# Engineering Solutions

Dr Hari

Technical Sales Manager

SCOTTSDALE

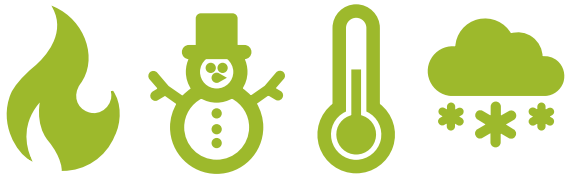
THE TRUSTED STEEL-FRAMING PARTNER

# Overview

History of cold-formed steel

Current global usage

Potential strength benefits



Behaviour under various temperature conditions

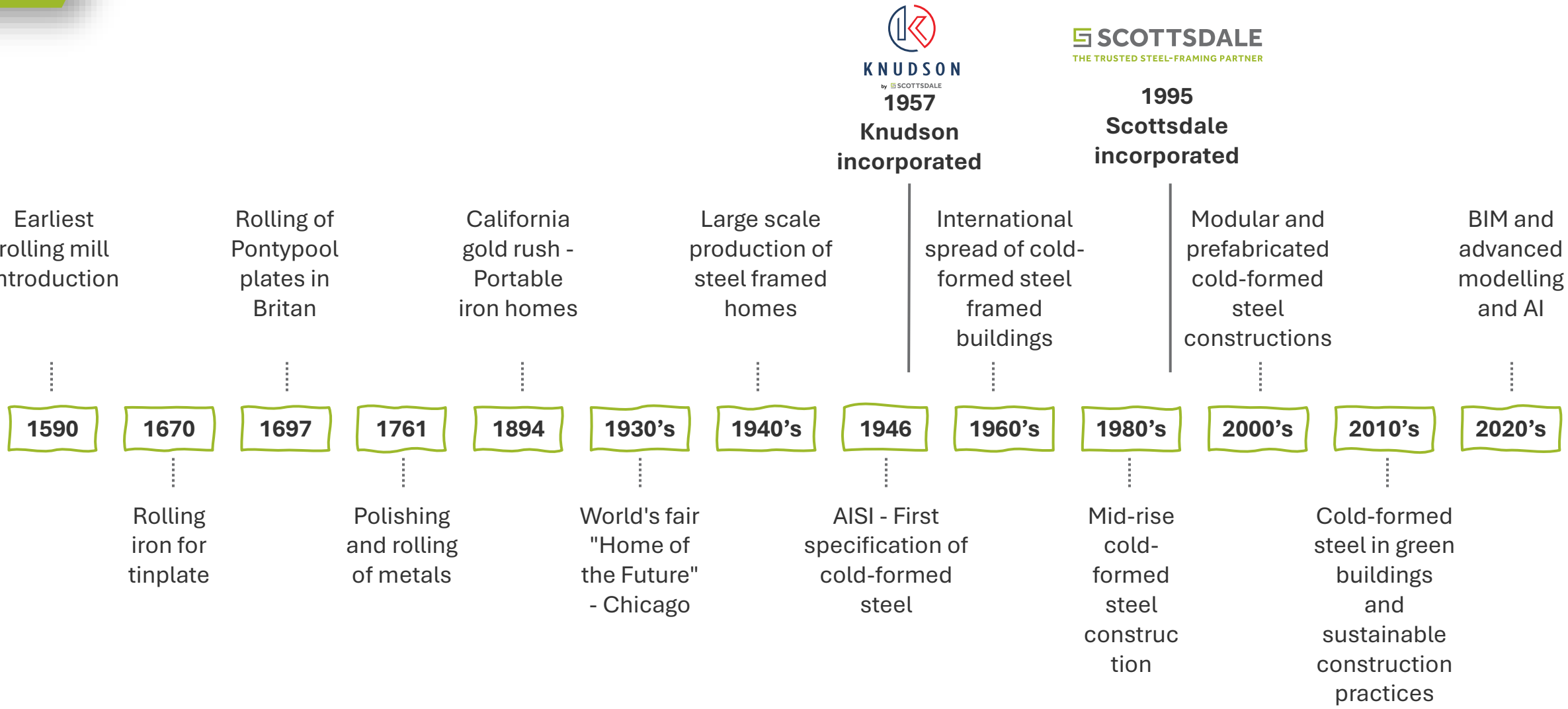
Engineering solutions, research and development

Current and future Engineering software development

# History of Cold-Formed Steel

A brief look into the past and evolution of cold-formed steel in buildings

# History of Cold-Formed Steel




*Source: Wikipedia, Deign of Cold-formed steel structures ASI, CFSEI*

# Current Global Usage

How cold-formed steel is used around the globe with various building types

# Global Presence


**16,000+ Roll formers**

**4600 Customers**

**100+ Countries**

**105 Patents**

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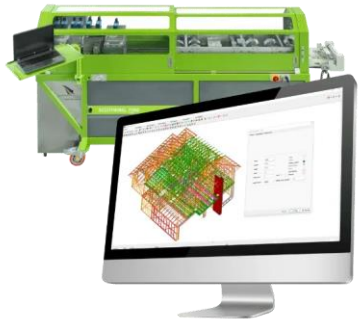
# Scottsdale Ecosystem

Machines



Software

Support

Material Supply

PARAMOUNT FINANCIAL

QuickTurn Financial

Western Equipment Finance

usbank

VENTUREFIRST

Finance

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# Scottsdale Ecosystem – Machine (Profiles)

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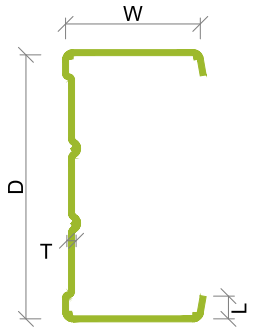


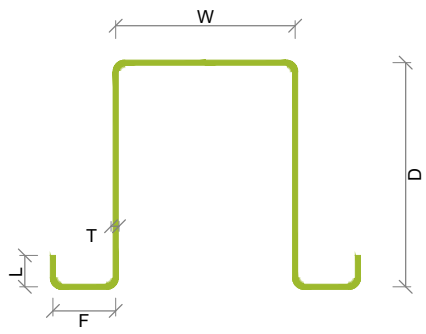



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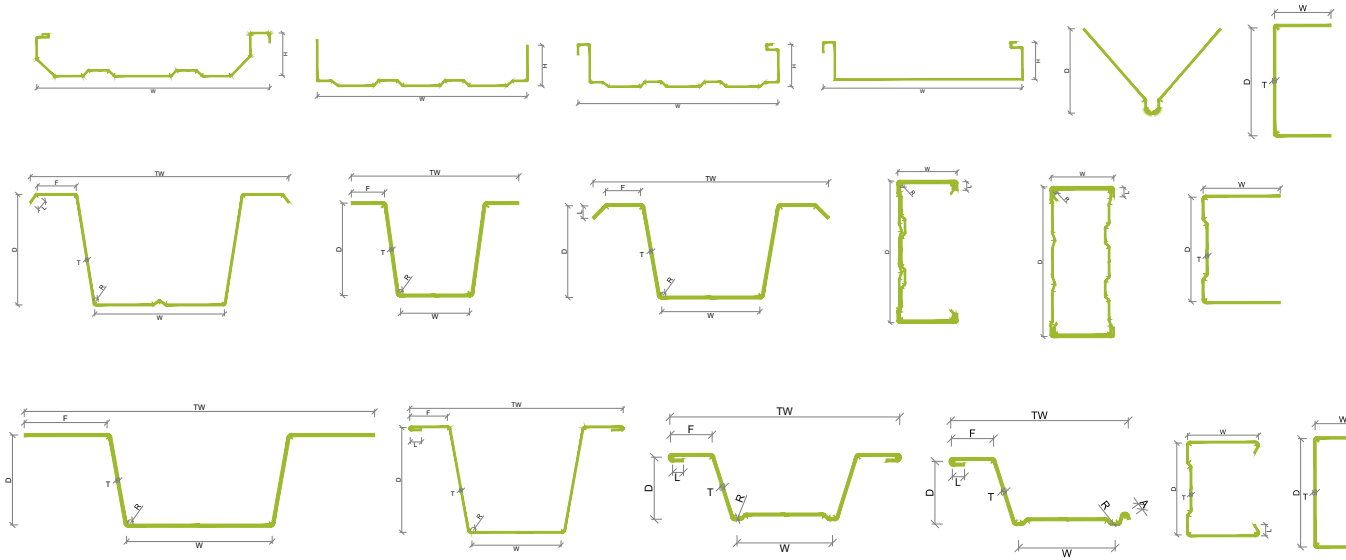

# Scottsdale Ecosystem – Software (Scottsdale)

**“ World-class software solutions for cold-formed steel construction ”**

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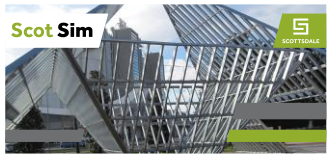
| ARCHITECTURAL PLANS IMPORT (Optional) | FRAMING MODEL GENERATION | ENGINEERING | REPORTING AND DOCUMENTATION (Optional) | PRODUCTION MANAGEMENT | ROLLFORMING |
|---|---|---|---|---|---|
| Review architectural plans and generate framing model in **ScotSteel.** | | **ScotSteel** using **ScotEngineering** module<br>**ScotSteel** using **ScotEngineering** module for geometry export to SpaceGass. | Using **ScotLayout** module of **ScotSteel** | | **Scottsdale roll formers**<br>**Panel roll formers**<br>· Scotpanel 5090 G1/G2/G3<br>· Scotpanel 7090 G1/G2/G3<br>· Scotpanel 5140 G1/G2/G3<br>· Scotpanel 7140 G1/G2/G3<br>· Scotpanel 7070 G1/G2/G3<br>· Scotpanel 7063 G1/G2/G3<br>· Scotpanel 8140 G2/G3<br>**Truss roll formers**<br>· Scottruss 6050 G1/G2<br>· Scottruss 6075 G1/G2 |
| · Review architectural plans.<br>· Import plans in .dxf format.<br>· Import/Use Revit models as a baseline start point. | Generate framing model in **ScotSteel** based on architectural plans. | **ScotStruct** | | **ScotRF** | |
| Import/Use Revit models as a baseline start point. | Convert architectural plans to framing model in Revit using **StrucSoft MWF.** | Bentley - STAAD PRO/Multiframe<br>CSI - ETABS, SAP | Revit with **StrucSoft MWF** Pro Metal layouts plugin | | |



