

# IDEA StatiCa 23 Release Webinar

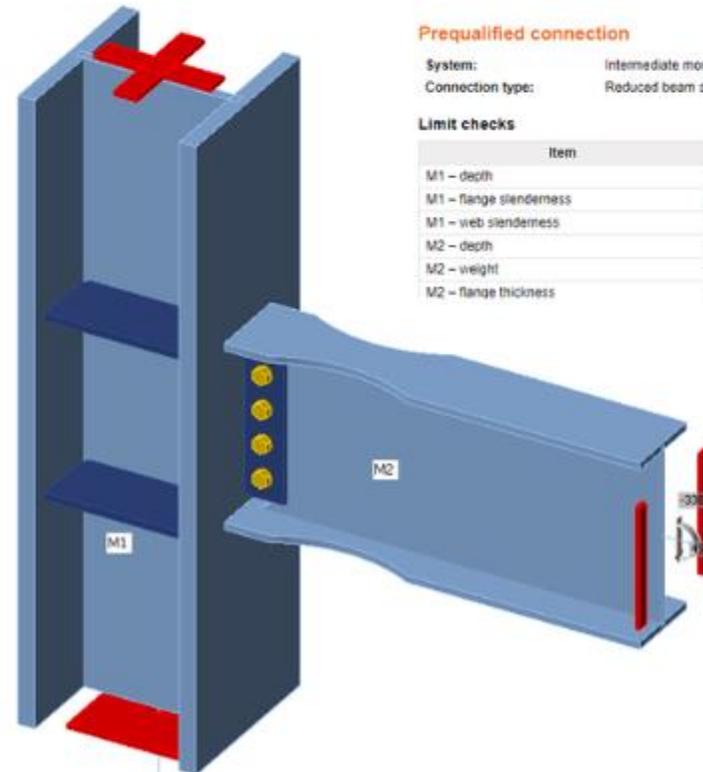
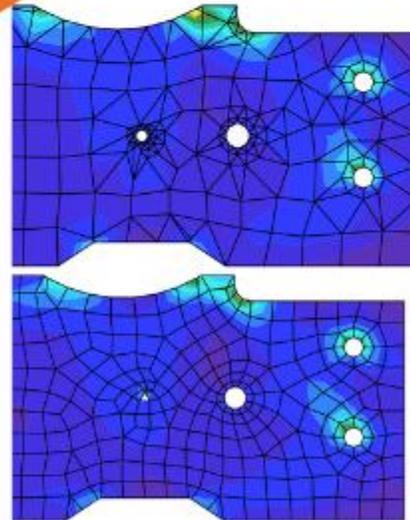
**IDEA StatiCa®**

Calculate yesterday's estimates

Wednesday  
May 31st  
Noon EST

### Prequalification limits

Prequalified connection is in accordance with AISC Seismic Provisions for Structural Steel Buildings



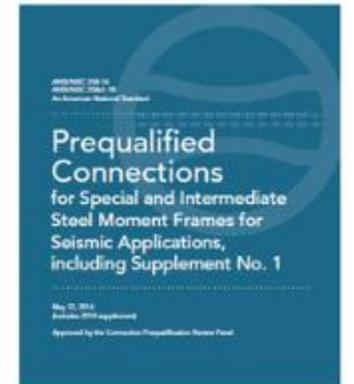
### Prequalified connection

System: Intermediate moment frames (IMF)

Connection type: Reduced beam section (RBS)

### Limit checks

Item	Value	Requirement	Reference	Status
M1 - depth	393.70	$\leq 1095.38$ mm	[I] 5.3.2(3)	OK
M1 - flange slenderness	5.45	$\leq 9.19$	[I] 5.3.2(6)	OK
M1 - web slenderness	14.18	$\leq 36.05$	[I] 5.3.2(6)	OK
M2 - depth	414.02	$\leq 1095.38$ mm	[I] 5.3.1(2)	OK
M2 - weight	75	$\leq 449$ kg/m <sup>3</sup>	[I] 5.3.1(3)	OK
M2 - flange thickness	16.00	$\leq 44.45$ mm	[I] 5.3.1(4)	OK



# Agenda

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1. Miscellaneous Enhancements
2. Prequalified moment connection checks per AISC 358
3. Welded built-up sections
4. No directional strength increase for HSS members
5. Moment calculation on stand-off anchors
6. Concrete Detail app: New ACI templates

[Release notes v23](#)



# Connection details and analysis type

The screenshot displays the IDEA StatiCa CONNECTION software interface. The main window shows a 3D model of a gusset connection with members labeled M3, SM1, and B. A red crosshair on member M3 is labeled with the value 300.000. The production cost is indicated as 1209 US\$. The software title bar shows '4-6Gussetconnection.ideaCon'. The interface includes a ribbon with tabs for Project, Design, Check, Report, and Materials. The Design tab is active, showing various tools for creating and editing connections. A purple dashed arrow points from the 'CON1' dropdown in the ribbon to the 'CON1' project item in the right-hand panel.

**CON1**

Production cost - 1209 US\$

300.000

M3

SM1

B

**CON1**

- Members
  - C
  - B
  - M3
- Load effects
  - LE1
- Operations
  - SM1
  - CUT1
  - CUT2

**CON1**

**Project item**

Name	CON1
Description	
Design code edition	AISC 360-16 (LRFD)
Analysis type	Stress, strain
Report	Stress, strain Stiffness Capacity design Joint design resistance Fatigue Fire resistance

# Report generation

Calculate yesterday's estimates

Project Design Check **Report** Materials

Wf to HSS Moment Conn

New Copy Generate Print Preview DOC PDF DXF Brief One page Detailed BOM Current All Selected

Project items Report view Type of report Items in report

**Report** [Reset](#)

- Project data
- Paragraph
- Materials
- Project items
  - Wf to HSS Moment Conn
- Code settings
- Theoretical background
- Software info

**Project items settings**

- Drawings - model
- Drawings - results
- Bill of material
- Cost estimation
- Formulas
- Explanations
- Picture colors

Design code: AISC - LRFD (2016) Analysis: Stress, strain Load effects: Equilibrium not required Units: in [www.ideastatica.com](http://www.ideastatica.com)

