Self-Certification

Compliance Document for Scottsdale Self-Certification (AU Trusses)

Version 1.1

30th March 2022

Contents

1 Introduction

The Compliance Document for **Scottsdale Self-Certification (AU Trusses)** consists of this Summary and two other documents:

a) The Installation Manual (Construction), and
b) The Self-Certification User Manual

Both of which are available for registered users of the Scottsdale Knowledge Base.

The Compliance Document for **Scottsdale Self-Certification (AU Trusses)** (this document) can be found on the Scottsdale Australia website at the following location:

https://www.scottsdalesteelframes.com/assets/entries/self-certification-compliance-document.pdf

2 General Information

2.1 Software Details

The following applications/modules provide the **Scottsdale Self-Certification (AU Trusses)** functionality and are incorporated in Release 22.3.3000 of the Scottsdale Software (Release Date: 30th March 2022).

Note: **Scottsdale Self-Certification (AU Trusses)** is specific functionality/modules within the wider Scottsdale Software suite, and is provided by multiple applications (listed below)

Application	Executable	Version Number	Description
N/A	Scottsdale Self-Certification (AU Trusses)	1.0	The Self-Certification functionality version.
ScotSteel	SCSDesign.exe	22.3.3002.2472	ScotSteel is the complete design software package.
SCS Environment	SCSEnviro_SC.exe	22.3.3002.1867	Engineering environment configuration software
Load Generator	AU_NZ_LoadGenerator.exe	1.0.0.24	Load generation software for Australian Standards
Member Checker – Hat Sections	AS_H_MemberCheck.exe	1.0.0.26	Member check for Hat Sections for Australian Standards
Member Checker – C Sections	AS_C_MemberCheck.exe	1.0.0.8	Member check for C Sections for Australian Standards

Figure 1 below shows the interaction between the Engineering components within the Scottsdale Software

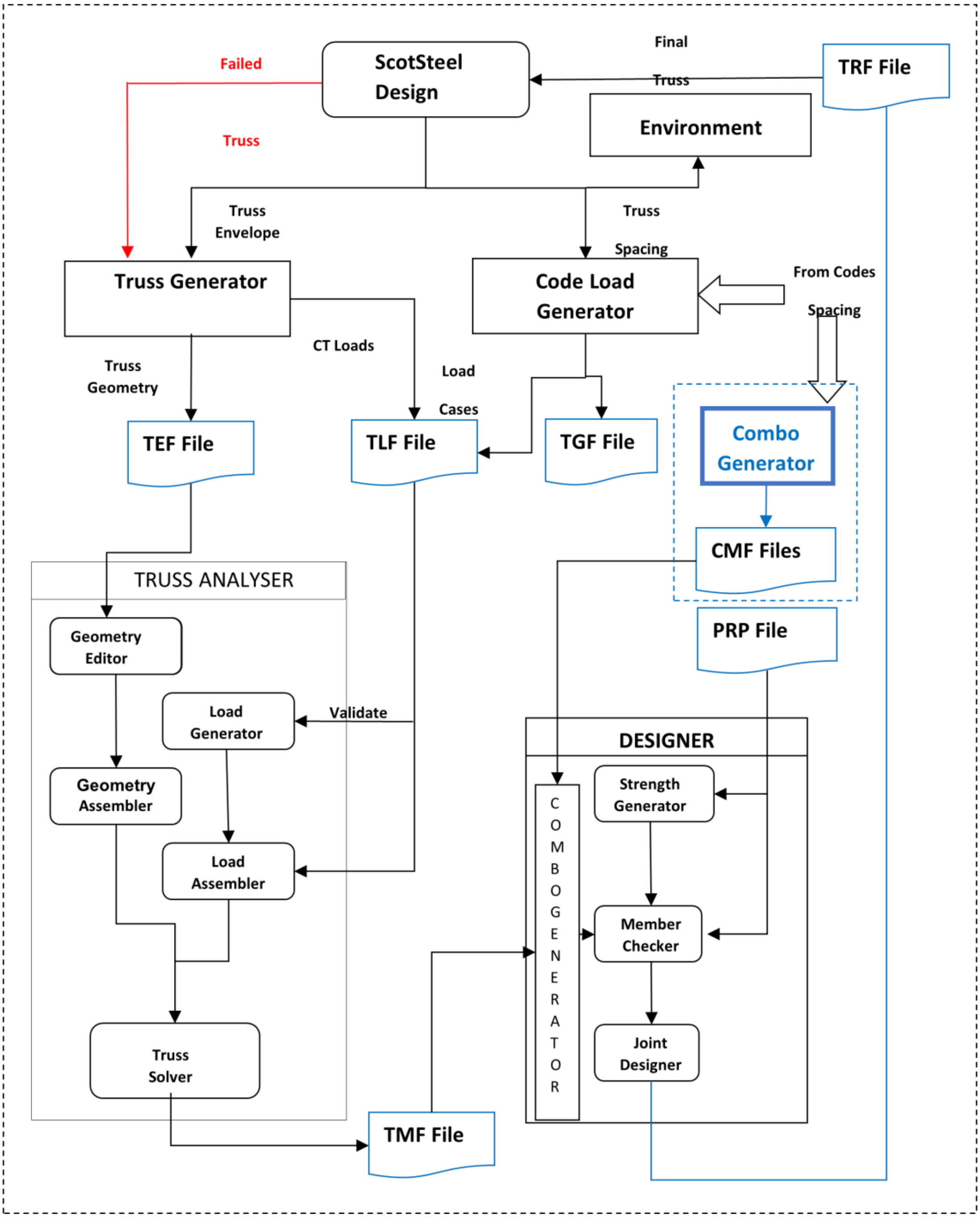


Figure 1 - Scottsdale Software (Engineering Modules)

2.2 Organisation Details

The **Scottsdale Self-Certification (AU Trusses)** functionality as part of the Scottsdale Software is produced and distributed by:

Scottsdale Australia PTY Ltd
Unit 4, 5 Henry Street
Loganholme QLD 4129
Australia

2.3 Scope and Limitations

2.3.1 Scope

Cold-formed steel trusses using Top Hat and/or C-section for roof and floor.

2.3.2 Limitations

a) Geometrical limits of the buildings must conform to limitation (a) to (e) of the ABCB Protocol for Structural Software as shown below
   a. The average roof height must be less than 7.25m
   b. The building width including roofed verandas must be less than 16.0 m
   c. The building length must be less than 5 times building width
   d. The roof pitch must not exceed 35°

The software checks for all the geometric limits and does not allow to proceed for self-certifications if any of them are exceed the limit

The programme has validation on the building width, length, height, and the roof pitch dimension. If these limits are exceeded, the software will not allow user to proceed. It gives the user a warning message as shown in Figure 2. If the dimensions are correct based on the building plan, the user must exit the environment and select the non-self-certification window as shown in Figure 3.

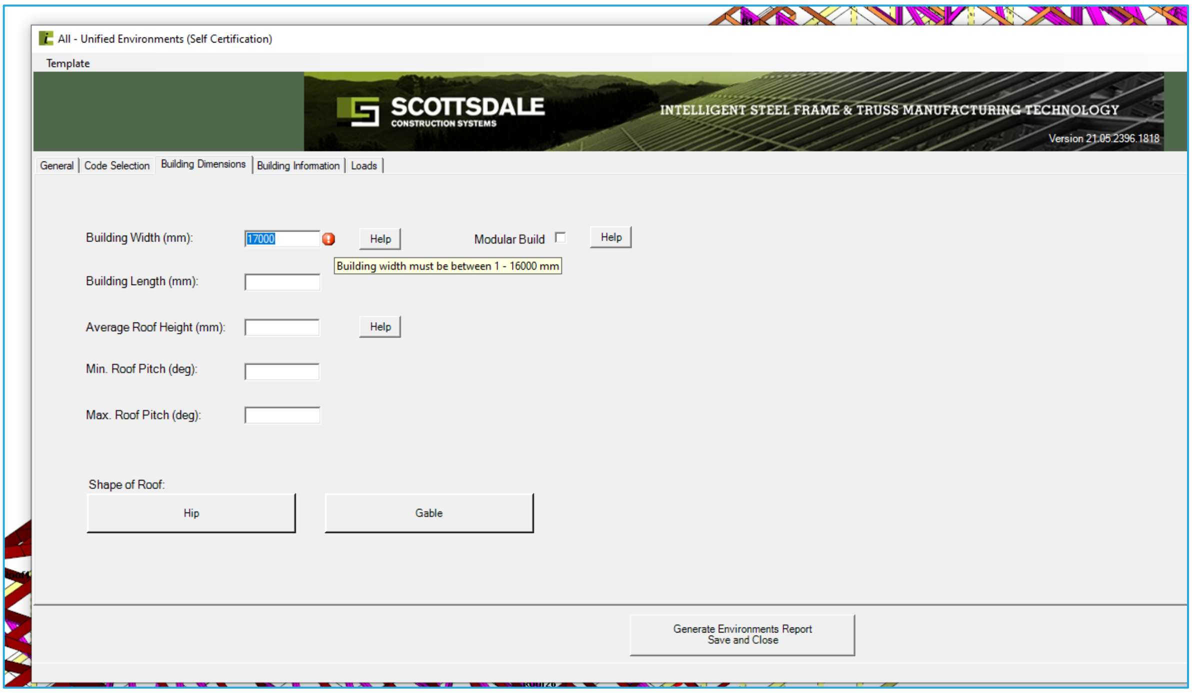


Figure 2 – Self-certification limit validation

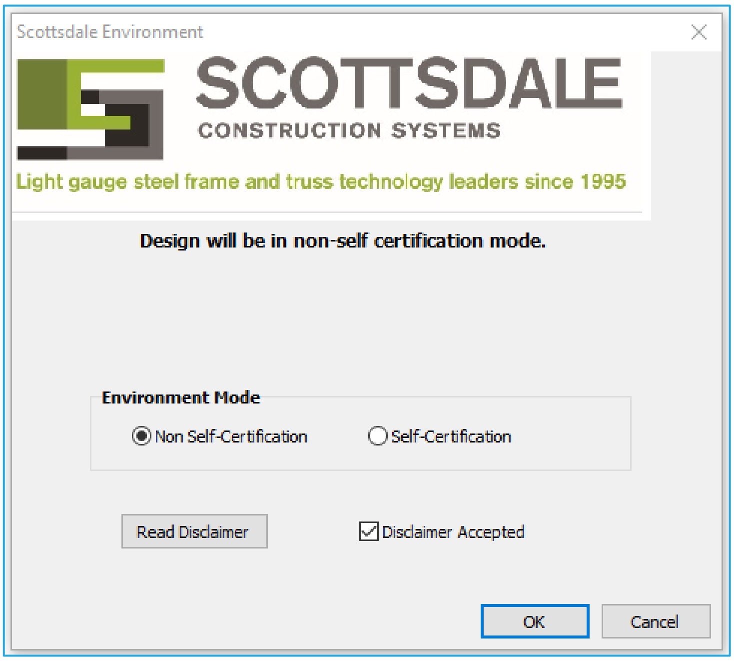


Figure 3 - Non self-certification selection window

As explained above, if the user enters dimensions outside of the limits, the software will not proceed or create the report. The screenshots below show each limitation with the warning message. Refer Figures 4 to 7 below.

