FTMA TECH TALK

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PARALLEL CHORD TRUSSES REPLACING STEEL BEAMS

The structural shape of parallel chord trusses consists of a combination of rectangles and triangles. The rectangle shape is proficient in resisting vertical load whereas its quite weak in lateral loading. However, the triangle shape can withstand lateral loads as shown in Figure 1. The parallel chords run along the length of the structure, providing support and stability.

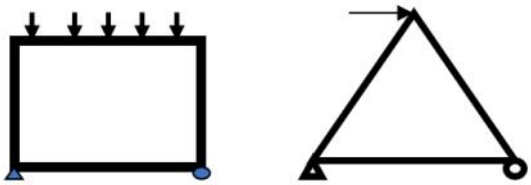

Figure 1 – Rectangle and square structural shapes

In this article, we will be looking at cost effective ways in replacing steel beams with parallel chord trusses on suitable double storey designs where there are no limitations in depth of the structural member.

Figure 2 – Typical location of steel beams

A typical example of a double storey floor plan is shown in Figure 2 with primary steel beams identified. We can exclude the steel beam above the garage opening due to depth limitations where a parallel chord truss is not appropriate. However, the blue dotted lines indicate locations along the upper storey perimeter where we typically have ample depth, although due consideration is needed when using a parallel chord truss which will extend above the floor line hence the upper wall frame height will need to be reduced to compensate. We will consider the beam above the garage as a comparison example going forward and limiting critical load deflection to 5mm. The loading condition for both member designs are as follows:

Roofing:	Concrete tiles
Ceiling:	13mm plaster board
Pitch:	22.5 deg
Design wind speed:	40m/s
Floor load:	DL - 0.5 kN/sq.m LL-1.5 kN/sq.m
Wall load:	DL – 0.4 kN/sq.m at 2.7m high

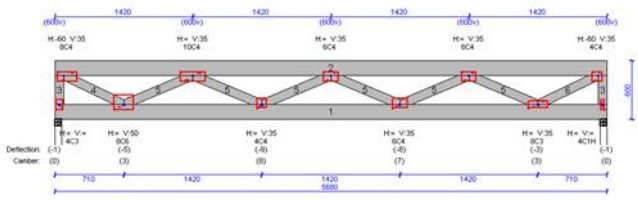

Figure 3 – PCG1 timber truss design (600mm deep)

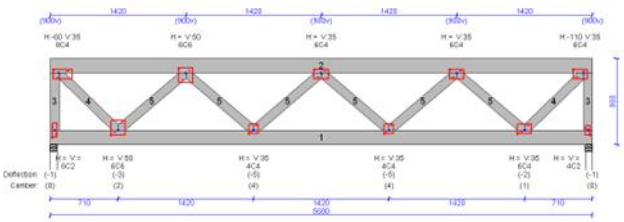

Figure 4 – PCG2 timber truss design (900mm deep)

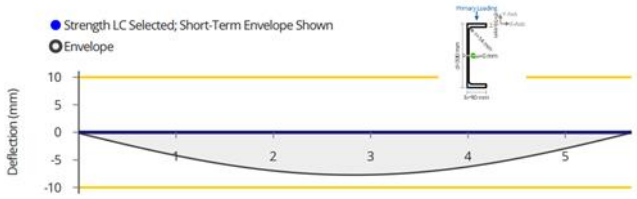

Figure 5 – Steel beam design (300 PFC)

Table 1 provides a summary of the three design options with respect to weight of structural elements and approximate cost comparisons:

Structural Element	Total weight (kg)	Cost (AUD $)	Comments
PCG1 600mm	91	Aprox. $325	Double truss
PCG2 900mm	97	Aprox. $400	Double truss
300 PFC Steel beam	240	Approx. $1075	Does not include the cost of welding, supporting elements (post, base plate etc..) and installation.

Table 1: Weight vs approximate cost comparisons

Limitations for PCG:

While Parallel Chord trusses can be designed at locations where the depth is not limited, it is imperative that no modifications such as holes & notches for plumbing or electrical services are permitted. This will avoid expensive rectification works and potential issues in the future.

Conclusion:

An additional benefit with Parallel Chord trusses is the ability to easily provide pre-camber to neutralise excessive deflections during the design stage. In contrast, pre-cambering of steel has limitations with manufacturing capability depending on span and radius while it can also be very expensive and not all steel fabricators have this ability.

While both timber parallel chord trusses and steel beams have their merits, PCG trusses provide robust design flexibility due to their cost-effectiveness, ease of installation, aesthetic appeal, and favourable sustainability profile. However, steel beams may still need to be utilized in specific cases where longer spans, heavier loads, or specialized structural requirements necessitate their use.

Table 2 summarises the advantages of PCG trusses over steel beam solutions.

Table 2: Summary of pro's & con's for PCG trusses vs steel beam

Structural Element	Depth criteria	Design Flexibility	Strength & efficiency	Span Capability	Ease of Installation	Environmental benefits
Timber parallel chord truss	Min 600mm	High flexibility	Adequate strength and stability for typical residential loads	Limited to 6.5m however need additional support >6.5m even extend up to 16m	Easier to handle and install	Timber trusses can contribute to sustainable construction practices
Steel beam	Starts at min 250mm	Limited flexibility	More than the adequate strength required for residential loads	For larger span with heavy loading condition.	Requires additional support due to weight	Steel production involves significant energy consumption and carbon emissions

This FTMA Tech Talk was written by Sasikumar Arjunan CPEng, Structural Engineer of our Principal Partner, Pryda.

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