Set Project items settings for detailed report and click Generate button

# Working plane reference

▼ **Work plane**

Method

▼ **Origin**

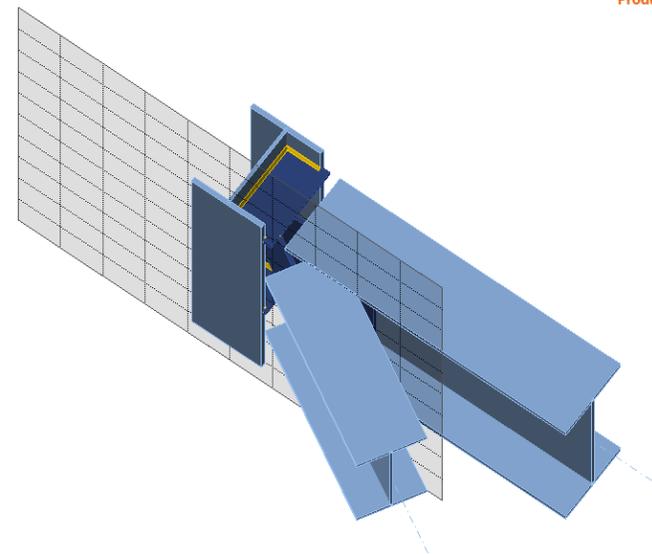
Origin

Member	Joint
X [mm]	Member
Y [mm]	Plate
Z [mm]	0

▼ **Rotation**

Rotation Y [°]	0.0
Rotation Z [°]	0.0

- Notch by other members
- Member cut
- Bracing position



CON1 ▾

New Copy Undo Redo Save

Members Plates LCS New Gallery

Propose Publish Manage Code setup Calculate Overall check

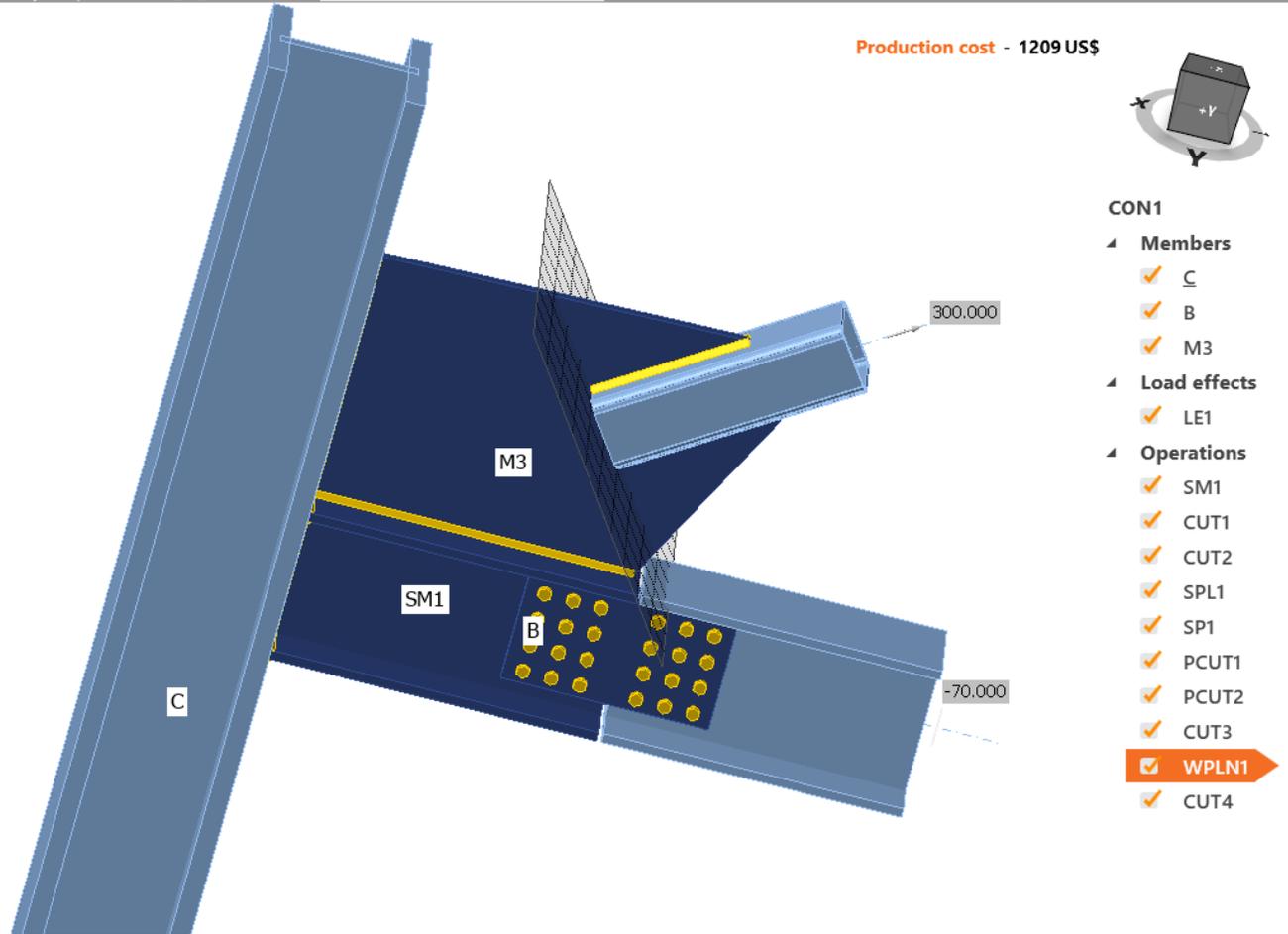
Settings Loads in equilibrium Loads - percentage

XLS Import Connection Import XLS Export

Member Load Operation

Project items Data Labels Pictures Connection Library CBFEM Options Import/Export loads New

Home Find Rotate Refresh View Generally located plate (SP1) Solid Transparent Wireframe WPLN1 [Work plane] Copy Delete



- CON1
- ▾ Members
    - C
    - B
    - M3
  - ▾ Load effects
    - LE1
  - ▾ Operations
    - SM1
    - CUT1
    - CUT2
    - SPL1
    - SP1
    - PCUT1
    - PCUT2
    - CUT3
    - WPLN1
    - CUT4

Work plane

Method By angles

Origin

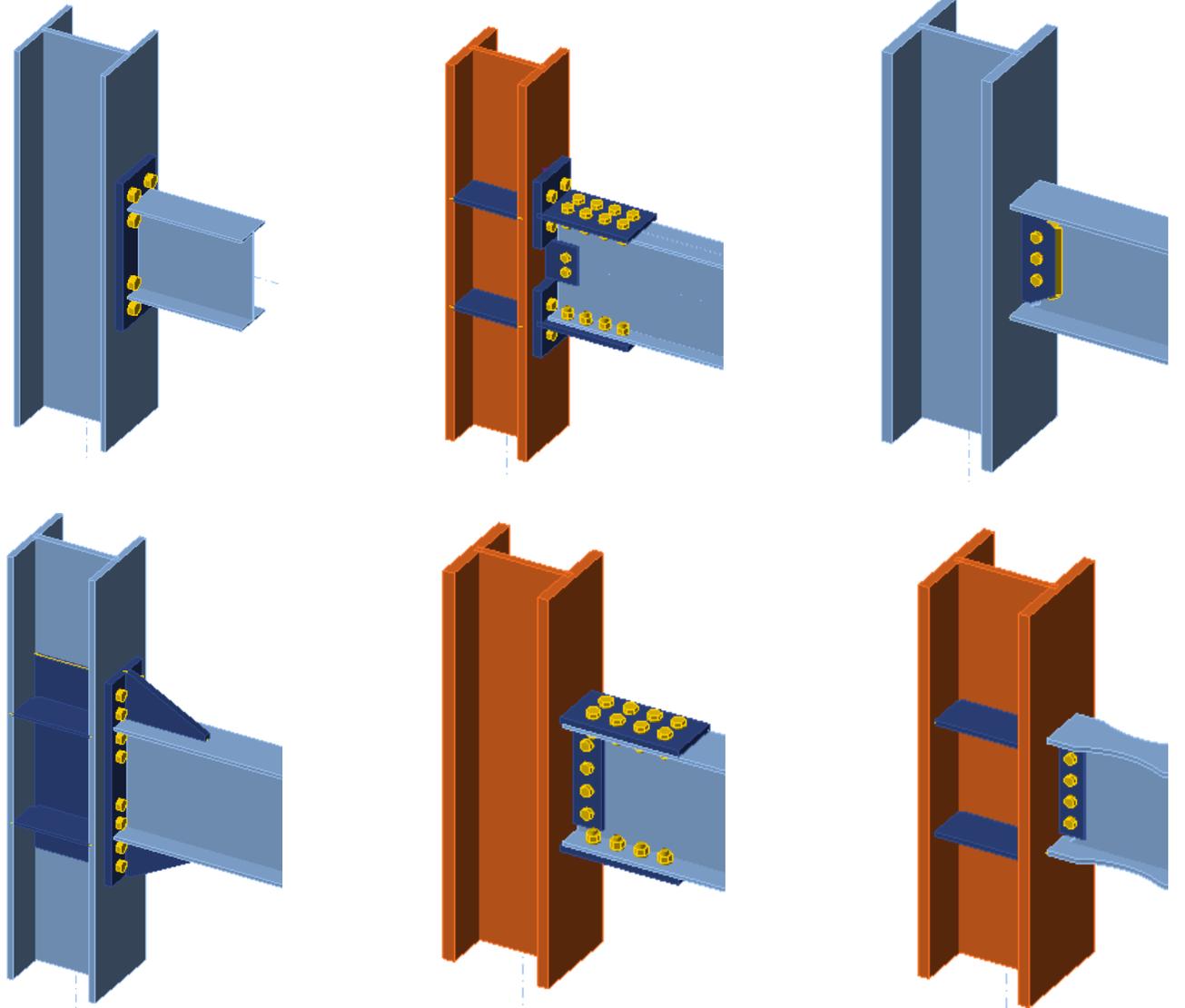
Origin	Member
Member	M3
X [in]	3'-7"
Y [in]	0"
Z [in]	0"