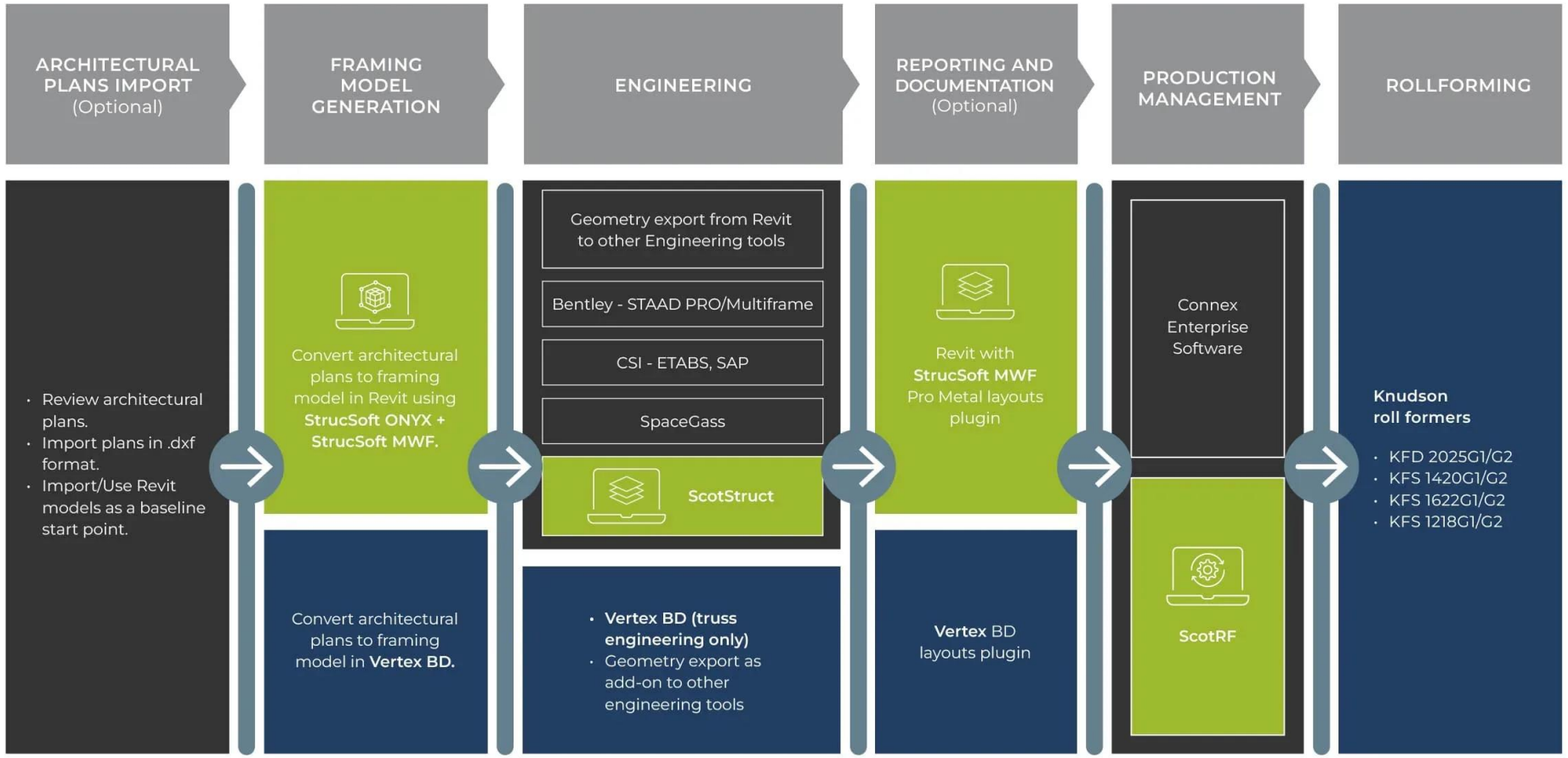






# Scottsdale Ecosystem – Software (Knudson)

**“ Most versatile software solution for all cold-formed steel structures”**




KNUDSON by SCOTTSDALE

VERTEX SYSTEMS BD

MWF PRO METAL

Revit

FRAMEBUILDER-MRD

Connex

BECK Automation

# Projects Around the Globe

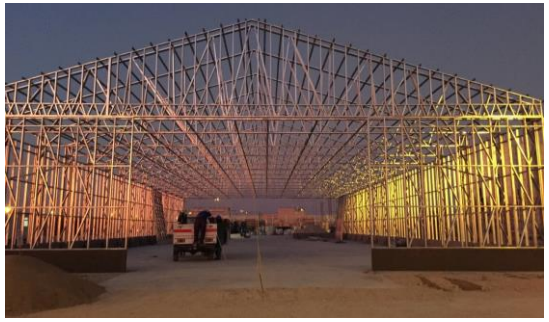
Australia

Argentina

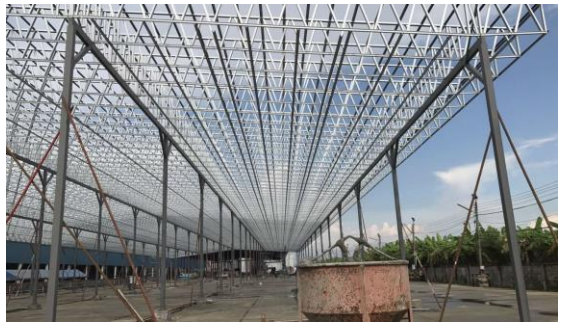
India

Kyrgyzstan

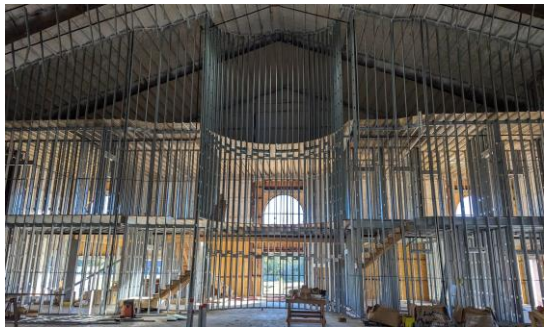
Qatar



South Africa



Thailand

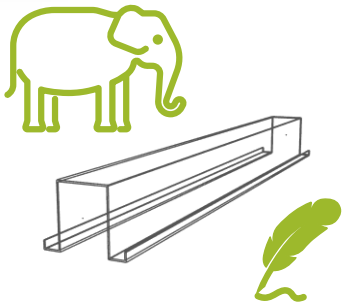


USA

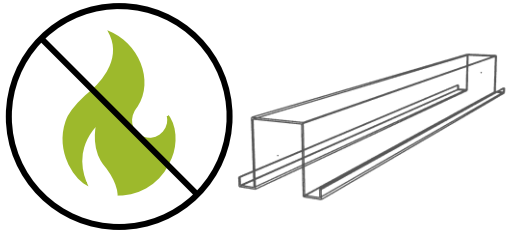
# Potential Strength Benefits

Cold-formed steel comparison with other framing elements

# Advantages of Cold-Formed Steel

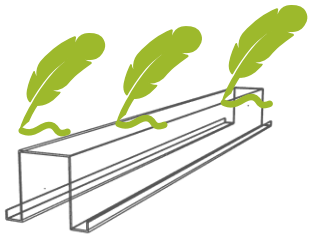


Higher strength to weight ratio



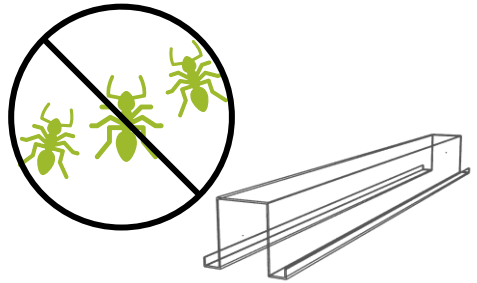
Non combustible

Fast and low cost in mass production



Reduced self-weight resulting in easier handling

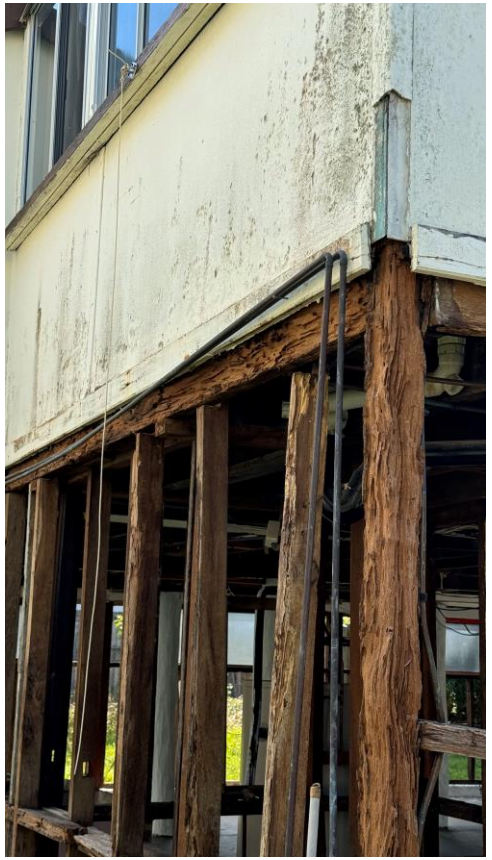
Eco friendly as steel is the most recycled material in the world



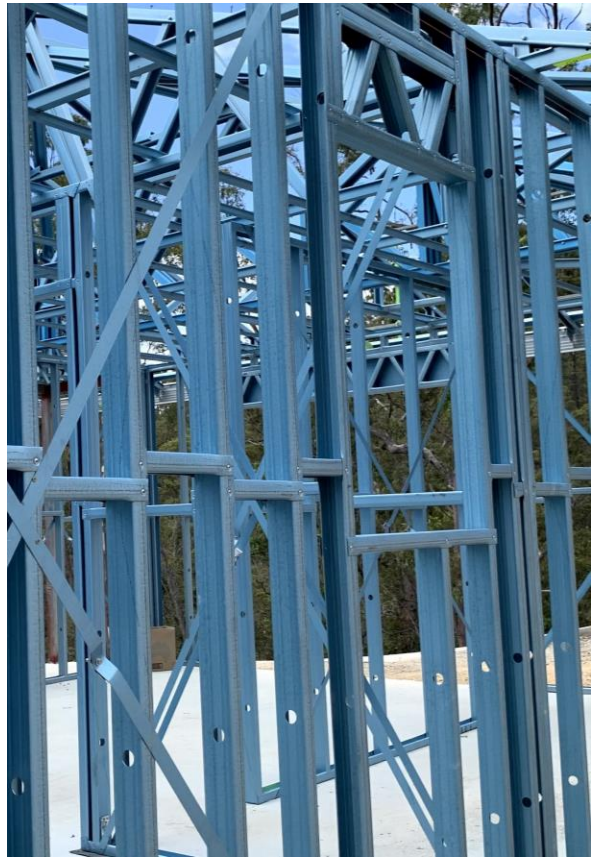
Resistance to termite attacks and weathering

# Comparison with Wood

- Termite attack compromising structural integrity
- Hard to get it straight
- Warps due to weather
- Higher dead load but lesser capacity
- Dimensions can vary if not prefabricated
- More labour and equipment on site due to heavy frames – Slower construction time
- Combustible



V/s



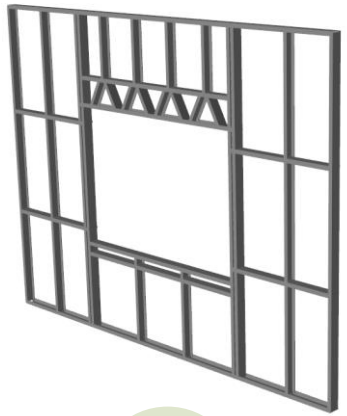
- Impossible for termites to eat
- Straight structures all the time
- Rigid and no warping due to weather
- Lower dead load but higher capacity
- Millimetre level precision using prefabrication methods
- More labour and equipment on site due to heavy frames – Faster construction time
- Non-combustible

# Behaviour Under Ambient Conditions

Cold-formed steel structural behaviour overview

# Structural Engineering Overview

1



**Geometry Generation**

Country code independent

2

**Loads Evaluation & Application**

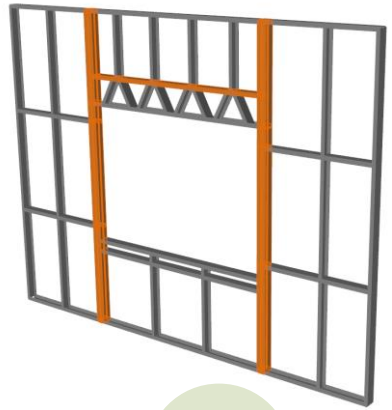
Country code dependent

3

**Structural Analysis**

Country code independent

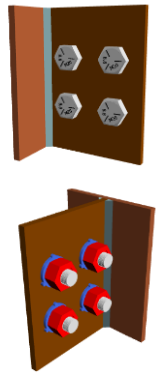
4



**Member Design**

Country code dependent

5



**Connection Design**

Country code dependent

# Major Country Codes for Loads and Design

| Loads | Design |
| --- | --- |
| AS 1170 series | AS/NZS 4600:2018 Cold-formed Steel Structures |
| ASCE 7, IBC | AISI S100-16 S3-22 – North American Specification for the Design of Cold-Formed Steel Structural Members |
| EN 1991 series | EN 1993-1-3:2006 - Eurocode 3: Design of steel structures - Part 1-3: General rules - Supplementary rules for cold-formed members and sheeting |

# Load Combinations

## AS 1170 – Strength load combinations

| | | |
|---|---|---|
| $E_d$ | $= [1.35G]$ | permanent action only (does not apply to prestressing forces) |
| $E_d$ | $= [1.2G, 1.5Q]$ | permanent and imposed action |
| $E_d$ | $= [1.2G, 1.5\psi_l Q]$ | permanent and long-term imposed action |
| $E_d$ | $= [1.2G, W_u, \psi_c Q]$ | permanent, wind and imposed action |
| $E_d$ | $= [0.9G, W_u]$ | permanent and wind action reversal |
| $E_d$ | $= [G, E_u, \psi_E Q]$ | permanent, earthquake and imposed action |
| $E_d$ | $= [1.2G, S_u, \psi_c Q]$ | permanent action, actions given in Clause 4.2.3 and imposed action |

## EN 1990 – Strength and service load combinations

| Persistent and transient design situations | Permanent actions | | Leading variable action (*) | Accompanying variable actions | |
|---|---|---|---|---|---|
| | Unfavourable | Favourable | | Main (if any) | Others |
| (Eq. 6.10) | $\gamma_{G,j,sup} G_{k,j,sup}$ | $\gamma_{G,j,inf} G_{k,j,inf}$ | $\gamma_{Q,1}$ $Q_{k,1}$ | | $\gamma_{Q,i} \psi_{0,i} Q_{k,i}$ |

(*) Variable actions are those considered in Table A1.1

NOTE 1 The $\gamma$ values may be set by the National annex. The recommended set of values for $\gamma$ are :

$\gamma_{G,j,sup} = 1,10$

$\gamma_{G,j,inf} = 0,90$

$\gamma_{Q,1} = 1,50$ where unfavourable (0 where favourable)

$\gamma_{Q,i} = 1,50$ where unfavourable (0 where favourable)

NOTE 2 In cases where the verification of static equilibrium also involves the resistance of structural members, as an alternative to two separate verifications based on Tables A1.2(A) and A1.2(B), a combined verification, based on Table A1.2(A), may be adopted, if allowed by the National annex, with the following set of recommended values. The recommended values may be altered by the National annex.

$\gamma_{G,j,sup} = 1,35$

$\gamma_{G,j,inf} = 1,15$

$\gamma_{Q,1} = 1,50$ where unfavourable (0 where favourable)

$\gamma_{Q,i} = 1,50$ where unfavourable (0 where favourable)

provided that applying $\gamma_{G,j,inf} = 1,00$ both to the favourable part and to the unfavourable part of permanent actions does not give a more unfavourable effect.

| Combination | Permanent actions $G_d$ | | Variable actions $Q_d$ | |
|---|---|---|---|---|
| | Unfavourable | Favourable | Leading | Others |
| Characteristic | $G_{k,j,sup}$ | $G_{k,j,inf}$ | $Q_{k,1}$ | $\psi_{0,i} Q_{k,i}$ |
| Frequent | $G_{k,j,sup}$ | $G_{k,j,inf}$ | $\psi_{1,1} Q_{k,1}$ | $\psi_{2,i} Q_{k,i}$ |
| Quasi-permanent | $G_{k,j,sup}$ | $G_{k,j,inf}$ | $\psi_{2,1} Q_{k,1}$ | $\psi_{2,i} Q_{k,i}$ |

## AS 1170 - Serviceability

$G$

$\psi_s Q$

$\psi_l Q$

$W_s$

$E_s$

## ASCE 7-22 - Basic load combinations

1a. $D$

2a. $D + L$

3a. $D + (L_r \text{ or } 0.7S \text{ or } R)$

4a. $D + 0.75L + 0.75(L_r \text{ or } 0.7S \text{ or } R)$

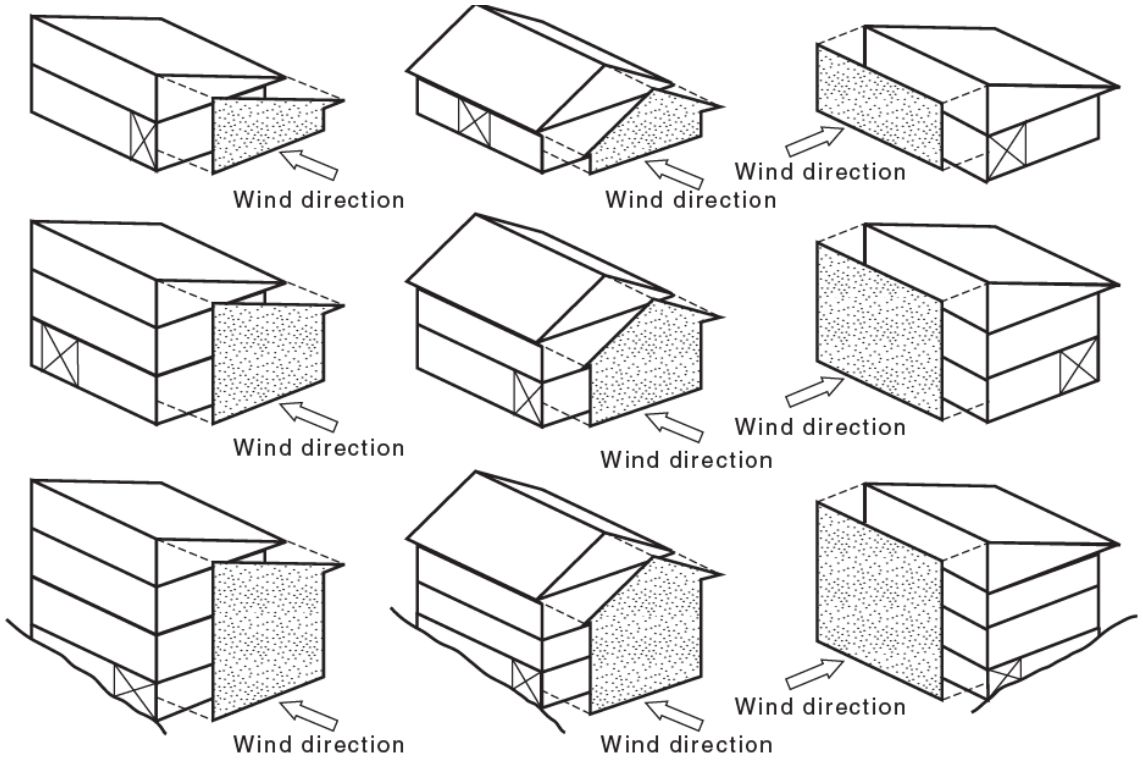
5a. $D + 0.6(W \text{ or } W_T)$

6a. $D + 0.75L + 0.75(0.6(W \text{ or } W_T)) + 0.75(L_r \text{ or } 0.7S \text{ or } R)$

