Double Tees

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Product brochure

Fulton Hogan

Double Tees

The ideal solution for large floor spans

Double Tee is a large, prestressed precast concrete unit which, with the addition of an in situ topping, forms a structural suspended floor suitable for use in most types of buildings. They are an excellent choice for car-parks and supermarkets where large, column-free spaces are required.

The Double Tee system's large 2,400mm unit width and long span results in faster construction times. The units require no temporary propping and once in place provide an immediate working platform. The large span can also simplify the floor support system, and when used with the Stahlton Shell Beam, gives further economic and time savings.

The Stahlton Double Tee, up to 550mm deep, has parallel sided 200 mm wide webs for superior fire rating and durability performance if required.

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At Stahlton, we pride ourselves on providing our customers quality, safety driven, products and services. All Fulton Hogan businesses are ISO9001 certified and our Stahlton Auckland and Christchurch plants have been certified by Precast New Zealand Incorporated.

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Acoustic rating

Stahlton Double Tees and a minimum 75mm depth of topping concrete will provide a Standard Transmission Class (STC) rating of 53dB. If a 9.5mm thick suspended ceiling is placed under the legs, a STC rating of 59dB is achievable, providing any gaps (e.g. recessed lighting),are insulated and limited to one every 5m^2.

Double tee acoustic rating

Topping thickness (mm)	STC	(dB)	STC	(dB) plus suspended ceiling
75	53		59	
100	54		60	

Thermal rating

Estimated thermal resistance ratings for Stahlton Double Tee and concrete topping are:

Double Tee thermal rating

Concrete Normal density	
0.045	R rating (m^2 °c/w) per 100mm thickness
Double tee + 75mm topping depth (mm)	R rating (m^2 °c/w)
Between the legs = 50mm flange thickness	0.056

These values are a guide only. Please contact Stahlton for further information.

Fire rating

Stahlton Double Tee floors with a minimum of 75mm of on-site topping concrete have a 90 minute Fire Resistance Rating (FRR). Refer NZS3101:Part1:2006 table 4.3 & 4.4 for one-way slabs. Increased FRR, up to 2 hours with single span Double Tees, is achievable in some circumstances. Please contact Stahlton if you wish to discuss further. Any penetrations through the Stahlton Double Tee flange must also be fire rated. Advice should be sought from the fire protection suppliers regarding suitability on their tested products.

Durability

Stahlton Double Tees meet exposure classifications A1, A2, B1 & B2 as per table 3.6 in NZS3101:Part1:2006 for a 50 year life.

Greater cover to the pre-stressing strands and a special concrete mix allow harsher environments to be achievable with Stahlton Double Tee section.

Roller Mills, Auckland

Consulting Engineers

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Loadings

Stahlton Double Tee floor systems are generally suitable for common loadings such as commercial, retail and car parks. The Load-span tables assume that there is **maximum strand** that the floor is un-propped, and that loads are uniformly distributed. Self-weight of the floor system applied with Load Factors of 1.2G and 1.5Q as per AS/NZS1170.0 have been allowed for in the design analysis, noting that ultimate demands tend **not** to govern.

For serviceability, partial pre-stress is applied so that the maximum crack width is 0.3mm and stress range in the reinforcement is not greater than 200MPa, deflections are limited to span/500, vibration limits to meet office use with damping ratio of 0.05 allows for full height partitions. Simply compare your unfactored superimposed live + dead load with the allowable shown on the table. Please note high dead loads will induce higher creep values than expected. Also loads as per cl 3.4.2(a) AS/NZS 1170.1 2002 have not been allowed for. If this is the case, please contact Stahlton for further advice.

Stahlton Double Tees can sustain point loads and line loads. However, significant loadings should be checked by a Stahlton Engineer at the preliminary design stage.

Intended unfactored loads and load factors should be clearly shown on the Consultant's drawings to avoid any confusion throughout the shop drawing and design process. Contact Stahlton for design advice if you have special loading case.

The Zeus Hanger

Zeus is an innovative new flanged support hanger for structured suspended precast concrete floors. Zeus has been developed by Stahlton as a cost-effective combined support and lifting detail for flange hung Stahlton Double Tees.