Rotation

Rotation Y [°] 0.0

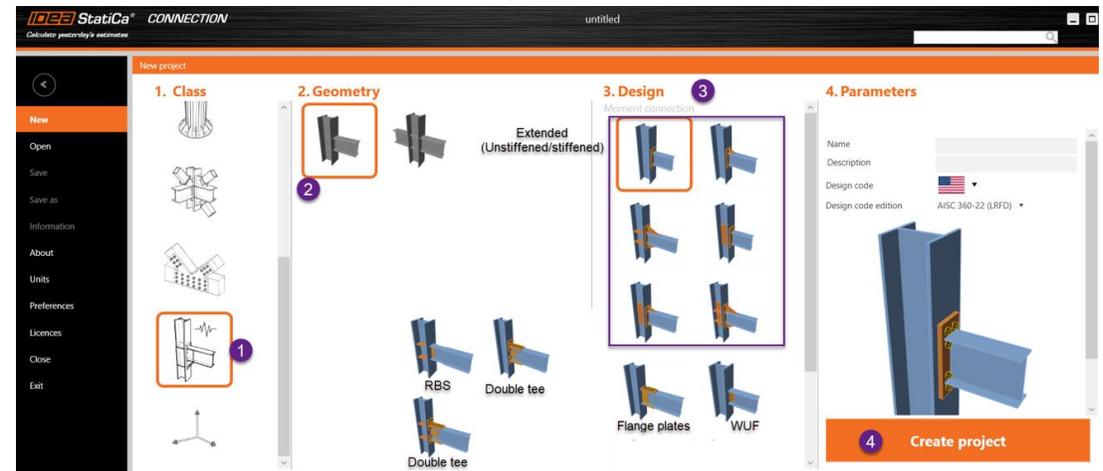
Rotation Z [°] 0.0

## 2. Prequalified connections AISC 358



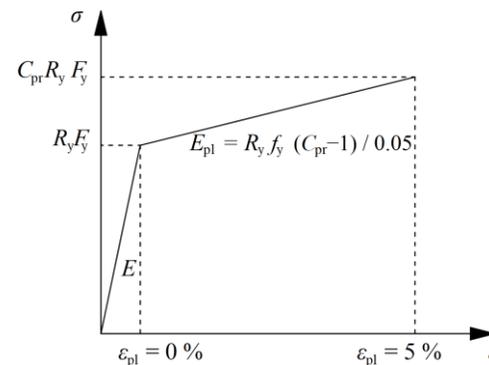
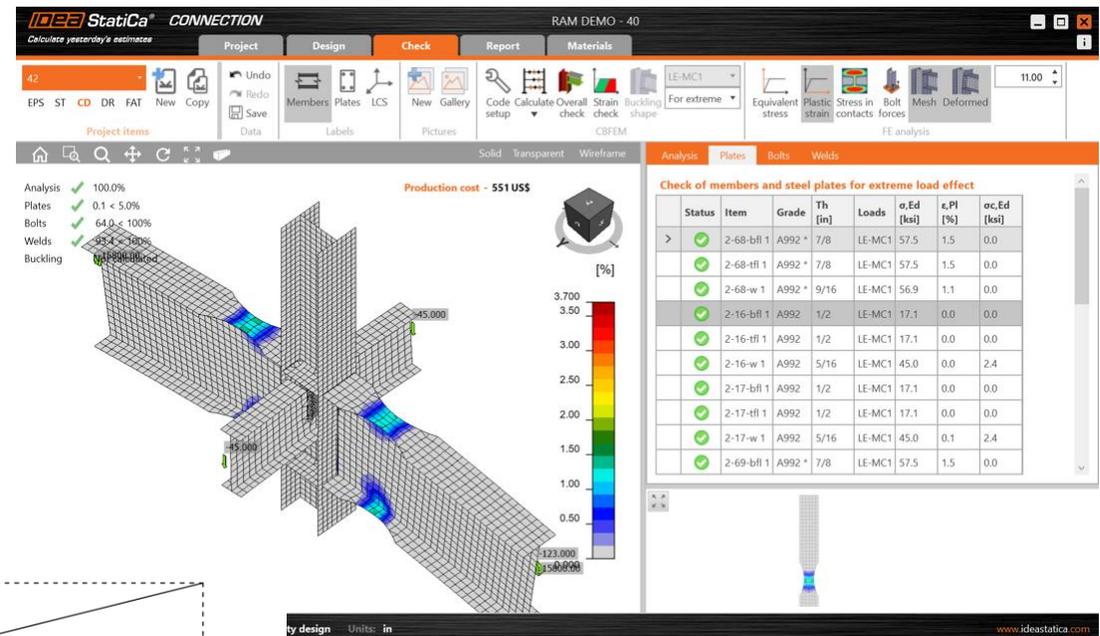
# Prequalified connections AISC 358

- **Model and code check** the AISC 358 detailing limits
- **Confirm** the plastic hinge location considering  $R_y$  and  $C_{pr}$
- **Design** all the other components in the joint



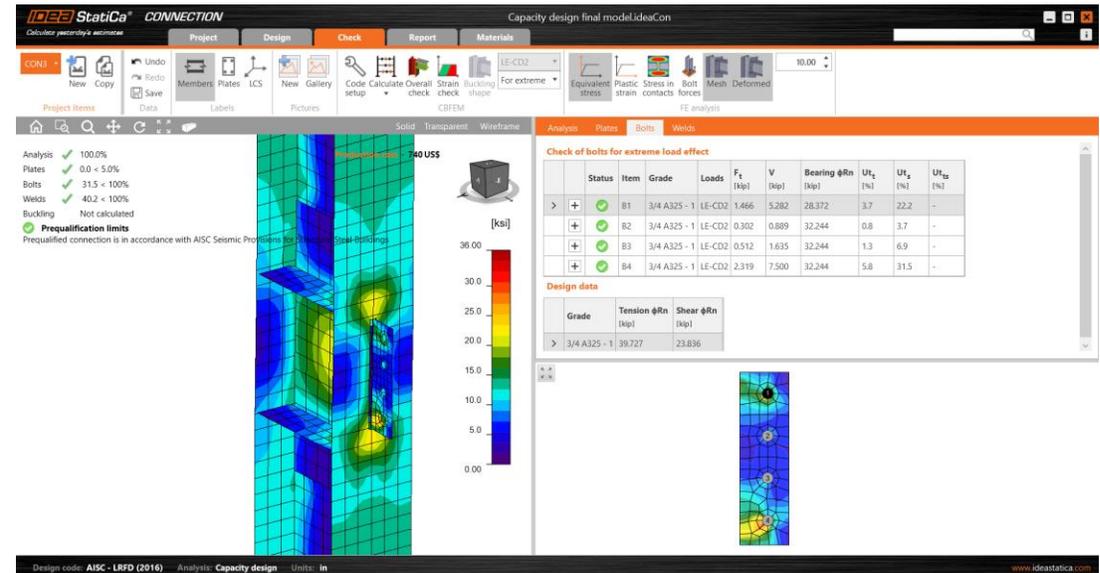
# Prequalified connections AISC 358

- Model and code check the AISC 358 detailing limits
- **Confirm** the plastic hinge location considering  $R_y$  and  $C_{pr}$
- Design all the other components in the joint



# Prequalified connections AISC 358

- Model and code check the AISC 358 detailing limits
- Confirm the plastic hinge location considering  $R_y$  and  $C_{pr}$
- Design all the other components in the joint



# SUPPORT CENTER

Prequalified connections

 SEARCH

PRODUCT

Steel (159) 

Connection (159) 

AISC (USA) (159) 

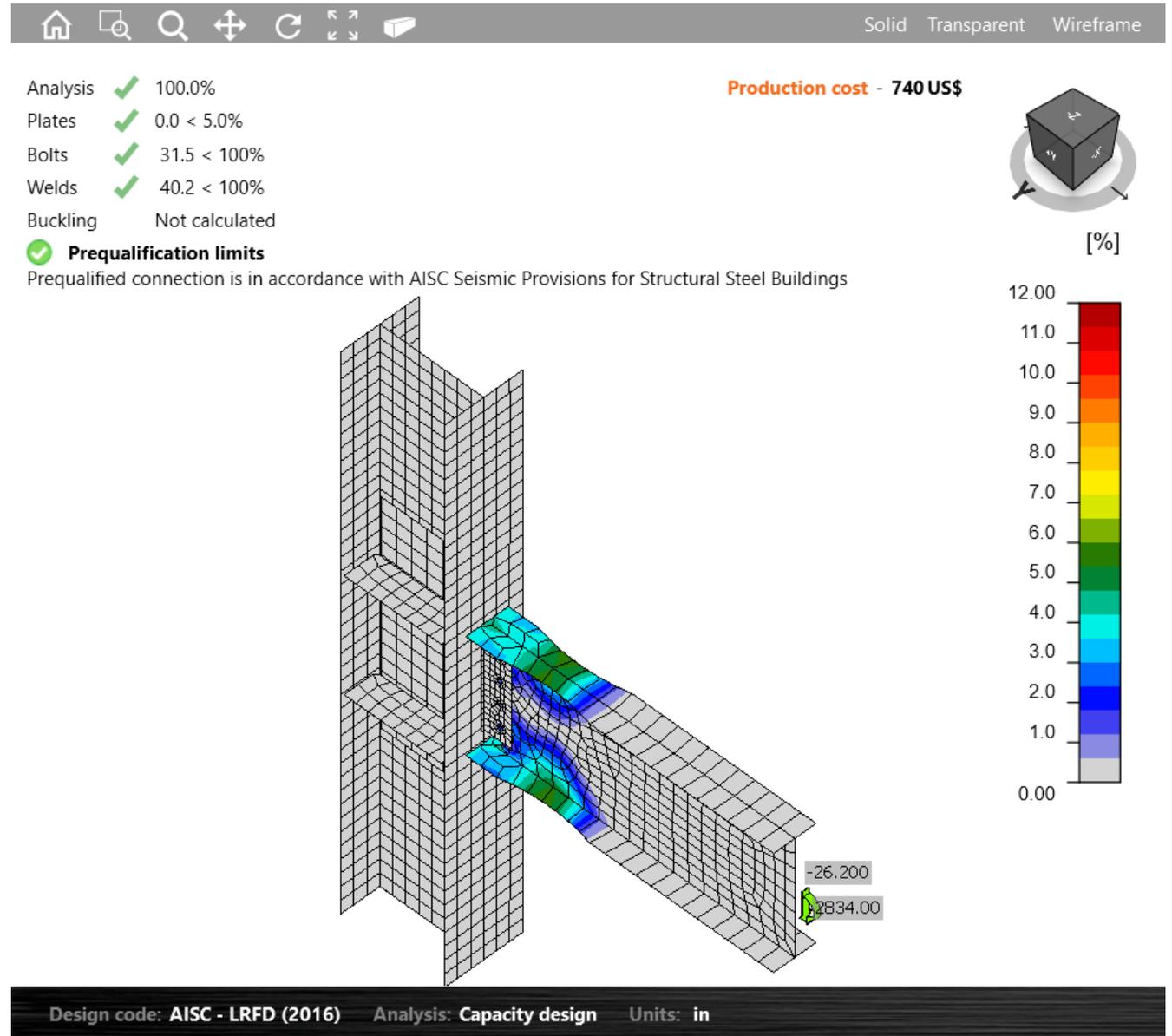
[Clear all](#)