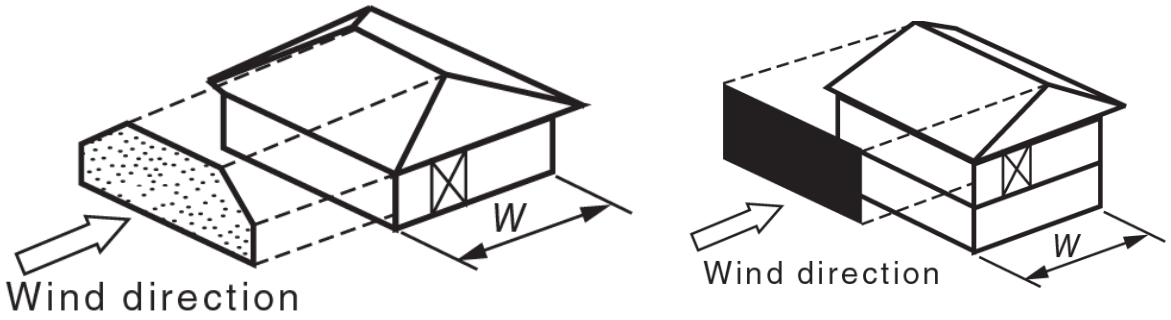
7a. $0.6D + 0.6(W \text{ or } W_T)$

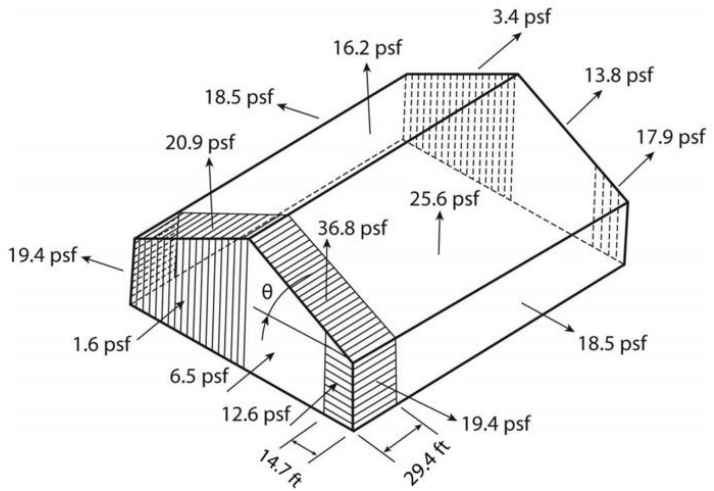
*Source: AS 1170.0, ASCE 7-22, EN1990:2002*

# Wind Behaviour and Design



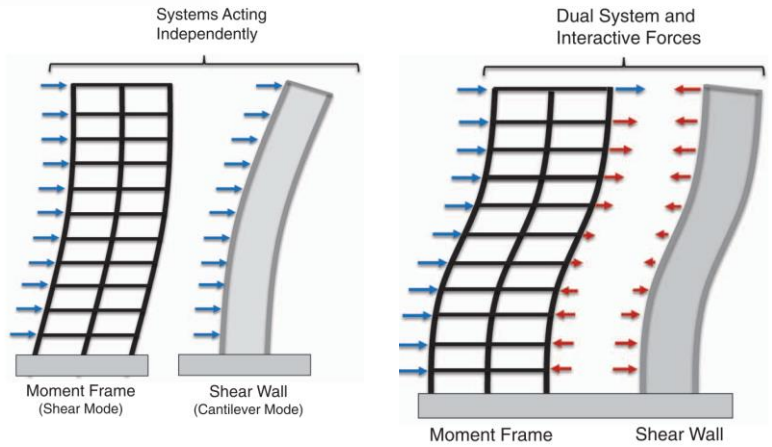

**Wind direction on different shapes**

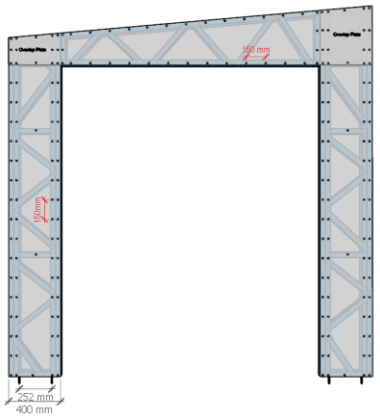


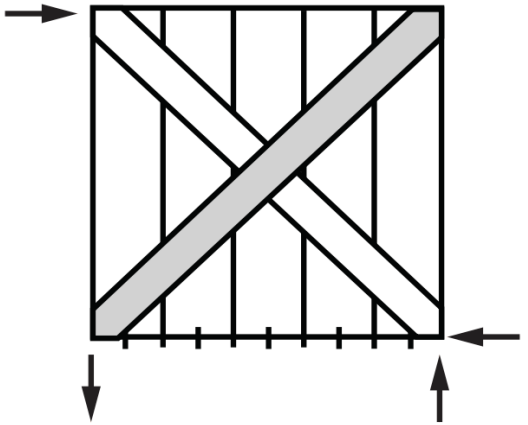

**Account for torsion based on structure if needed**

# Seismic Behaviour and Design

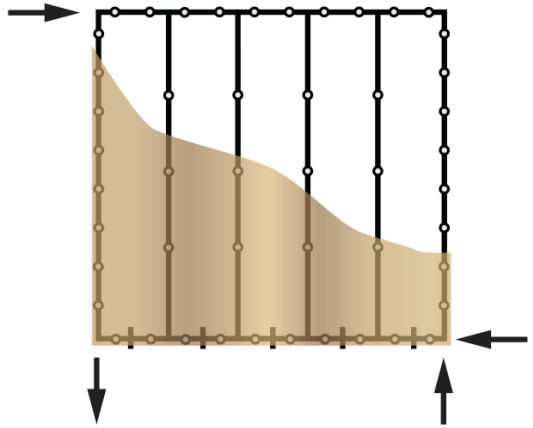


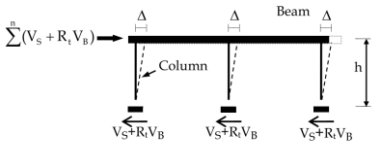

**Plated portal frame**

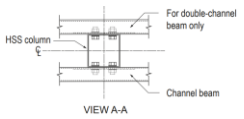


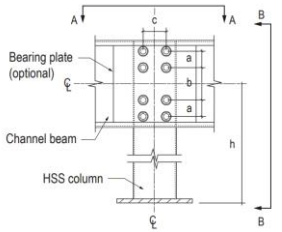
**Strap bracing**

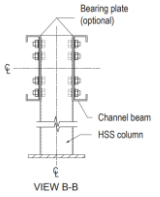


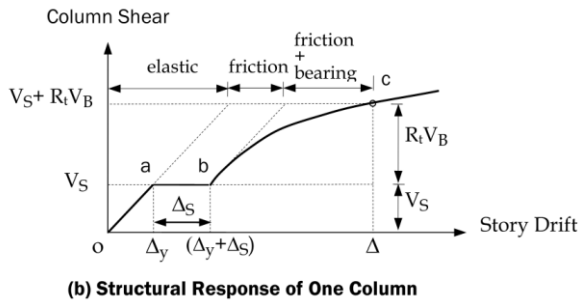
**Sheet bracing**



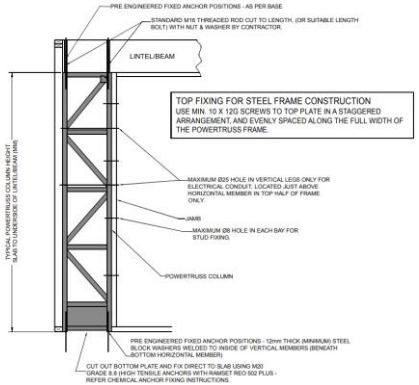



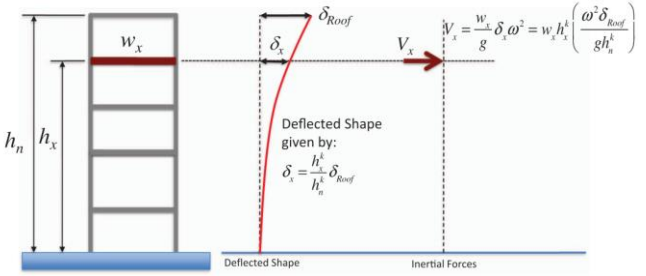




**Special bolted moment frames may be required**



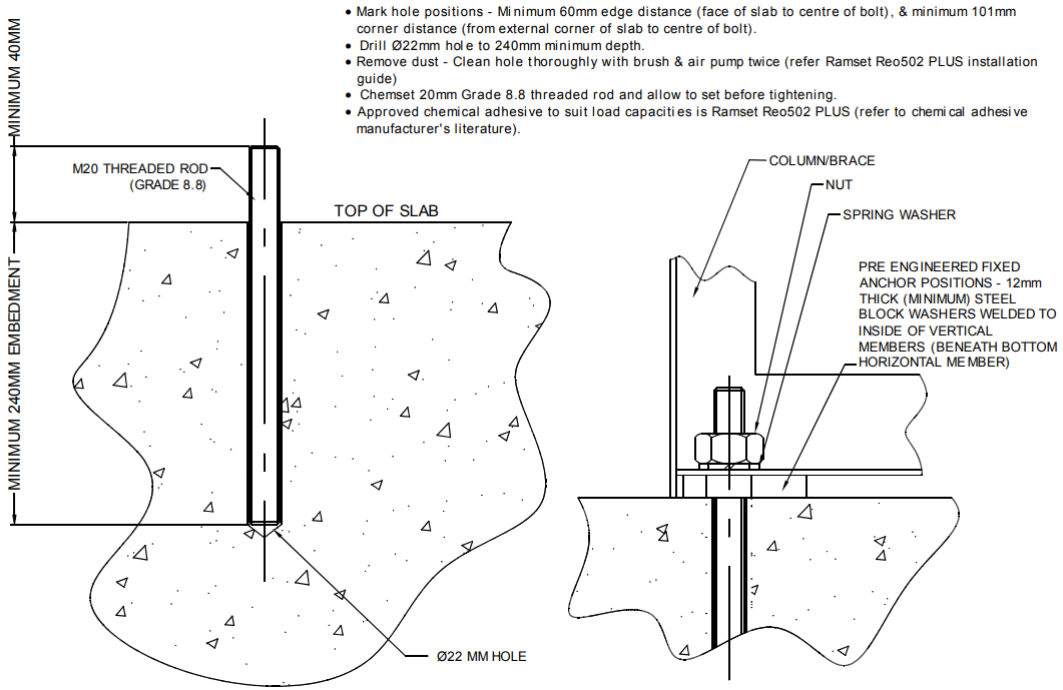

**Welded portal trusses**



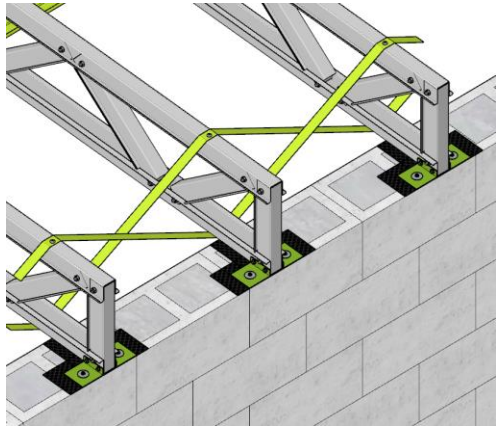

**Equivalent lateral force analysis (ELF)**

*Source: AISI S400-20, NIST, Powertruss, ASCE Design Guide*

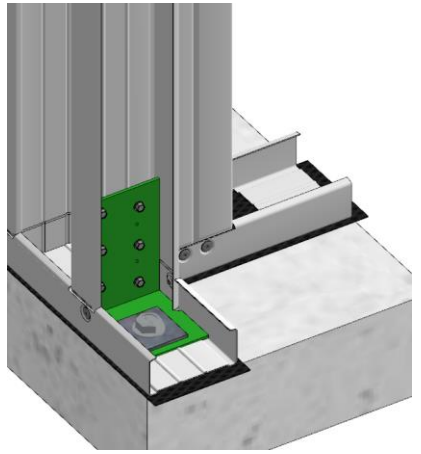
# Tie Downs




**Chemical anchors to resist higher uplifts**



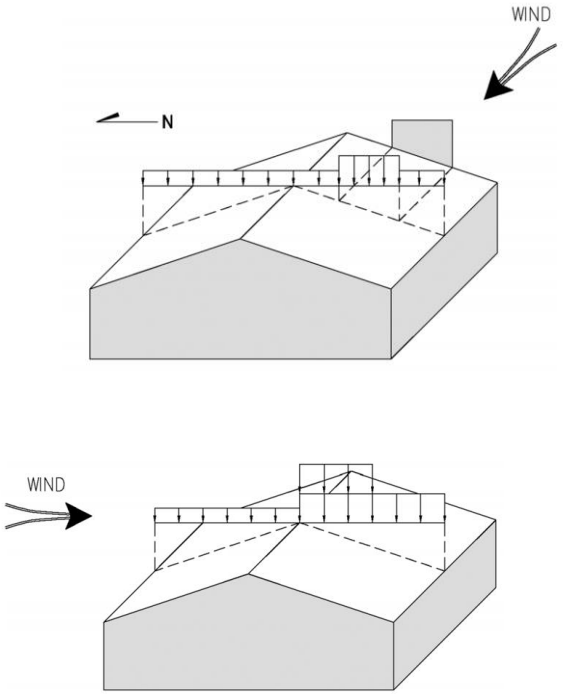
**Roof truss to block wall tie down**

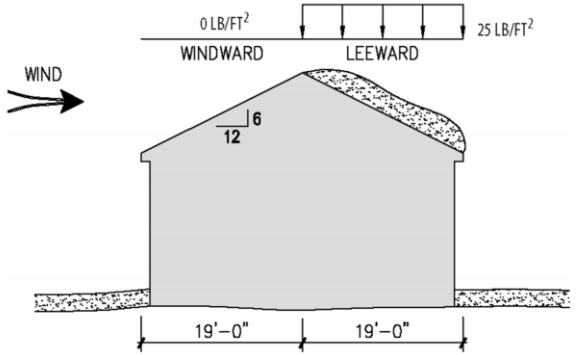


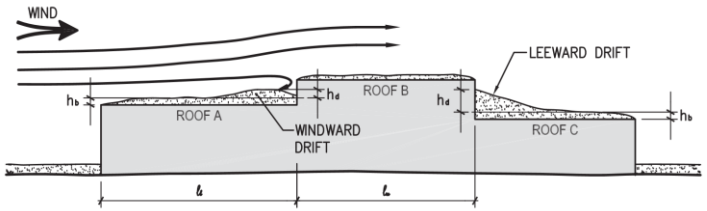
**Wall to concrete footing tie down**

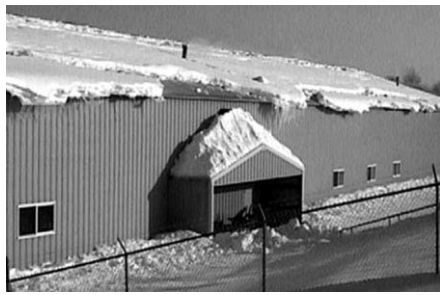
**Anchor design software for cracked concrete**