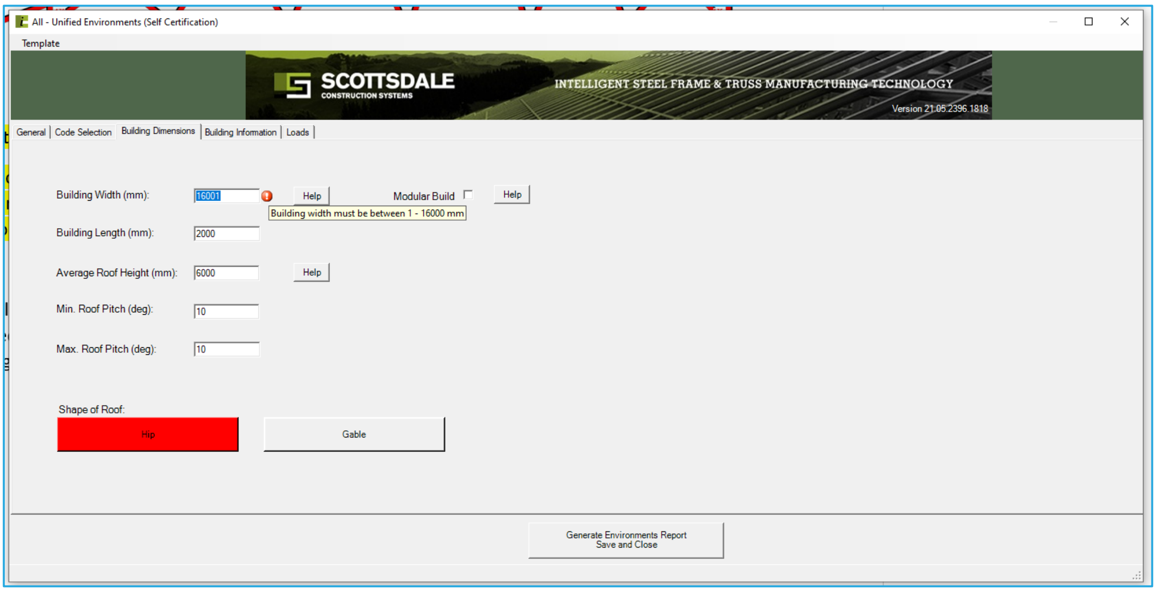


Figure 4 - Building width validation

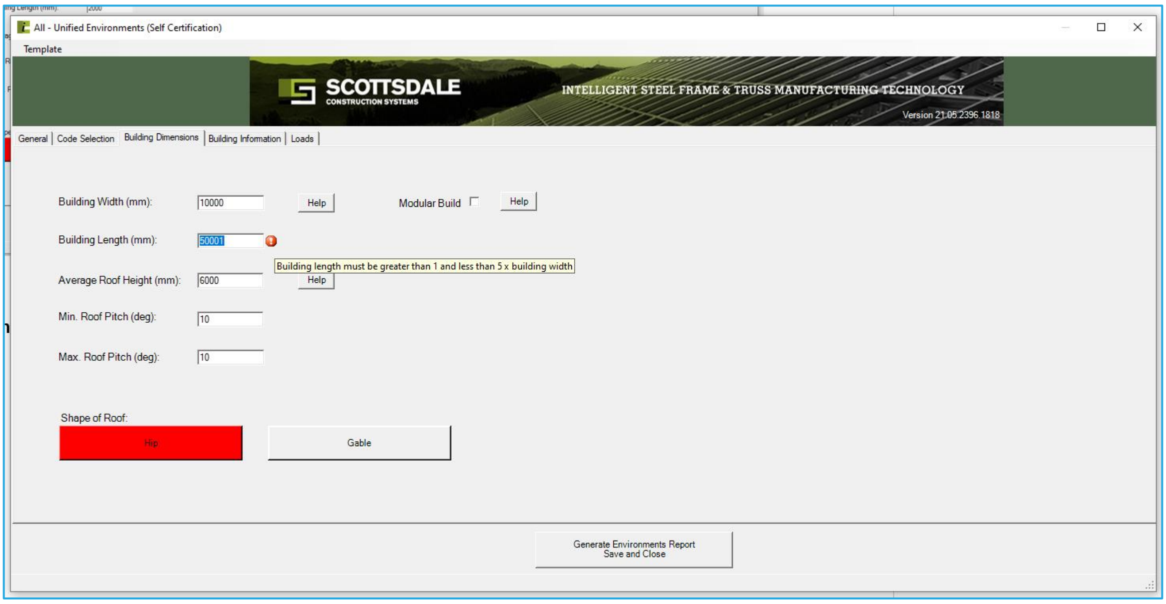


Figure 5 - Building length validation

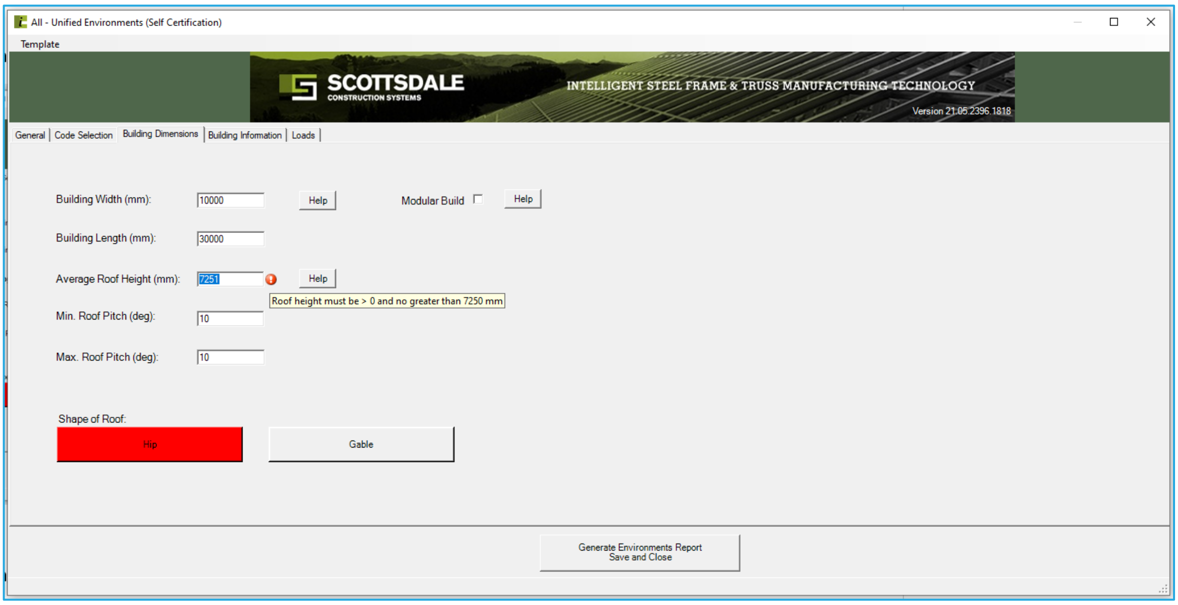


Figure 6 - Building height validation

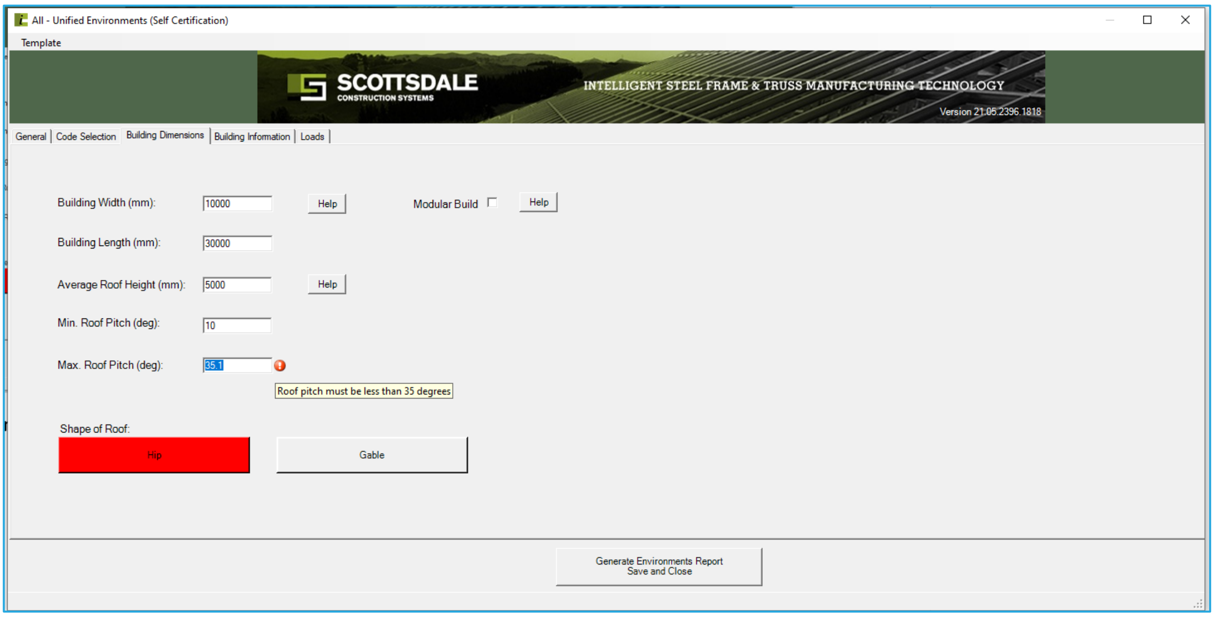
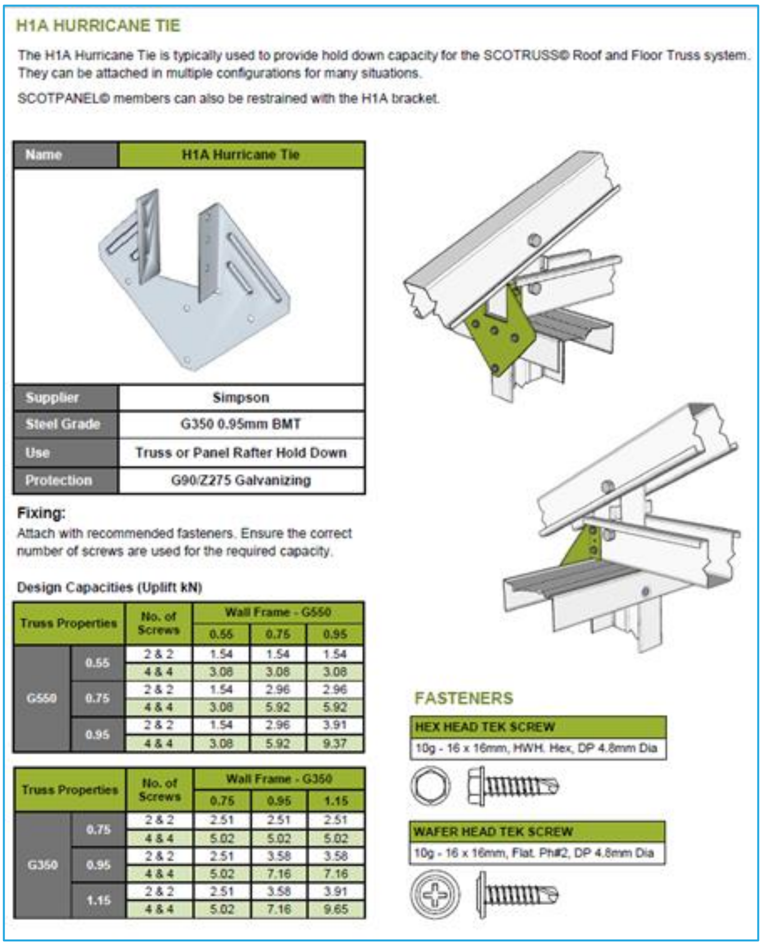


Figure 7 - Roof angle validation

b) The software package is designed to interface with Scottsdale's design software 'ScotSteel and must be used only in this context.

c) The software does not include the tie downs of the trusses including child trusses to girder trusses. Tie down is not part of the truss software. The software calculates the critical reactions at the support points. These reactions are displayed in the truss output report. The Scottsdale Design Engineering Manual (within the Scottsdale Knowledge Base) provides the tie down bracketry details including the number of screws. An example of H1A Hurricane Tie is shown in Figure 8 below. The recommended tiedown details are provided with the truss output report.



H1A HURRICANE TIE

The H1A Hurricane Tie is typically used to provide hold down capacity for the SCOTRUSS© Roof and Floor Truss system. They can be attached in multiple configurations for many situations.

SCOTPANEL© members can also be restrained with the H1A bracket.

Name	H1A Hurricane Tie
Supplier	Simpson
Steel Grade	G350 0.95mm BMT
Use	Truss or Panel Rafter Hold Down
Protection	G90/Z275 Galvanizing

Fixing:
Attach with recommended fasteners. Ensure the correct number of screws are used for the required capacity.

Design Capacities (Uplift kN)

Truss Properties		No. of Screws	Wall Frame - G550		
			0.55	0.75	0.95
G550	0.55	2 & 2	1.54	1.54	1.54
		4 & 4	3.08	3.08	3.08
	0.75	2 & 2	1.54	2.96	2.96
		4 & 4	3.08	5.92	5.92
	0.95	2 & 2	1.54	2.96	3.91
		4 & 4	3.08	5.92	9.37

Truss Properties		No. of Screws	Wall Frame - G350		
			0.75	0.95	1.15
G350	0.75	2 & 2	2.51	2.51	2.51
		4 & 4	5.02	5.02	5.02
	0.95	2 & 2	2.51	3.58	3.58
		4 & 4	5.02	7.16	7.16
	1.15	2 & 2	2.51	3.58	3.91
		4 & 4	5.02	7.16	9.65

FASTENERS

HEX HEAD TEK SCREW
10g - 16 x 16mm, HWH. Hex, DP 4.8mm Dia

WAFER HEAD TEK SCREW
10g - 16 x 16mm, Flat. Ph#2, DP 4.8mm Dia

Figure 8 - Example Tie Instruction

2.4 User Qualification

Users of the software must be:

- Fully trained in accordance with the Scottsdale Training Manual with a Certificate of completion.
- Fully identified and recognised by Scottsdale as a competent user with experience in construction and/or manufacturing of trusses.
- Fully informed by Scottsdale on any up-to-date enhancements/additions to the software.
- The validity of the certification will last a period of no more than 3 years.

2.5 History of Revisions/Updating

Within the design software (ScotSteel) there is a button which allows users to download and view the latest software changes document:

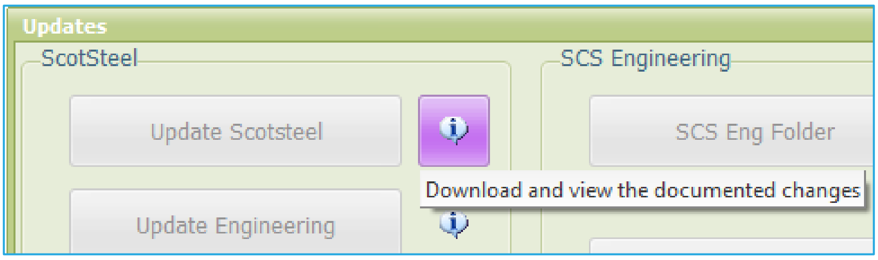


Figure 9 - Updates and Changes Documentation (ScotSteel)

The document is available to all users to view and refer to at any time.

The changes document shows the version number of the release. The software version number consists of 4 numbers: Year.Month.Major Build.Minor Build.

The last four releases of ScotSteel were:

- Mar 2022 – Version 22.3.3000.2472
- Feb 2022 – Version 22.2.3000.2364
- April 2021 - Version 21.3.2940.1739
- November 2020 - Version 20.11.2940.1606

Below is the link to the actual release notes (stored on the Scottsdale Knowledge Base for authorised users):
https://knowledge.scottsdalesteelframes.com/software-releases

3 Software Features

3.1 Referenced Documents

The software is based on information from the following NCC and other referenced documents:

3.1.1 NCC references

- AS-NZS 1170 -Part 0: 2002 General Principles (Incorporating Amendment Nos 1,2,3,4 and 5)
- AS-NZS 1170 -Part 1: 2002 Permanent Imposed and Other Actions (Incorporating amendment Nos 1 and 2-Reconfirmed 2016)
- AS-NZS 1170 -Part 2: 20011 Wind Actions (Incorporating amendment Nos 1,2,3,4 and 5)
- AS 4055: 2012 Wind load for housing (Third edition 2012)
- AS-NZS 1170 -Part 3: 2003-Snow and Ice Actions (Incorporating amendment Nos 1 and 2)
- AS/NZS 4600:2018 Cold-formed steel structures
- Building Code of Australia 2019 Volume 1 and 2: Amendment 1
- NASH Standard Residential and Low-rise steel framing – Part1 – Design Criteria (2005) – Incorporating Amendment C: September 2011
- NASH Standard Residential and Low-rise steel framing – Part2 – Design Solutions (2014) – Incorporating Amendment A:2015

3.1.2 Other references

- NASH Handbook - Design of Residential and Low-rise Steel Framing 2009

3.2 Inputs

3.2.1 Loads

Loads can be entered in window as shown in Figure 10 below.

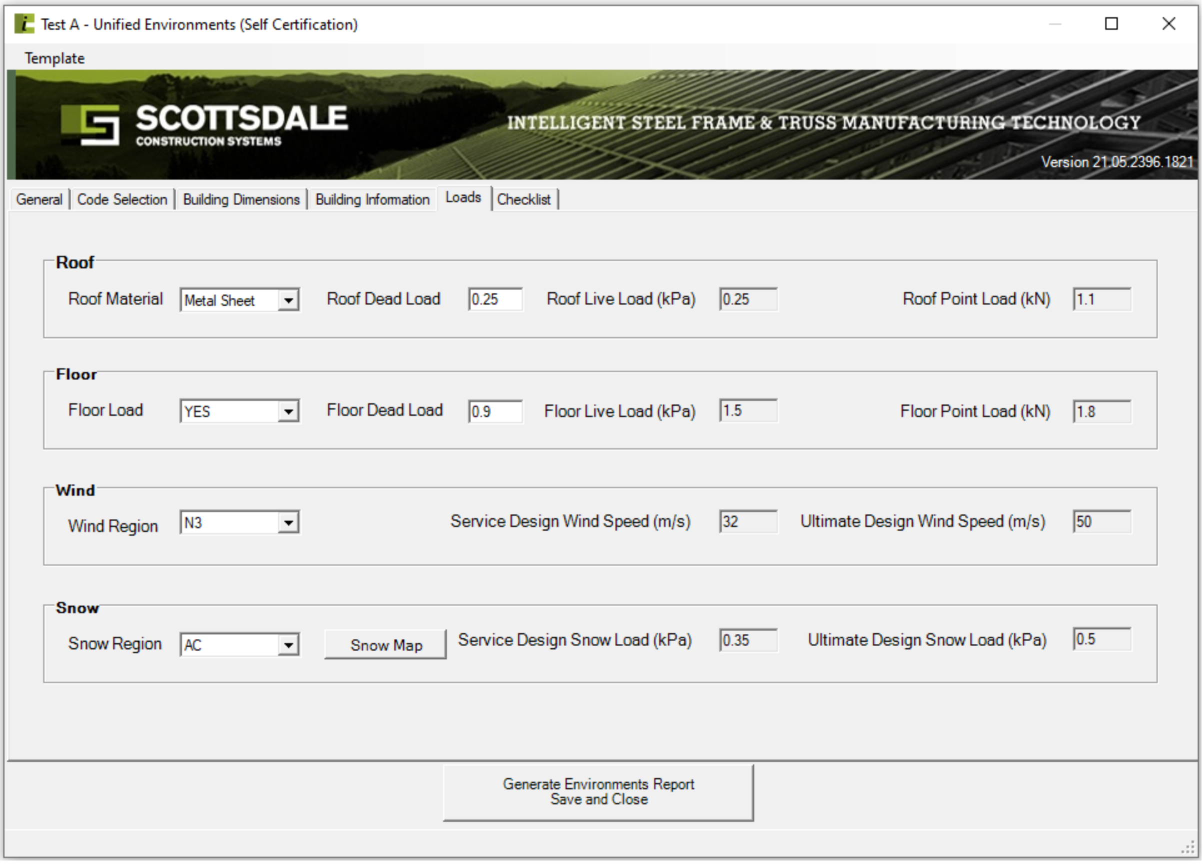


Figure 10 - Load input window

3.2.1.1 Dead load

- **Roof dead load:** based on the roof material (sheet roof - 0.25 kPa, Tile roof – 0.75 kPa)
- **Ceiling dead load:** Hard Coded as 0.2 kPa
- **Floor dead load:** Hard Coded as 0.9 kPa

3.2.1.2 Live Load

User can select the building usage from the drop-down list as shown in Figure 11 below. The live load will be automatically determined from the software based on the building usage.

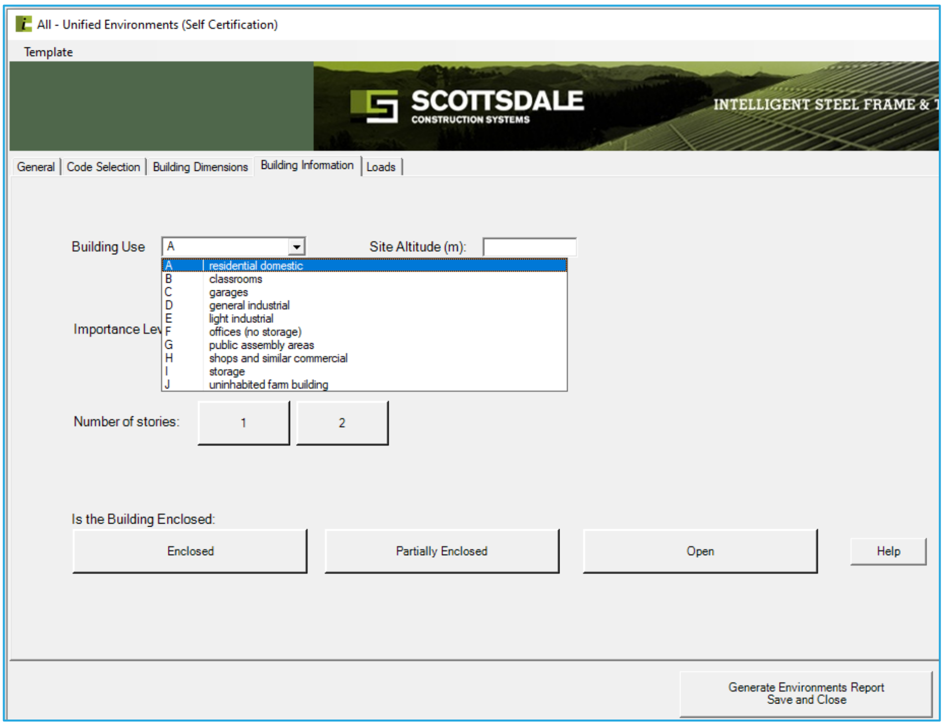


Figure 11 - Building usage selection

- **Roof Live load:** 0.25 kPa
- **Floor Live load:** Will be automatically changed based on the building usage (refer Table 1 below)
- **Roof Point load:** 1.1 kN for residential and 1.4 kN for commercial
- **Floor Point load:** Will be automatically changed based on the building usage (refer Table 1 below)

Building Use		Floor Live (kPa)	Floor Point (kN)
A	Residential	1.5	1.8
B	Classroom	3	2.7
C	Garages	2.5	13
D	General Industrial	5	4.5
E	Light Industrial	3	3.5
F	Offices (no Storage)	3	2.7
G	Public assembly area	4	2.7
H	Shops and similar	4	3.6
I	Storage	7.5	4.5
J	Farm Building	5	4.5

Table 1 - Live Loads Vs. building usage

- **Ceiling Point load:** 1.1 kN when the head height is greater than 1.2 m and 0.9 kN when the clearance is less than 1.2 m

3.2.1.3 Wind Load

User can select the wind class from the drop-down list (N1 to N6 or C1 to C6). Once user select the wind region, software can determine the design wind velocity based on the hard-coded tables (Figure 12 below) in accordance with AS 4055 -2012 and as shown below.