## Resources

- [Blog post: AISC 358 Prequalified Moment Connection Checks are here!](#)
- [Theoretical background](#)
- [Capacity design tutorial](#)

# Live demo Reduced beam section (RBS)

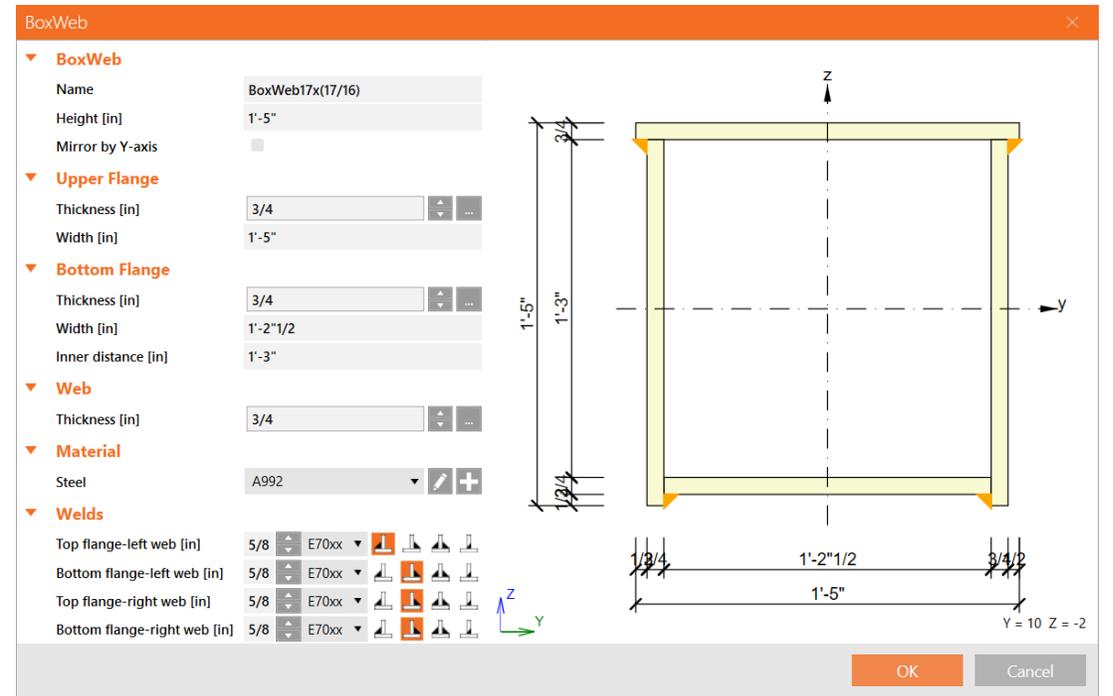
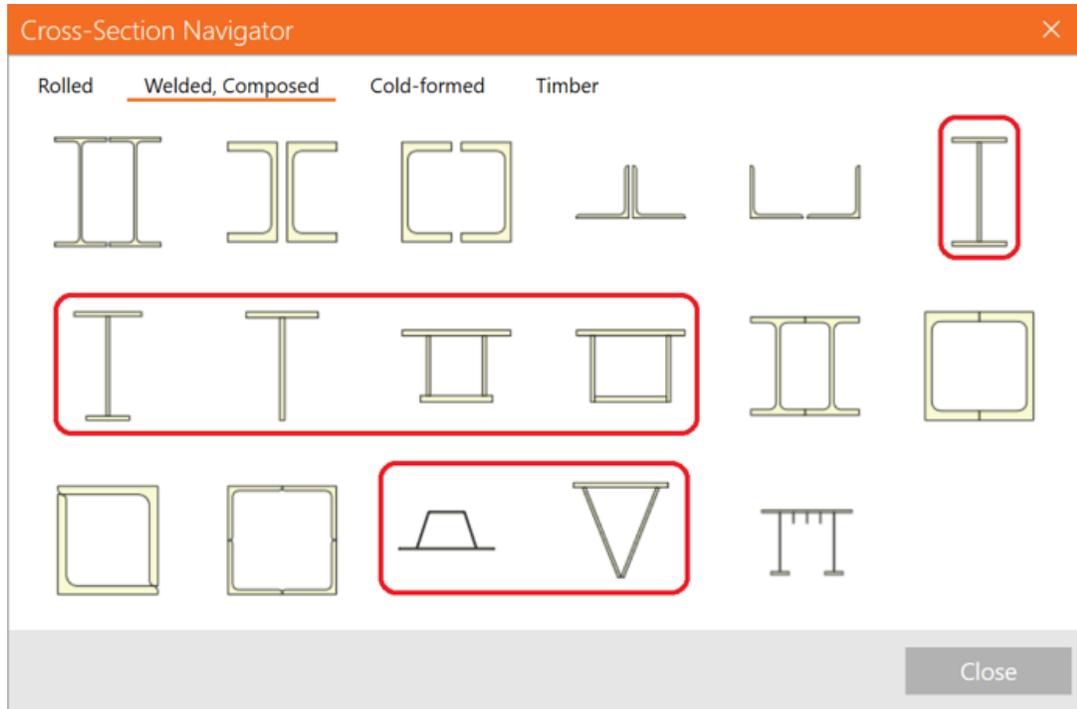
- Capacity design tutorial AISC
- File to download



# Design workflow

1. Select Capacity design, Type of moment frame, and prequalified connection. Assign dissipative item.
2. Model and comply with the detailing limits based on AISC 358
3. Calculate the probable maximum moment at plastic hinge ( $M_{Pr}$ ) and Shear force at plastic hinge location ( $V_h$ ).
4. Determine the beam plastic hinge location depending on the Preq conn type and input the force position
5. Change resistance factors
6. Run the analysis and verify the plastic strain is happening at the planned location calculated in step 4.
7. Pull out the report with the prequalification details