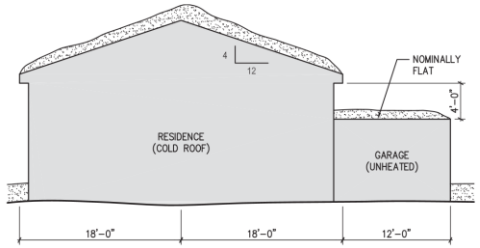
# Snow Behaviour and Design



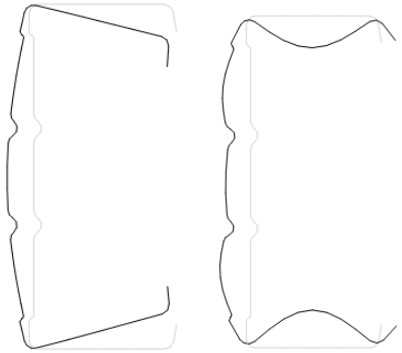



**Partial snow loads**

**Unbalanced snow loads**

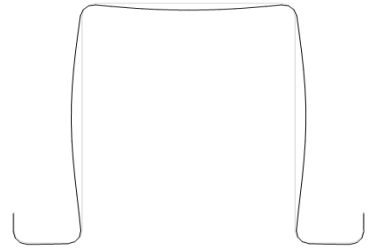
**Drift and sliding roof snow load**

# Buckling Modes in Cold-Formed Steel

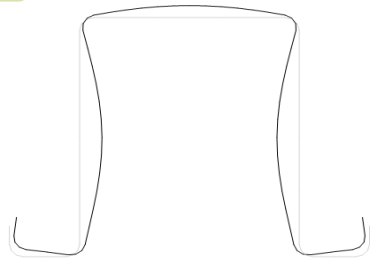


Distortional Buckling

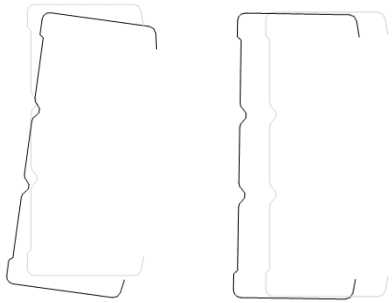
**ScotSteel/ScotStruct checks it all**

Distortional Buckling



Local Buckling

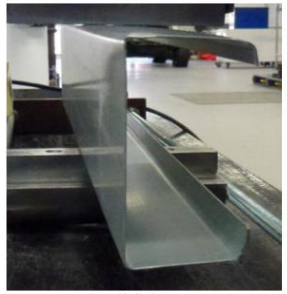


Global Buckling

Local Buckling

Global Buckling

# Web Crippling of Cold-Formed Steel

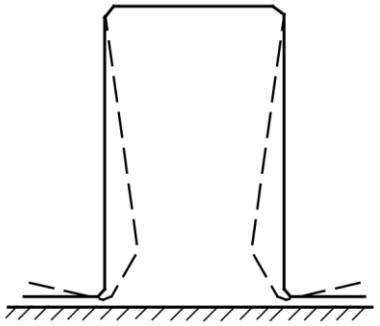


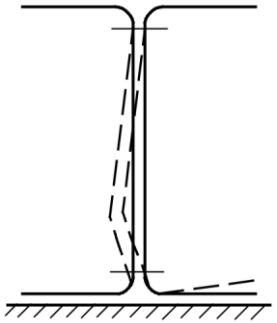
a) Initial stage

b) Web started to cripple

c) Flange crushing

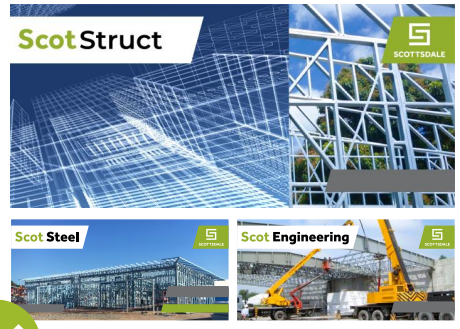
d) Ultimate failure

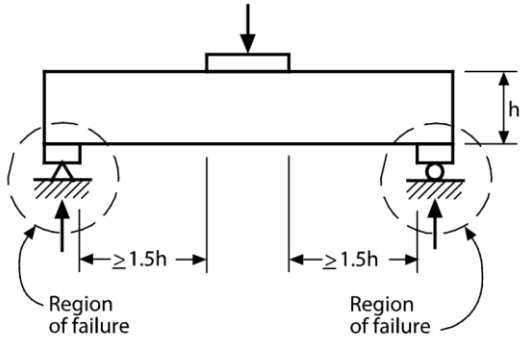




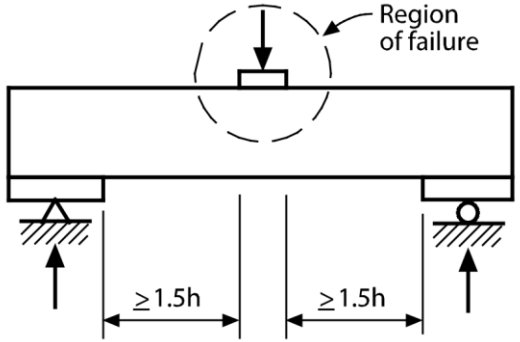
Source: AISI S100-16

**YES!! SCOTSTEEL/ SCOTSTRUCT Checks that too!!**

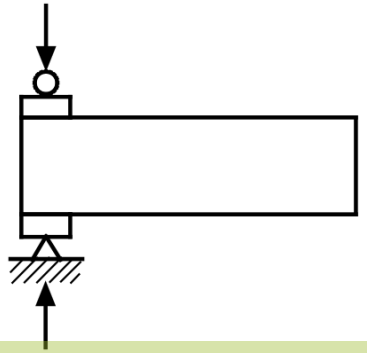


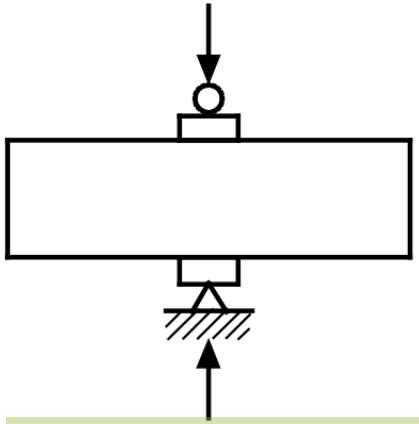

**End One Flange (EOF)**




**Internal One Flange (EOF)**



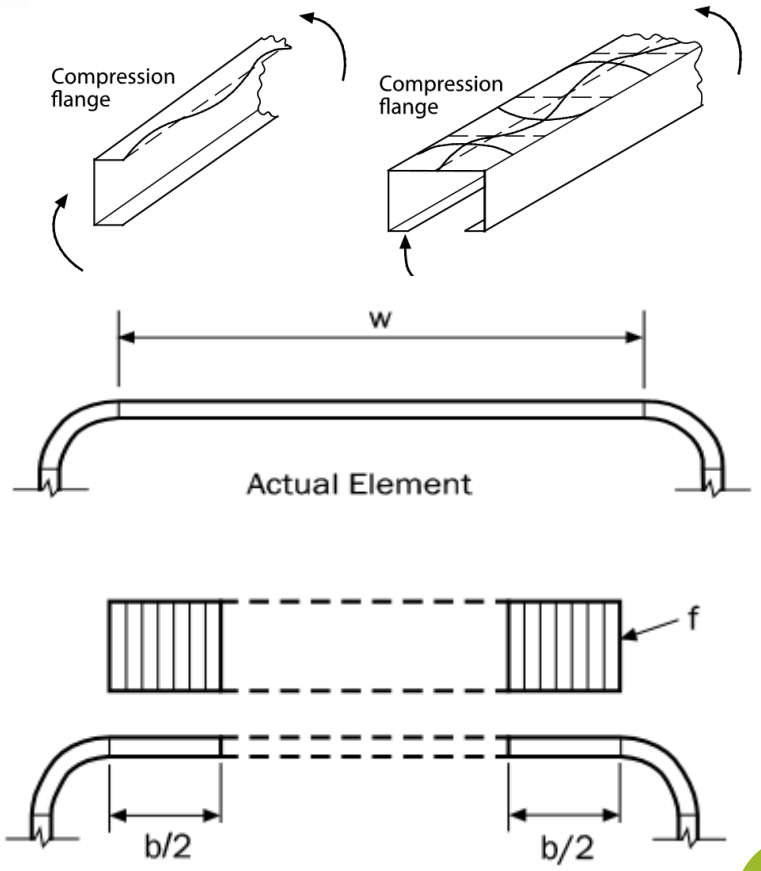
**End Two Flange (ETF)**



**Internal Two Flange (ITF)**

# Effective Width Method vs Direct Strength Method in Cold Formed Steel Design

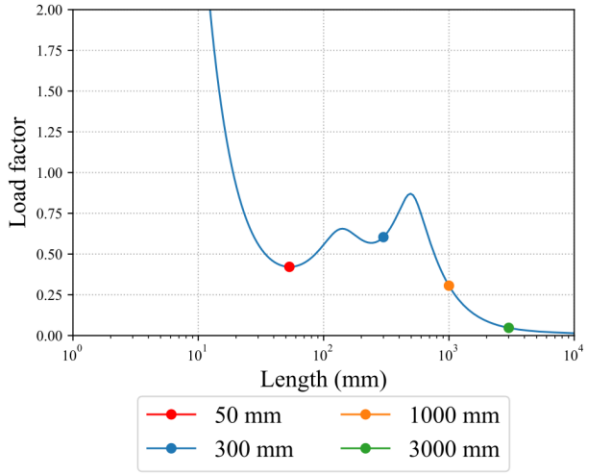
Effective Width Method (EWM)



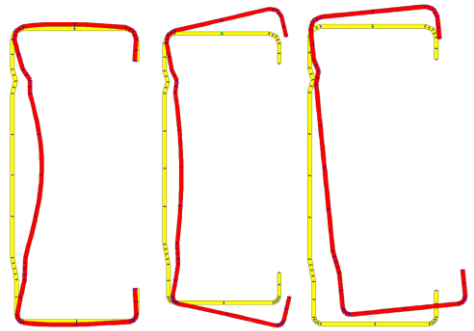

Compute Effect

**AND YES!!**
**SCOTSTEEL/SCOTSTRUCT can handle both methods**




Signature Curve

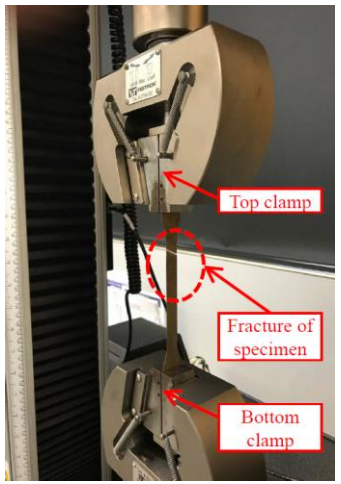


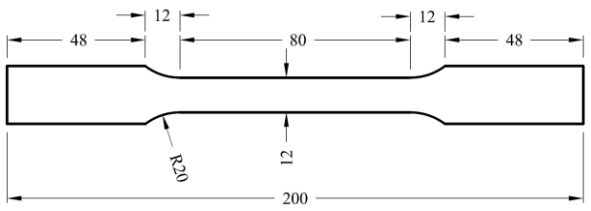
Buckling Modes (Finite Strip Analysis)

Direct Strength Method (DSM)

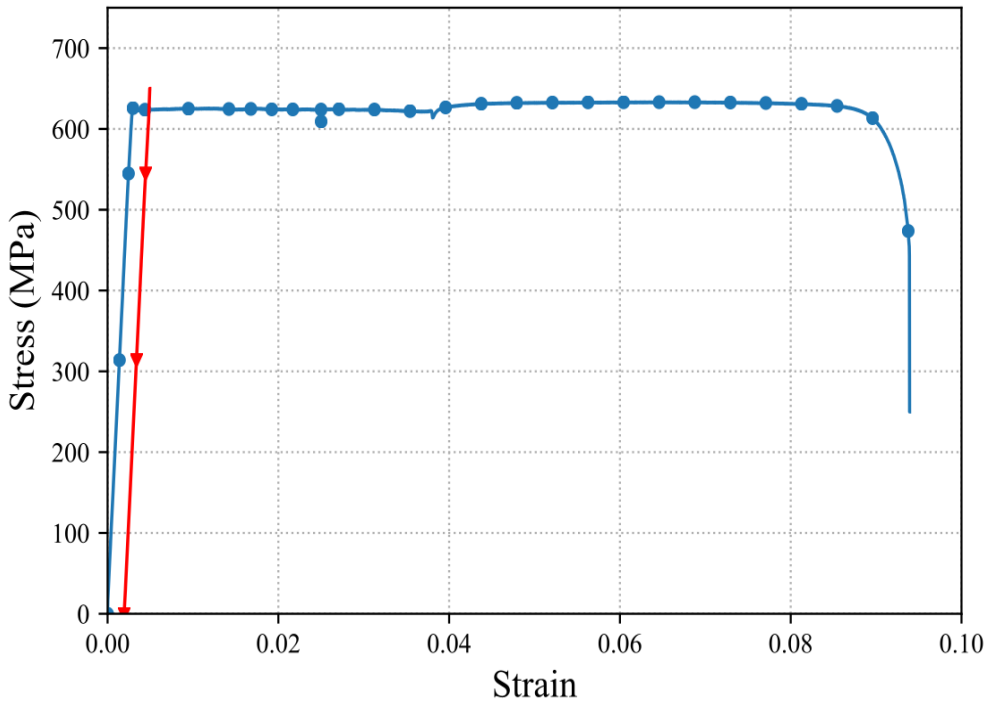
# Tensile Coupon Tests and Mill Certificates

**“CHECK BEFORE YOU BUY STEEL”**

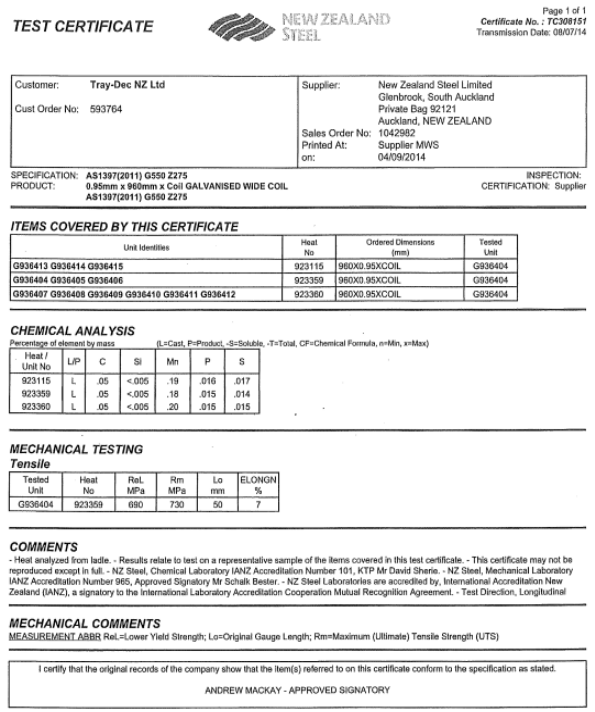



**Typical tensile coupon test**




**Typical stress vs strain curve**



TEST CERTIFICATE — NEW ZEALAND STEEL

Page 1 of 1
Certificate No.: TC308151
Transmission Date: 08/07/14

| | |
|---|---|
| Customer: Tray-Dec NZ Ltd | Supplier: New Zealand Steel Limited, Glenbrook, South Auckland, Private Bag 92121, Auckland, NEW ZEALAND |
| Cust Order No: 593764 | Sales Order No: 1042982 |
| | Printed At: Supplier MWS |
| | on: 04/09/2014 |