TABLE 2.1A

DESIGN GUST WIND SPEED (V_h) FOR NON-CYCLONIC REGIONS A AND B

Wind class	Design gust wind speed (V_h) at height (h) m/s	
	Serviceability limit state ($V_{h,s}$)	Ultimate limit state ($V_{h,u}$)
N1	26	34
N2	26	40
N3	32	50
N4	39	61
N5	47	74
N6	55	86

TABLE 2.1B

DESIGN GUST WIND SPEED (V_h) FOR CYCLONIC REGIONS C AND D

Wind class	Design gust wind speed (V_h) at height (h) m/s	
	Serviceability limit state ($V_{h,s}$)	Ultimate limit state ($V_{h,u}$)
C1	32	50
C2	39	61
C3	47	74
C4	55	86

Figure 12 - Design gust wind speed

The wind pressure is calculated from the determined design wind velocity. The software detects the wind coefficient based on the average building height, building width, truss length, the roof pitch, and the truss shape.

3.2.1.4 Snow Load

User can select the snow region from the drop-down list as “N0, AN, AC, AS and AT” and enter the site elevation under the building information. Based on the snow region and the elevation, software can calculate the ground snow load as shown in Figure 13 below.

SNOW CALCULATION	
region	AN
altitude [m]	1000
ground snow load, [kPa]	0.60
Exposure Reduction Coefficient	1.00
ultimate snow load, [kPa]	0.60
service snow load, [kPa]	0.30

Figure 13 - Snow load calculation

The software can calculate all the possible scenarios of applied snow load on truss by considering the roof pitch/truss shape. There are four different snow load cases as shown in Figure 14 below.

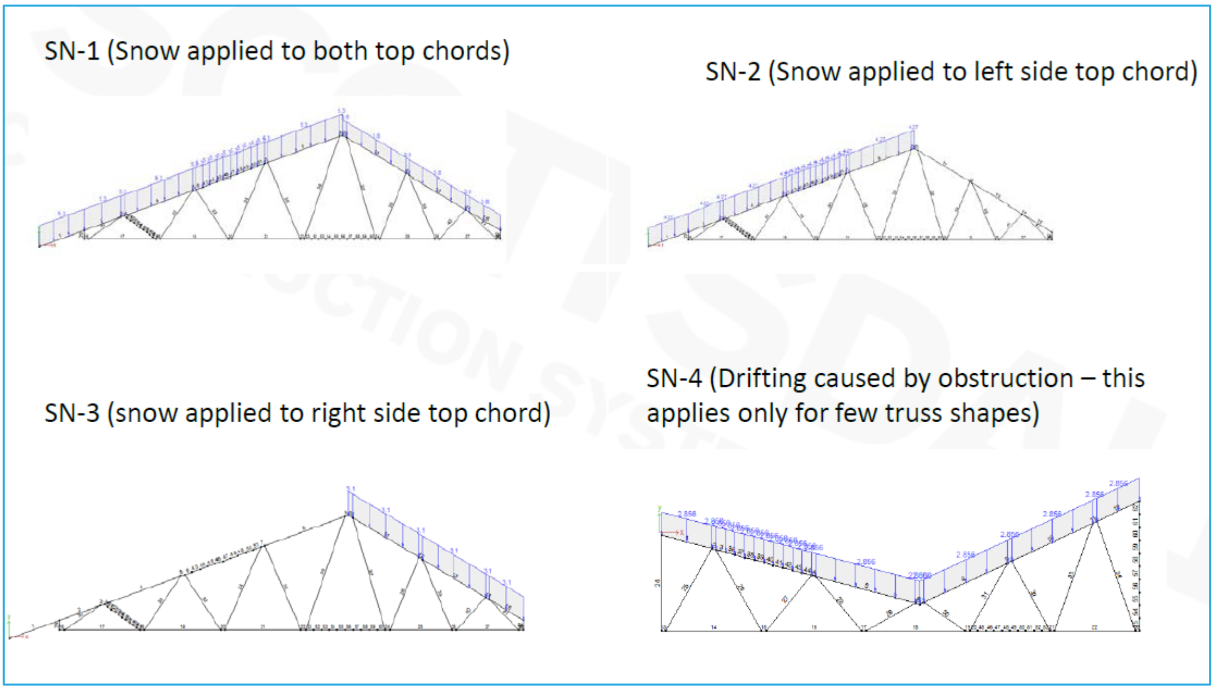


Figure 14 - Snow load display

3.2.2 Load combinations

3.2.2.1 Serviceability Design

Serviceability Design is conducted to check the deflection of the truss nodes. Following deflection limits are considered.

For roof

- Dead = Span/300 or 12 mm whichever is the minimum
- Live = Span/250
- Wind = Span/150

For floor

- Dead = Span/300 or 12 mm whichever is the minimum
- Live = Span/250

The following loads are considered in the software.

1. Dead Load
    a. Roof - Roof dead load + ceiling dead load
    b. Floor - Floor dead load + ceiling under floor

2. Live Load
    a. Roof - Roof live load + ceiling live load
    b. Floor - Floor live load + ceiling under floor live load (ceiling live load is considered as zero)

3. Snow Load - Applied only on roof trusses

Snow load is calculated as per the section 3.2.1.4 given above and applied as 4 separate cases SN-1 to SN-4.

4. Wind Load - Applied only on roof trusses
   Wind loads are calculated by determining both external and internal coefficients. Both upward and downward loads are calculated. External wind loads are calculated by considering 4 different directions as shown in Figure 15 below. WE and EW load cases represent the wind loads along the truss in both directions. NS load case represent the wind load across the truss by considering the truss as an edge truss. So that NS wind load gives the highest uplift load on truss. SN load case is also for the cross wind and truss will be in the far end of the building. This load case gives the maximum downward load. Internal load is calculated by considering non-cyclonic and cyclonic conditions.

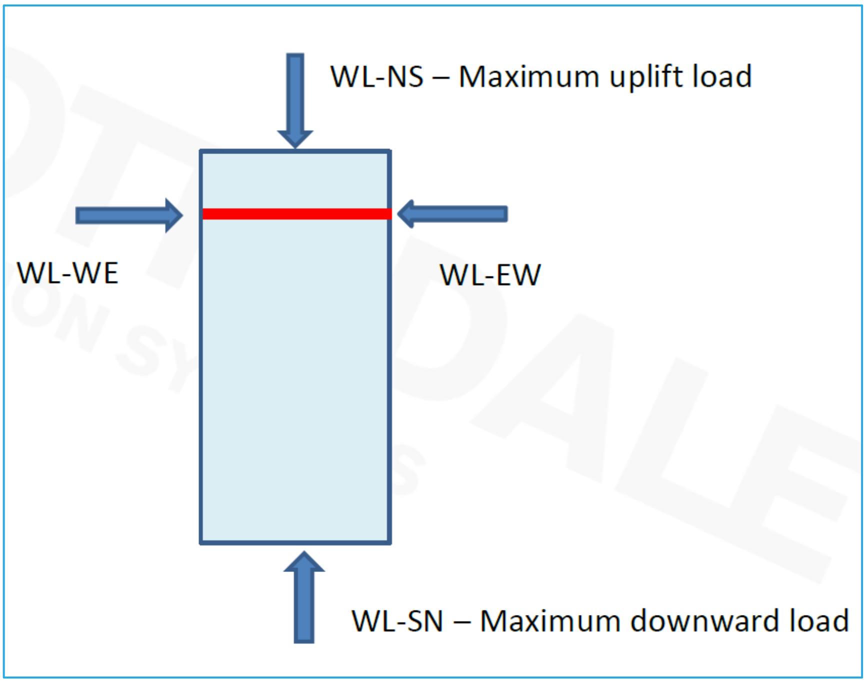


Figure 15 - Wind direction

External and internal wind loads are then combined to get the service wind load cases as shown in Table 2 below. The software applies all the specified wind combinations and determines the critical deflection values.

The below table shows the wind load external and internal combinations by considering all 4 directions specified in Figure 15 above. It combines External uplift+ Internal uplift, External uplift + internal down wind, External downwind+ internal uplift, External downwind + internal downwind for all the directions

WL-WE1	WL-WE2	WL-EW1	WL-EW2	WL-NS1	WL-SN1	WL-IP1	WL-IP2	WL-IP3	WL-IP4
1	0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	1	0	0
0	1	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	1	0	0
0	0	1	0	0	0	1	0	0	0
0	0	1	0	0	0	0	1	0	0
0	0	0	1	0	0	1	0	0	0
0	0	0	1	0	0	0	1	0	0
0	0	0	0	1	0	0	0	1	0

0	0	0	0	**1**	0	0	0	0	**1**
0	0	0	0	0	**1**	0	0	**1**	0
0	0	0	0	0	**1**	0	0	0	**1**

Table 2 - SLS load combinations

3.2.2.2 Ultimate Design

- Roof Trusses
  - 1.35 Dead = 1.35 X (Roof dead load + ceiling dead load)
  - 1.2 Dead + 1.5 Live = 1.2 X (Roof dead load + ceiling dead load) + 1.5 X (Roof live load + ceiling live load)
  - 1.2 Dead + 1.5 Point Load = 1.2 X (Roof dead load + ceiling dead load) + 1.5 X (Roof point load)
  - 1.2 Dead + Snow = 1.2 X (Roof dead load + ceiling dead load) + (Snow load on roof)
  - 1.2 Dead + Wind = 1.2 X (Roof dead load + ceiling dead load) + (External wind load + internal wind load)
  - Wind - 0.9 Dead = (External wind load + internal wind load) - 0.9 X (Roof dead load + ceiling dead load)
- Floor Trusses
  - 1.35 Dead = 1.35 X (Floor dead load + ceiling under floor dead load)
  - 1.2 Dead + 1.5 Live = 1.2 X (Floor dead load + ceiling under floor dead load) + 1.5 X (Floor live load)
  - 1.2 Dead + 1.5 Point Load = 1.2 X (Floor dead load + ceiling under floor dead load) + 1.5 X (Floor point load)

Note: More details about the load combinations are available in the documents “AU_NZ_SLSCombos” and “AU_NZ_ULSCombos” which, are attached below.

AU_NZ_SLSCombos.CMF   AU_NZ_ULSCombos.CMF

3.3 Analysis and Design

3.3.1 Load application

Uniformly distributed loads are applied to the top and bottom chord as required.

Concentrated load applies on the centre of every member one at a time. This applies to both top and the bottom chord of the truss between nodal points. Concentrated load is combined with dead loads (1.2 Dead Load + 1.5 Point Load). The software determines the induced forces with this load. The below Figures 16 and 17 below show the typical position of concentrated load on main member and the joint, respectively.

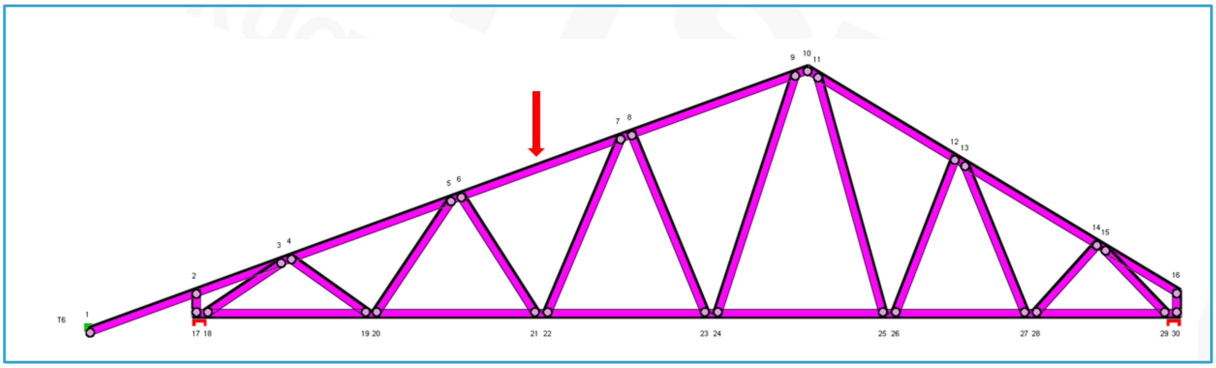


Figure 16 - Concentrated load on the main Top Chord panel member. Applied at the centre of the member

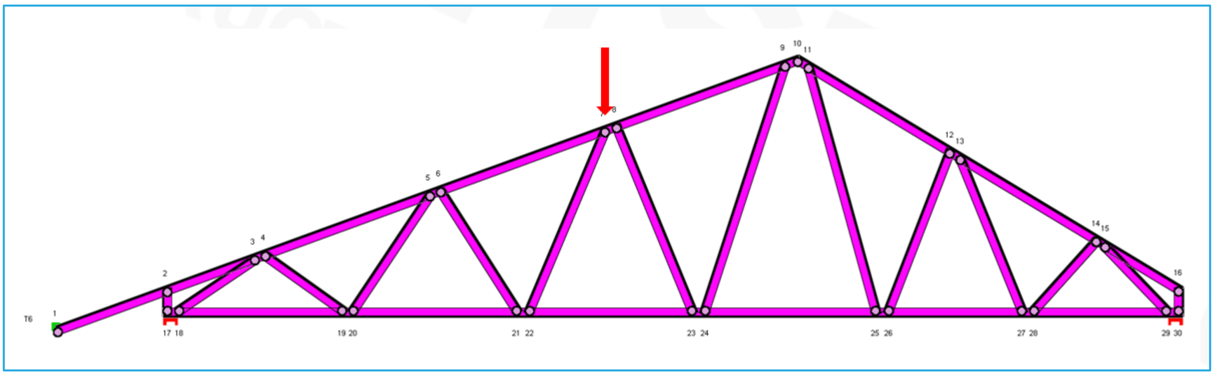


Figure 17 - Concentrated load on Top Chord joint. Applied at the centre of the joint

3.3.2 Member section details

Members of the truss will be selected from the Tables 3 and 4 below. It is to be noted that the software is limited to the below-mentioned section types only.

Designation	Depth (mm)	Web Width (mm)	Flange width (mm)	Lip depth (mm)	Radius	Feed width (mm)	Thickness (BMT) (mm)	Grade
6050 /0.75/G350	51	41	14	7	2	173	0.75	G350
6050 /0.95/G350							0.95	G350
6050 /1.15/G350							1.15	G350
6050 /0.55/G550	51	41	14	7	2	173	0.55	G550
6050 /0.75/G550							0.75	G550
6050 /0.95/G550							0.95	G550
6075 /0.75/G550	76.4	42.2	14	7	2	224	0.75	G550
6075 /0.95/G550							0.95	G550

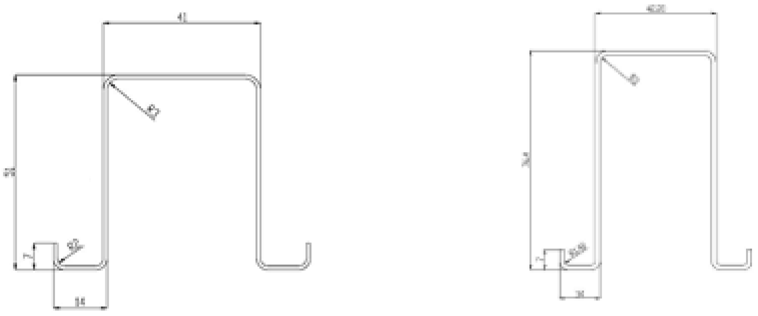
6075 /1.15/G350								1.15	G350
6075 /0.95/G350	76.4	42.2	14	7	2	224		0.95	G350
6075 /1.15/G350								1.15	G350

Table 3 - Top-hat sections

Designation	Stud depth (mm)	Flange width (mm)	Lip depth (mm)	Web stiffener distance (mm)	Corner web stiffener offset (mm)	Corner radius	Feed width (mm)	Thickness (BMT)) (mm)	Grade
C63_37/0.55/G550	63	37	7.5	25	1	2	143	0.55	G550
C63_37/0.75/G550								0.75	G550
C63_37/0.95/G550								0.95	G550
C63_37/0.75/G350								0.75	G350
C70_37/0.55/G550	70	37	7.5	25	1	2	153	0.55	G550
C70_37/0.75/G550								0.75	G550
C70_37/0.95/G550								0.95	G550
C76_37/0.55/G550	76	37	7.5	25	1	2	156	0.55	G550
C76_37/0.75/G550								0.75	G550
C76_37/0.95/G550								0.95	G550
C90_37/0.75/G350	90	37	7.5	25	1	2	173	0.75	G350
C90_37/0.95/G350								0.95	G350
C90_37/1.15/G350								1.15	G350
C90_37/0.55/G550	90	37	7.5	25	1	2	173	0.55	G550
C90_37/0.75/G550								0.75	G550
C90_37/0.95/G550								0.95	G550
C90_47/0.75/G350	90	47	9.5	25	2	2	190	0.75	G350
C90_47/0.95/G350								0.95	G350
C90_47/1.15/G350								1.15	G350
C90_47/0.75/G550	90	47	9.5	25	2	2	190	0.75	G550
C90_47/0.95/G550								0.95	G550
C140_48/0.75/G350	140	48	9	46	1	2	244	0.75	G550
C140_48/0.95/G350								0.95	G550
C140_48/1.15/G350								1.15	G350
C140_48/0.75/G550	140	48	9	46	1	2	244	0.75	G550
C140_48/0.95/G550								0.95	G550

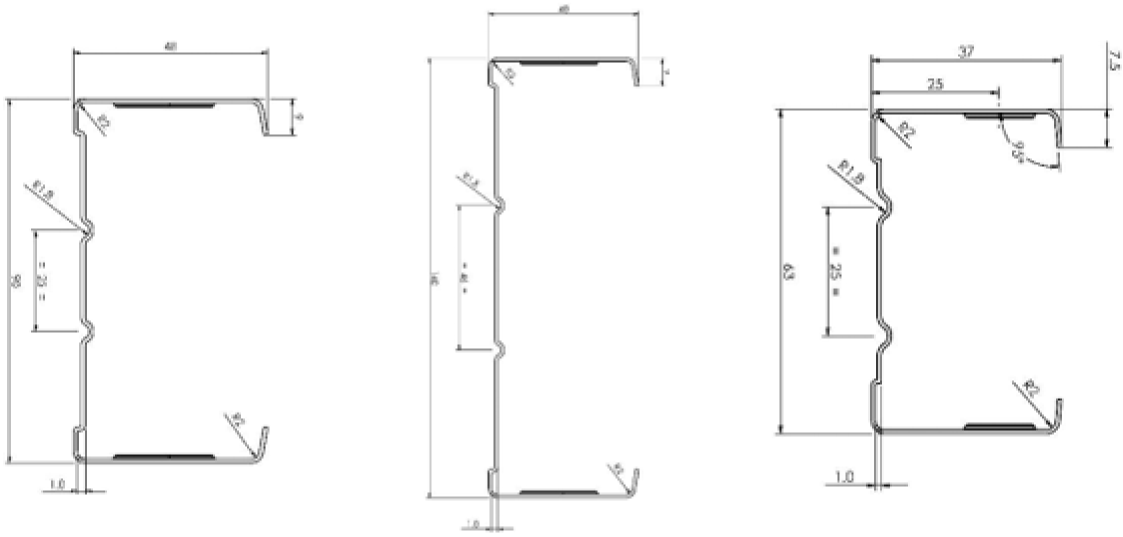
Table 4 - Lipped channel sections (C-section)

Geometry of the top-hat sections are shown in Figure 18 while Figure 19 shows the details of C-sections.