The hanger has been designed in accordance with AS/NZS 1170 and NZS3101:2006. It is the only hanger to date tested to the "Jensen Protocol" which recognise combined diaphragm elongation and beam rotation induced in flooring systems under extreme seismic loading. Zeus also comes hot-dipped galvanised for added durability.

End seating

All Stahlton Double Tee flooring systems require a minimum of 75mm or span/180, whichever is greater, seating on concrete walls or beams. If concrete supports are armoured or on steelwork the end seating can be reduced by 15mm as per cl 18.7.4 NZS 3101:Part1:2006. A construction tolerance of 10mm needs to be added to these figures. Refer NZS3109:1997 table 5.1. We also recommend the use of low friction bearing strips under the bearings of the Double Tees.

Double Tees can be supported at the end on the 55mm thick flange using Cazaly or Zeus hanger brackets. This avoids the contractor having to form the beams between the legs and allows the depth of the tee to be almost entirely within the required depth of the supporting beam. Other options are partial leg support and full leg support. Due to concentrated bearing pressures under longer spanning partial and full leg support tees we cast in a bearing plate at the bottom of the legs as a standard detail.

Topping

The topping concrete strength should be specified as a minimum of 25MPa as per cl 5.2.1 NZS 3101:Part1:2006. Floor reinforcement and saddle bars should be designed and shown on the Consulting Engineer's drawings. Steps in the topping can be formed using suitable density polystyrene, however the extra topping thickness needs to be accounted for as a gravity load, as well as the benefit of added stiffness, and allowed for in the design.

Zeus hanger bracket

In-house design

Our in-house design team is led by our National Technical and Design Manager, and we work with structural designers to provide an economical and bespoke design specifically for the needs of each structure and load case. Our National Technical and Design Manager is a Chartered Professional Engineer, signing off every shop drawing and provides a Producer Statement for the design (PS1) for every product Stahlton designs for your project. Through regular quality audits as part of our ISO9001 Certification Stahlton also provide Producer Statements for the Manufacture (PS3 & PS4).

Design weight including topping concrete

The self-weight of the various Stahlton Double Tee systems are:

75mm of 25MPa topping concrete

Double Tee depth (mm)	Self wt (kPa)
200	3.5
250	3.7
300	3.9
350	4.1
400	4.4
450	4.6
500	4.8
550	5.0
600	4.8

Double Tee units being placed on precast concrete frame

The Double Tee is an excellent choice for car-parks

Contractors

Temporary propping

Temporary propping is not usually required for Stahlton Double Tees.

If propping is required, such as for multiple storey buildings, back propping should be in place for a minimum of two levels below the level being constructed or to solid ground. Load on the "back-props" from the finished floors should be relieved, remaining snug, prior to the props supporting the level being constructed take wet concrete topping load.

The propping can be removed when the topping concrete strength has reached 15 MPa.

Topping

Care should be taken when pouring not to mound up the concrete in one place as this can produce high point loads during construction. Topping concrete levels generally should follow the camber of the Stahlton Double Tees, unless instructed otherwise.

Camber

Stahlton Double Tees will arrive at site with some camber (hog). This is unavoidable due to the nature of pre-stressing. The amount of camber will depend on a number of factors, including amount of prestress, how long the units have been manufactured exposed to the elements and length of the unit to name a few variables. Propping set to the required precamber (hog) will eliminate the camber variations between the double tees. Generally we predict in the design of the floor system that long term deflections will provide a near flat suspended floor. Please contact Stahlton if you have any queries.

Double Tee handling using Zeus hangers

Handling & storage

Stahlton Double Tees are usually lifted close to each end. Specifically designed lifting chains and hooks, or lifting clutches can be used to lift the units. Stahlton Double Tees will arrive on site with provision for hooks or lifting clutches to Zeus hanger, "swift lift" anchor or strand lifting eyes located at the ends. These anchoring points should be used without substitution. All lifting gear should be checked for any wear or damage regularly as concrete elements can be abrasive.

Stahlton Double Tees need to be dunnaged near the lifting points if stored on site. The dunnage blocks need to be aligned on top of each other so as to not induce large point loads on the units below.