# 3. Welds on built up sections



Fillet1

New Copy

Undo Redo Save

Members Plates LCS

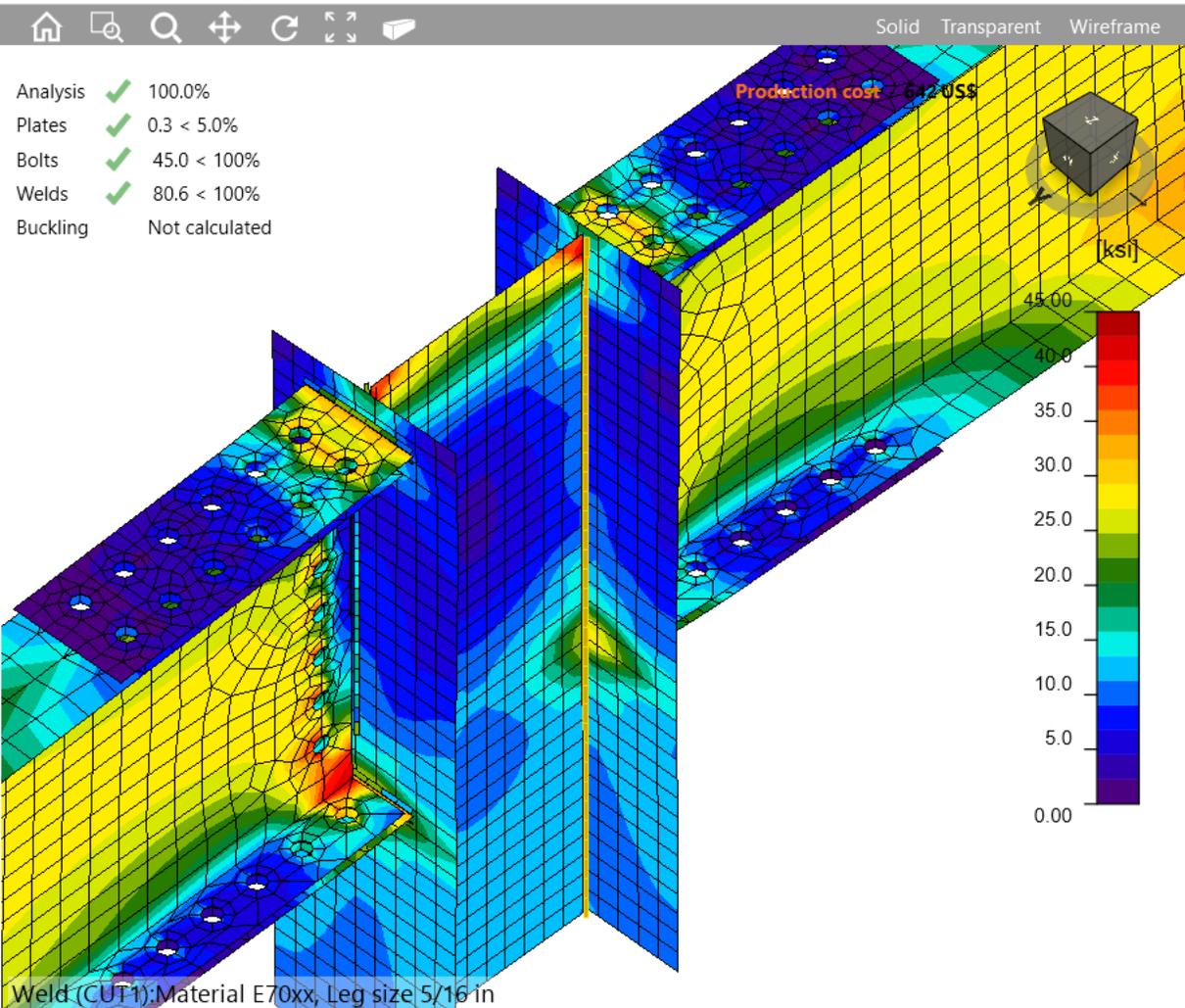
New Gallery

Code setup Calculate Overall check Strain check Buckling shape

LE1 For extreme

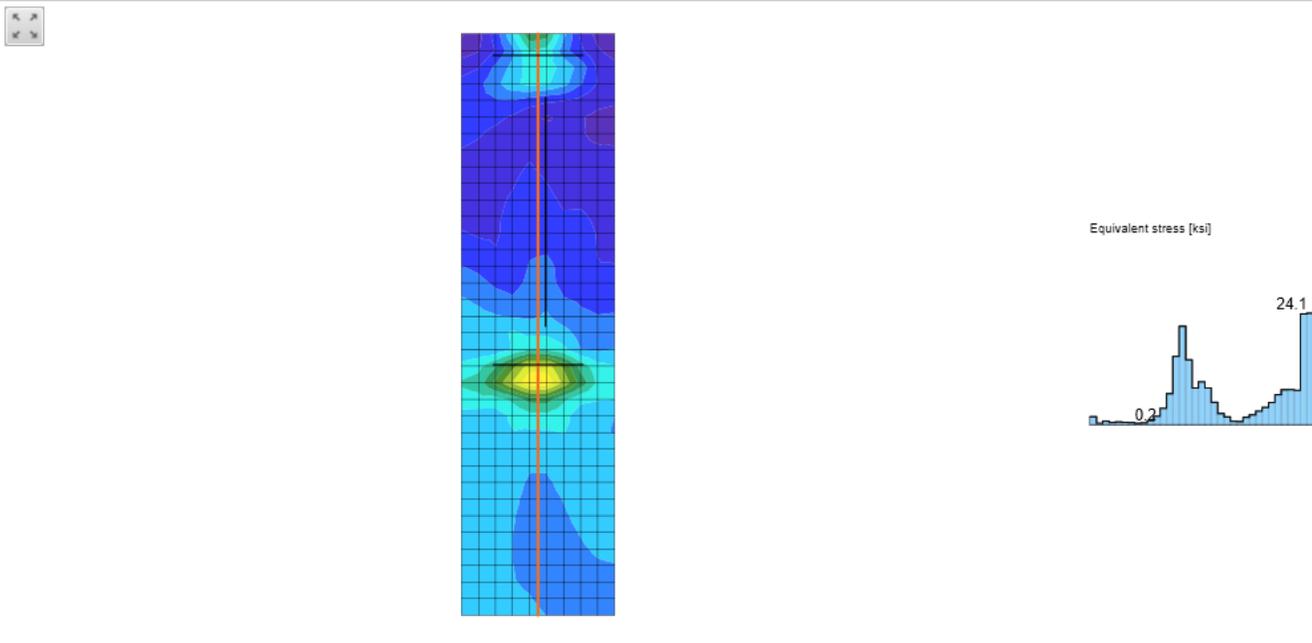
Equivalent stress Plastic strain Stress in contacts Bolt forces Mesh Deformed

10.00



Analysis Plates Bolts Welds

+	✓	Column-tfl 1	FP12	E70xx	▲ 1/4 ▼	▲ 3/8 ▼	1'-5"15/16	7/8	LE1	7.465	9.930	75.2
+	✓			E70xx	▲ 1/4 ▼	▲ 3/8 ▼	1'-5"15/16	7/8	LE1	6.908	9.196	75.1
+	✓	Column-tfl 1	Column-w 1	E70xx	▲ 1/4 ▼	▲ 5/16 ▼	3'-9"5/8	1"5/16	LE1	10.363	13.557	76.4
+	✓			E70xx	▲ 1/4 ▼	▲ 5/16 ▼	3'-9"5/8	1"5/16	LE1	10.349	13.544	76.4
+	✓	Column-bfl 1	Column-w 1	E70xx	▲ 1/4 ▼	▲ 5/16 ▼	3'-9"5/8	1"5/16	LE1	10.349	13.544	76.4
>	+	✓		E70xx	▲ 1/4 ▼	▲ 5/16 ▼	3'-9"5/8	1"5/16	LE1	10.364	13.557	76.4



# 4. AISC 360-2022

## No directional strength increase for fillet welds on rectangular HSS

### 4. Strength

- (a) The design strength,  $\phi R_n$ , and the allowable strength,  $R_n/\Omega$ , of welded joints shall be the lower value of the base material strength determined according to the limit states of tensile rupture and shear rupture and the weld metal strength determined according to the limit state of rupture as follows.

For the base metal

$$R_n = F_{nBM}A_{BM} \quad (J2-2)$$

For complete-joint-penetration and partial-joint-penetration groove welds, and plug and slot welds

$$R_n = F_{nw}A_{we} \quad (J2-3)$$

For fillet welds

$$R_n = F_{nw}A_{we}k_{ds} \quad (J2-4)$$

where

$A_{BM}$  = area of the base metal, in.<sup>2</sup> (mm<sup>2</sup>)

$A_{we}$  = effective area of the weld, in.<sup>2</sup> (mm<sup>2</sup>)

$F_{nBM}$  = nominal stress of the base metal, ksi (MPa)

$F_{nw}$  = nominal stress of the weld metal, ksi (MPa)

$k_{ds}$  = directional strength increase factor

- (1) For fillet welds where strain compatibility of the various weld elements is considered

$$k_{ds} = (1.0 + 0.50\sin^{1.5}\theta) \quad (J2-5)$$

- (2) For fillet welds to the ends of rectangular HSS loaded in tension

$$k_{ds} = 1.0$$

- (3) For all other conditions

$$k_{ds} = 1.0$$

$\theta$  = angle between the line of action of the required force and the weld longitudinal axis, degrees

The values of  $\phi$ ,  $\Omega$ ,  $F_{nBM}$ , and  $F_{nw}$ , and limitations thereon, are given in Table J2.5.

**User Note:** The base metal check need not be performed for fillet welds as

- [Steel tube institute: Directionality Increase for Fillet Welds to HSS](#)

Home 🔍 📏 ↺ ↻ ⌂

Solid Transparent Wireframe

Analysis  100.0%

Plates  0.0 < 5.0%

Loc. deformation  0.0 < 3%

Welds  75.8 < 100%

Buckling Not calculated

Production cost - 5 US\$

Analysis Local deformation Plates Welds

Check of welds for extreme load effect

Status	Item	Edge	Xu	t <sub>w</sub> [in]	w [in]	L [in]	L <sub>c</sub> [in]	Loads	F <sub>n</sub> [kip]	φR <sub>n</sub> [kip]	Ut [%]
<input checked="" type="checkbox"/>	CH-tfl 1	D1	E70xx	3/16	1/4	6*1/8	5/16	LE1	1.258	1.672	75.2
<input checked="" type="checkbox"/>	D2-arc 7	D1	E70xx	3/16	1/4	4*9/16	1/8	LE1	0.451	0.595	75.8
<input checked="" type="checkbox"/>	CH-tfl 1	D2	E70xx	3/16	1/4	1'-0"1/4	5/16	LE1	1.257	1.672	75.2

Weld resistance check (AISC 360-22 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = 1.672 \text{ kip} \geq F_n = 1.257 \text{ kip}$$

Where:

$F_{nw} = 42.0 \text{ ksi}$  – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX}$ , where:
  - $F_{EXX} = 70.0 \text{ ksi}$  – electrode classification number, i.e. minimum specified tensile strength
  - Directional strength increase is not used for HSS welds

Home 🔍 📏 ↺ ↻ ⌂

Solid Transparent Wireframe

Analysis  100.0%

Plates  0.0 < 5.0%

Loc. deformation  0.1 < 3%

Welds  44.0 < 100%

Buckling Not calculated

GMNA Calculated

Production cost - 10 US\$

Analysis Local deformation Plates Welds

Check of welds for extreme load effect

Status	Item	Edge	Xu	t <sub>w</sub> [in]	w [in]	L [in]	L <sub>c</sub> [in]	Loads	F <sub>n</sub> [kip]	φR <sub>n</sub> [kip]	Ut [%]
<input checked="" type="checkbox"/>	CH-arc 21	D1	E70xx	1/4	3/8	1'-0"13/16	1/4	LE1	1.183	2.689	44.0
<input checked="" type="checkbox"/>	CH-arc 21	D2	E70xx	1/4	3/8	1'-0"13/16	1/4	LE1	1.177	2.689	43.8

Weld resistance check (AISC 360-22 – J2-4)

$$\phi R_n = \phi \cdot F_{nw} \cdot A_{we} = 2.689 \text{ kip} \geq F_n = 1.177 \text{ kip}$$

