# Shell Beams

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ENGINEERED CONCRETE
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Product brochure

## Shell Beams

### A simplified flooring solution

**If you are looking for a quick and efficient formwork system, the Stahlton Shell beam is the solution for you. Shell beams are commonly used with Stahlton precast floor systems to streamline building programs and reduce on-site labour. Pre-stressed shell beam units, with the addition of a reinforcing cage and on-site concrete, form a structural beam with clean steel formed appearance.**

**When completed, the steel mould surfaces are tidy and suitable for receiving further treatment such as paint or textured spray. Shell beams are suitable for movement resisting frames in seismic regions. The units are pre-stressed in conjunction with conventional reinforcing for maximum efficiency of the shell beam units.**

PRECAST NEW ZEALAND INC CERTIFIED PLANT

**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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## General

Stahlton Engineered Concrete supplies Shell beams to any location in New Zealand. Stahlton Shell beams come in 400mm or 600mm standard widths and available in varying depths up to 600mm. The legs on each side can vary in height to form building edges or steps in the building.

Shell beams speed up and simplify construction by reducing mid-span propping and providing a steel mould precast like surface finish economically.

## Durability

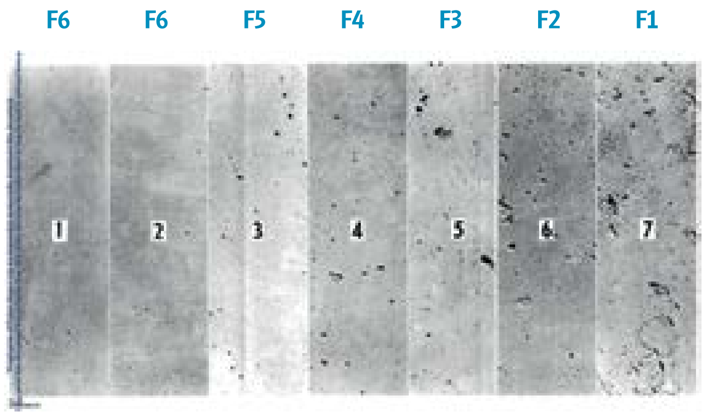
Stahlton Shell beams meet exposure classifications A1, A2, B1 & B2 as per table 3.6 in NZS3101:Part1:2006 for a 50 year life. Greater cover to the pre-stressing strands and a special concrete mix allow harsher environments or longer design life to be achievable.

## Fire rating

All Stahlton Shell beams have a minimum Fire Resistance Rating (FRR) of 2 hours. Refer NZS3101:Part1:2006 table 4.6. Increased FRR, up to 4 hours is achievable in some circumstances; please contact Stahlton if you wish to discuss further. Any penetrations through the Shell beams must also be fire rated. Please seek advice from the fire protection suppliers regarding suitability of their tested products.

## Surface finishes

Refer NZS3114:1987 for the descriptions of the various surface finishes available for you to specify your needs; off the mould, eg. "F6" (number 1 & 2 on photo below) to "F1" (number 7), off the trowel, eg. "U3" or any special surface like timber boards, polished (honed), exposed aggregates, lettering, etc. Stahlton can typically achieve F5 finishes. However, we can also tailor the finish to suit your specific needs at an additional cost.



# Consulting Engineers

## Loadings

Stahlton Shell beams for floor systems are suitable for generally common loadings such as commercial, retail and car parks. The positive moment capacity tables are for ultimate limit state and assume that there is maximum strand and exclude core reinforcement.

## End seating

Stahlton Shell beams typically sit a minimum of 20mm seating onto the columns or supporting element while propped a maximum of 300mm from each end during construction. A construction tolerance noted in NZS3109:1997 table 5.1 needs to be allowed for.

## Topping

The topping concrete strength should be specified as a minimum of 25MPa as per cl 5.2.1 NZS 3101:Part1:2006. Core reinforcement, floor reinforcement and saddle bars should be designed and shown on the Consulting Engineer's drawings.

## In-house design

With our in-house design capability, led by our National Technical and Design Manager, 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 core topping concrete

The self-weight of the various Stahlton Shell beams including the core to underside of the floor system are:

| Section depth, mm x width, mm | Self wt (kN/m) |
|---|---|
| 400dx400w | 4.0 |
| 600dx400w | 6.0 |
| 400dx600w | 6.0 |
| 600dx600w | 9.0 |

