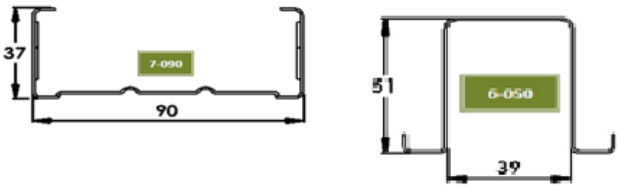
Truss Comparison- Top Hat Vs C-Section

The common profiles for roof and floor trusses used in the cold formed building industry are top hats and C-sections. Scottsdale Construction Systems decided to conduct an analytical investigation of the floor trusses and roof trusses to determine the better profile. The result of this investigation showed that top hat trusses perform better than C-section trusses. This report shows the summary of this investigation.



The investigation was conducted for both roof and floor trusses. Two different types of comparisons were conducted.

1. Compare the maximum span.
2. Compare the linear meter/truss.

Conclusions

1. When designing a joist or a truss with a fixed span you can use either a Top Hat or C section. If both have the same properties (panel length, depth and thickness) and both pass then there is not much difference in the steel usage.

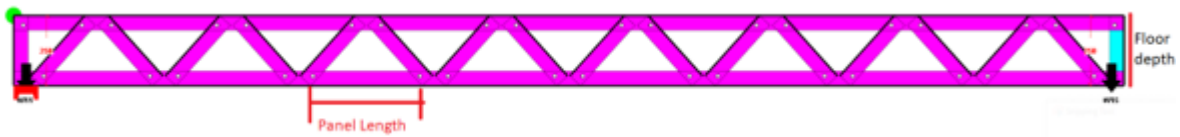
2. If you increase the span and keep the same properties (panel length, depth and thickness) the C section will fail before the Top Hat. Then the detailer will need to change the properties (gauge, panel length and depth and # of ply). This will allow the C Section to pass however it will now be using more steel than the Top Hat. Refer to tables in section 2.

3. The results clearly proved that the spans of top hat floor trusses are significantly higher than the spans of C-section trusses using the same properties (panel length, depth and thickness). As an example, when top hat trusses span 9.1 m, C-section trusses can span only 6.5 m with the same configuration (panel length, depth and thickness).

Options to increasing the Span

The Scottsdale engineering team have modelled different combinations of floor joists. Before we get started, let's do some joist basics first. There are at least 5 different ways we can increase the span of a joist to ensure it passes load tests. In each case they will increase the steel usage required and the cost.

1. Decrease the panel length by increasing the number of webs. This is not always possible but the preferred method to optmise the joist.
2. Increase the gauge between 0.55mm, 0.75mm, 0.95mm and 1.15mm .
3. Increase the floor depth. This generally ranges from 300mm to 450mm. It can be difficult to adjust because the architectural plans have often determined the floor depth.
4. Decrease the spacing between trusses. Normally 450 but can range between 300mm up to 600mm. This is not preferred because by decreasing spacing you are increasing the number of joists required.
5. Increase the number of Ply by 2 or 3. This is least preferred because it doubles or triples the size, weight and cost.



1.0 TEST RESULTS FOR Floor trusses

The below parameters were considered in this investigation

- **Floor Dead load – 1.1 kPa (0.9 kPa floor + 0.2 kPa ceiling under floor) 0.9 kPa floor load was considered to simulate the internal walls above the floor trusses in addition to the standard floor weights.**
- Steel Grade – G550
- Steel thickness – 0.75 mm and 0.95 mm
- Floor live load – 1.5 kPa
- Floor point load – 1.8 kN

1.1 Maximum span comparison

The investigation was conducted by using different floor depth and the different truss spacing. The below tables (Table 1 & 2) show the maximum span of each scenario. Table 3 shows the percentage of span differences between both profiles.