Where:

$F_{nw} = 53.5 \text{ ksi}$  – nominal stress of weld material:

- $F_{nw} = 0.6 \cdot F_{EXX} \cdot (1 + 0.5 \cdot \sin^{1.5} \theta)$ , where:
  - $F_{EXX} = 70.0 \text{ ksi}$  – electrode classification number, i.e. minimum specified tensile strength
  - $\theta = 42.1^\circ$  – angle of loading measured from the weld longitudinal axis

# 5. Moment calculation in anchors with a gap

**Analysis Results:**

- Analysis: 100.0% ✓
- Plates: 0.1 < 5.0% ✓
- Loc. deformation: 0.1 < 3% ✓
- Anchors: 108.9 > 100% ✗
- Welds: 76.3 < 100% ✓
- Concrete block: Not calculated
- Buckling: Not calculated

**Production cost - 912 US\$**

**Stand-off anchor bending resistance (AISC 360-16 – F11)**

$$\phi_b M_n = \phi_b \cdot Z \cdot F_y \leq \phi_b \cdot 1.6 \cdot S_x \cdot F_y$$

$$\phi_b M_n = \phi_b \cdot 1.6 \cdot S_x \cdot F_y = 1.29 \text{ kip.ft} \geq M_f = 0.50 \text{ kip.ft}$$

Where:  
 $\phi_b = 0.75$  – resistance factor

**Check of anchors for extreme load effect**

**Anchors in tension**

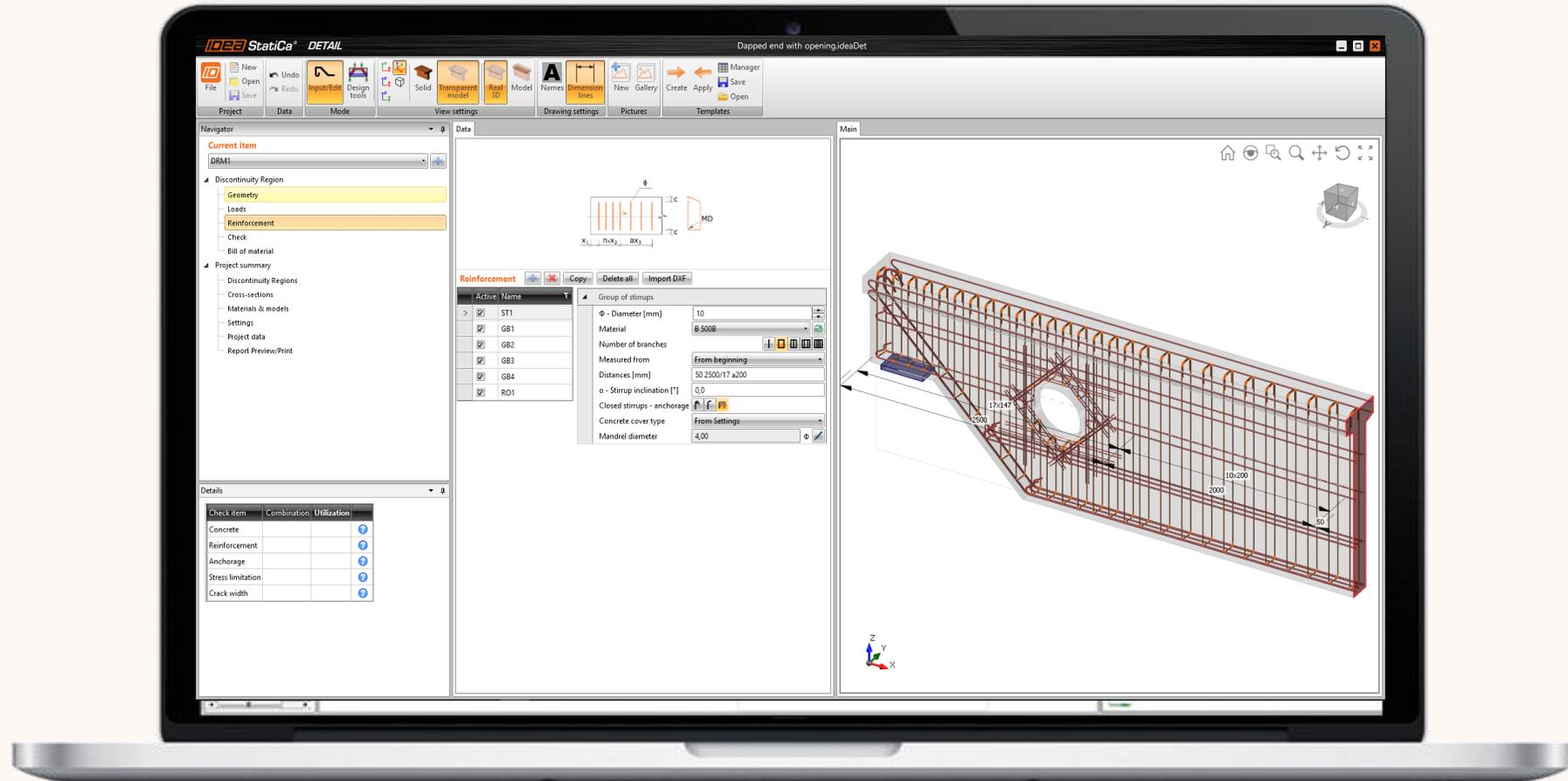
Status	Item	Grade	Loads	Nf [kip]	V [kip]	M [kip.ft]	$\phi N_{cbg}$ [kip]	$\phi V_{cbg}$ [kip]	$\phi V_{cp}$ [kip]	Utt [%]	Uts [%]
+	A5	1 1/2 F1554 Gr.55 (2010) - 1	LE1	15.857	0.640/0.640	0.16	56.064	-	220.188	82.3	2.2
+	A6	1 1/2 F1554 Gr.55 (2010) - 1	LE1	22.651	0.089/0.089	0.02	56.064	-	220.188	82.3	0.3
+	A7	1 1/2 F1554 Gr.55 (2010) - 1	LE1	15.852	0.641/0.641	0.16	56.064	-	220.188	82.3	2.2

**Anchors in compression**

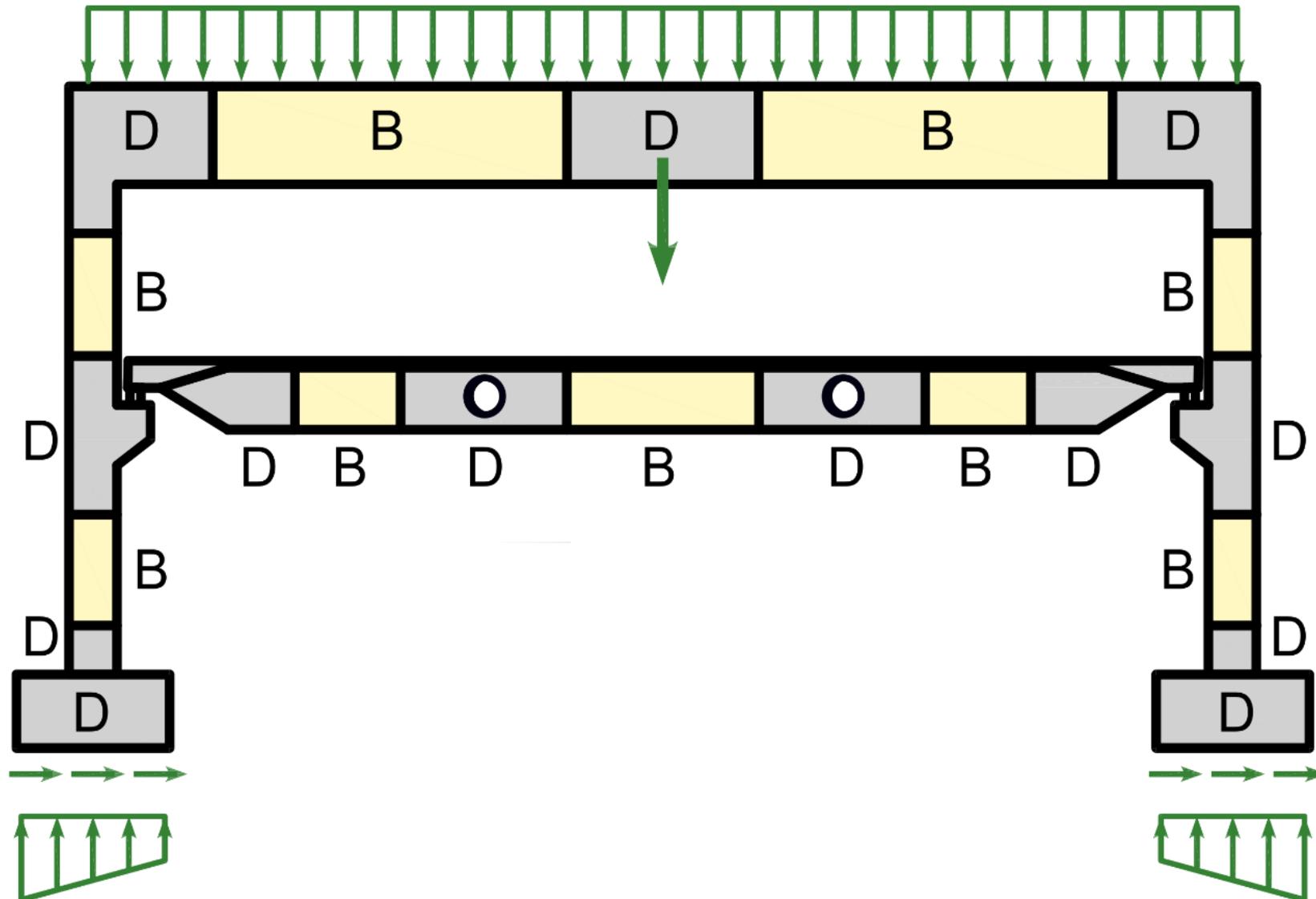
Status	Item	Grade	Loads	Fc [kip]	V [kip]	M [kip.ft]	$\phi V_{cbg}$ [kip]	$\phi V_{cp}$ [kip]	Uts [%]	Uts,s [%]	Uts,c [%]
+	A10	1 1/2 F1554 Gr.55 (2010) - 1	LE1	-36.955	1.996/1.996	0.50	-	-	106.5	106.5	-
+	A2	1 1/2 F1554 Gr.55 (2010) - 1	LE1	-36.954	1.995/1.995	0.50	-	-	106.4	106.4	-
+	A1	1 1/2 F1554 Gr.55 (2010) - 1	LE1	-40.640	1.773/1.773	0.44	-	-	108.9	108.9	-
+	A3	1 1/2 F1554 Gr.55 (2010) - 1	LE1	-19.344	1.671/1.671	0.42	-	-	67.8	67.8	-
+	A9	1 1/2 F1554 Gr.55 (2010) - 1	LE1	-19.344	1.669/1.669	0.42	-	-	67.8	67.8	-
+	A8	1 1/2 F1554 Gr.55 (2010) - 1	LE1	-0.559	1.190/1.190	0.30	-	-	24.0	24.0	-