Care needs to be taken as to the suitability of the ground the units are stored on and should be checked by a suitable qualified engineer.

Penetrations & fixings

An Information Bulletin IB95 Drilling, Cutting or Forming Holes in Suspended Concrete Floor Slabs, published by CCANZ, is available on the Stahlton website. Stahlton recommends that this document is read and adhered to.

Stahlton Double tees have a standard spacing of 1200mm centres between legs and can have penetrations up to 800mm wide through the flange section of the floor system. Coring through the legs should be avoided due the concentration of critical reinforcement. If a leg and strand is cut on-site, temporary prop either side of the penetration immediately, then contact Stahlton Engineered Concrete as a design check will need to be done to ascertain whether the unit is still structurally sound.

Fixings can be drilled into Stahlton Double tees using a hammer drill or "dyna-drill', maintaining minimum edge distances and avoiding the strands to gain adequate embedment. Please seek advice from the fixing manufacturer as to the suitability and the load carrying capacity of their products in Stahlton Double Tees.

Units can be laid out and designed with additional pre-stressing strands to allow for penetrations. However this needs to be thought about at the start of the project and built into the design before the units are cast, bearing in mind the design may already be at our prestressing limit and extra strand could induce more hog in the double tees.

Product data sheet

Double Tee flooring

Stahlton Double Tee is a large component, prestressed precast concrete unit which, with the addition of an in situ topping, forms a structural suspended floor suitable for use in most types of building. Double Tees are ideally suited to car-parks and supermarkets where large, column-free spaces are required. The large unit size and large span capabilities of the Double Tee system result in very fast construction times.

- The large units require no temporary propping and once in place provide an immediate working platform.
- The large span capability can also considerably simplify the floor support system, and when used with the Stahlton Shell Beam gives further economies and time savings.

The Stahlton Double Tee, up to 550mm deep, has parallel sided 200 mm wide webs for superior fire rating and durability performance if required.

Double Tee

Unfactored maximum superimposed live load (Qb) in kilopascals (kPa), (assuming no superimposed dead load ie. SDL = 0kPa).

75mm of 25MPa topping concrete

Double Tee	Self wt	Simply supported span (m)														
depth (mm)	(kPa)	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
200	3.5	14.0	8.0	4.7	3.7											
250	3.7		12.5	7.5	6.4	4.8	3.4									
300	3.9			12.9	9.1	6.9	5.3	4.0								
350	4.1				11.7	9.5	7.1	5.3	4.1	3.2						
400	4.4					12.0	9.1	6.9	5.8	4.6	3.7					
450	4.6					13.0	10.5	9.2	7.4	5.8	4.5	4.1	2.7			
500	4.8						12.8	9.9	8.1	7.1	6.1	5.0	4.2	3.3	2.6	
550	5.0							14.0	11.2	9.0	7.3	5.9	4.8	4.0	3.3	2.6
600	4.8								12.5	10.1	8.2	6.7	5.4	4.3	3.5	2.7

Notes regarding load/span tables:

1. Consideration needs to be given to long term creep effects due to higher superimposed dead loads. Contact Stahlton's technical people for guidance.
2. The Load Span tables assume loads are uniformly distributed. Consideration is required for shear actions induced from point loads. Again, contact Stahlton's technical people for advice.
3. Theoretical cambers have been limited to span/400. Consider higher cambers for situations close to the tabulated load limits.
4. Refer to Stahlton's website www.stahlton.co.nz for more information.
5. The actual prestress used and the capacity of the floor varies according to the design load specified.

Double Tee section properties

Section properties are based on standard widths of 2.4m plus a 75mm concrete topping. Composite section modular ratio = 0.67.