Table 1. Maximum span of C90 profile floor trusses

Section	Truss spacing (mm)	Floor Depth (mm)					
		200	250	300	350	400	450
C90x0.75	300	2100	2500	3100	3500	3900	4200
	350	2100	2500	3000	3400	3800	4000
	400	2000	2400	2800	3200	3600	3800
	450	2000	2350	2800	3100	3400	3600
	600	1800	2300	2700	2900	3100	3200
C90x0.95	300	3500	4400	5100	5700	6000	6500
	350	3400	4400	5000	5600	5900	6300
	400	3300	4200	4800	5500	5800	6100
	450	3200	4100	4700	5300	5700	5900
	600	3100	3800	4400	4900	5300	5500

Table 2. Maximum span of top hat floor trusses

Section	Truss spacing (mm)	Floor Depth (mm)					
		200	250	300	350	400	450
Top-hat (6050x0.75)	300	3300	4100	5000	5700	6500	7000
	350	3200	4000	4800	5500	6300	6900
	400	3100	3900	4700	5400	6000	6700
	450	3100	3900	4600	5200	5700	6500
	600	2900	3600	4300	4800	5200	5900
Top-hat (6050x0.95)	300	5000	6300	7200	7900	8500	9100
	350	4800	6100	6900	7600	8200	8600
	400	4700	6000	6700	7300	7900	8400
	450	4600	5700	6500	7100	7700	8200
	600	4300	5300	6000	6600	7100	7600

Table 3. The span difference between top hat and C-section floor trusses

Type	Truss spacing (mm)	Floor Depth (mm)					
		200	250	300	350	400	450
0.75 G550	300	57%	64%	61%	63%	67%	67%
	350	52%	60%	60%	62%	66%	73%
	400	55%	63%	68%	69%	67%	76%
	450	55%	66%	64%	68%	68%	81%
	600	61%	57%	59%	66%	68%	84%
0.95 G550	300	43%	43%	41%	39%	42%	40%
	350	41%	39%	38%	36%	39%	37%
	400	42%	43%	40%	33%	36%	38%
	450	44%	39%	38%	34%	35%	39%
	600	39%	39%	36%	35%	34%	38%

The results clearly proved that the spans of top hat floor trusses are significantly higher than the spans of C-section trusses. As an example, when top hat trusses span 9.1 m, C-section trusses can span only 6.5 m with the same configuration.

1.2 Floor truss – linear meter comparison

The linear meter and cost comparison was undertaken by considering the fixed span for both C-section and top hat floor trusses. Floor depth was selected based on the best linear meter.

Table 4. Comparison of linear meters and the cost

Profile Thickness (mm)	Span (m)	Top-hat (6050)			C-Section (C90)			Length Difference	Cost Difference
		Length (m)	Depth (mm)	Cost	Length (m)	Depth (mm)	Cost		
0.75	4	13.9	300	$39.34	14.6	300	$41.32	5.04%	5.04%
	5	17.2	300	$48.68	21.3	450	$60.28	23.84%	23.84%
	6	20.7	350	$58.58	41.8	300	$118.29	101.93%	101.93%
	7	25.1	450	$71.03	48.6	300	$137.54	93.63%	93.63%
	8	54.5	350	$154.24	56	450	$158.48	2.75%	2.75%
	9	63	450	$178.29	65.1	450	$184.23	3.33%	3.33%
	10	70.4	500	$199.23	81	500	$229.23	15.06%	15.06%
	11	115.4	500	$326.58	116.6	500	$329.98	1.04%	1.04%
0.95	4	13.9	300	$47.54	14.1	300	$48.22	1.44%	1.44%
	5	17.2	300	$58.82	17.5	300	$59.85	1.74%	1.74%
	6	20.6	300	$70.45	21.4	400	$73.19	3.88%	3.88%
	7	24.2	350	$82.76	26.4	500	$90.29	9.09%	9.09%
	8	27.7	450	$94.73	33.8	450	$115.60	22.02%	22.02%
	9	31.9	500	$109.10	62.8	400	$214.78	96.87%	96.87%
	10	69.5	450	$237.69	70.2	450	$240.08	1.01%	1.01%
	11	113.8	450	$389.20	115.1	450	$393.64	1.14%	1.14%

Table 4 clearly shows that top hat trusses are cost effective than the C-section trusses. In some scenarios the difference is higher than 90%.

2.0 Roof trusses

The below parameters were considered in this investigation.