**Stand-off** Thickness [in]: 3"    **Gap**

# IDEA StatiCa Detail

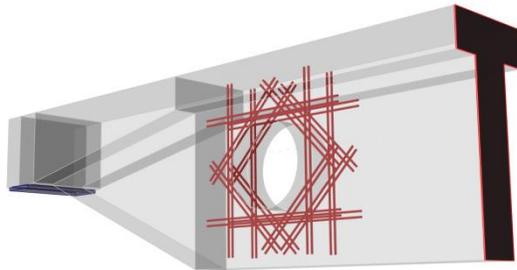


# BEAM & COLUMN DETAILS

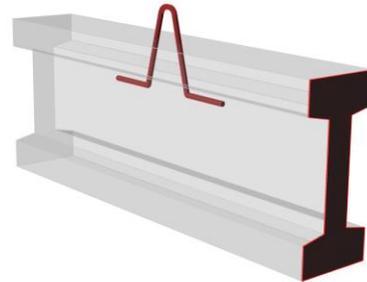


# IDEA STATICA DETAIL

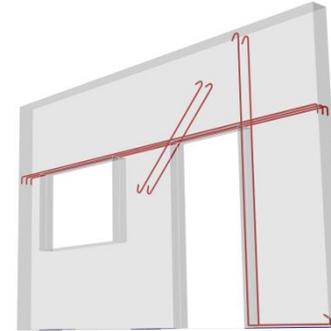
Dapped ends



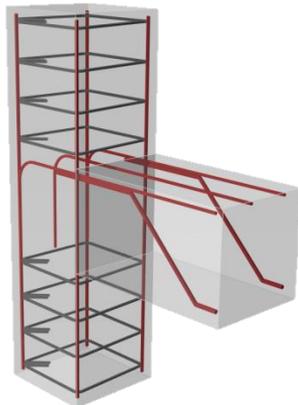
Hangings



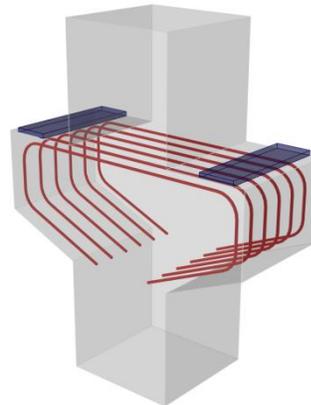
Walls



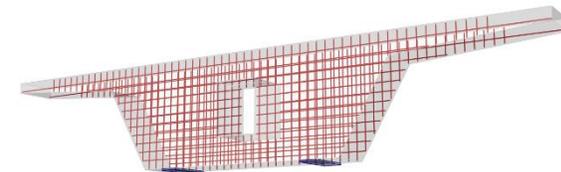
Frame joints



Corbels / Brackets

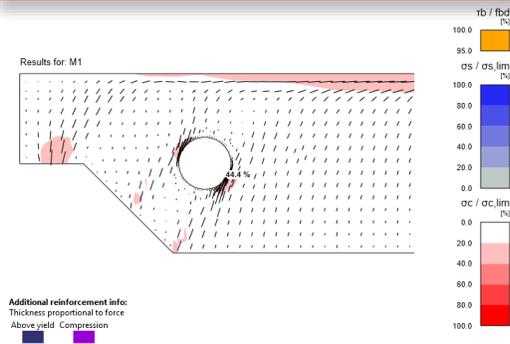


Diaphragms

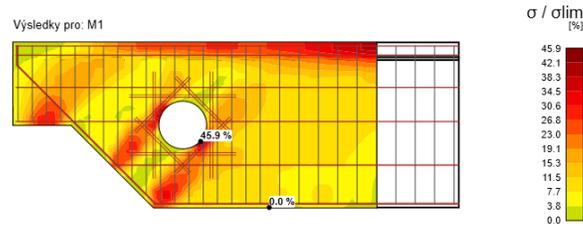


# DESIGN AND CODE-CHECK

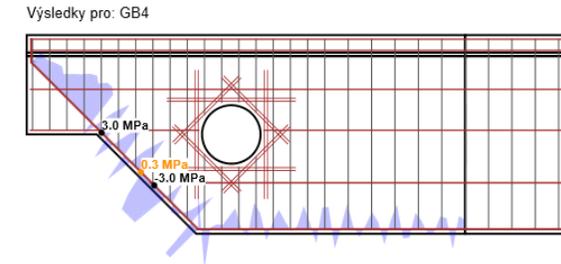
## Overall check



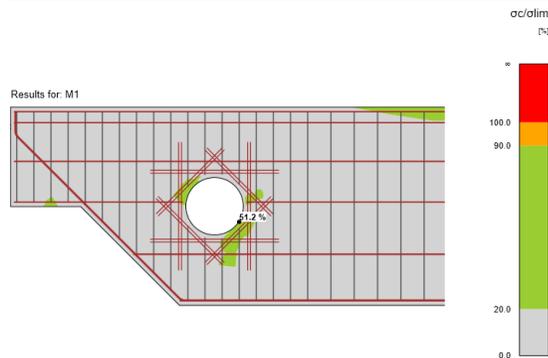
## Strength



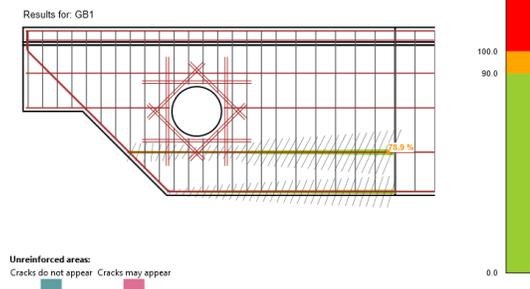