			Bare Unit					Composite unit				
Double tee	Unit wt	Overall	A	Y_b	I	Z_b	A'	Y_b'	I'	Z_b'	Z_t'
depth (mm)	(kg/m)	depth (mm)	x10^{3}mm^2	mm	x10^{9}mm^4	x10^{6}mm^3	x10^{3}mm^2	mm	x10^{9}mm^4	x10^{6}mm^3	x10^{6}mm^3
200	495	275	194	138	0.59	4.31	374	179	1.42	7.95	14.82
250	546	325	214	173	1.09	6.32	394	218	2.21	10.16	20.70
300	594	375	233	205	1.86	9.08	413	252	3.32	13.19	27.02
350	655	425	257	235	2.92	12.41	437	289	4.95	17.12	36.37
400	717	475	281	266	4.24	15.96	461	321	6.77	21.08	43.95
450	770	525	302	298	5.71	19.16	482	357	8.89	24.89	52.89
500	821	575	322	324	7.94	24.51	502	387	11.97	30.93	63.67
550	857	625	336	352	10.35	29.41	516	419	15.31	36.54	74.32
*600	819	675	321	398	11.30	28.39	501	467	16.31	34.93	78.42

*tapered leg in Christchurch

Important information on Stahlton Double Tees

End seating

Stahlton Double tee flooring requires a recommended minimum, and the greater of, 75mm or L/180 seating onto unarmoured concrete beam or wall A construction tolerance needs to be compensated for as per cl.18.74 NZS3101:Part 1:2006. Stahlton and the code requires the use of low-friction bearing strips.

Temporary propping

Stahlton Double tee flooring does not usually require propping.

Camber

Stahlton Double tees will arrive on site with a camber. This is unavoidable due to pre-stressing. Cambers will vary and be influenced by the amount of prestress required to resist the induced loads, length and age of the units exposed to the elements.

Handling & storage

Stahlton Double tees are designed to be lifted using hooks and chains to Zeus hanger, "swift-lift" lifting anchors or strand lifting eyes located at ends.

Double tees need to be dunnaged as close as possible to the lifting location and with blocks in line with the block below, on solid and even ground. Ensure lifting equipment is regularly checked.

Penetrations

Stahlton Double tee flooring does allow flexibility for accommodating penetrations in specific locations avoiding the strands. If a strand is cut on-site, place a prop either side and contact Stahlton's Technical Department for a design review. Also refer to our standard drawings for acceptable details for attaching fixings to the soffit of the double tees.

Specifications

Drawing call-up

To specify the Stahlton Double Tee on your drawings, we suggest you use the following designation:

Stahlton depth Double Tee

For example if the project is to be made from 300mm deep Stahlton Double Tee with a 75mm deep topping, then the specification would read:

Stahlton 300 Double Tee with 75mm topping

Written specification clauses

Stahlton Double Tee products in general comply with the following standards:

(i) NZS 3101:2006 'Concrete Structures Standard Part 1 & 2'

(ii) NZS 3109:1997 'Concrete Construction'

(iii) AS/NZS 4671:2001 'Steel Reinforcing Materials'

(iv) BS 5896:1980 'Specification for High Tensile Steel Wire and Standard for the Prestressing of Concrete'

Design

(i) The design of Stahlton Double Tee shall be in accordance with the requirements and recommendations of NZS 3101:2006 'Concrete Structures Standard Part 1 & 2' and/or any recognised international Standard or part thereof, for example BS 8110:2007 'The Structural Use of Concrete'.

(ii) The prestress strand pattern in the Stahlton Double Tee shall be designed to sustain the loadings shown on the Consulting Engineer's drawings and allowance will be made for self weight of the unit and topping concrete.

(iii) The Stahlton Double Tee shall be designed for exposure classification A1/A2/B2/B2 as per table 3.7 in NZS 3101:2006.

(iv) The Stahlton Double Tee unit shall have a FRR (Fire Resisting Rating) of 90/90/90. Penetrations through the flooring system shall be reinstated to the required FRR by an approved fire protection system.

(v) Stahlton Double Tee shall be designed to have a maximum crack width of 0.3mm under full live load conditions.

(vi) The acoustic STC (Sound Transmission Class) and IIC rating of the floor system shall meet or exceed 55dB as tested at a registered institution or a field test of 50dB measured in 'on-site' conditions. These ratings apply to the finished floor system, including any carpeting and suspended ceiling systems.

(vii) The Stahlton Double Tee units shall have a minimum end seating detailed by the engineer plus tolerance of 20mm if seated on an unamoured concrete beam.

Materials

(i) Concrete shall be specifically mixed depending on environmental conditions and should have a 28 day cylinder strength of 50MPa as a minimum.

