Clad truss stair design elements

T2
design

Truss construction methods have natural application to commercial-scale staircase designs, but are still relatively uncommon. The T2 utilises a non-visual truss assembly (see the T1 brochure for an example of a visual 'feature' truss design), cladding the structural members in opaque material. The resulting impression is impressive in monolithic aspect.

The broad expanse of material following the geometric course of the flights provides the opportunity for creating a striking feature. Clad in raw or painted steel sheet, the stark silhouette of the T2 can invade and dominate a space and provide contrast for more naturalistic surrounds.

Clad in timber, the staircase remains a warmer, yet still imposing design, drawing on the natural beauty of timber and the extensive use of angles.

Figure 1. Plan. Critical dimensions in the initial design phase include tread going and desired width between handrails / panels. Tread going ultimately determines total going of the staircase. Arden recommends allowing sufficient top tread width (e.g. > 100mm) to allow handrail height to achieve level on upper floor.

Figure 2. Front Elevation. Critical dimensions required before fabrication can commence include accurate covered and structural floor-to-floor rises.
Commercial grade mild steel truss staircase frames are typically constructed from 50mm SHS and follow conventional truss engineering to form two parallel sets of structural beams (i.e. the trusses) that then become the balustrade. The simple fact that balustrade to the side of staircases has a minimum height above the nosing line of the stairs of 865mm (BCA) creates the situation where the depth of the truss is typically around 1000mm deep. This depth of truss has enormous structural strength and results in staircases of exceptional stiffness and spanning capacity.

An additional benefit delivered by the use of the T2 truss based staircase design is the ease in which the design can be broken down into a number of smaller pre-fabricated panel components, which then makes site installation lighter and easier than the use of traditional structural steel components (such as PFC, U-Beam or RHS beams). The end-result of these attributes is a better value-for-money staircase that offers exceptional performance.

F indicated on dimensions denotes a nominal dimension that typically varies according to specific application, engineering requirements or client preferences.
From a design point-of-view, it should be remembered that the vertical load capacity of the trusses is only one of the structural considerations. Thought must be given to the outward balustrade loads that are applied to the trusses as defined in AS1170.1 -2002 (Structural design actions). Typically this design issue is overcome by way of a series of connecting beams the run between the trusses under the line of the stair treads and risers. These beams then tie the trusses together and form a structural “U-shape” when viewing a cross section of the stairs.

One further consideration is the issue of lateral bracing of the assembled staircase, and obviously becomes more of a consideration in longer stair runs that are independent of adjoining structures. In this situation, some cross-bracing of the interlinked trusses may be required (i.e. in the bottom section of the structural U-shape).

Linings to the steel truss frames can be wide and varied, ranging from plate steel sheet to plasterboard linings to T&G or plywood boarding, or to practically any building sheeting system.

Figure 3. Side elevation. A straight flight with landing configuration is depicted. The T2 truss stringer / balustrade solution is effective on most staircase formats (e.g. L or U shaped).

Figure 4. Cut-away side elevation. Cross bracing is set out to balance load on upper and lower flights towards a fulcrum point. Structural truss members are completely enclosed cladding (sheet metal shown).

Figure 5. Cut-away side elevation: base fixing detail. The enclosed truss may be supported by a pin and plate assembly, providing the impression of the total structure ‘hovering’ just off the ground. Fixings to structural floor concealed below coverings.
Figure 6. Cut-away side elevation: composite tread and landing detail. Mild steel tread plates support the core of the composite tread or landing and provide lateral bracing to the twin truss assemblies. A variety of composite or monolithic treads incorporating steel support plates (refer to the corresponding Arden brochure) are appropriate for use in the T2 design. Non-slip Latham strips or similar on or inset to the leading edge of the tread are recommended for commercial installations.
Figure 7. Cut-away side elevation: top fixing and top tread details. Standard plate and chemset rod to concrete fixing is employed. Fixing plate is welded directly to the truss structural members with connection located within bulkhead. For continuous interacting balustrade, differing relative heights of raking and level balustrade / handrail require a top tread allowance to achieve a smooth transition.
Clad truss stair

Outer layer: steel sheet panels with consistent scale and seam lines

Main truss structure made up of 50mm mild steel SHS members

Top, bottom and end segments butt-joined with main panels

Tread-to-truss linking plate consisting of laser cut 12mm plate fitting between structural members.

Laser-cut slits in sheet to locate and allow for tread tag plates

Tread support tags welded to linking plate and SHS members and fixed to tread support plates on-site

Landing support tag

Tread support tags

Timber / timber veneer / shiplap / tongue & groove cladding

Handrail / balustrade edge trim

Shadow line

Mitre returns on edge-trim / handrail

Edge-trim traces entire edge of balustrade

Small profile mounting pin under truss not visible

Grain follows slope of flight
Figure 8. Exploded view of a truss assembly. CAD technology and CNC laser cut steel component allow for exact design and easy assembly of a large number of interacting components. A fitted tread-to-truss linking plate is welded in segments to the truss structure. This is connected to tread support tags which penetrate the inner side of the surrounding sheet cladding. Support tags are themselves welded to the composite tread support plates.

Figure 9. Truss clad with feature timber (tongue and groove / shiplap / veneer / etc) cladding. The use of timber cladding allows for the specification of a detail such as the one depicted: a 32mm timber capping and shadow-line tracing the entire perimeter of the balustrade. Other custom cladding details may be specified by the architect or client.

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Figure 10. Timber clad truss side elevation.

10A. Top left corner detail. The shadow line traces the entire perimeter of the balustrade and may continue to any returning void edge balustrade. 32mm capping / handrail is mitred around the perimeter.

10B. Mid section transition detail. The grain or slope of feature timber components follow the nosing line and are mitred to continue the lines up the staircase.
compliance

Arden is a BSA licensed contractor for carpentry, joinery, glass, glazing and aluminium as well as structural metal fabrication and erection. Arden supplies a Form 16 (Licensed Contractor) on all projects. In design and construct contracts, a Form 15 (Design Engineer) certification is supplied upon request. For products and services incorporating the T2 system, this table shows compliance with relevant codes and standards.

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For all commercial applications, it is important that sufficient space for the stairwell cavity be allowed to satisfy Australian Standards and BCA requirements.

The footprint is primarily driven by the floor to floor rise, as well as the staircase configuration chosen. However, stringer and balustrade style design may increase the amount of space required. Allowing too small a cavity can restrict the design options of the staircase. Also, points at where the staircase interacts with other structures are best addressed early in the design cycle.

Consultation with Arden early on will help ensure that these design issues can be addressed in a cost-effective manner.