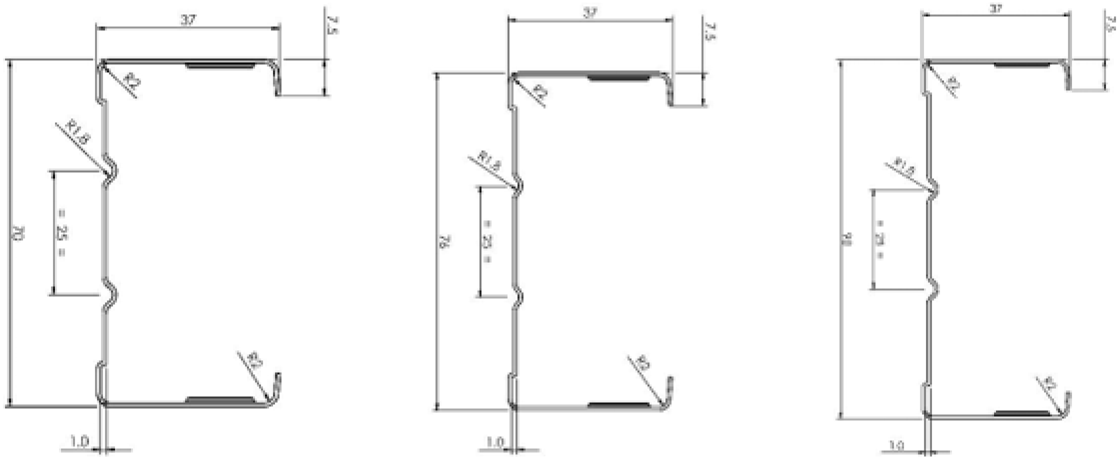


6050 6075

Figure 18 - Top-hat section geometries used in ScotSteel software



C90_47 C140_48 C63_37



C70_37 C76_37 C90_37

Figure 19 - Lipped channel section geometries used in ScotSteel software

3.3.3 Structural analysis

Structural analysis of the truss is carried out using finite element analysis technique with beam elements. The beam element considered for the analysis consists of an element connected by two nodes. Each node in the element has three degrees of freedom which includes translation along two axes and rotation about one axis. The cross-section considered for analysis is constant throughout the analysis. The Analyser uses a standard Cholesky matrix decomposition as shown in Eq.(1) so that the entire truss is reduced to a solvable series of simultaneous equations that do not require the loads to be present. These loads can then be applied separately without repeating the decomposition of the structural assembly. This method is rapid, stable, and almost always converges. The trusses can be determinate or statically indeterminate. The Analyser is independent of the number of load cases and can be specifically tailored to suit various code requirements.

$$A = LL^T \qquad (1)$$

Where:

- L = given matric
- L^T = transpose of the matrix

Firstly, the software selects a truss based on an inbuilt prioritising algorithm wherein trusses of a similar shape carrying same loads are grouped and analysed. Then the design of the corresponding trusses takes place based on the selected code of practice. The order of analysis also identifies the prerequisite trusses that needs to be analysed in case of multiple auxiliary trusses connected to a main truss (e.g. Analysis of a Girder truss).

3.3.4 Design

If the building dimensions are within the limits of the self-certification requirements, the design will pass self-certification and the user can proceed with the engineering. Otherwise, it will give a warning message and will not allow the user to proceed with the self-certification.

In the design software, when you engineer the trusses and they all pass, the summary window will pop-up and the trusses become green as shown in Figure 20 below, to show the user they have passed:

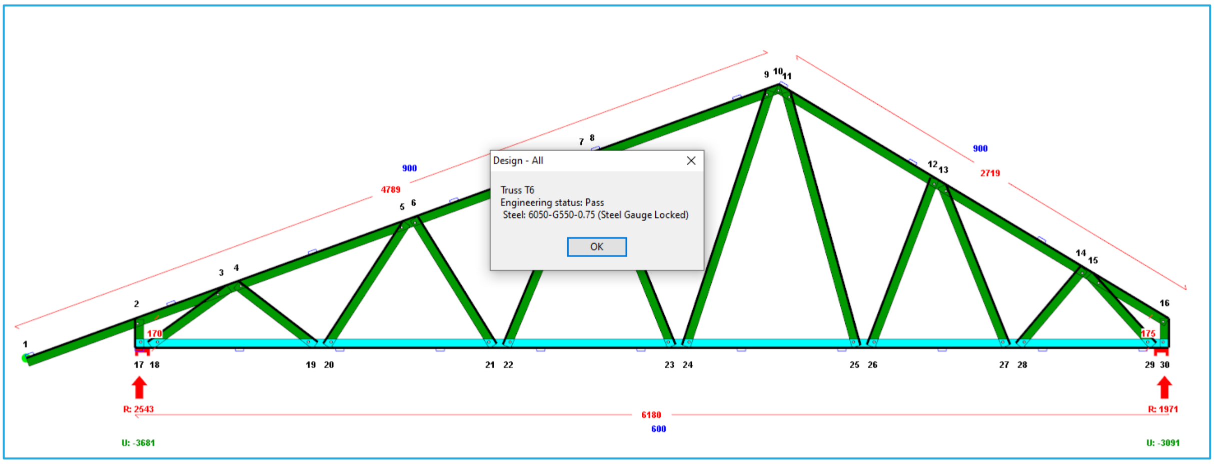


Figure 20 - Truss with passed status

If the design is not satisfactory, a pop-up window will appear advising of the failure and the truss will turn red as shown in Figure 21 below. The user can then add more web members, select a thicker section, or add more trusses by reducing the spacing until the truss passes.

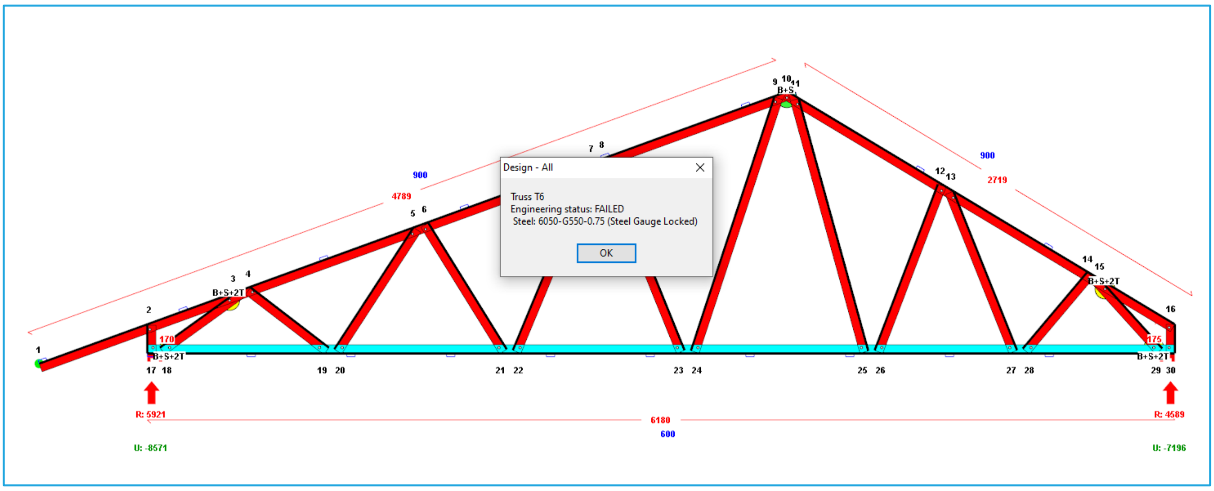


Figure 21 - Truss with failed status

3.3.5 Options for structural detail input

The members/sections are selected for roof trusses or floor trusses from the dropdown list as shown in Figure 22 below. This list is established in accordance with AS/NZS 4600 by computation the capacities based on effective width method. Software checks all the capacities like, bending, shear, axial and combinations of them.

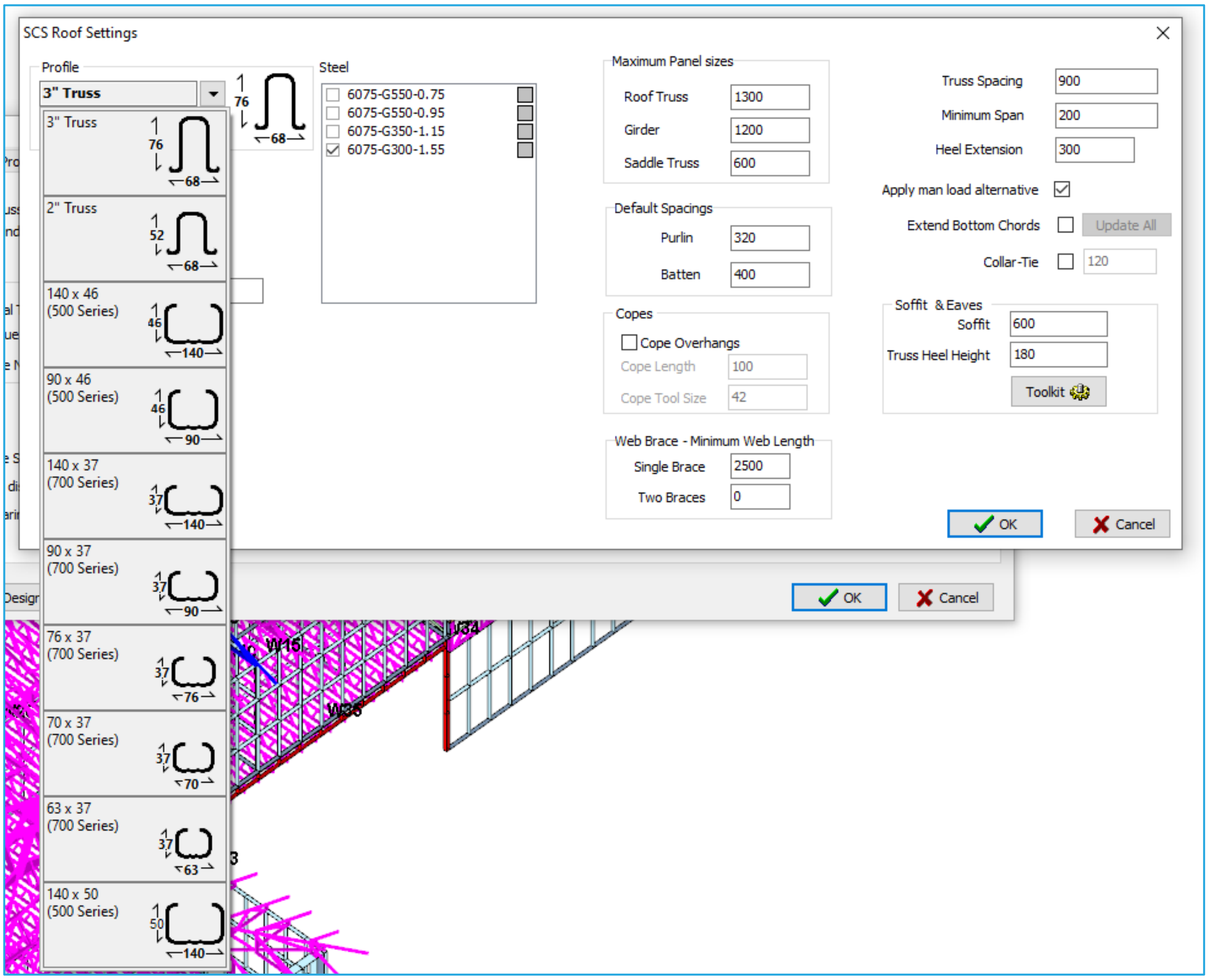


Figure 22 - Scottsdale sections from the project properties

The selected sections appear under the truss profile as shown in Figure 23 below:

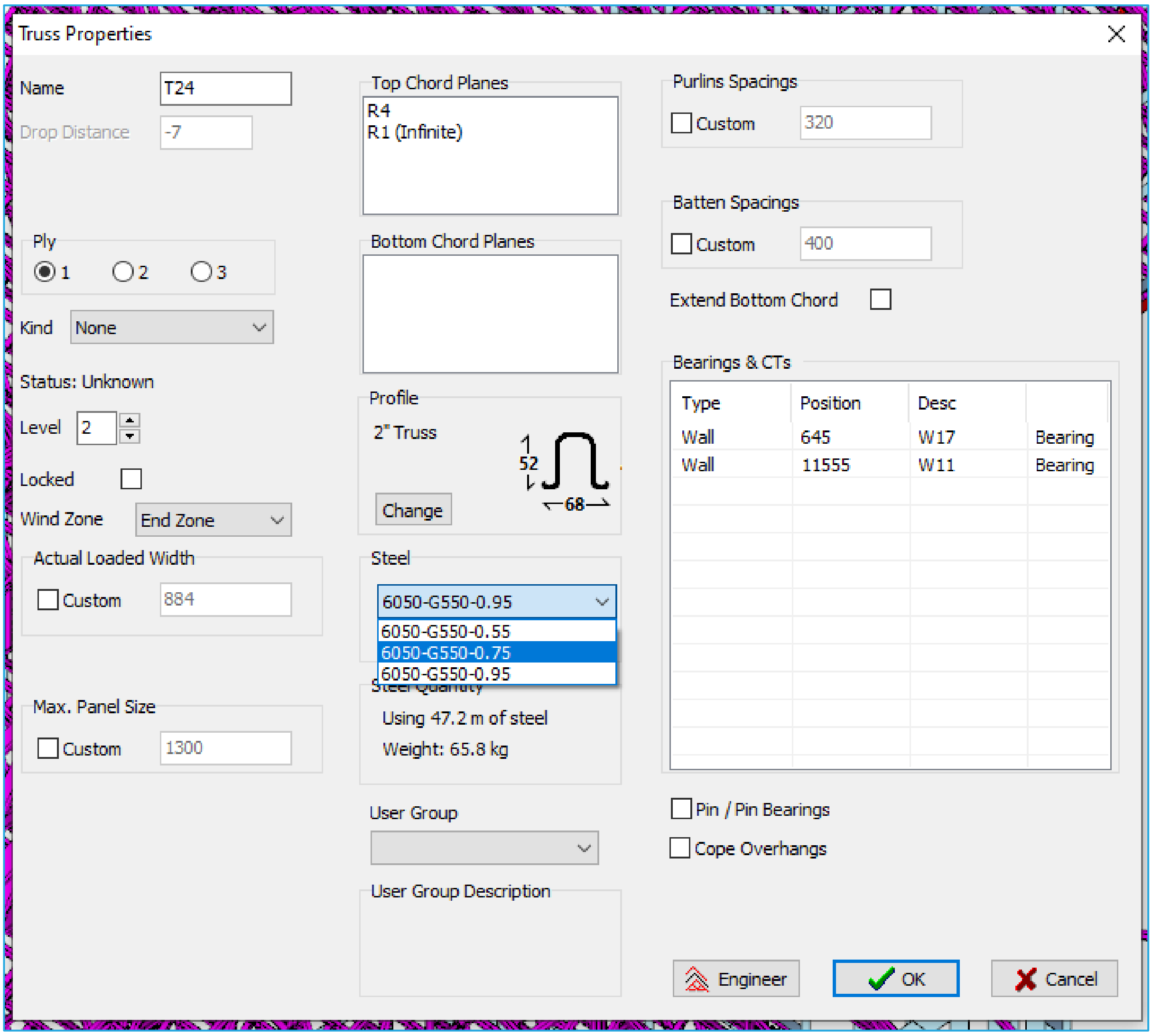


Figure 23 - Scottsdale truss properties

The software first analyses and conduct the design check from the thinnest/weakest section. It is then stepped up to the next stronger section if the first one is failed. The whole truss is then analysed and checked for the second section.