## Anchorage



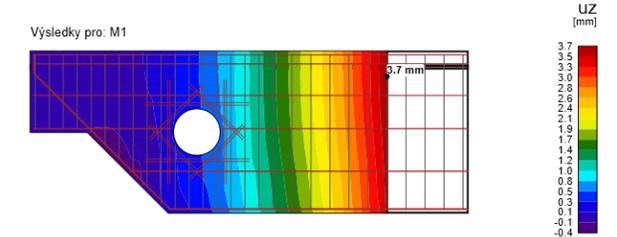
## Stress



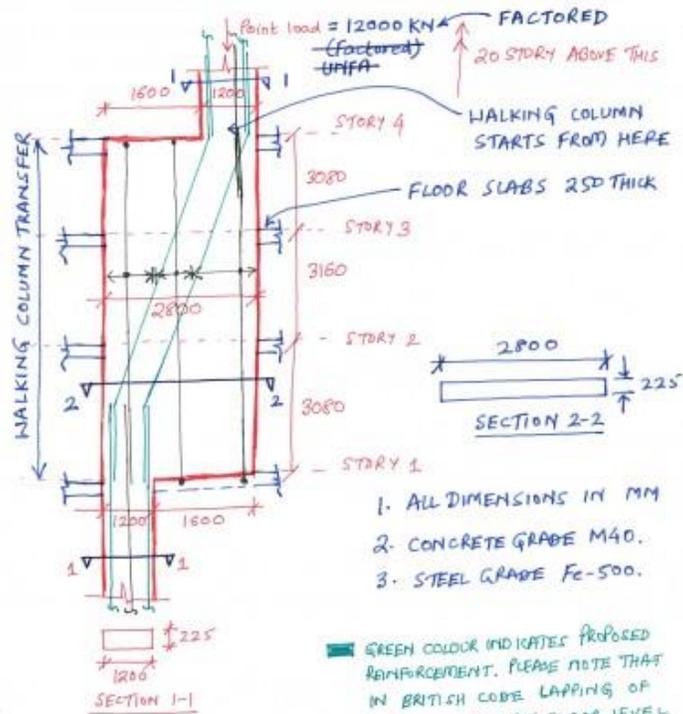
## Cracks



## Deflection



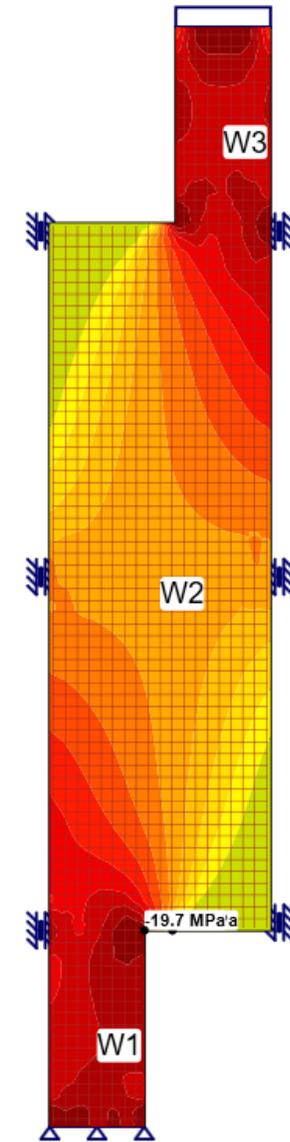
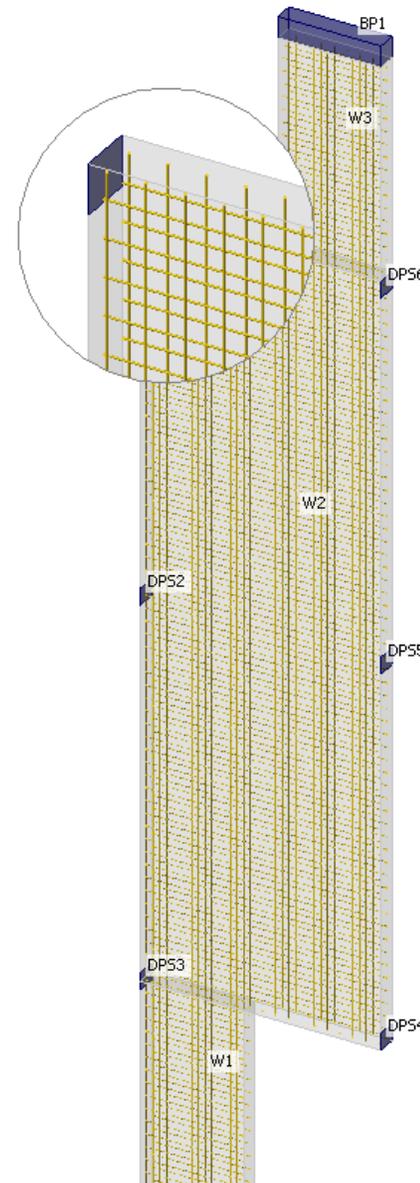
# PRACTICAL PROBLEM



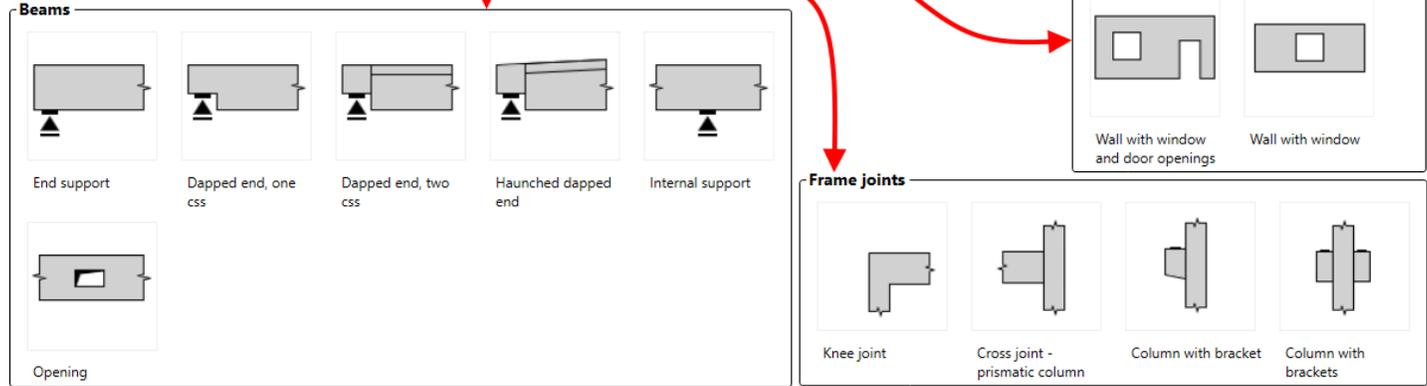
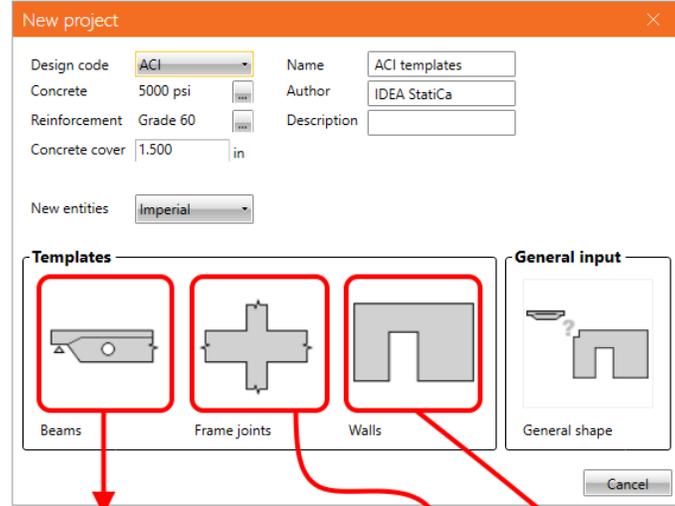
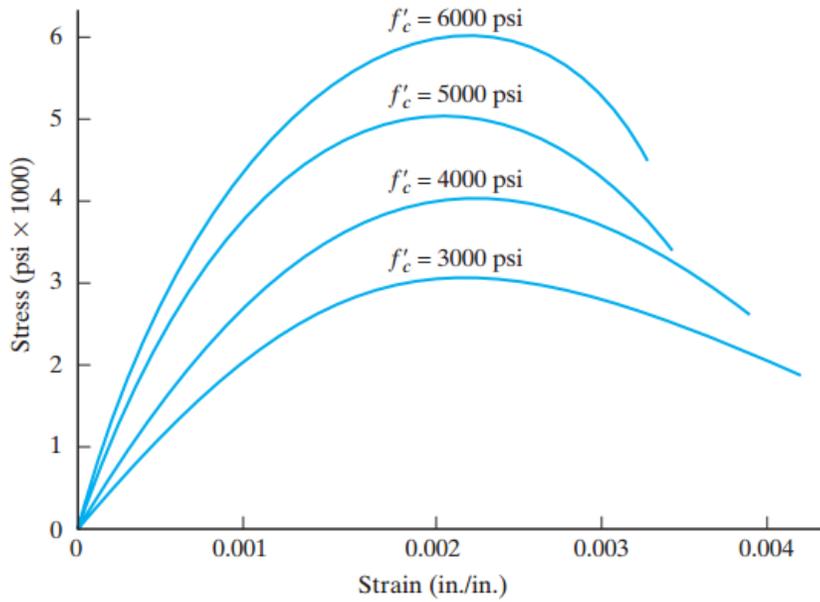
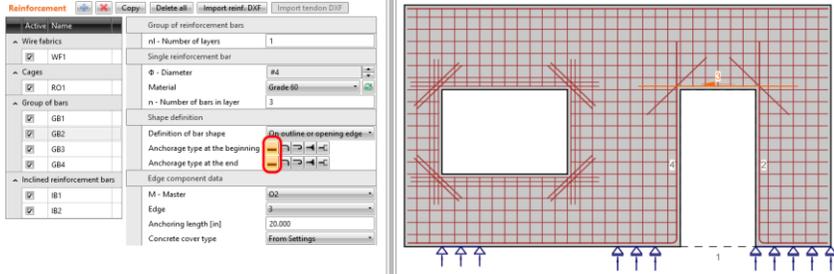
1. ALL DIMENSIONS IN MM
2. CONCRETE GRADE M40.
3. STEEL GRADE Fe-500.

GREEN COLOUR INDICATES PROPOSED REINFORCEMENT. PLEASE NOTE THAT IN BRITISH CODE LAPPING OF BARS OCCURS AT FLOOR LEVEL AS SHOWN.

BLACK LINE ALSO INDICATES A PROPOSED TYPE OF REINFORCEMENT ARRANGEMENT



# Improvements V23



Q&A