SPECIFICATION: AS1397(2011) G550 Z275
PRODUCT: 0.95mm x 960mm x Coil GALVANISED WIDE COIL AS1397(2011) G550 Z275
INSPECTION: CERTIFICATION: Supplier

ITEMS COVERED BY THIS CERTIFICATE

| Unit Identities | Heat No | Ordered Dimensions (mm) | Tested Unit |
|---|---|---|---|
| G936413 G936414 G936415 | 923115 | 960X0.95XCOIL | G936404 |
| G936404 G936405 G936406 | 923359 | 960X0.95XCOIL | G936404 |
| G936407 G936408 G936409 G936410 G936411 G936412 | 923360 | 960X0.95XCOIL | G936404 |

CHEMICAL ANALYSIS
Percentage of element by mass (L=Cast, P=Product, -S=Soluble, -T=Total, CF=Chemical Formula, n=Min, x=Max)

| Heat / Unit No | L/P | C | Si | Mn | P | S |
|---|---|---|---|---|---|---|
| 923115 | L | .05 | <.005 | .19 | .016 | .017 |
| 923359 | L | .05 | <.005 | .18 | .015 | .014 |
| 923360 | L | .05 | <.005 | .20 | .015 | .015 |

MECHANICAL TESTING
Tensile

| Tested Unit | Heat No | ReL MPa | Rm MPa | Lo mm | ELONGN % |
|---|---|---|---|---|---|
| G936404 | 923359 | 680 | 730 | 50 | 7 |

COMMENTS
- Heat analyzed from ladle. - Results relate to test on a representative sample of the items covered in this test certificate. - This certificate may not be reproduced except in full. - NZ Steel, Chemical Laboratory IANZ Accreditation Number 101, KTP Mr David Sherie. - NZ Steel, Mechanical Laboratory IANZ Accreditation Number 965, Approved Signatory Mr Schalk Bester. - NZ Steel Laboratories are accredited by, International Accreditation New Zealand (IANZ), a signatory to the International Laboratory Accreditation Cooperation Mutual Recognition Agreement. - Test Direction, Longitudinal

MECHANICAL COMMENTS
MEASUREMENT ABBR ReL=Lower Yield Strength; Lo=Original Gauge Length; Rm=Maximum (Ultimate) Tensile Strength (UTS)

I certify that the original records of the company show that the item(s) referred to on this certificate conform to the specification as stated.

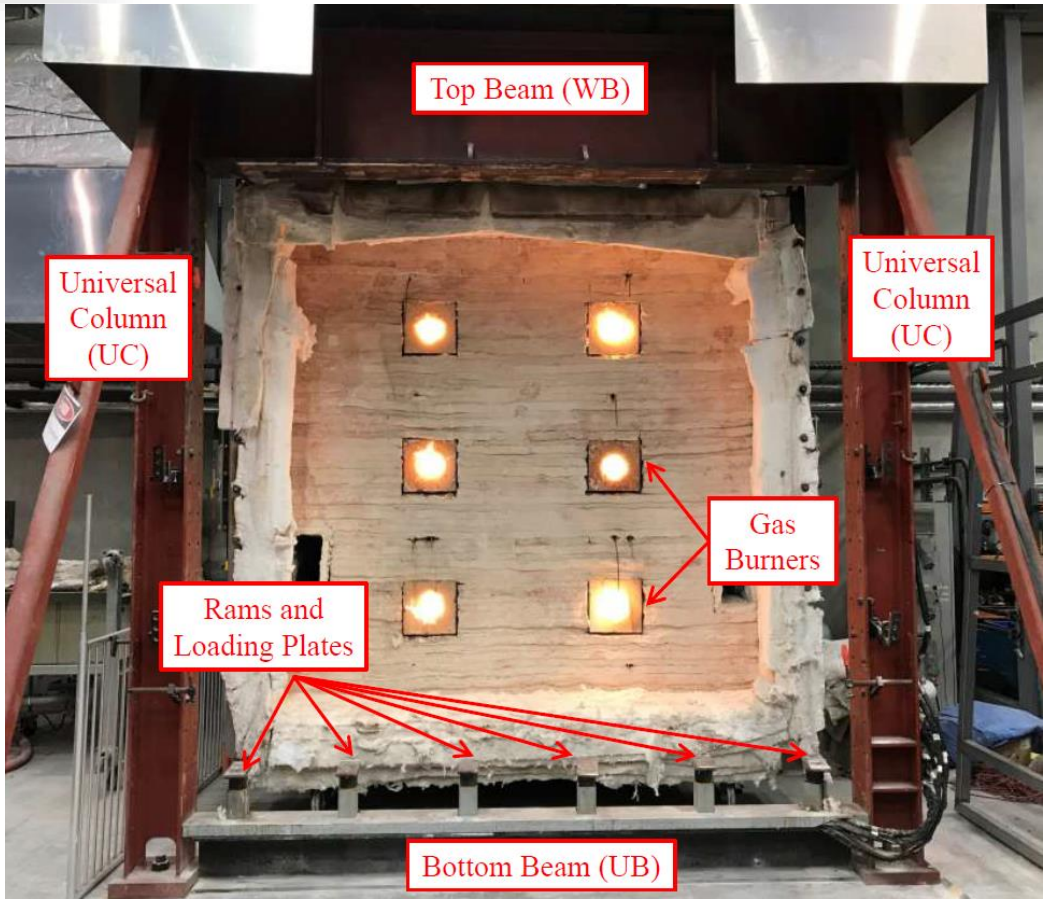
ANDREW MACKAY - APPROVED SIGNATORY

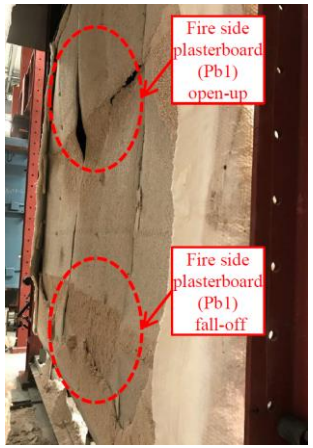
**Typical mill certificate**

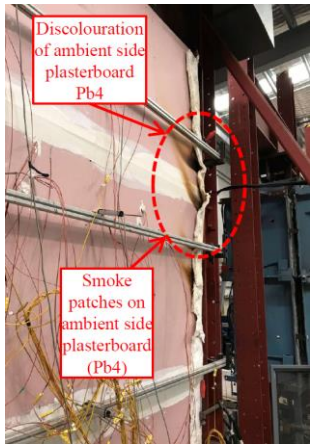
# Behaviour Under Extreme Conditions

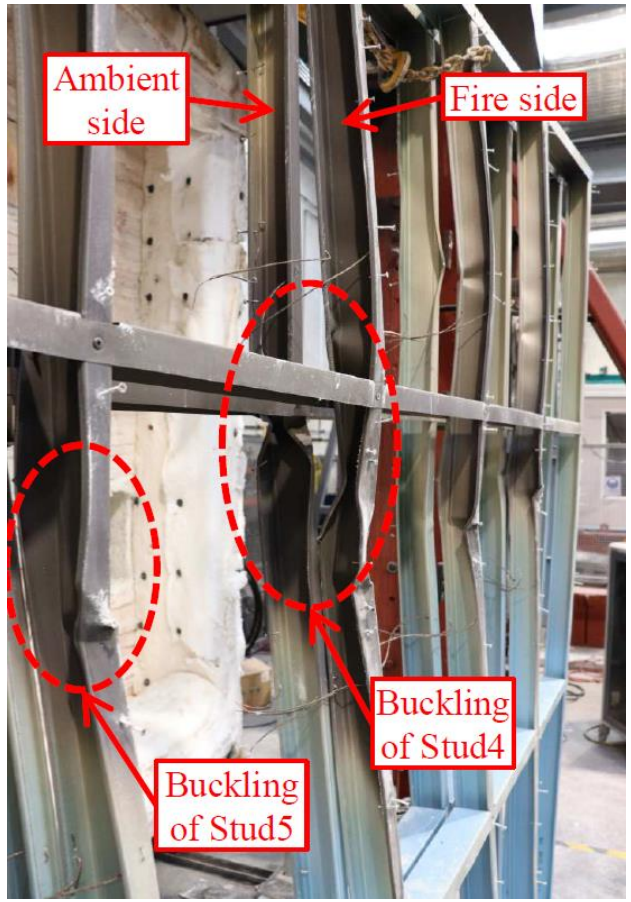
Cold-formed steel structural behaviour under various temperature loading conditions

# Full Scale Fire Tests – Walls (SCOTPANEL)



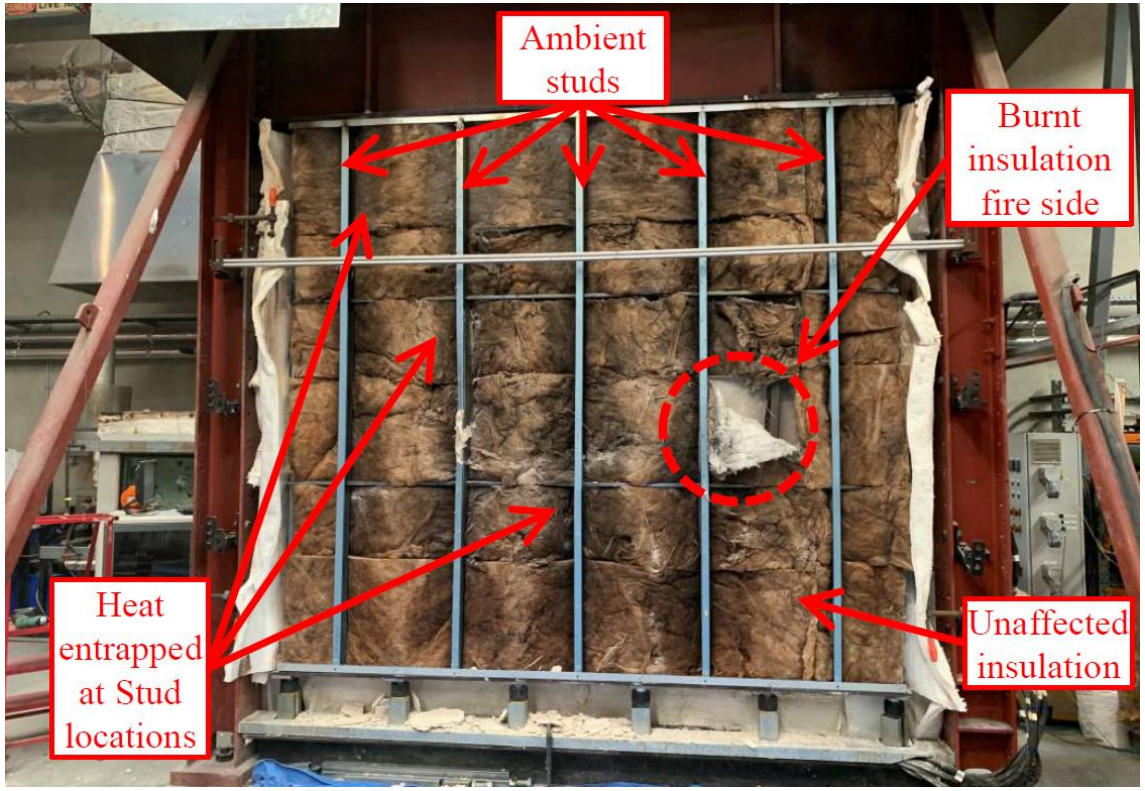



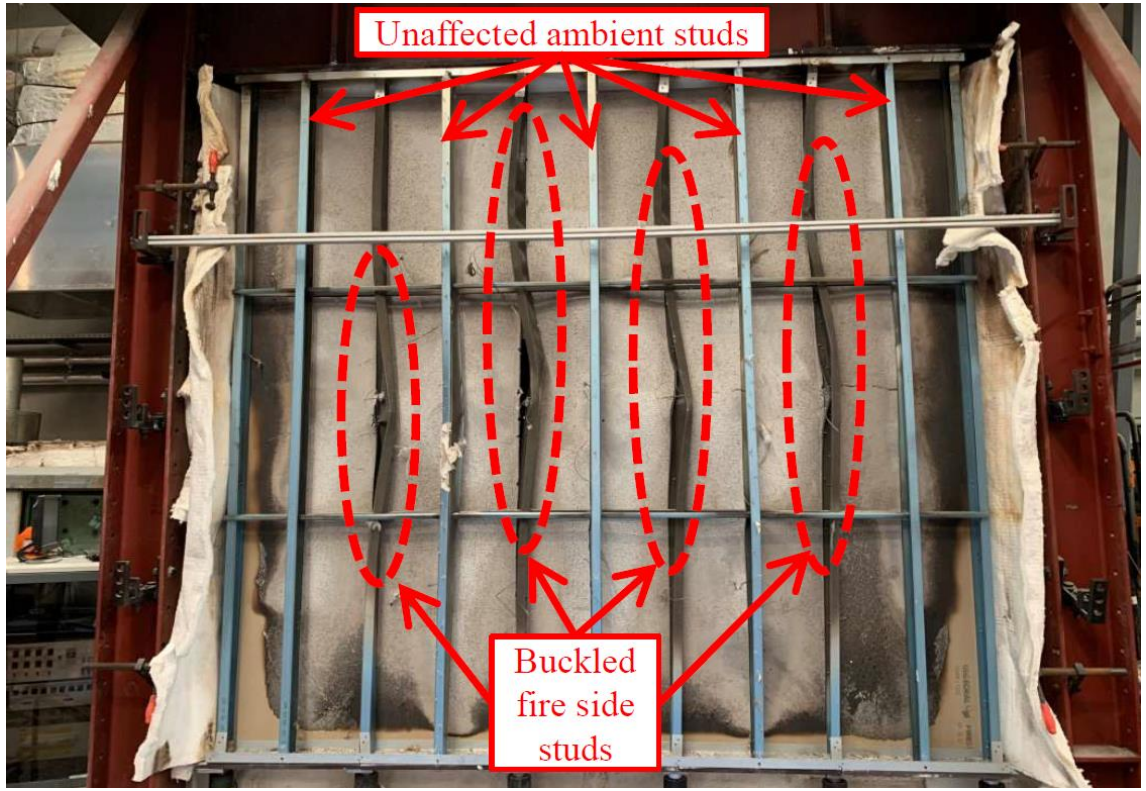




*Source: QUT WAFEL*

# Heat Entrapment – Effect of Insulation (SCOTPANEL)




*Source: QUT WAFEL*

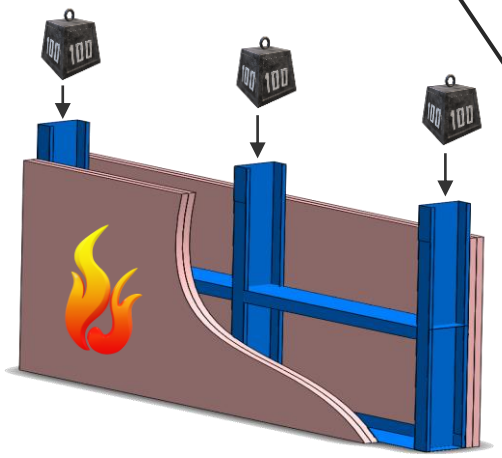
# Floor Fire Tests (SCOTTRUSS)