E.g., For the truss, it will analyse and check for 0.55 mm thick steel first. If it fails, the whole truss is automatically changed to 0.75 mm thick steel and then analysed and design for 0.75 mm steel. If it passes, the software displays the results, otherwise will move to the next thickness.

If user wants to select only one section, they can select the section and locked it as shown in Figure 24. This will apply only to the selected truss/trusses.

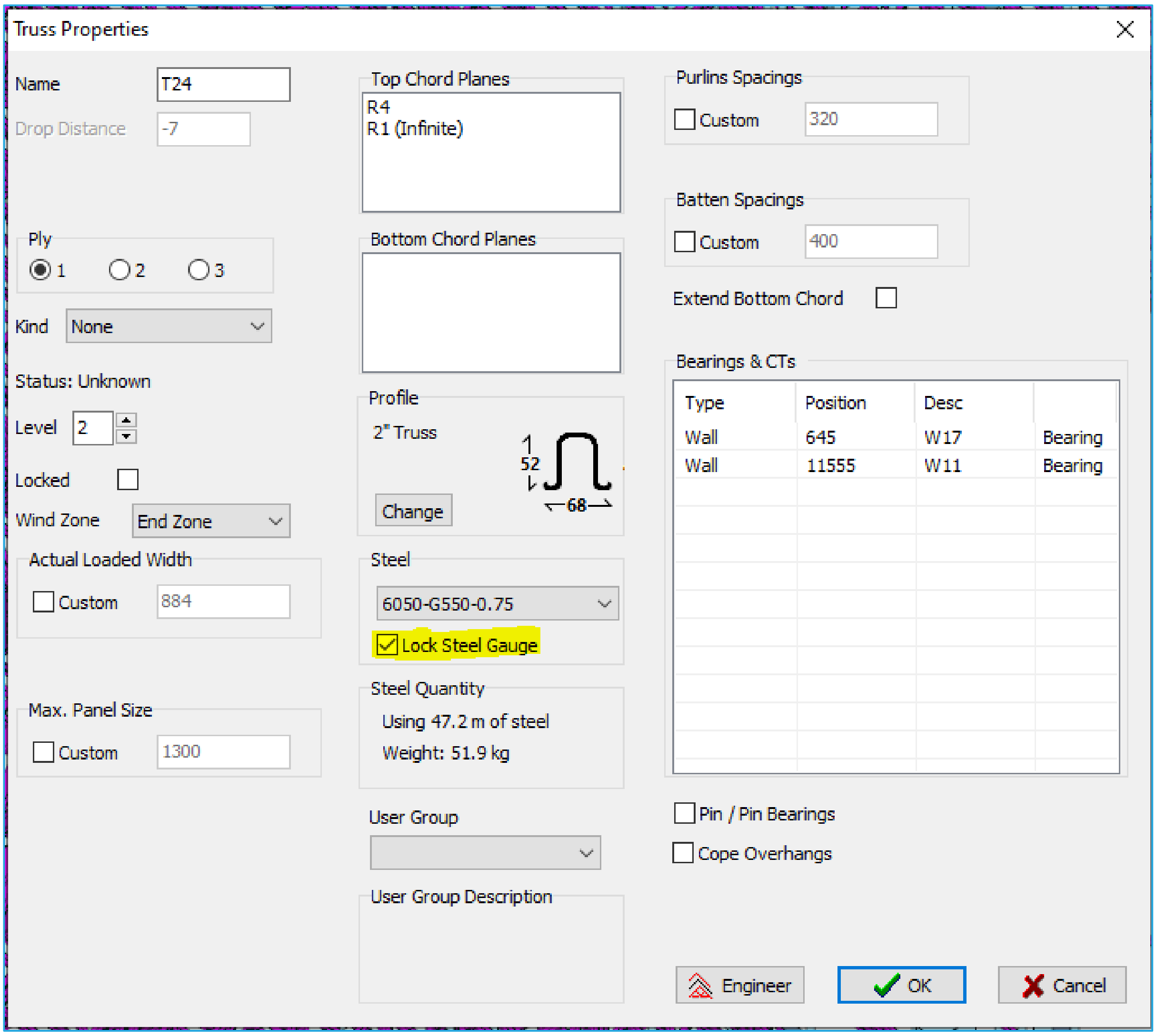


Figure 24 - Truss properties with locked section

Once it completes the analyses and design, software will show a brief summary (pass or fail) and change the colour based on the truss status as shown in Figures 25 and 26.

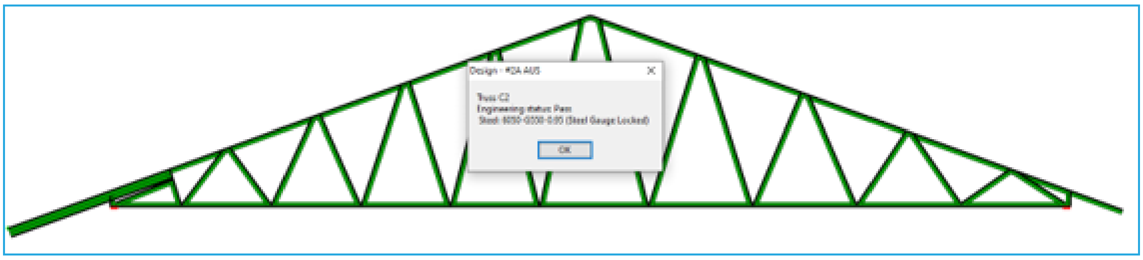


Figure 25 - Green – Pass

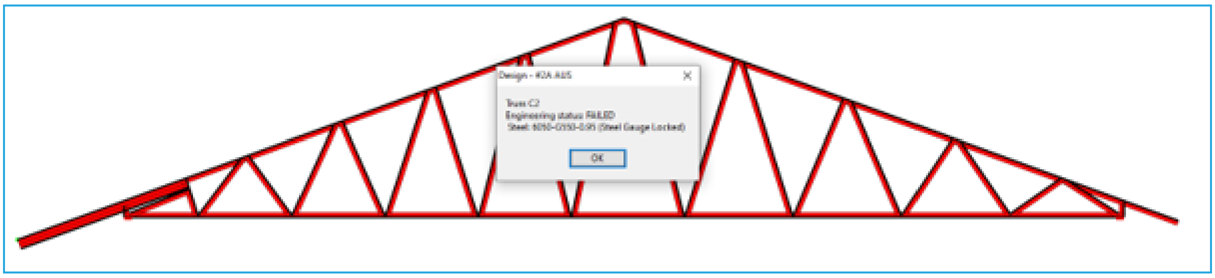


Figure 26 - Red - Fail

The user can see the colour coding of the truss to see where the failure is as given in Figure 27 below.

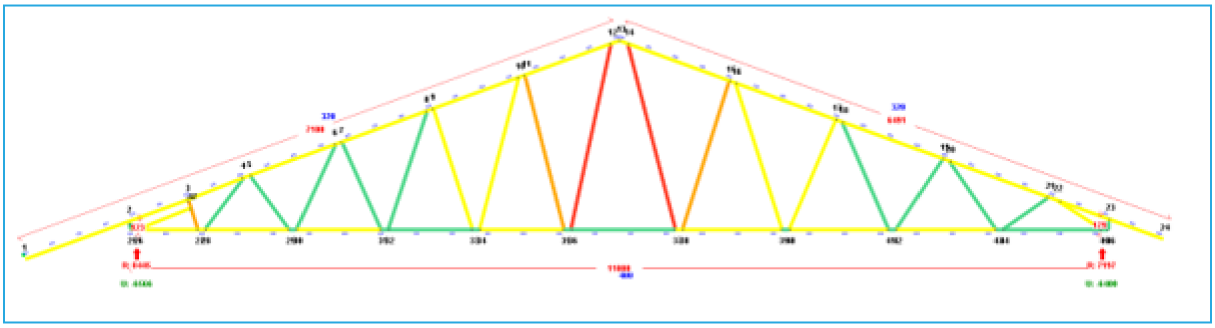


Figure 27 – Truss Colour Coding

The colour coding is based on the critical ratio of the member as shown in Figure 28 below.

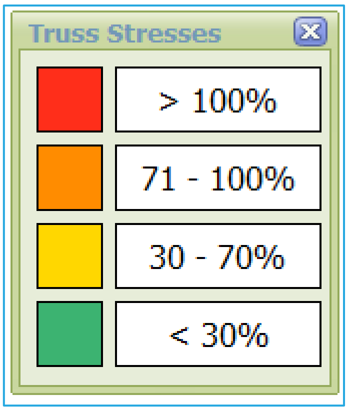


Figure 28 - Truss stress ratios

Green, yellow, and orange – the member is stronger than the applied forces.

- Green – the induced forces are less than 30% of the capacity of the member.
- Yellow – the induced forces are higher than 30% and less than 70% of the capacity of the member.
- Orange – the induced forces are higher than 70% and less than 100% of the capacity of the member.
- Red – the member is weak and needs to be redesigned.

The software will then show the truss summary, with member-by-member critical ratio. It shows whether the trusses pass or fail. It shows the maximum ratio for top chord, bottom chord, and web member. It also displays the maximum deflection with the allowable limits as shown in Figure 29 below.

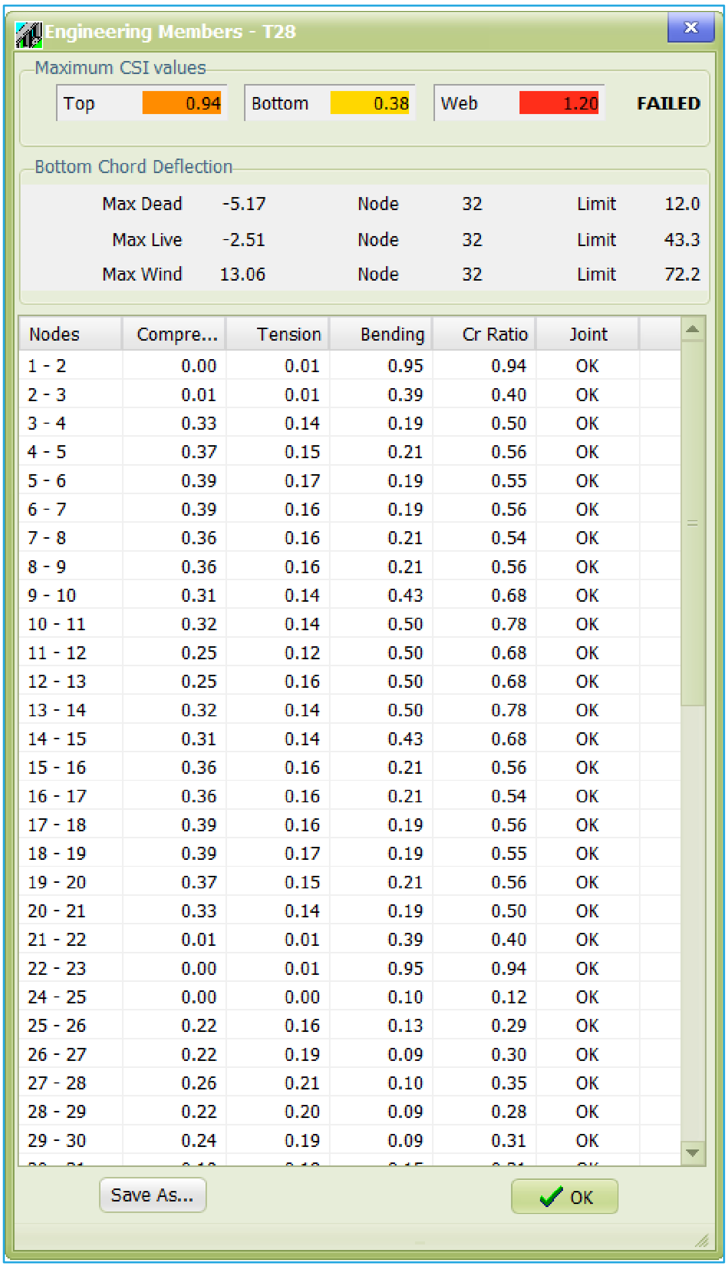


Figure 29 - Truss status with CR ratios

Figure 30 shows the colour coding of the members. The user can identify which members are failed, as shown in red, and can then modify the truss to make it pass. Once modified, the truss become un-engineered, and user will need to re-engineer it.

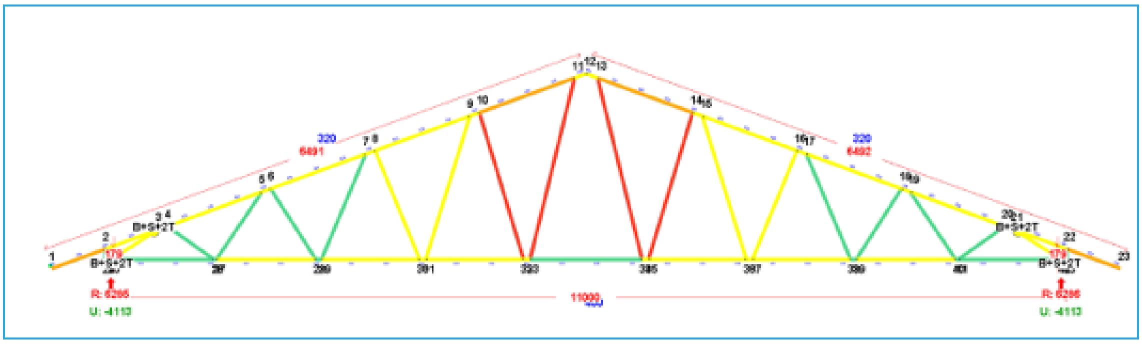


Figure 30 - Colour coding of a failure truss

Web members are failing in this truss. So user can change the thickness, change the webbing configuration, or add web brace as shown in Figure 31 and re-engineer it. Truss now passes.

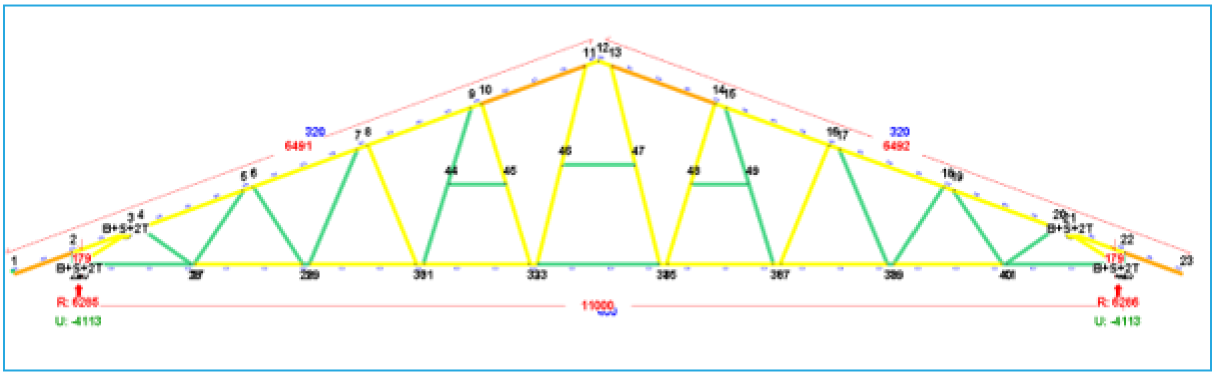


Figure 31 - Colour coding with a truss pass

Connections – The connection capacities are calculated based on the test results. Two different connection types are used as shown below for selected section type.

- C-section trusses
  - 2 Rivets
  - 4 Rivets
  - 2 Rivets + 2 TEKs
  - 2 Rivets + 4 TEKs
- Top hat trusses
  - Bolt
  - Bolt + Spacer
  - Bolt + Spacer + 2 TEKs
  - Bolt + Spacer + 4 TEKs
- Rivet is 4.8 mm diameter standard rivet
- TEK is 4.8 mm TEK screw
- Bolt is 9.5 mm diameter bolt

Connections are checked and designed for the critical induced axial force at the connection. The checking starts with the strongest connection and progresses to the weakest one until failure has occurred. Once it has failed, it is automatically moved to the previous stronger connection to display the results. As an example, for top hat trusses, it will always start with Bolt + Spacer + 4 TEKs. If it passes only, it moves to Bolt + Spacer + 2TEKs and then to the Bolt + Spacer. If the Bolt + Spacer fails, the design connection will be Bolt + Spacer + 2 TEKs.

3.4 Outputs

Description of the information that will be provided for regulatory approval:

The below documents shall be submitted for approval

1. Architectural plans including dimensions (By customer)
2. Environmental output (generates from SCS software)
3. Project layouts (generates by user from SCS software)
4. Truss PDF output (generates by SCS software)
5. Tie down documentation (generated from SCS software)
6. Scottsdale Certification (generated from SCS software)

The below section describes about the Environmental output generated by software.