Shell beams supporting rib and infills



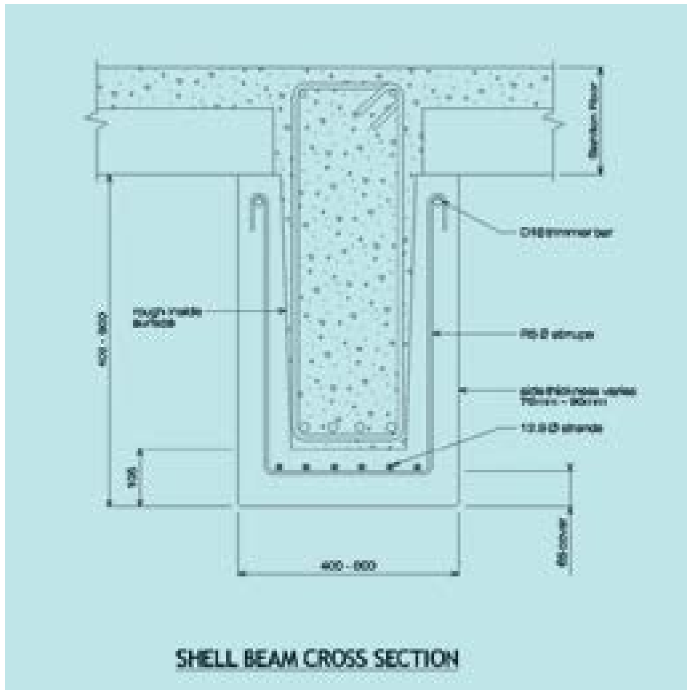
## Design & manufacture

The precast shell cannot be designed as an isolated structural element. For this reason units are made to details and actions supplied by others. Units are manufactured to length from minimum 45MPa concrete in steel moulds. Maximum pre-stress is 6 strands, 12.9mm diameter with characteristic breaking load of 184kN in 400mm wide units located 70mm from the soffit of the shell beam, and 8 strands in 600mm wide units.

All beam shear reinforcing should be designed for incorporation within the in situ core. The beam shells are too thin to accommodate effective shear reinforcing.

For incorporating shell beams for moment resisting frames in seismic regions, the shell portion of the section is excluded in the plastic hinge regions so all seismic actions are resisted entirely from the core reinforcement and section.

The inside of the Stahlton Shell beams have a clean exposed aggregate finish for a secure bond with the in-situ core concrete to create a composite section. If the bond stress limit is exceeded through horizontal shear demand, particularly for shorter vertical leg heights and in cases of nil seating, tie reinforcement is cast at the ends of the shell beam to provide additional connectivity between the shell and the core.




## Further information

Designers should contact Stahlton technical staff early in the design process to ensure the most effective use of, not only the prestressed units, but also the associated structural and architectural detailing. Preliminary design advice, cost estimates and specifications are available on a no obligation basis.

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 Technical Department if you have special loading cases for design advice.

There are 3 Stahlton Design Responsibility scenarios:

1. **Design of the shell only.**

   Stahlton will design the shell beams as a shell only to span between the temporary propping locations. The shells will be designed to support loads from the construction of the composite floor only. Beam composite section design and continuity at supports is by others.

2. **Design of the shell to support loads during construction of the floor and design of the beam composite section (+ve midspan moment)**

   Stahlton will design the shells beam to span between the temporary propping locations while supporting loads from the construction of the composite floor.

   Stahlton will design the beam as a composite section to resist midspan (+ve) moment assuming the shell core reinforcement shown on the consultants is incorporated in the beam. Dead (if beams are propped in their span) and live load continuity moment design is by others.

Or

The composite section has been designed for the precast concrete floor loading specified by the project's design engineer.

3. **Shell during construction plus full frame action (+ve/ -ve bending moments)**

   Stahlton will design the beam shells to span between the temporary propping locations while supporting loads from the construction of the composite floor.

   Stahlton will design the beam as a composite section to resist mid-span positive moment and negative end moments provided by the project's design engineer.

# Contractors

## Temporary propping

Temporary propping is usually required for Stahlton Shell beams. Shell beams shall be propped within 300mm from each end and then equally spaced between as shown on our layout shop drawing to the precamber shown (X) in mm.

Stability during construction of the shell beams, including propping is the responsibility of the contractor. Care must be taken and allowance made in the contractors design for variations of all construction loads acting on opposite sides of the shell beams, for example edge beams as well as load variations during pouring the topping concrete.

For multiple storey buildings back propping should be in place for a minimum of 2 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 15MPa.

## 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.

## Camber

Stahlton Shell beams 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, time since the units were manufactured and exposure to the elements and length to name a few variables. Generally we predict in the design of the floor support system that long term deflections will provide a near flat suspended floor. Please contact Stahlton if you have any queries.

## Handling & storage

Stahlton Shell beams are usually lifted close to each end. Specifically designed lifting chains and and lifting clutches can be used to lift the units. The Stahlton Shell beams will arrive on site with provision for lifting clutches. 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 Shell beams 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. Handling weights of Stahlton Shell beams are:

| Section depth, mm x width, mm | Self-weight, kg/m |
|---|---|
| 400dx400w | 245 |
| 600dx400w | 330 |
| 400dx600w | 300 |
| 600dx600w | 380 |

## 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 recommend this document is read and adhered to.

Stahlton Shell beams can have penetrations formed or core drilled through the upstand section of the shell beam and coring through the bottom flange should be avoided due the concentration of critical reinforcement. If a strand is cut on-site, temporary prop either side of the penetration immediately, then contact Stahlton Engineered Concrete as a design check wiill need to be done to ascertain whether the unit is still structurally sound.