Buckling of top chord, bottom chord and web members

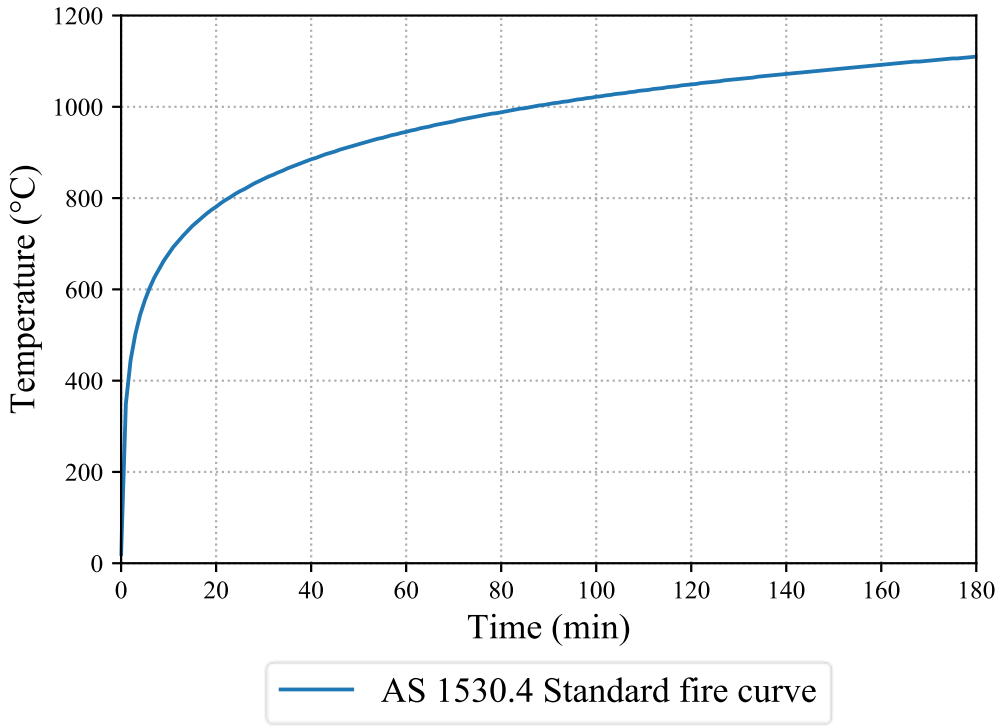
*Source: QUT WAFEL*

# In the Event of a Fire


# Fire Resistance Level (FRL)



- Failure Criteria
  - Structural Adequacy — The ability to maintain stability and adequate load bearing capacity as determined by AS 1530.4
  - Integrity — The ability to resist the passage of hot gases as specified by AS 1530.4
  - Insulation — The ability to maintain a temperature on the ambient surface within limits as in AS 1530.4




**ISO 834 based Standard Fire Curve**

**Integrity**

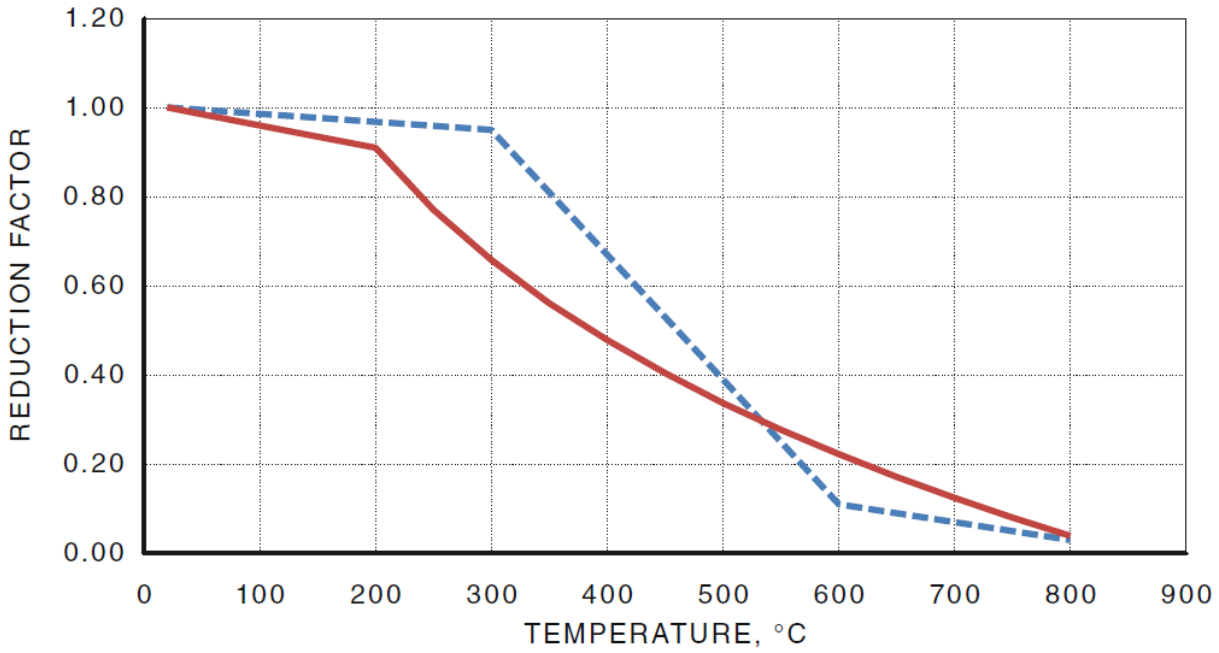
**Structural Adequacy** → 60/60/60 ← **Insulation**

**Example of Fire Resistance Level (FRL)in minutes**

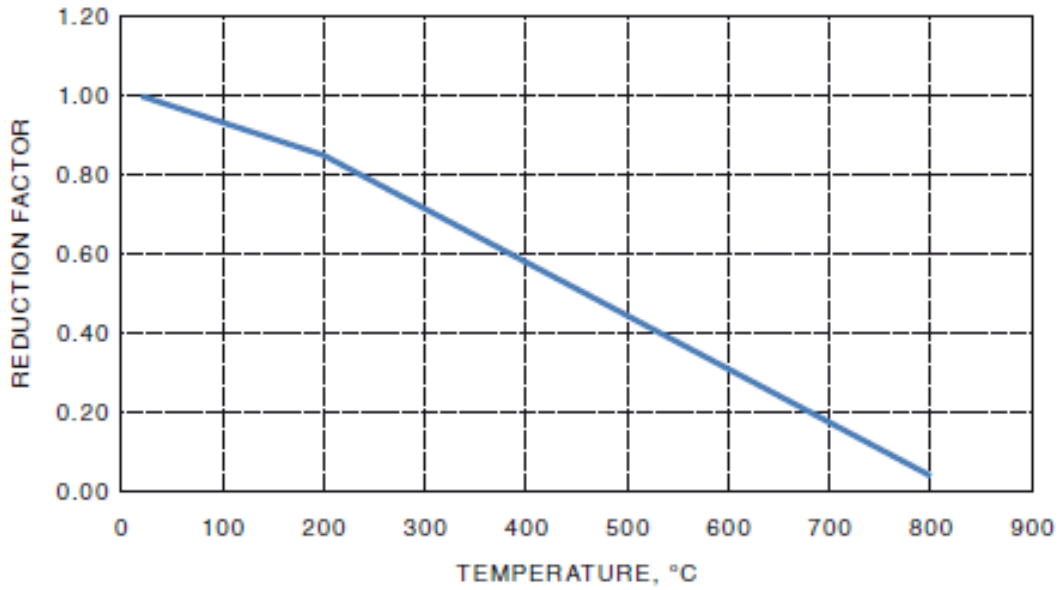
*Source: AS 4600, QUT WAFEL*

# Fire Design - Behaviour

**“Ensure these reductions are included during fire design”**



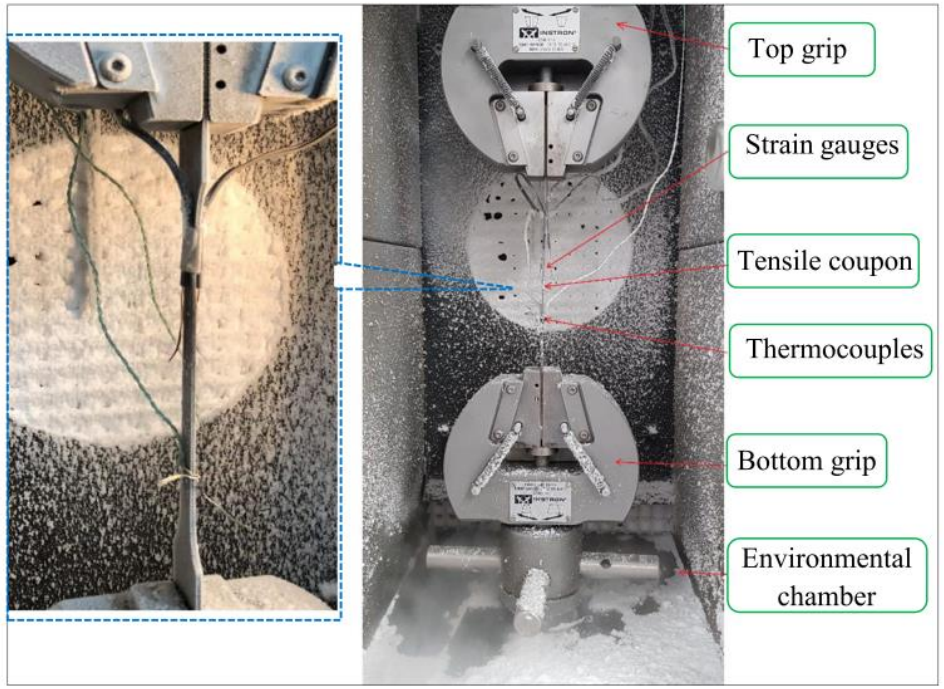

**Variation of yield stress of steel with temperature**



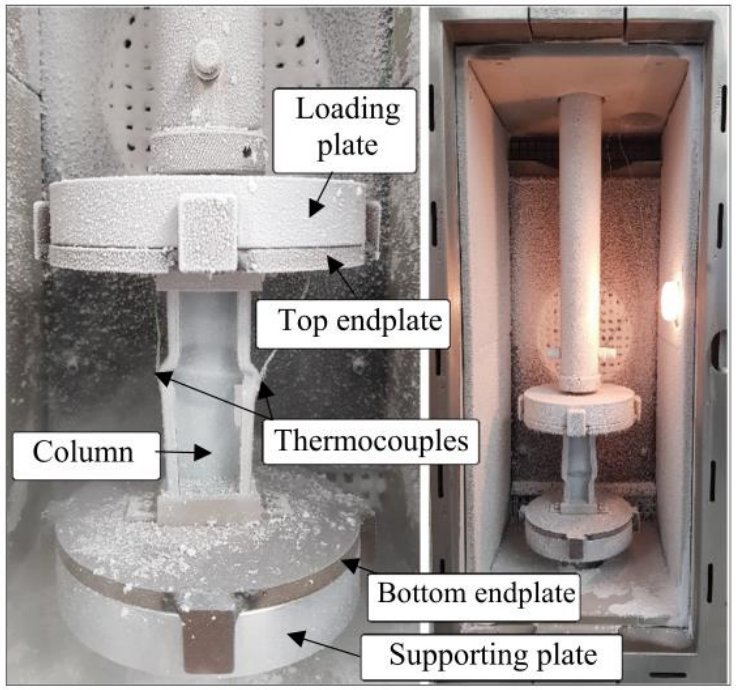

**Variation of elastic modulus with temperature**

*Source: AS 4600*

# Design Under Sub Zero Conditions




Typical tensile coupon test




Short column compression tests

| Temp. (°C) | Specimen number | G550 0.55 mm | G300 0.55 mm | G300 0.8 mm |
|---|---|---|---|---|
| 20 | 1 | 23.80 | 16.93 | 18.47 |
| | 2 | 24.32 | 16.82 | 18.25 |
| -10 | 1 | 25.34 | 17.89 | - |
| | 2 | 24.96 | 18.42 | - |
| -30 | 1 | 25.64 | 19.28 | 21.08 |
| | 2 | 25.80 | 19.69 | 21.03 |
| -50 | 1 | 26.29 | 21.55 | 23.57 |
| | 2 | 26.02 | 21.37 | 24.08 |
| -70 | 1 | 28.34 | 23.81 | 26.09 |
| | 2 | 27.45 | 23.81 | - |