SCOTTSDALE CONSTRUCTION SYSTEMS	Project Name		Project No.	
	Address			
	Company			
	Detailer		Certificate No.	
	Reference	Example - Unified Environments (Self Certification)		

Disclaimer

[illegible]

SELF CERTIFIED FOR TRUSSES ONLY

BUILDING DATA	
code	AU
wind code	AS/NZS 1170.2
building use (code)	A
importance level	2
annual prob. of excedence - wind, (1/x)	500
annual prob. of excedence - snow, (1/x)	150
annual prob. of excedence - EQ, (1/x)	500
building length, (m)	20.00
building width, (m)	16.00
roof type	Hip
max. roof pitch, (deg)	20.0
min roof pitch, (deg)	10.0
roof height, (m)	4.50
modular build	False
number of stories	2
is building enclosed	Enclosed
roof material	Metal Sheet

SITE DATA	
elevatation above sea level, (m)	700
wind region	N3

GRAVITY LOADS			
	dead load, (kPa)	live load, (kPa)	point load, (kN)
roof	0.25	0.25	1.1
ceiling under roof	0.2	0	1.1
floor	0.9	1.5	1.8
ceiling under floor	0.2	0	1.1

WIND CALCULATION	
service design wind speed (m/s)	32.00
ultimate design wind speed (m/s)	50.00
service dynamic pressure (kPa)	0.61
ultimate dynamic pressure (kPa)	1.50

SNOW CALCULATION	
region	AC
altitude (m)	700
ground snow load, (kPa)	0.80
Exposure Reduction Coefficient	1.00
service snow load, (kPa)	0.56
ultimate snow load, (kPa)	0.80

LOAD SUMMARY	
wind uplift service (roof), (kPa)	-0.44
wind uplift service (canopy), (kPa)	-1.05
wind uplift ultimate (roof), (kPa)	-1.08
wind uplift ultimate (canopy), (kPa)	-2.57
wind pressure service (roof), (kPa)	0.28
wind pressure service (canopy), (kPa)	0.59
wind pressure ultimate (roof), (kPa)	0.68
wind pressure ultimate (canopy), (kPa)	1.44
roof dead load, (kPa)	0.25
roof imposed load, (kPa)	0.25
roof point load, (kN)	1.10
service snow load, (kPa)	0.56
ultimate snow load, (kPa)	0.80
roof ceiling dead load, (kPa)	0.20
roof ceiling live load, (kPa)	0.00
roof ceiling point load, (kN)	1.10
floor dead load, (kPa)	0.90
floor live load, (kPa)	1.50
floor point load, (kN)	1.80
floor ceiling dead load, (kPa)	0.20
floor ceiling live load, (kPa)	0.00
floor ceiling point load, (kPa)	1.10
wind face load service (walls), (kPa)	0.55
wind face load ultimate (walls), (kPa)	1.36
wall dead load (hardcoded), (kPa)	n/a
wind internal wall face load service, (kPa)	-0.18
wind internal wall face load ultimate, (kPa)	-0.45

SOFTWARE CHECKLIST	
Software version number	21.8.1.1833
Have input sources been checked?	Yes
Do the inputs to the software match the design documentation?	Yes
Have critical components been checked?	Yes
Has documentation of any additional checks deemed to be warranted been included?	Yes
List any major assumptions and provide comments on them (e.g. internal walls as supports, special hold down requirements, top chord restraints, overhang support, special loads, etc	-

Figure 32 - Engineering Environmental output

The software generates two main outputs. The first one, called environments details, displays the project details and whether it is for self-certification or not. It further describes the building information, site details and the applied loads. The below figures (Figures 33 to 38) show screenshots of the Environment output.

SCOTTSDALE CONSTRUCTION SYSTEMS Leaders in Light Gauge Steel Frame and Truss Technology Version 21.06.2396.1818	Project Name	Main sample	Project No.	SCS
	Address	LoganHolme		
	Company	SCS	Detailer	Ashley
	Reference	#2A AUS - Unified Environments (Self Certification)		

SELF CERTIFIED FOR TRUSSES ONLY

Figure 33 - The project details

BUILDING DATA	
code	AU
wind code	AS/NZS 1170.2
building use (code)	A
importance level	2
annual prob. of excedence - wind, (1/x)	500
annual prob. of excedence - snow, (1/x)	150
annual prob. of excedence - EQ, (1/x)	500
building length, (m)	3.00
building width, (m)	15.00
roof type	Hip
max. roof pitch, (deg)	20.0
min roof pitch, (deg)	10.0
roof height, (m)	6.00
modular build	False
number of stories	2
is building enclosed	Enclosed

Figure 34 - Building information

SITE DATA	
elevatation above sea level, (m)	600
wind region	N3

Figure 35 - Site details

Corresponding loads:

GRAVITY LOADS			
	dead load, (kPa)	live load, (kPa)	point load, (kN)
roof	0.25	0.25	1.1
ceiling under roof	0.2	0	1.1
floor	0.9	1.5	1.8
ceiling under floor	0.2	0	1.1

Figure 36 - Gravity Loads

WIND CALCULATION	
service site wind speed (m/s)	32.00
ultimate site wind speed (m/s)	50.00
service dynamic pressure (kPa)	0.61
ultimate dynamic pressure (kPa)	1.50

Figure 37 - Wind loads

SNOW CALCULATION	
region	AS
altitude (m)	600
ground snow load, (kPa)	0.72
Exposure Reduction Coefficient	1.00
ultimate snow load, (kPa)	0.72
service snow load, (kPa)	0.50

Figure 38 - Snow loads

The full report is attached below:

Example - Unified
Environments (Self C

The below section describes the truss PDF output generated by the software

Truss passes the engineering

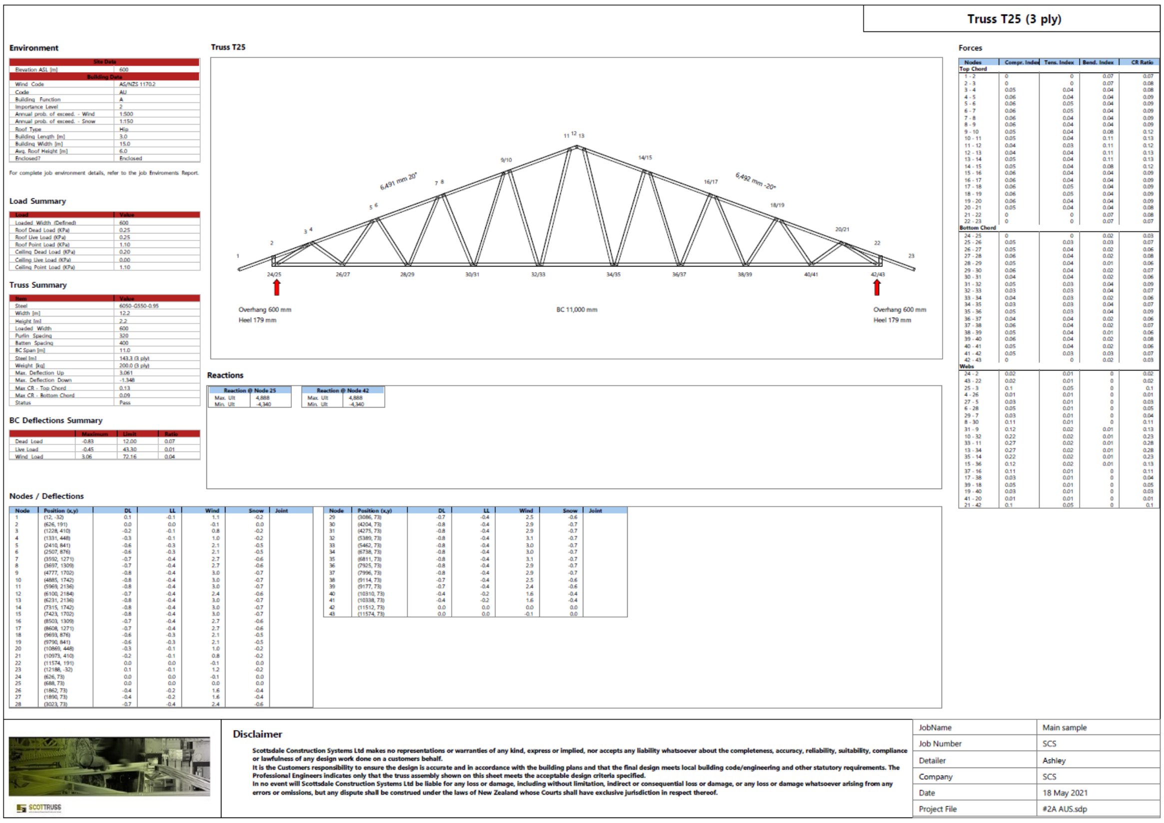


Figure 39 - Truss Passes

Truss fails the engineering – It displays the warning message.

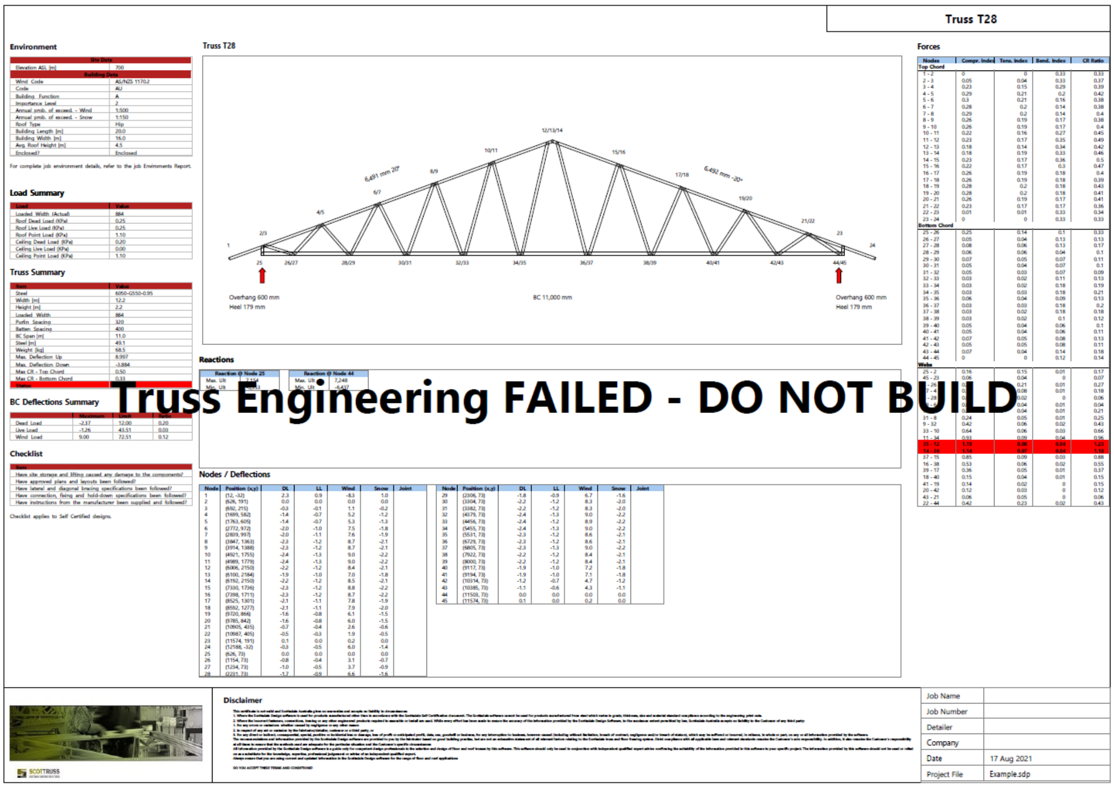


Figure 40 - Truss Fails

Once the truss analysis is complete, it generates the truss output report for each truss separately. This report gives both input and output details, showing the truss status as pass or fail. Refer Figures 41 to 51 below.

The truss number is displayed, and number of plies as shown below.

Truss T25 (3 ply)

Figure 41 - Truss designation

The truss is displayed with node numbers, relevant spans, and support positions.

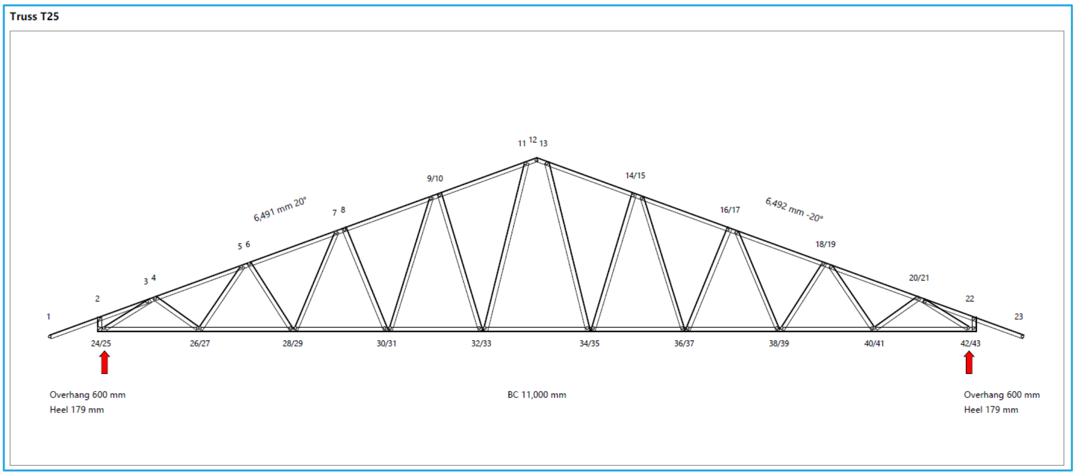


Figure 42 - Truss details

Environment displays the building and site details:

Environment

Site Data	
Elevation ASL [m]	600
Building Data	
Wind Code	AS/NZS 1170.2
Code	AU
Building Function	A
Importance Level	2
Annual prob. of exceed. - Wind	1:500
Annual prob. of exceed. - Snow	1:150
Roof Type	Hip
Building Length [m]	3.0
Building Width [m]	15.0
Avg. Roof Height [m]	6.0
Enclosed?	Enclosed

For complete job environment details, refer to the job Enviroments Report.

Figure 43 - Building details

Load Summary displays the basic applied loads:

Load Summary

Load	Value
Loaded Width (Defined)	600
Roof Dead Load (KPa)	0.25
Roof Live Load (KPa)	0.25
Roof Point Load (KPa)	1.10
Ceiling Dead Load (KPa)	0.20
Ceiling Live Load (KPa)	0.00
Ceiling Point Load (KPa)	1.10

Figure 44 - Basic loads

The Truss Summary displays the truss details including the pass/fail status, and shows the critical failure ratio and maximum deflection:

Truss Summary

Item	Value
Steel	6050-G550-0.95
Width [m]	12.2
Height [m]	2.2
Loaded Width	600
Purlin Spacing	320
Batten Spacing	400
BC Span [m]	11.0
Steel [m]	143.3 (3 ply)
Weight [kg]	200.0 (3 ply)
Max. Deflection Up	3.061
Max. Deflection Down	-1.348
Max CR - Top Chord	0.13
Max CR - Bottom Chord	0.09
Status	Pass

Figure 45 - Truss Summary (Pass)

Truss Summary

Item	Value
Steel	6050-G550-0.95
Width [m]	12.2
Height [m]	2.2
Loaded Width	900
Purlin Spacing	320
Batten Spacing	400
BC Span [m]	11.0
Steel [m]	47.8
Weight [kg]	66.7
Max. Deflection Up	13.777
Max. Deflection Down	-6.066
Max CR - Top Chord	0.59
Max CR - Bottom Chord	0.39
Status	FAILED

If truss fails, it displays the warning message in the middle of the report as shown below:

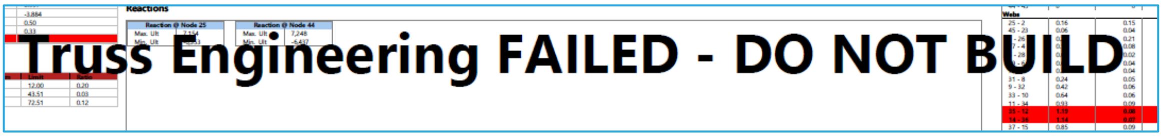


Figure 46 - Truss status

User can see the maximum deflection and deflection limits due to different basic loads and the critical ratio:

BC Deflections Summary

	Maximum	Limit	Ratio
Dead Load	-0.83	12.00	0.07
Live Load	-0.45	43.30	0.01
Wind Load	3.06	72.16	0.04

Figure 47 - Critical deflection

It also shows the deflection at each node due to different basic loads and displays the connection details of each joint. Blank means bolt only. If the connection requires a spacer or screws it will display as shown below.