Fixings can be drilled into Stahlton Shell beams using a hammer drill or "dyna-drill", maintaining minimum edge distances and avoiding the strands to gain adequate embedment. Advice should be sought from the fixing manufacturer as to the suitability and the load carrying capacity of their products in Stahlton Shell beams.

Shell beam units

# Product data sheet

### Shell beam section – Precast unit only

This table gives the ultimate moment and ultimate shear capacity for individual simply supported shell beams.

| Precast unit depth, mm | 400 | | 600 | |
|---|---|---|---|---|
| Precast unit width, mm | 400 | 600 | 400 | 600 |
| Ultimate resisting moment, kNm | 123 | 156 | 225 | 292 |
| Ultimate resisting shear, kN | 210 | 210 | 330 | 330 |

### T-Beam composite section using Stahlton flooring products

This table gives composite section ultimate moment capacities (kNm) at mid-span for individual simply supported shell beams. Width of T-flange overhang is 8 x topping thickness of 75mm concrete:

Additional capacity is available using specific design adding reinforcement in the core to resist negative moments at the ends and/or additional mid-span capacity.

| Precast unit Depth, mm | | 400 | | | 600 | |
|---|---|---|---|---|---|---|
| Precast unit width, mm | 400 | 600 | o/a depth | 400 | 600 | o/a depth |
| 50mm flange Double Tee | 348 | 457 | 525 | 519 | 685 | 725 |
| 75mm Flat Slab | 369 | 485 | 550 | 540 | 714 | 750 |
| 100mm Rib | 410 | 536 | 600 | 580 | 767 | 800 |
| 150mm Hollowcore & 125mm Rib | 433 | 571 | 625 | 605 | 800 | 825 |
| 200mm Hollowcore & 175mm Rib | 476 | 628 | 675 | 647 | 857 | 875 |
| 300mm Hollowcore & 275mm Rib | 559 | 739 | 775 | 730 | 968 | 975 |
| 400mm Hollowcore | 641 | 848 | 875 | 811 | 1075 | 1075 |

### Shell beam geometric section properties – Precast unit only

| Section depth, mm x width, mm | A, x103mm2 | Yb, mm | Ixx, x109mm4 |
|---|---|---|---|
| 400dx400w | 96 | 161 | 1.340 |
| 600dx400w | 128 | 244 | 4.173 |
| 400dx600w | 116 | 141 | 1.559 |
| 600dx600w | 148 | 218 | 4.845 |

**Notes:**

Refer to our website for additional information and details of shell beams.

Depth of shell beams can be varied between 250mm and 600mm and the webs can differ in height.

Contact Stahlton's Technical & Design office for additional information and queries.



Shell beam can be used on residential apartments

# Specifications

## Drawing call-up

To specify the Stahlton Shell beam system on your drawings, we suggest you use the following designation:

Stahlton width Shell beam with depth overall

For example if the project is to be made from 400mm wide Stahlton Shell beam with a 600mm depth overall, then the specification would read:

Stahlton 400mm wide Shell beam, 600mm deep overall

## Written specification clauses

Stahlton Shell beam 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 Shell beam 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 Shell beam 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 Shell beam shall be designed for exposure classification A1/A2/B2/B2 as per table 3.6 in NZS 3101:2006.

(iv) The Stahlton Shell beam 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 Shell beam 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 Shell beam units shall have a minimum of 20mm end seating propped within 300mm from ends during construction, plus tolerance of 15mm if seated of 15mm 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 45MPa 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 Shell beam 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 Shell beam units shall conform with Stahlton Engineered Concrete ISO 9001 Quality Assurance Operating Procedures.

(ii) Stahlton Shell beam units shall be nominally 400mm or 600mm wide.

(iii) Theinnersurface of the Stahlton Shell beam 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 Shell beam units shall be in accordance with NZS 3109 Table 5.1 (usually +/- 10mm).



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## Handling, protection & placing units

(i) The Shell beam units shall to be designed to sustain all lifting stresses.

(ii) The Shell beam shall be lifted only at the lifting position as nominated by the manufacturer.

(iii) Shell beam 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 Shell beam 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 Shell beam 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 Shell beam units shall be clean and free of all dust, oil or any deleterious substances which may adversely affect the wet topping bond to the Hollowcore 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. The key-ways between each Shell beam unit must also be filled with well-compacted topping concrete.

(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 Shell beam 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 Shell beam unit or topping concrete shall be in accordance with the details agreed by the Specifying Engineer and the Shell beam manufacturer prior to any work being undertaken on site.

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