Short column compression test results

**“No reduction in capacities at sub-zero temperatures”**

*Source: Mahenthirarasa et.al*

# Engineering Solutions – Research and Development

Analysis and design procedures with latest research and developments

# Bracing Tests

K-bracing

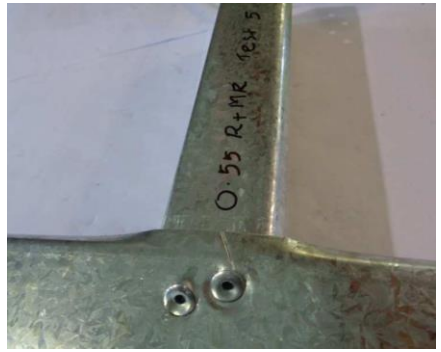
30-mm brace

150-mm brace

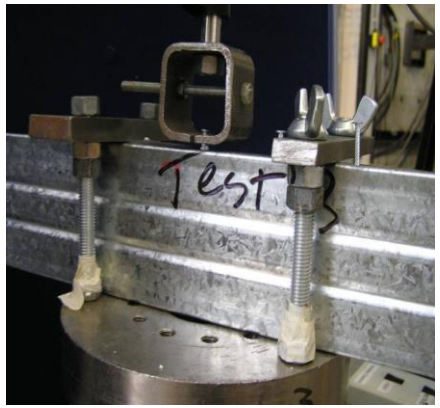
# Connection Tests

**“Capacities included in ScotSteel engineering calculations”**

**Hat section roof truss connection tests**

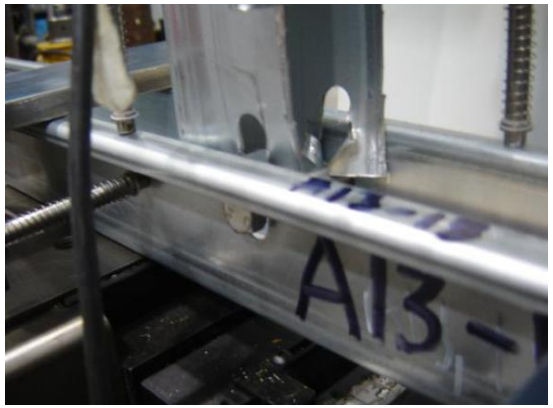



**Rivet connection**




**Nail pull out**

**Bolt tension**




**Bolt web connection**

# Lintel Tests

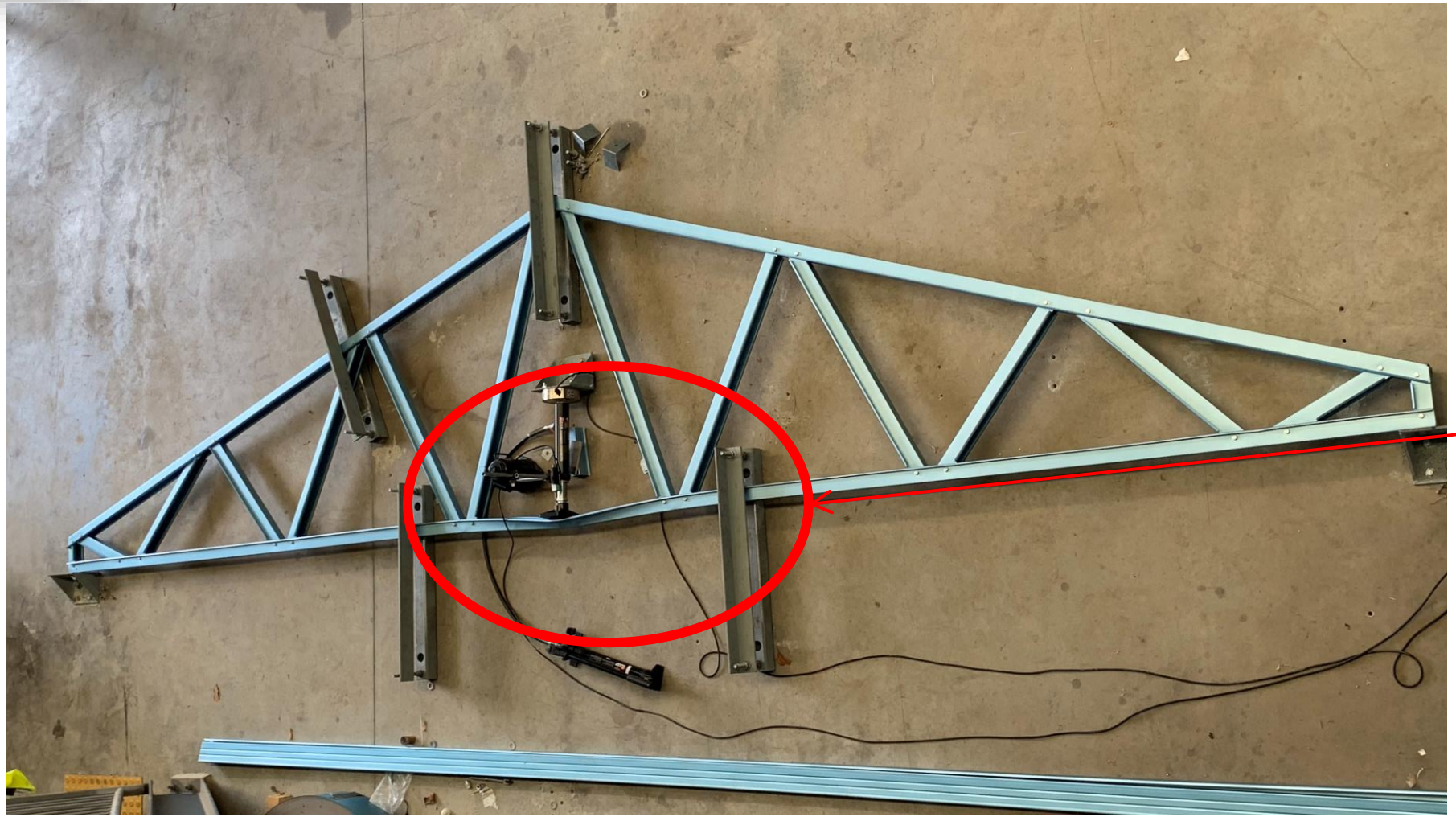

No plating


Single plating


Double plating

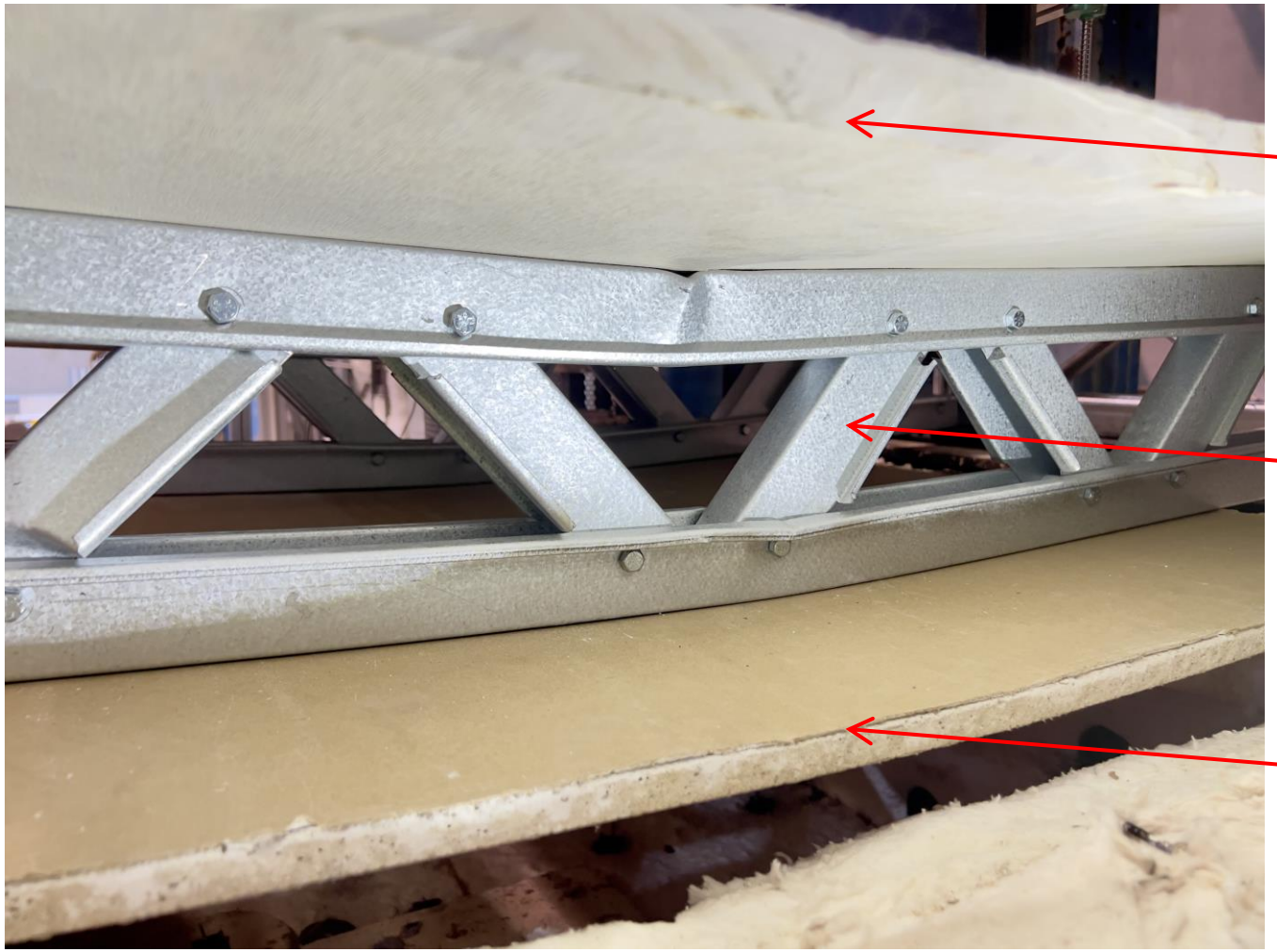
Rivet failure

# Truss Testing – Hat Section (SCOTTRUSS)



Buckling bottom chord

# Full Scale Floor Truss Testing (SCOTTRUSS)

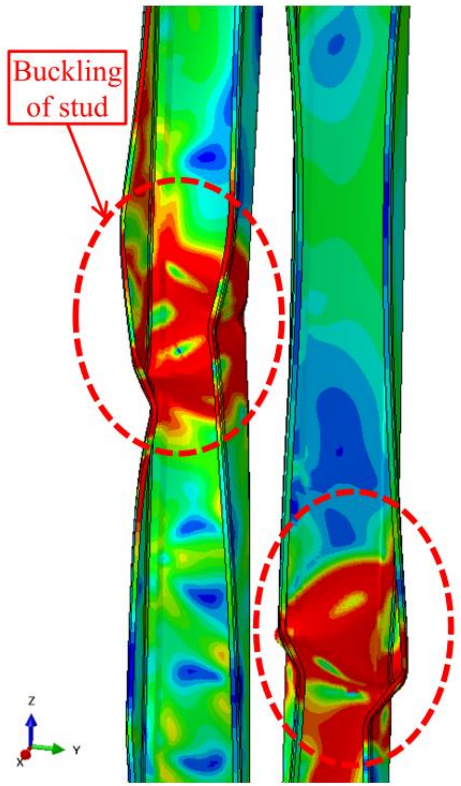


Floorboard on top

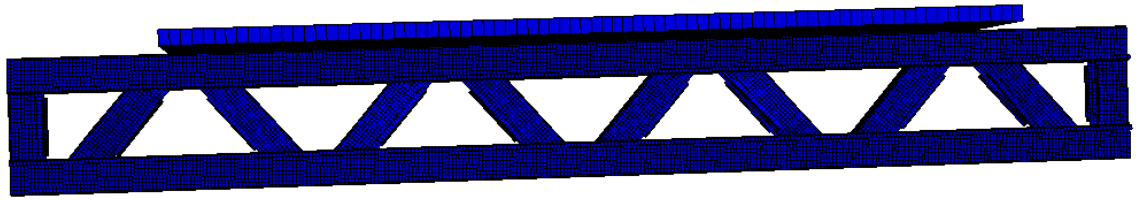
Buckling top chord

Floorboard on bottom

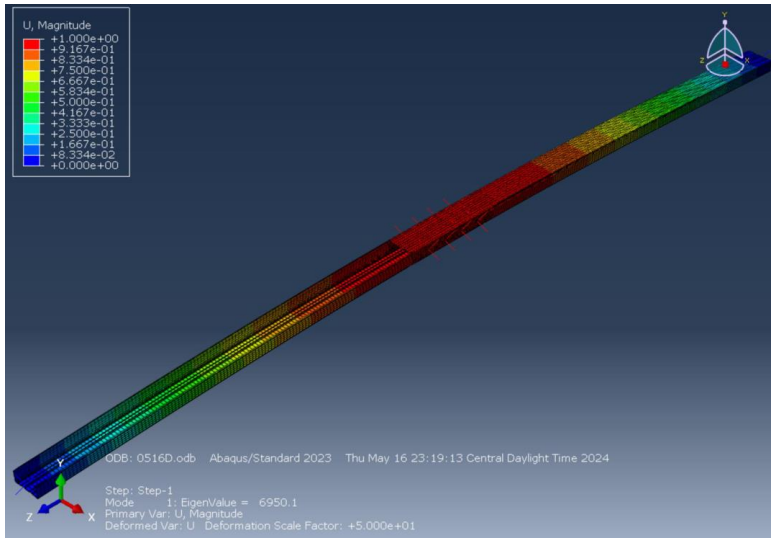
# Advanced Finite Element Analysis




Buckling behaviour of C-section members (SCOTPANEL)

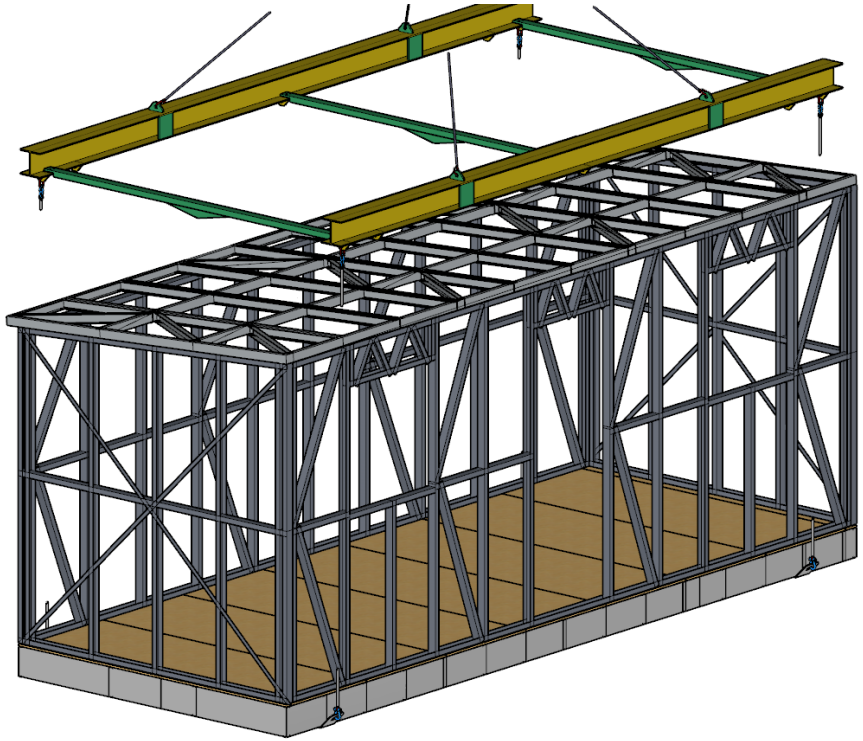


Buckling behaviour of Hat section members (SCOTTRUSS)

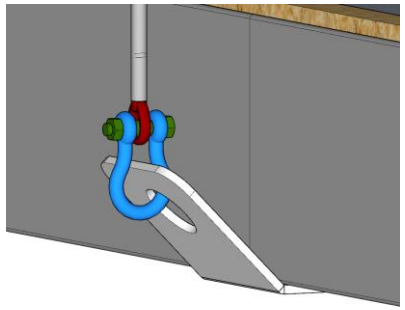



Buckling behaviour of FE24 (FRAMEEXTEND24)

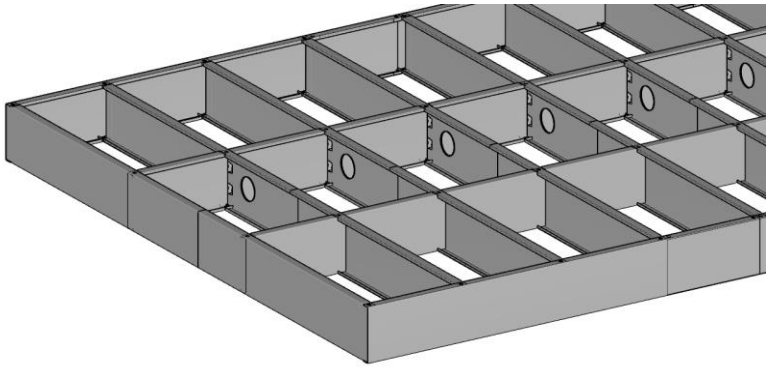
# Modular Construction



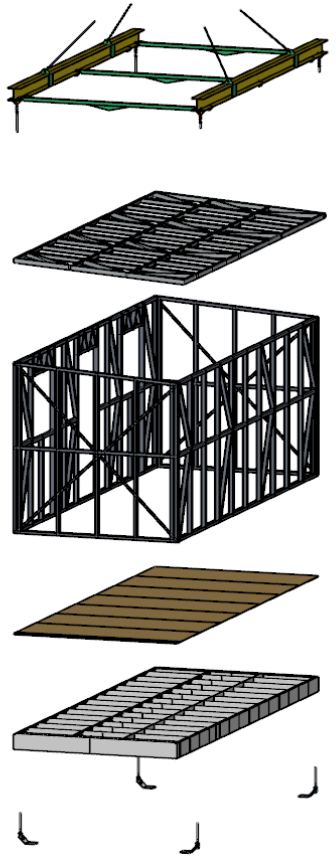
Modular lifting set-up



Lifting lugs



C-section joists from KFS FRAMEMAKER



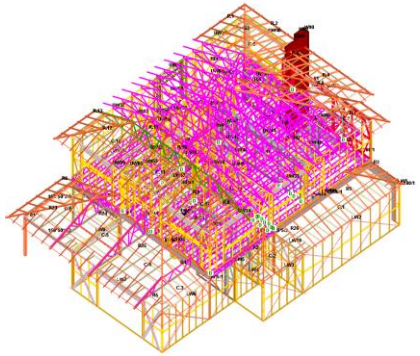
Components within a lift

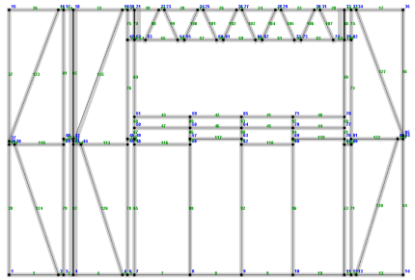
# Current and Future Engineering Software Development