Nodes / Deflections

Node	Position (x,y)	DL	LL	Wind	Snow	Joint	Node	Position (x,y)	DL	LL	Wind	Snow	Joint
1	(12, -32)	-0.1	-0.2	2.7	-0.5		29	(10743, 494)	-0.4	-0.2	2.0	-0.3	
2	(626, 191)	0.0	0.0	-0.1	0.0		30	(11574, 191)	0.0	0.0	-0.1	0.0	
3	(1457, 494)	-0.5	-0.3	2.3	-0.4		31	(12188, -32)	-0.1	-0.2	3.0	-0.6	
4	(1552, 528)	-0.6	-0.4	3.1	-0.6		32	(626, 73)	0.0	0.0	-0.1	0.0	
5	(3148, 1109)	-1.0	-0.6	5.4	-1.0		33	(697, 73)	0.0	0.0	0.0	0.0	
6	(3267, 1153)	-0.9	-0.5	4.5	-0.8	B+S	34	(1185, 73)	-0.3	-0.1	1.2	-0.2	
7	(3326, 1153)	-0.9	-0.5	4.6	-0.8		35	(2315, 73)	-0.9	-0.5	4.4	-0.8	
8	(3556, 1153)	-0.9	-0.5	4.8	-0.8		36	(2386, 73)	-0.9	-0.5	4.6	-0.8	
9	(3624, 1153)	-0.9	-0.5	4.9	-0.8		37	(3326, 73)	-0.9	-0.5	4.8	-0.8	
10	(4379, 1153)	-0.9	-0.5	4.6	-0.8		38	(3394, 73)	-0.9	-0.5	4.8	-0.8	
11	(4452, 1153)	-0.9	-0.5	4.5	-0.8		39	(3624, 73)	-0.9	-0.5	4.8	-0.8	
12	(5207, 1153)	-0.7	-0.4	3.7	-0.6		40	(3697, 73)	-0.9	-0.5	4.8	-0.8	
13	(5279, 1153)	-0.7	-0.4	3.5	-0.6		41	(4452, 73)	-0.9	-0.5	4.4	-0.8	
14	(6034, 1153)	-0.4	-0.2	2.1	-0.4		42	(4524, 73)	-0.8	-0.5	4.2	-0.7	
15	(6106, 1153)	-0.3	-0.2	1.6	-0.3		43	(5279, 73)	-0.6	-0.4	3.3	-0.6	
16	(6553, 1153)	0.0	0.0	0.3	0.0		44	(5351, 73)	-0.6	-0.3	3.0	-0.5	
17	(6654, 1153)	-0.1	0.0	0.4	-0.1	B+S+2T	45	(6106, 73)	-0.3	-0.1	1.3	-0.2	
18	(6934, 1153)	-0.6	-0.3	3.0	-0.5		46	(6175, 73)	-0.1	-0.1	0.8	-0.1	
19	(7688, 1153)	-0.8	-0.4	4.1	-0.7		47	(6654, 73)	0.0	0.0	0.0	0.0	B+S+2T
20	(7761, 1153)	-0.8	-0.5	4.3	-0.7		48	(6934, 73)	-0.6	-0.3	3.2	-0.5	
21	(8516, 1153)	-0.8	-0.5	4.3	-0.7		49	(7006, 73)	-0.8	-0.4	4.1	-0.7	
22	(8588, 1153)	-0.9	-0.5	4.5	-0.8		50	(7761, 73)	-0.9	-0.5	4.5	-0.8	
23	(8656, 1153)	-0.9	-0.5	4.6	-0.8		51	(7833, 73)	-0.9	-0.5	4.5	-0.8	
24	(8874, 1153)	-0.9	-0.5	4.6	-0.8		52	(8588, 73)	-0.9	-0.5	4.5	-0.8	
25	(8933, 1153)	-0.9	-0.5	4.5	-0.8		53	(8806, 73)	-0.9	-0.5	4.6	-0.8	
26	(8985, 1134)	-1.0	-0.5	4.8	-0.8		54	(8874, 73)	-0.9	-0.5	4.7	-0.8	
27	(9052, 1109)	-1.0	-0.6	5.2	-0.9		55	(8939, 73)	-1.0	-0.5	4.8	-0.8	
28	(10648, 528)	-0.5	-0.3	2.6	-0.5		56	(9814, 73)	-0.8	-0.5	4.1	-0.7	

Figure 48 - Node deflection and connections

The report gives the maximum reaction and the maximum uplift at the support points:

Reactions

Reaction @ Node 25		Reaction @ Node 42	
Max. Ult	4,888	Max. Ult	4,888
Min. Ult	-4,340	Min. Ult	-4,340

Figure 49 - Reactions

The user can see the critical ratio of compression, tension, bending and, combine bending and axial for each truss member as shown below:

Forces

Nodes	Compr. Index	Tens. Index	Bend. Index	CR Ratio
Top Chord				
1 - 2	0	0	0.07	0.07
2 - 3	0	0	0.07	0.08
3 - 4	0.05	0.04	0.04	0.08
4 - 5	0.06	0.04	0.04	0.09
5 - 6	0.06	0.05	0.04	0.09
6 - 7	0.06	0.05	0.04	0.09
7 - 8	0.06	0.04	0.04	0.09
8 - 9	0.06	0.04	0.04	0.09
9 - 10	0.05	0.04	0.08	0.12
10 - 11	0.05	0.04	0.11	0.13
11 - 12	0.04	0.03	0.11	0.12
12 - 13	0.04	0.04	0.11	0.13
13 - 14	0.05	0.04	0.11	0.13
14 - 15	0.05	0.04	0.08	0.12
15 - 16	0.06	0.04	0.04	0.09
16 - 17	0.06	0.04	0.04	0.09
17 - 18	0.06	0.05	0.04	0.09
18 - 19	0.06	0.05	0.04	0.09
19 - 20	0.06	0.04	0.04	0.09
20 - 21	0.05	0.04	0.04	0.08
21 - 22	0	0	0.07	0.08
22 - 23	0	0	0.07	0.07
Bottom Chord				
24 - 25	0	0	0.02	0.03
25 - 26	0.05	0.03	0.03	0.07
26 - 27	0.05	0.04	0.02	0.06
27 - 28	0.06	0.04	0.02	0.08
28 - 29	0.05	0.04	0.01	0.06
29 - 30	0.06	0.04	0.02	0.07
30 - 31	0.04	0.04	0.02	0.06
31 - 32	0.05	0.03	0.04	0.09
32 - 33	0.03	0.03	0.04	0.07
33 - 34	0.04	0.03	0.02	0.06
34 - 35	0.03	0.03	0.04	0.07
35 - 36	0.05	0.03	0.04	0.09
36 - 37	0.04	0.04	0.02	0.06
37 - 38	0.06	0.04	0.02	0.07
38 - 39	0.05	0.04	0.01	0.06
39 - 40	0.06	0.04	0.02	0.08
40 - 41	0.05	0.04	0.02	0.06
41 - 42	0.05	0.03	0.03	0.07
42 - 43	0	0	0.02	0.03
Webs				
24 - 2	0.02	0.01	0	0.02
43 - 22	0.02	0.01	0	0.02
25 - 3	0.1	0.05	0	0.1
4 - 26	0.01	0.01	0	0.01
27 - 5	0.03	0.01	0	0.03
6 - 28	0.05	0.01	0	0.05
29 - 7	0.03	0.01	0	0.04
8 - 30	0.11	0.01	0	0.11
31 - 9	0.12	0.02	0.01	0.13
10 - 32	0.22	0.02	0.01	0.23
33 - 11	0.27	0.02	0.01	0.28
13 - 34	0.27	0.02	0.01	0.28
35 - 14	0.22	0.02	0.01	0.23
15 - 36	0.12	0.02	0.01	0.13
37 - 16	0.11	0.01	0	0.11
17 - 38	0.03	0.01	0	0.04
39 - 18	0.05	0.01	0	0.05
19 - 40	0.03	0.01	0	0.03
41 - 20	0.01	0.01	0	0.01
21 - 42	0.1	0.05	0	0.1

Figure 50 - Induced forces

If the truss fails, the failure ratios are highlighted as shown below:

Forces

Nodes	Compr. Index	Tens. Index	Bend. Index	CR Ratio
Top Chord				
1 - 2	0	0	0.33	0.33
2 - 3	0.01	0.01	0.33	0.34
3 - 4	0.24	0.18	0.16	0.37
4 - 5	0.27	0.19	0.18	0.42
5 - 6	0.28	0.21	0.18	0.41
6 - 7	0.29	0.2	0.18	0.43
7 - 8	0.26	0.19	0.2	0.41
8 - 9	0.27	0.19	0.2	0.43
9 - 10	0.23	0.17	0.35	0.52
10 - 11	0.24	0.17	0.48	0.59
11 - 12	0.18	0.14	0.48	0.53
12 - 13	0.18	0.19	0.48	0.59
13 - 14	0.24	0.17	0.48	0.59
14 - 15	0.23	0.17	0.35	0.52
15 - 16	0.27	0.19	0.2	0.43
16 - 17	0.26	0.19	0.2	0.41
17 - 18	0.29	0.2	0.18	0.43
18 - 19	0.28	0.21	0.18	0.41
19 - 20	0.27	0.19	0.18	0.42
20 - 21	0.24	0.18	0.16	0.37
21 - 22	0.01	0.01	0.33	0.34
22 - 23	0	0	0.33	0.33
Bottom Chord				
24 - 25	0	0	0.1	0.13
25 - 26	0.24	0.15	0.13	0.3
26 - 27	0.22	0.17	0.08	0.29
27 - 28	0.28	0.19	0.08	0.36
28 - 29	0.22	0.18	0.06	0.26
29 - 30	0.26	0.17	0.07	0.32
30 - 31	0.19	0.16	0.11	0.27
31 - 32	0.22	0.15	0.19	0.39
32 - 33	0.15	0.13	0.19	0.32
33 - 34	0.16	0.12	0.1	0.25
34 - 35	0.15	0.13	0.19	0.32
35 - 36	0.22	0.15	0.19	0.39
36 - 37	0.19	0.16	0.11	0.27
37 - 38	0.26	0.17	0.07	0.32
38 - 39	0.22	0.18	0.06	0.26
39 - 40	0.28	0.19	0.08	0.36
40 - 41	0.22	0.17	0.08	0.29
41 - 42	0.24	0.15	0.13	0.3
42 - 43	0	0	0.1	0.13
Webs				
24 - 2	0.06	0.04	0	0.07
43 - 22	0.06	0.04	0	0.07
25 - 3	0.46	0.24	0.02	0.47
4 - 26	0.06	0.05	0	0.06
27 - 5	0.11	0.03	0	0.11
6 - 28	0.15	0.03	0.01	0.15
29 - 7	0.16	0.04	0.01	0.16
8 - 30	0.37	0.05	0.01	0.38
31 - 9	0.56	0.06	0.02	0.58
10 - 32	0.91	0.09	0.04	0.94
33 - 11	1.21	0.08	0.04	1.25
13 - 34	1.21	0.08	0.04	1.25
35 - 14	0.91	0.09	0.04	0.94
15 - 36	0.56	0.06	0.02	0.58
37 - 16	0.37	0.05	0.01	0.38
17 - 38	0.16	0.04	0.01	0.16
39 - 18	0.15	0.03	0.01	0.15
19 - 40	0.11	0.03	0	0.11
41 - 20	0.06	0.05	0	0.06
21 - 42	0.45	0.24	0.02	0.47

Figure 51 - Induced forces of failed truss

The below attachments show the truss with pass and failed status. This includes the tie down details too.

Example - Truss T28.pdf

Example - Truss T28.pdf

4 Software Quality Assurance

4.1 Software QA requirements

Every build of the software is given a distinct version number that is controlled by the source control versioning of each change made. All production releases of the software come with release documentation that lists all changes made in the current version since the previous version. Every change is linked to a software bug or enhancement request in our workflow system.

4.1.1 Engineering QA

Structural analysis is checked using independent Multiframe software**.**

Multiframe software is used to check the Scottsdale software. The models were created in Multiframe independently and applies all the loads and load combinations. The induced forces (bending, compression, tension, and shear) and deflection results are then compared with Scottsdale Software.

Screenshots of Multiframe analysis and comparison results are shown below. Refer Figures 52 and 53 and, Table 5 below.

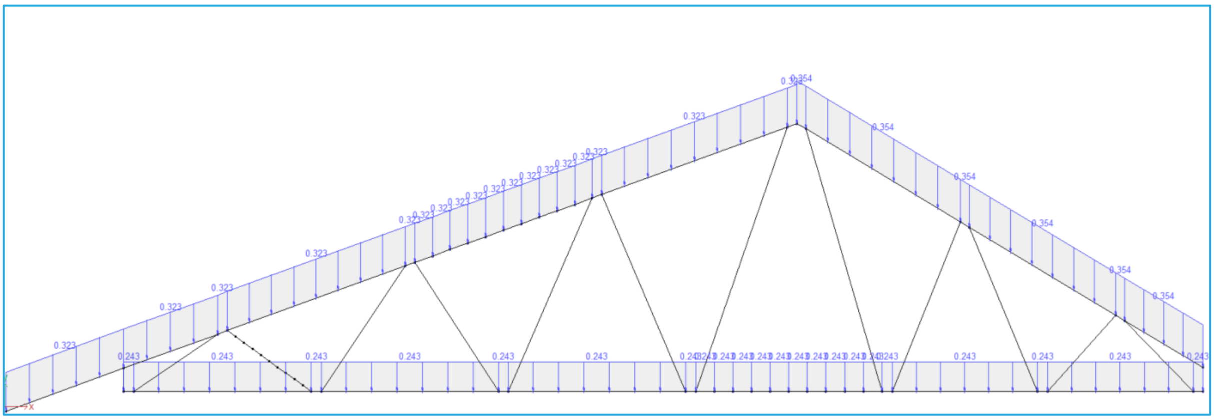


Figure 52 - Applied loads from Multiframe

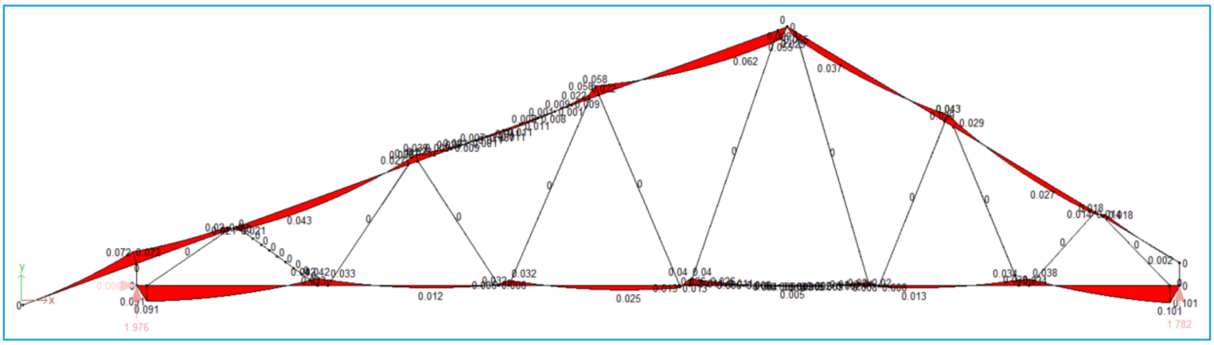


Figure 53 - Induced forces from Multiframe

			MultiFrame			SCS Analyser			Multiframe/SCS		
Combo No	Member No:	Node No	Axial (N)	Shear (N)	Bending (Nmm)	Axial (N)	Shear (N)	Bending (Nmm)	% Axial	% Shear	% Bending
25	6 - Top Chord	L1	4048	316	70201	4048	316	70325	100.0%	99.9%	99.8%
		L2	4038	257	39474	4038	257	39606	100.0%	100.0%	99.7%
		L3	4028	198	15029	4028	198	15167	100.0%	100.2%	99.1%
		L4	4018	140	-3133	4018	140	2991	100.0%	100.0%	104.7%
		L5	4008	81	-15011	4008	81	14868	100.0%	100.5%	101.0%
		L6	3998	23	-20607	3998	23	20465	100.0%	99.4%	100.7%
		L7	3988	-36	-19920	3988	36	19781	100.0%	99.1%	100.7%
		L8	3978	-94	-12950	3978	94	12817	100.0%	100.2%	101.0%
		L9	3968	-153	364	3968	153	428	100.0%	99.8%	85.0%
		L10	3958	-211	19840	3959	211	19953	100.0%	100.1%	99.4%
		L11	-3948	270	-45659	3949	270	45759	100.0%	99.9%	99.8%
	23 - Bottom Chord	L1	-2106	137	45946	2106	138	45988	100.0%	99.6%	99.9%
		L2	-2106	115	32643	2106	115	32681	100.0%	99.7%	99.9%
		L3	-2106	92	21744	2106	92	21777	100.0%	99.9%	99.8%
		L4	-2106	69	13248	2106	69	13278	100.0%	100.2%	99.8%
		L5	-2106	46	7157	2106	46	7182	100.0%	100.8%	99.6%
		L6	-2106	24	3469	2106	24	3490	100.0%	98.2%	99.4%
		L7	-2106	1	2185	2106	1	2202	100.0%	100.0%	99.2%
		L8	-2106	-22	3304	2106	22	3317	100.0%	100.0%	99.6%
		L9	-2106	-45	6828	2106	45	6837	100.0%	99.5%	99.9%
		L10	-2106	-68	12755	2106	68	12760	100.0%	99.4%	100.0%
		L11	2106	90	-21086	2106	90	21087	100.0%	100.4%	100.0%
	31 - Web	L1	-930	0	0	930	0	0	100.0%		
		L2	-930	0	0	930	0	0	100.0%		
		L3	-930	0	0	930	0	0	100.0%		
		L4	-930	0	0	930	0	0	100.0%		
		L5	-930	0	0	930	0	0	100.0%		
		L6	-930	0	0	930	0	0	100.0%		
		L7	-930	0	0	930	0	0	100.0%		
		L8	-930	0	0	930	0	0	100.0%		
		L9	-930	0	0	930	0	0	100.0%		
		L10	-930	0	0	930	0	0	100.0%		
		L11	930	0	0	930	0	0	100.0%		

Table 5 - Comparison between Multiframe and Scottsdale Truss Software (Truss T6)

4.1.2 Member Designs

Member designs are checked using independent Cold-steel software.

