by precise dimensions, enhancing visual clarity.

3 Step-by-Step Connection Strength Calculation:

The inclusion of a step-by-step connection strength calculation, complete with **units**, provides a detailed and transparent understanding of the design process.

4 Powered by LaTeX for Readability and Verification:

Leveraging **LaTeX** ensures that all equations are not only easy to read but also verified for accuracy, adding a layer of reliability to the design reports.

These features collectively contribute to making your design reports a **leading** choice in the market, offering a comprehensive, visually informative, and meticulously calculated representation of connection strength in structural designs.

Check moment end plate thickness requirement

Bolt tensile strength

$$\begin{aligned}
 P_t &= F_t A_b \\
 &= 90 \text{ kips} \left(\frac{3.1416(1 \text{ in.})^2}{4} \right) \\
 &= 70.69 \text{ kips}
 \end{aligned}$$

The no prying bolt moment strength

$$\begin{aligned}
 \phi M_{np} &= \phi 2P_t(h_0 + h_1) \\
 &= 0.75(2)(70.6858 \text{ kips})(22.539 \text{ in.} + 18.017 \text{ in.}) \\
 &= 4300 \text{ kip-in.} > M_{uc} = 2200 \text{ kip-in. O.K.}
 \end{aligned}$$

The end plate yield line mechanism parameter

$$\begin{aligned}
 s &= \frac{1}{2} \sqrt{b_p g} \\
 &= \frac{1}{2} \sqrt{(8.25 \text{ in.})(5.5 \text{ in.})} \\
 &= 3.368 \text{ in.} > p_{fi} = 2 \text{ in.}
 \end{aligned}$$

$$\begin{aligned}
 Y_p &= \frac{b_p}{2} \left[h_1 \left(\frac{1}{p_{fi}} + \frac{1}{s} \right) + h_0 \left(\frac{1}{p_{fo}} + \frac{1}{2s} \right) \right] + \frac{2}{g} [h_1(p_{fi} + s) + h_0(d_e + p_{fo})] \\
 &= \frac{8.25 \text{ in.}}{2} \left[18.017 \text{ in.} \left(\frac{1}{2 \text{ in.}} + \frac{1}{3.36805 \text{ in.}} \right) + 22.539 \text{ in.} \left(\frac{1}{2 \text{ in.}} + \frac{1}{2(3.36805 \text{ in.})} \right) \right] \\
 &\quad + \frac{2}{5.5 \text{ in.}} [18.017 \text{ in.}(2 \text{ in.} + 3.36805 \text{ in.}) + 22.539 \text{ in.}(1.625 \text{ in.} + 2 \text{ in.})] \\
 &= 184.4 \text{ in.}
 \end{aligned}$$

$$\begin{aligned}
 t_{p, \text{Req'd}} &= \sqrt{\frac{1.11 \phi M_{np}}{\phi_b F_{yp} Y_p}} \\
 &= \sqrt{\frac{1.11(0.75)(5733.47 \text{ kip-in.})}{0.9(50 \text{ ksi})(184.395 \text{ in.})}} \\
 &= 0.7584 \text{ in.} < 0.875 \text{ in. O.K.}
 \end{aligned}$$

(AISC design guide 4 Equ 3.10)

Figure 4.1 Connection Design Report Example

4.2 Automated 2D Drawings with FreeCAD

4.2.1 General

The introduction of automatic 2D drawing generation in version V1.5 of our software is a significant advancement (with FreeCAD only). This feature allows users to effortlessly generate member/connection assembly drawings and connection drawings, complete with dimensions and annotations, enhancing the overall design documentation process. Also users can make any changes in these drawings. The provided video link "<https://www.youtube.com/watch?v=aRVq2v3a-wk>" offers a detailed demonstration of this functionality.

Additionally, the commitment to supporting member drawings in future versions further underscores your dedication to providing comprehensive design solutions and a seamless user experience. This development is sure to benefit users by simplifying the generation of accurate and detailed design documentation.

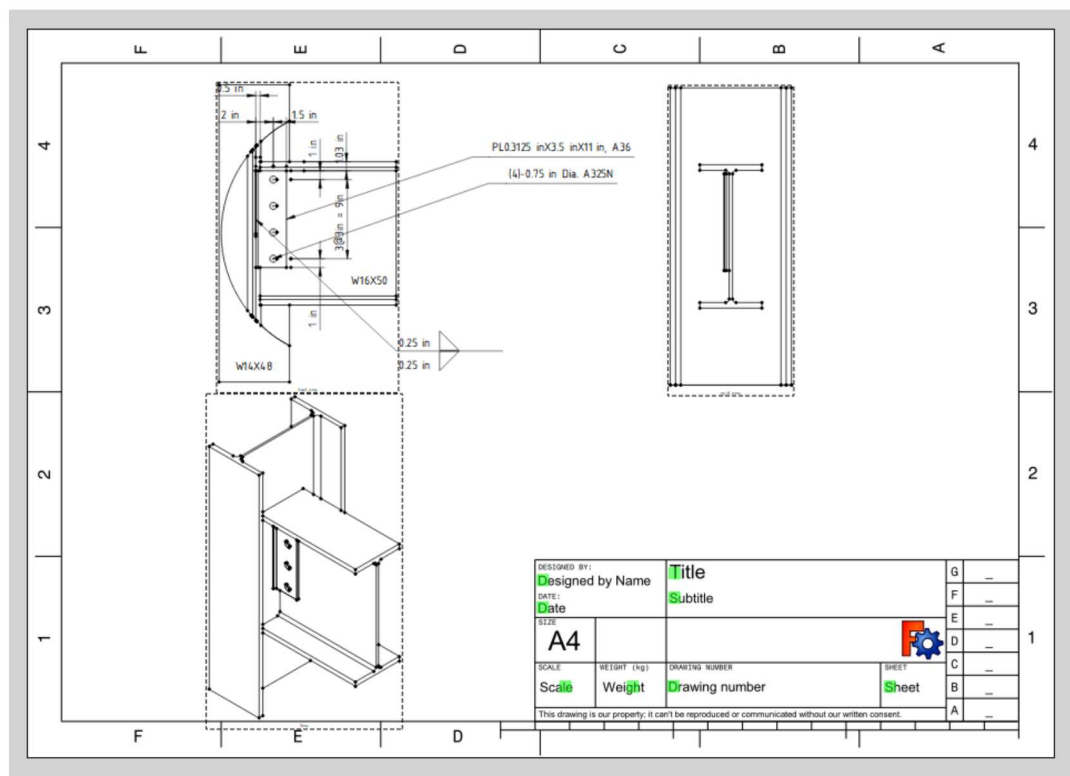


Figure 4.2 Automated 2D Drawing example

4.2.2 Drawing Parameter Settings

(Coming soon)

Reference

AISC Steel Construction Manual, 13th Ed

AISC Steel Construction Manual, 14th Ed

AISC Steel Construction Manual, 15th Ed

AISC Design Guide 4: Extended End-Plate Moment Connections Seismic and Wind Applications