Software tools and automation for cold-formed steel structures

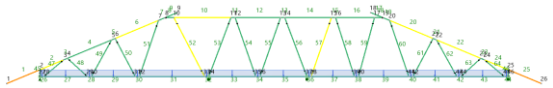
# Scottsdale's Current Software - Overview

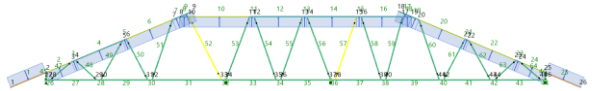
1

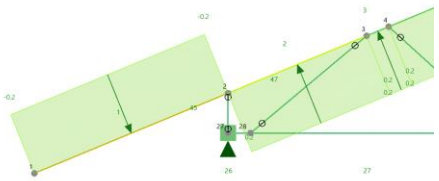




2







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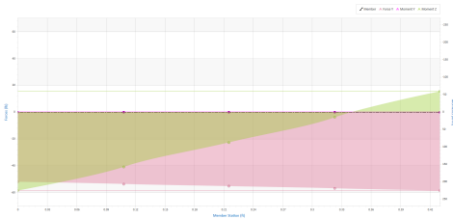
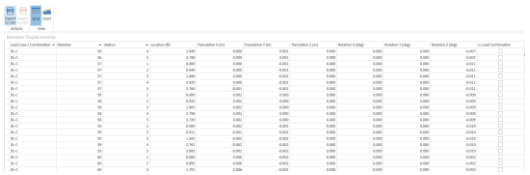




4

| Member Type | Maximum CSI Ratio |
|---|---|
| Bottom Chord | 0.169 |
| Top Chord | 0.851 |
| Web | 0.421 |

| Critical Check |
|---|
| Combined Compression and Bending Eq. 3.5.1(3) |
| Distortional buckling bending check - Eq. 3.3.1 (2) (x-axis) |
| Combined Compression and Bending Eq. 3.5.1(1) |

Combined Forces

| Member | 25 |
|---|---|
| Section Name | 6050-G550-0.85 |
| Unbraced member length restricting distortional buckling (Lm) | 2.176 ft |
| Unbraced member length about x-axis (Lx) | 1.958 ft |
| Unbraced member length about y-axis (Ly) | 2.393 ft |
| Unbraced member length for twisting (Lt) | 1.958 ft |
| Man load alternative applied | No |
| Load Combination | ULS-071 |
| Station | 1 |
| Design axial force (N) | -158.381 lb |
| Design bending moment x-axis (Mx) | -5083.858 lb-in |
| Design bending moment y-axis (My) | 0.000 lb-in |
| Design shear force x-axis (Vx) | 0.000 lb |
| Design shear force y-axis (Vy) | 382.366 lb |
| Design concentrated load/reaction (R) | 0.000 lb |
| Combined tension and bending - nominal member moment capacity - Eq. 3.5.... | 0.835 |
| Combined tension and bending - nominal section moment capacity - Eq. 3.5.2(2) | 0.594 |

5

Joint/Connection Checks

| Member | Section | Node | Force (lb) | Capacity (lb) |
|---|---|---|---|---|
| Load Combination: ULS-001 | | | | |
| 8 | 6050-G550-0.85 | 8 | 104.294 | 1764.751 |
| 18 | 6050-G550-0.85 | 19 | 155.329 | 1764.751 |
| 26 | 6050-G550-0.85 | 27 | 0.000 | 1764.751 |
| 44 | 6050-G550-0.85 | 46 | 0.000 | 1764.751 |

| Ratio | Joint | Joint Code | Status |
|---|---|---|---|
| 0.059 | Bolt no spacer | B | Pass |
| 0.088 | Bolt no spacer | B | Pass |
| 0.000 | Bolt no spacer | B | Pass |

**Geometry Generation**

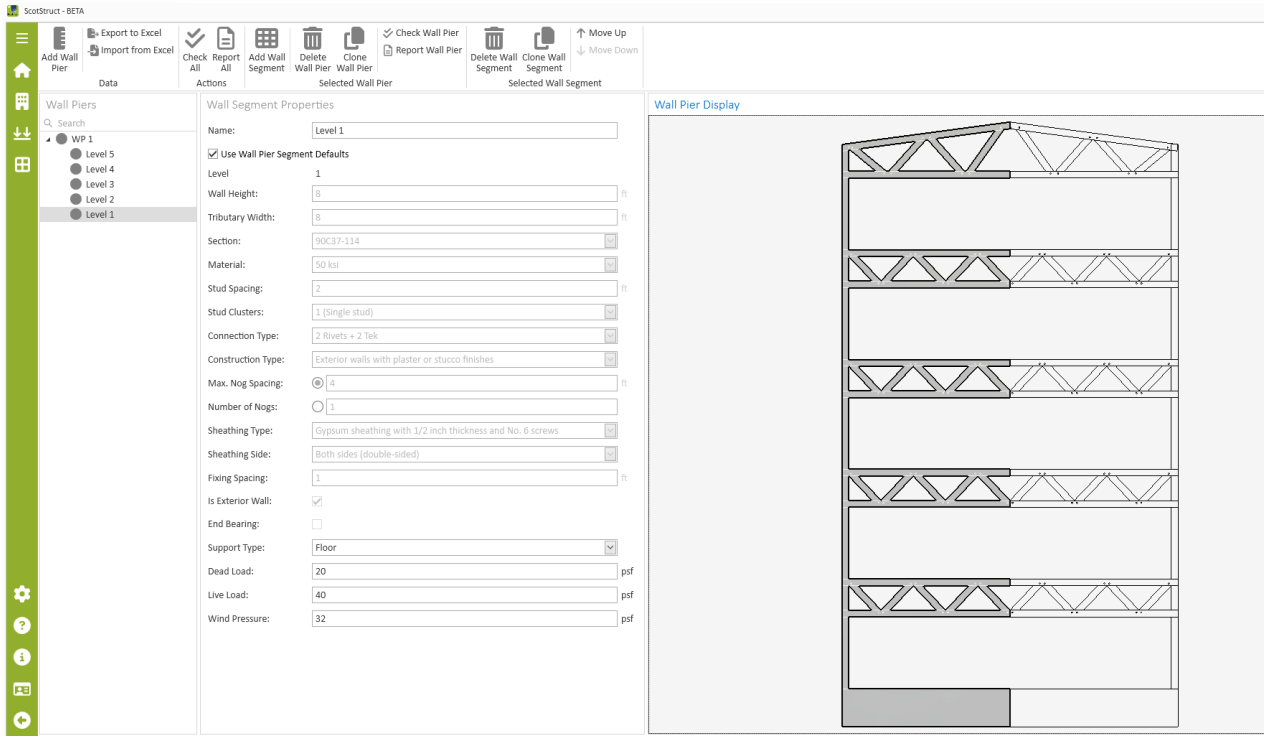
**Loads Evaluation & Application**

**Structural Analysis**

**Member Design**

**Connection Design**

# Engineering Automation Roadmap




**ScotStruct - Bearing wall module shown**

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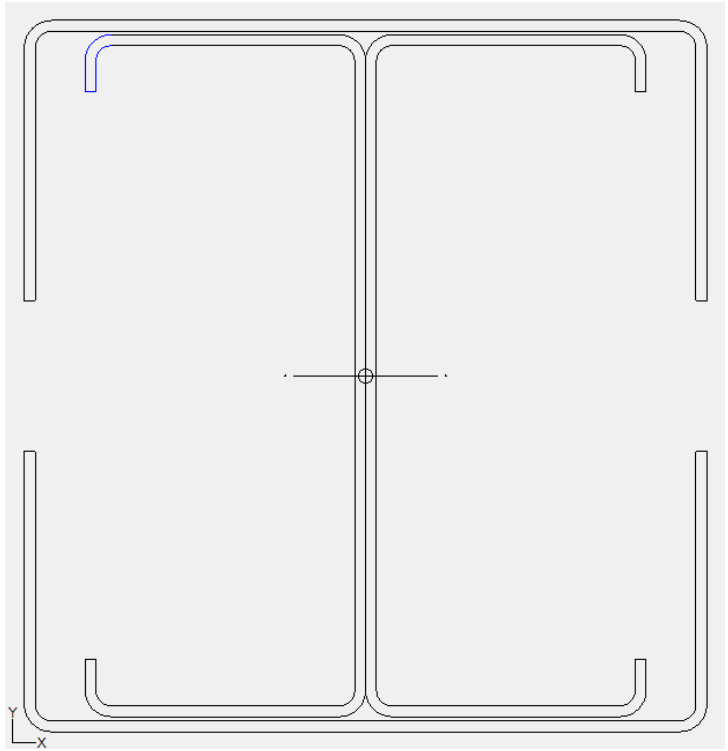
- **More modules** to the ScotStruct software
- Tight **integration** amongst all modules
- Integration with ScotSteel and other **standalone** application
- **Import and export** support for commonly used engineering formats for easier data transfer
  - DWG
  - DXF
  - IFC
- One click **PDF reports** for engineering sign off for all modules
- Whole cold-formed steel building design with state-of-the-art **DSM** methodology
- Desing for complex configurations and built-up sections

# Design for Complex Built Up Sections (Upcoming)



Composite columns

EWM/DSM based results

Member Check - AISI S100-16/S3-22, US, LRFD

Load Combination: 1.2D+W+L
Design Parameters at 1.6000 m:

| | | | | | |
|---|---|---|---|---|---|
| Lx | 3.2000 m | Ly | 1.6000 m | Lt | 1.6000 m |
| Kx | 1.0000 | Ky | 1.0000 | Kt | 1.0000 |

Section: B2BBoxed.cfss
Material Type: A653 SS Grade 33, Fy=227.53 MPa

| | | | | | |
|---|---|---|---|---|---|
| Cbx | 1.2988 | Cby | 2.0833 | ex | 0.0000 mm |
| Cmx | 1.0000 | Cmy | 1.0000 | ey | 0.0000 mm |
| Braced Flange: None | | kϕ | 0 kN | | |
| Red. Factor, R: 0 | | Lm | 3.2000 m | | |

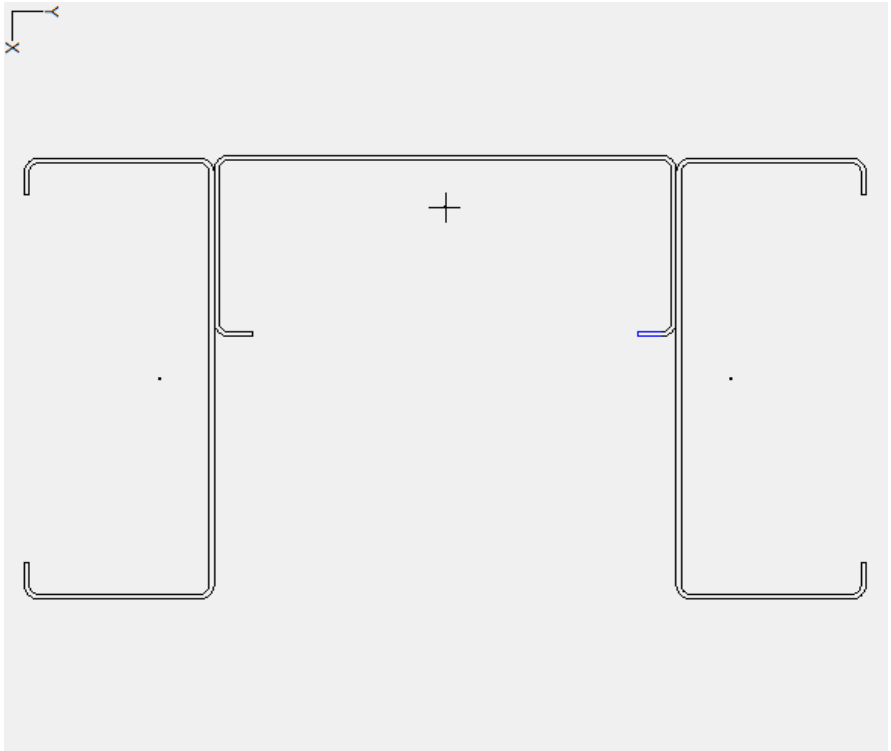
| Loads: | P (kN) | Mx (kN-m) | Vy (kN) | My (kN-m) | Vx (kN) |
|---|---|---|---|---|---|
| Total | 6.832 | -0.7471 | 0.000 | 0.0000 | 0.000 |
| Applied | 6.832 | -0.7673 | 0.000 | 0.0000 | 0.000 |
| Strength | 82.893 | 5.1998 | 52.044 | 2.7707 | 49.660 |

Interaction Equations

| | | |
|---|---|---|
| Eq. H1.2-1 | (P, Mx, My) | 0.082 + 0.148 + 0.000 = 0.230 <= 1.0 |
| Eq. H2-1 | (Mx, Vy) | Sqrt(0.021 + 0.000)= 0.145 <= 1.0 |
| Eq. H2-1 | (My, Vx) | Sqrt(0.000 + 0.000)= 0.000 <= 1.0 |

| | | | |
|---|---|---|---|
| ○ Beams ◉ Columns | | Spacing | 2 ft |
| Span | 3.2 m | Dead Load | 240 lb/ft |
| Spans | 1 | Live Load | 480 lb/ft |
| Bracing | Mid-Point | Wind Load | 20 psf |

Example column usage engineering results for 6 storey



Composite chord members

# Other Modelling and Design Tools

revolutic

CHECKWIND

MECA

MECAWIND

Custom spreadsheets

**Wind generation tools**

SpaceGass

Bentley

Staad.Pro

Multiframe

ATIR

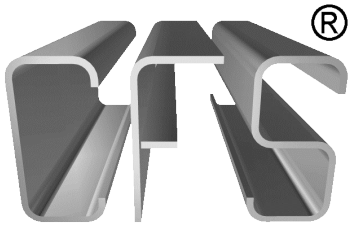
Strap

csi COMPUTERS & STRUCTURES, INC. STRUCTURAL AND EARTHQUAKE ENGINEERING SOFTWARE

ETABS

SCIA BY ALLPLAN

**General purpose modelling tools**



CFS by RSG

Dlubal

SHAPE-THIN

**Cold-formed steel design tools**

# Summary

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