The critical ratio given from the SCS software was checked against the Cold-formed steel software. The results are as shown below.

In the example below, for member number 6 the critical ratio is 0.6. Refer Figure 54 below.

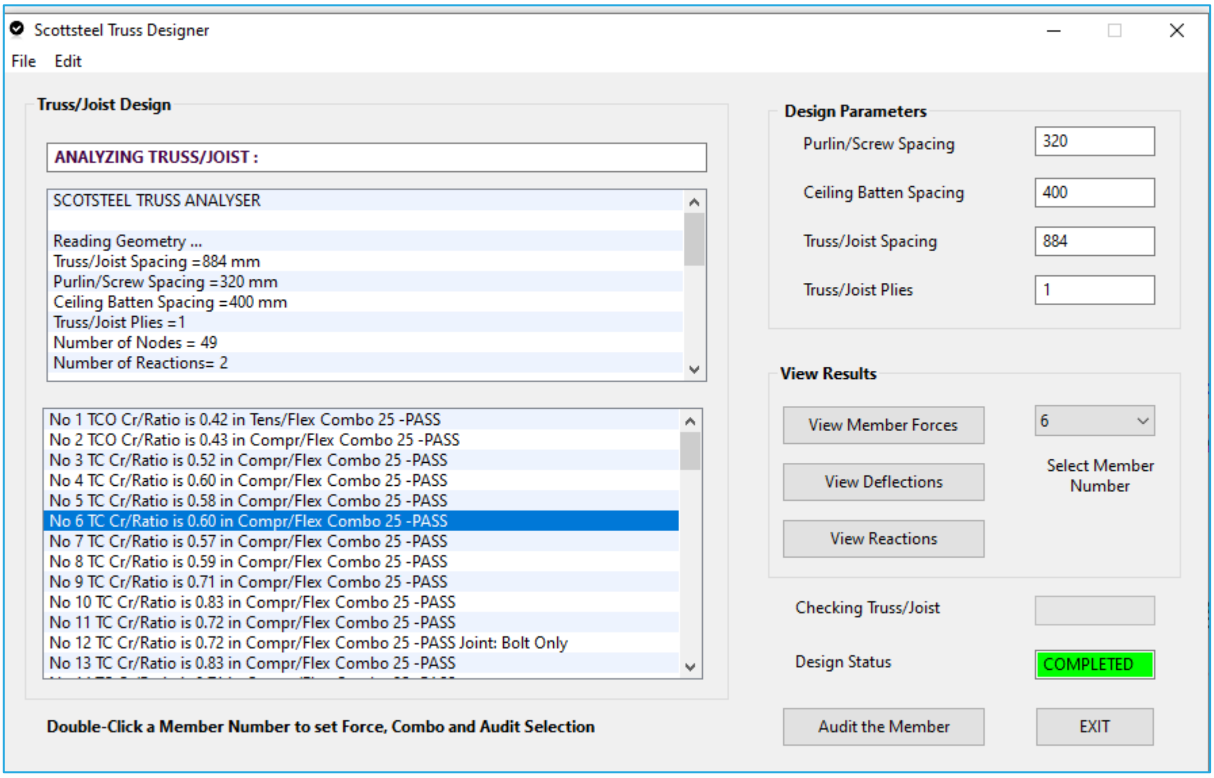
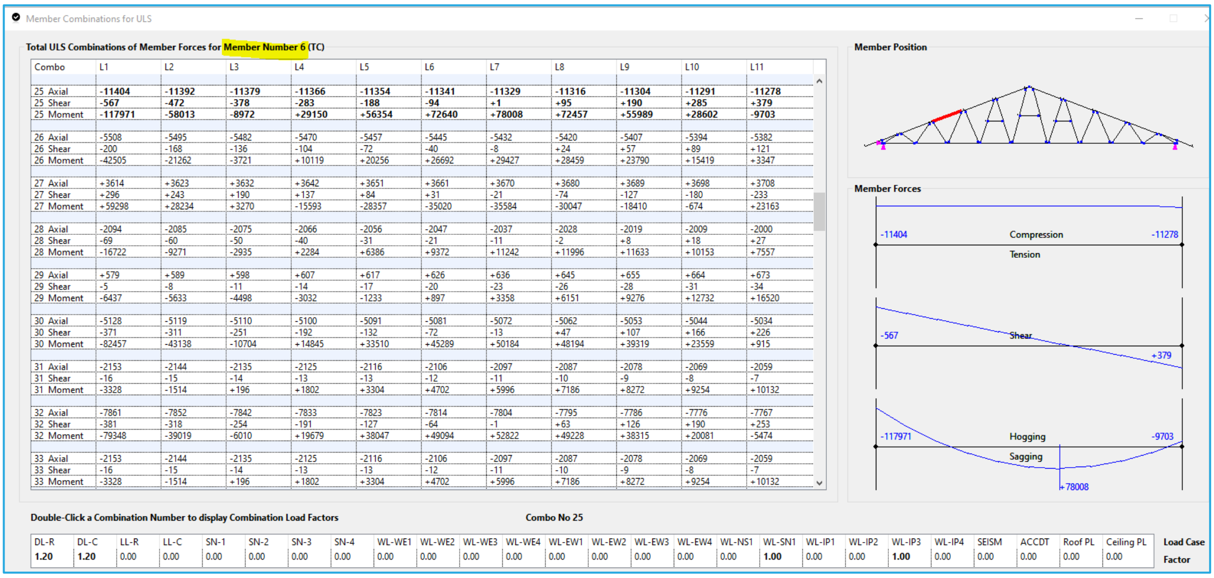


Figure 54 - SCS truss analysis results

Figure 55 below shows the induced forces on member 6:



Combo	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11
25 Axial	**-11404**	**-11392**	**-11379**	**-11366**	**-11354**	**-11341**	**-11329**	**-11316**	**-11304**	**-11291**	**-11278**
25 Shear	**-567**	**-472**	**-378**	**-283**	**-188**	**-94**	**+1**	**+95**	**+190**	**+285**	**+379**
25 Moment	**-117971**	**-58013**	**-8972**	**+29150**	**+56354**	**+72640**	**+78008**	**+72457**	**+55989**	**+28602**	**-9703**
26 Axial	-5508	-5495	-5482	-5470	-5457	-5445	-5432	-5420	-5407	-5394	-5382
26 Shear	-200	-168	-136	-104	-72	-40	-8	+24	+57	+89	+121
26 Moment	-42505	-21262	-3721	+10119	+20256	+26692	+29427	+28459	+23790	+15419	+3347
27 Axial	+3614	+3623	+3632	+3642	+3651	+3661	+3670	+3680	+3689	+3698	+3708
27 Shear	+296	+243	+190	+137	+84	+31	-21	-74	-127	-180	-233
27 Moment	+59298	+28234	+3270	-15593	-28357	-35020	-35584	-30047	-18410	-674	+23163
28 Axial	-2094	-2085	-2075	-2066	-2056	-2047	-2037	-2028	-2019	-2009	-2000
28 Shear	-69	-60	-50	-40	-31	-21	-11	-2	+8	+18	+27
28 Moment	-16722	-9271	-2935	+2284	+6386	+9372	+11242	+11996	+11633	+10153	+7557
29 Axial	+579	+589	+598	+607	+617	+626	+636	+645	+655	+664	+673
29 Shear	-5	-8	-11	-14	-17	-20	-23	-26	-28	-31	-34
29 Moment	-6437	-5633	-4498	-3032	-1233	+897	+3358	+6151	+9276	+12732	+16520
30 Axial	-5128	-5119	-5110	-5100	-5091	-5081	-5072	-5062	-5053	-5044	-5034
30 Shear	-371	-311	-251	-192	-132	-72	-13	+47	+107	+166	+226
30 Moment	-82457	-43138	-10704	+14845	+33510	+45289	+50184	+48194	+39319	+23559	+915
31 Axial	-2153	-2144	-2135	-2125	-2116	-2106	-2097	-2087	-2078	-2069	-2059
31 Shear	-16	-15	-14	-13	-13	-12	-11	-10	-9	-8	-7
31 Moment	-3328	-1514	+196	+1802	+3304	+4702	+5996	+7186	+8272	+9254	+10132
32 Axial	-7861	-7852	-7842	-7833	-7823	-7814	-7804	-7795	-7786	-7776	-7767
32 Shear	-381	-318	-254	-191	-127	-64	-1	+63	+126	+190	+253
32 Moment	-79348	-39019	-6010	+19679	+38047	+49094	+52822	+49228	+38315	+20081	-5474
33 Axial	-2153	-2144	-2135	-2125	-2116	-2106	-2097	-2087	-2078	-2069	-2059
33 Shear	-16	-15	-14	-13	-13	-12	-11	-10	-9	-8	-7
33 Moment	-3328	-1514	+196	+1802	+3304	+4702	+5996	+7186	+8272	+9254	+10132

DL-R	DL-C	LL-R	LL-C	SN-1	SN-2	SN-3	SN-4	WL-WE1	WL-WE2	WL-WE3	WL-WE4	WL-EW1	WL-EW2	WL-EW3	WL-EW4	WL-NS1	WL-SN1	WL-IP1	WL-IP2	WL-IP3	WL-IP4	SEISM	ACCDT	Roof PL	Ceiling PL	Load Case
1.20	**1.20**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.00**	0.00	0.00	**1.00**	0.00	0.00	0.00	0.00	0.00	Factor

Figure 55 - SCS truss typical member induced forces

Figure 56 below shows the effective lengths of member 6:

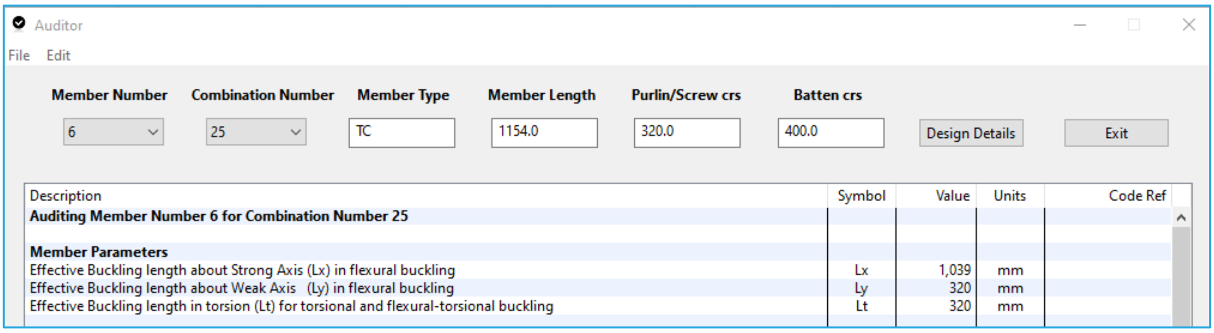


Figure 56 - Effective length calculations from SCS software

The loads and member forces are entered in the Cold-steel software and checked as shown in Figure 57 below:

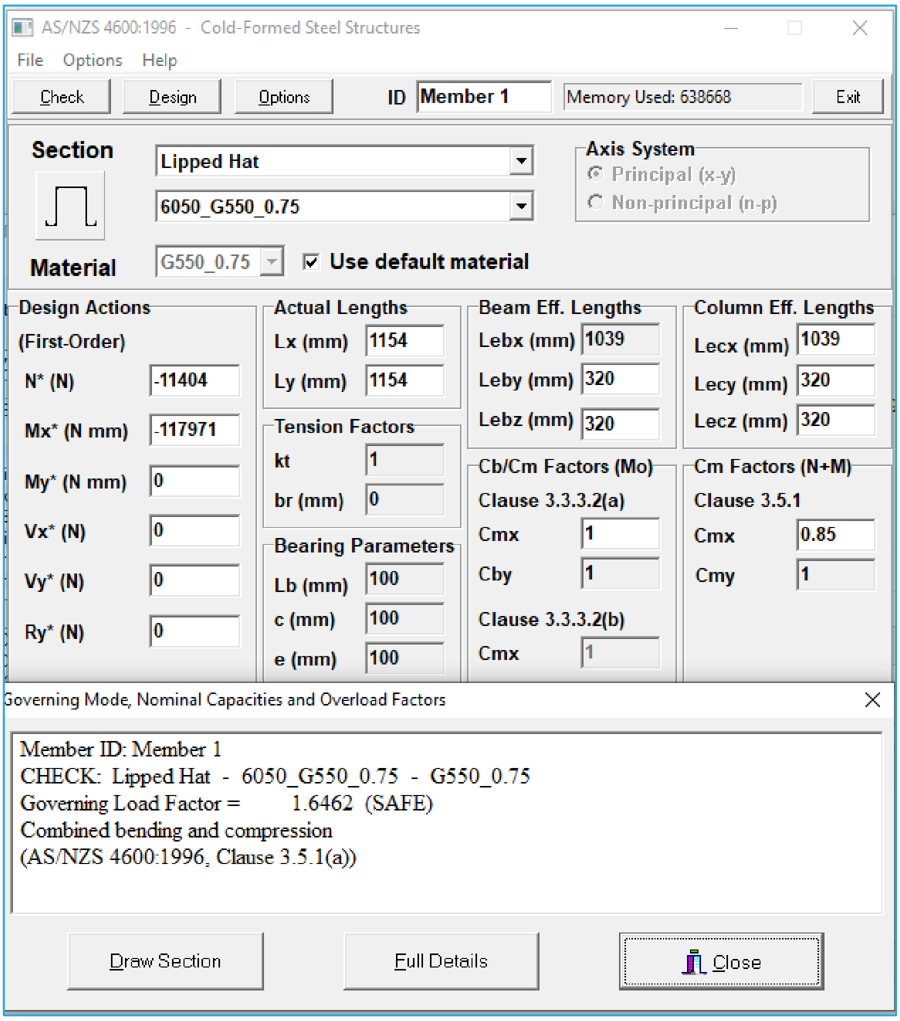


Figure 57 - Screenshot of Cold Steel software

The critical ratio from the ColdSteel software is 1.6462, which in SCS software is 1/1.6462 = 0.607

Both critical ratios calculated from SCS design software and Cold Steel software are the same.

A commercial software package **"Beyond Compare 4"** was used to compare the results between the new version with the released version. Beyond Compare 4 is a software which can compare the content of two different files. Every time before the new version is released, this software is used to compare the overall loadings and final results between two versions. Figure 58 below shows the screenshot of comparison of two different versions. It can display the same and different results:

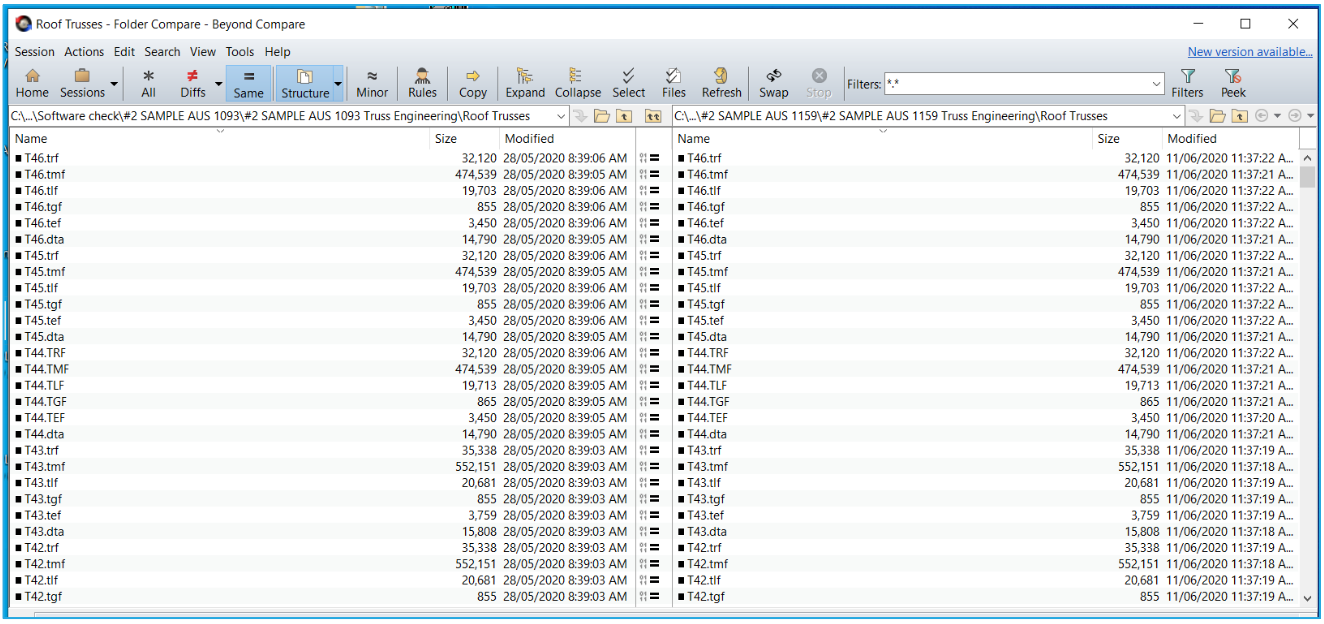


Figure 58 - Screenshot from a Beyond Compare 4

The above screen shows that the geometry, loads and forces of all the trusses are the same in two different versions of the software.