(ii) All concrete shall show signs of thorough compaction otherwise rejected if repair cannot be undertaken to bring the unit back to the original specification.

(iii) An air entraining agent complying with BS EN 934-2-2001 may be included in the concrete mix to improve workability.

(iv) The strand reinforcement used in Stahlton Double Tee shall be 11.3mm, 12.7mm or 12.9mm diameter complying with the requirements of AS/NZS 4671:2001.

(v) Prestressing strand shall be clean and free from deleterious substances. Superficial rust is acceptable, however strand with corrosion that has caused surface pitting shall be rejected for the main longitudinal reinforcement of the unit.

Manufacture

(i) Materials, execution of stressing prestress strand and workmanship of the Stahlton units shall conform with Stahlton Engineered Concrete ISO 9001 Quality Assurance Operating Procedures.

(ii) Stahlton Double Tee units shall be nominally 2400mm wide and made in nominal depth of 200mm, 250mm, 300mm, 350mm, 400mm, 450mm, 500mm and 550mm.

(iii) The top surface of the Stahlton Double Tee unit shall have a nominal roughness of 5mm or more as stipulated in NZS3101:2006 clause 18.5.4.1(a).

(iv) The tolerance for length of the Stahlton Double Tee units shall be in accordance with NZS 3109 Table 5.1 (usually **+/-** 10mm - 20mm).

Handling, protection & placing units

(i) The Double Tee units shall to be designed to sustain all lifting stresses.

(ii) The Double Tee units shall be lifted only at the lifting position as nominated by the manufacturer.

(iii) The Double Tee units shall be handled using certified lifting hooks or clutches. Chain angles must not exceed 30 degrees to the vertical and must be checked regularly for wear and tear.

(iv) Dunnage used for storing the Double Tee units needs to be of suitable quality and placed on 'good' ground at the correct points in from the end of the units.

(v) Where units are stacked one above the other, bearing dunnage shall be positioned in vertical lines.

(vi) The Double Tee units shall be handled and placed according to references contained in the Occupational Safety & Health approved code of practice entitled 'Safe Handling, Transportation and Erection of Precast Concrete'

(vii) The units shall not be damaged in any way including chips and cracks during the erection and placing phase. Any damage should be brought to the attention of the supervising Engineer immediately.

Temporary propping

(i) Design of temporary propping, back propping, bracing systems and ground conditions to support prop loads shall be carried out by a suitably qualified Engineer.

(ii) Propping shall not be removed until the topping concrete has reached at least 60% of the 28 day strength.

(iii) It is the Contractor's responsibility to ensure the propping system used on site meets the criteria as detailed in the aforementioned design and any additional requirements shown on the Stahlton Engineered Concrete drawings.

(iv) All proposed systems with supporting calculations shall be submitted to the Specifying Engineer prior to erection on site for approval.

Topping concrete

(i) The top surface of the Double Tee units shall be clean and free of all dust, oil or any deleterious substances which may adversely affect the wet topping bond to the Double Tee units.

(ii) Pre-wet precast concrete surfaces prior to placing the topping concrete.

(iii) Free water shall be broomed away before the topping is applied.

(iv) Topping reinforcement shall be laid and supported to the Specifying Engineer's requirements and shall be supported to prevent displacement during concreting.

(v) Topping concrete shall have a maximum aggregate size of _____ (normally 13mm) and a 28 day strength of _____ (minimum of 25MPa) and be well compacted with mechanical vibrators.

(vi) Topping concrete shall be poured to a true surface so that the specified thickness of _____ (minimum of 75mm) is achieved at the centre of the span.

(vii) In-situ concrete shall be cured by the application of an approved curing membrane or by being kept continuously wet for not less than seven days.

Fixings & penetrations

(i) Fixing to the Double Tee units shall be in accordance with the approved details only and shall not impair or reduce the strength of the unit in any way.

(ii) Documentation of tested fixings proposed for the project shall be submitted to the Specifying Engineer prior to installation.

(iii) Penetrations, setdowns or chases to the Double Tee unit or topping concrete shall be in accordance with the details agreed by the Specifying Engineer and the Double Tee manufacturer prior to any work being undertaken on site.

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