- Steel Grade – G550
- Steel thickness – 0.95 mm
- Wind region – N2
- Truss spacing – 900 mm
- Roof type – sheet
- Roof pitch – 10 Deg to 25 Deg

2.1 Maximum span comparison

Table 5. Comparison of roof truss spans

Roof Pitch	C90 - Span (mm)	Top Hat-Span (mm)	Span difference
10	11000	12180	11%
15	15180	16380	8%
20	18180	20180	11%
22.5	18180	20180	11%

This clearly shows that top hat roof trusses can span more than the C-section roof trusses.

2.2 Liner meter comparison

Table 6. Comparison of linear meter and cost for roof trusses

Roof Pitch	Truss Span (mm)	C90 - Ln meter	Top Hat Ln meter	Ln m difference	Cost difference
10	11000	39.9	33.4	19%	19%
15	15180	73.6	62.2	18%	18%
20	18180	119.7	97.0	23%	23%
22.5	18180	129.0	104.6	23%	23%
25	18180	140.0	114.5	22%	22%

Ln- Linear meter

Table 6 proves that the top hat roof trusses are cost effective than the C-section roof trusses.

As a conclusion Scottsdale Construction System recommends to use top hat trusses over C-section trusses. It will reduce the cost of floor trusses up to 100% and roof trusses around 20%.

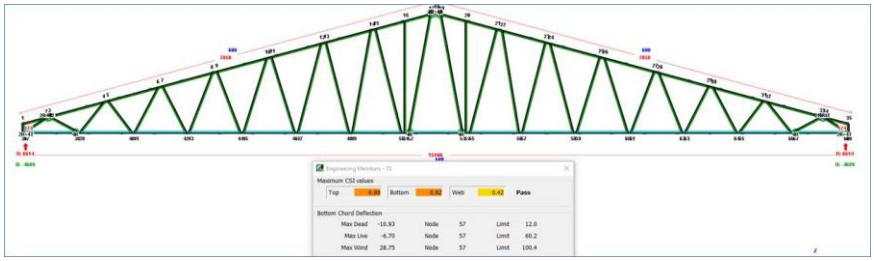
APPENDIX A

What is the span with Roof Pitch = 20 Deg? **C90_0.95 Duo pitch roof truss can span 18.18 m while top hat profile can span 20.18 m**

- Roof pitch = 20 Deg
- Wind category = N2
- Truss spacing = 900 mm
- Max panel length = 1000 mm
- Heel Height = 175 mm

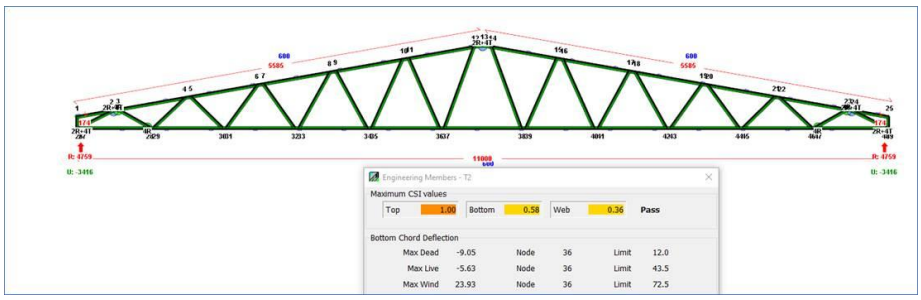
What is the span with Roof Pitch = 15 Deg? **C90_0.95 Duo pitch roof truss can span 15.18 m while top hat profile can span 16.38 m .**

- Roof pitch = 15 Deg
- Wind category = N2
- Truss spacing = 900 mm
- Max panel length = 1000 mm
- Heel Height = 175 mm



What is the span with Roof Pitch = 10 Deg? **C90_0.95 Duo pitch roof truss can span 11 m while top hat profile can span 12.18 m.**

- Roof pitch = 10 Deg
- Wind category = N2
- Truss spacing = 900 mm
- Max panel length = 1100 mm
- Heel Height = 175 mm



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ABOUT SCOTTSDALE

Scottsdale Construction Systems based in Brisbane, Australia has been operating since 1995. Scottsdale is dedicated to innovating, manufacturing, delivering and supporting the most globally advanced light gauge steel (LGS) wall frame & roof truss technolog