HOLLOW-CORE TECHNICAL MANUAL

1ST EDITION 2023

TOPFLOOR

ECHO

Group of Companies

Table of CONTENTS

Our STORY

Since its establishment in 1983, Echo has developed a reputation of excellence in the provision of innovative and cost efficient flooring solutions. As industry leaders, the Echo Group has served an array of prestigious and loyal clients.

A range of hollow core walls; security and retaining, in both vertical and horizontal handling configurations, have been available since 2008.

The aim of our company is to provide over the top service and to design the most cost-effective floor, wall and stair solutions for our valued clients.

With the assistance of our own specialist in-house design office, we are able to provide our clients and their team of professionals with a design solution. From the initial concept to the final design, this co-operative approach to construction reduces costs, improves quality and results in an efficient use of products.

By combining our renowned expertise in precast, the group can deliver a total precast structural solution that meets specific construction needs.

Creating the perfect solution is key.

HOLLOW-CORE

Floor & Wall solutions

Hollow-core products include:

- Prestressed floors
- Prestressed security walls
- Prestressed retaining walls (both gravity and cantilever methods)
- Solid beams
- Precast prestressed lintels
- Precast stairs.

The pioneers

We have demonstrated versatility, quality and confidence in using a high quality, safe and economic method of construction in hundreds of projects.

The fact that we provide an overall floor or wall solution has secured many and diverse projects.

A complete service

Our hollow-core products are designed, manufactured and installed by us, as a part of our commitment to providing economical flooring and walling solutions.

From the initial concept through to the design and installation, Echo hollow-core is a complete service which can be tailored to meet specific structural requirements.

Hollow-core benefits include:

- Factory manufacturing
- Reduced on-site labour
- Rapid construction (speed)
- Design flexibility
- Durability of the end product
- Long spans; up to 11m
- Fire resistance – according to clause 7.3 of SANS 10100 – IED 2.2 Table 46
- Quality management system similar to ISO9001 2015
- Manufactured to SANS 1879 2011
- Pre-planning is the secret of success in using hollow-core.

Versatile applications

- Factories and industrial developments
- Churches, sporting facilities / stadiums and cinema seating
- Galleries
- Apartments
- Individual houses and house additions
- Cluster developments
- High density housing
- Townhouses
- Offices
- Reservoir roofs
- Attenuation tank roofs
- Suspended ground floor slabs
- Medium rise load bearing masonry structures up to 6 floors

Overview of prestressed hollow-core casting procedures

CAST ON STEEL BEDS

Reinforcing type

Slip-formed on continuous steel beds and reinforced with prestressed wire and strand:

- Wire: Triple indented low relaxation 5.0mm wire
- Strand: Stabilised 9.3mm and 12.5mm strand

The steel should be free from loose or heavy rust, scale, oil or grease, or any material that might interfere with the bond between the reinforcement and concrete.

The wiring patterns are determined according to slab depth, length and imposed load requirements.

The wire and strand are stressed to 70% of their ultimate capacity.

Concrete strength:
The 28-day compressive strength of the concrete mix is 50 MPa (the high strength concrete facilitates rapid curing).

Curing:
The casting beds are heated all year round and the slabs cure under a tarpaulin, for 8 - 12 hours to achieve a minimum recommended 35 MPa before de-tensioning and stripping the panels from the casting beds.

Availability:
This is a purpose-made product; delivery is possible in 5 - 10 days depending on the complexity and slab depths required.

Prestressed hollow-core standard sizes

Standard depths:	120 mm, 150 mm, 170 mm, 200 mm, 250 mm
Standard lengths:	In 100 mm increments up to 11 m
Standard width:	1200 mm
Non-standard widths:	In 100 mm increments

Our slabs and the way we manufacture them.

Our

SERVICES OFFERED

- Design and engineers' certificate for the slab, stairs and beams only
- Manufacture
- Delivery and installation
- Lining levelling of the slabs to ensure a level soffit (ceiling)
- Grouting of the longitudinal joints

The secret to success when using precast slabs is all in the pre-planning

The reasons why:

- To economise the design
- To solve aesthetical issues upfront
- To provide solutions for engineering concerns
- To devise a project methodology to optimise the efficiency of cranes and to minimise the crane size required

We provide a slab solution to clients, not just a product.

Even though we are involved with the design development of a project, the principal engineer remains responsible for the structural integrity of the building. We only provide the engineer's certificate for the slab.

Manufacture

We employ the slip-formed method of construction, and this method is suitable for a pretensioned long-line system of manufacture, without transverse or shear steel.

The manufacturing beds are typically 130 m long and the slab is cut to required lengths before lifting. The longitudinal edges of the precast units are designed and profiled to receive grout in the joints and to create a shear interlock which provides load transfer and prevents differential deflection. The top surface is generally prepared to receive a screed or structural topping. Because they are cast on a steel surface, the soffits are smooth and ready to receive a decorating finish direct without the need for plastering.

Delivery & installation

This is generic to all companies; the panels are delivered to site on 25 - 30 ton trucks and hoisted into position by mobile or truck-mounted cranes. This means that clear and sound access to the building on which the slabs are to be erected is required. A gate access of 3.5m is required with no obstructions in the gateway.

Where the crane is established with the stabilising outriggers a clear 7 m area is required. The installation of 400m² per day, per installation team is possible. Long distance projects with installations of 250 - 300m² per day is possible. We use various size cranes depending on the site requirements and access available. Should a suspended slab be required inside an existing building, the entrance available must be a minimum 4.5m high and 3.5m wide, provided there is sufficient turning space in front of the entrance for articulated trucks.

Lining & leveling of the slabs to ensure a level soffit (ceiling)

To obtain a flush ceiling on brickwork, the load bearing walls must be level. Avoid internal walls being higher. If brickwork is not level, a mortar bed may be required on top of the brickwork.

We do line and level as best possible on un-level brickwork, but packers are used to line and level. The space between the brickwork and the slab must be hard packed with a dry mortar mix prior to the slab being loaded with bricks and before any traffic is allowed above the slab.

Our

SERVICES OFFERED

cont.

Grouting of the longitudinal joints

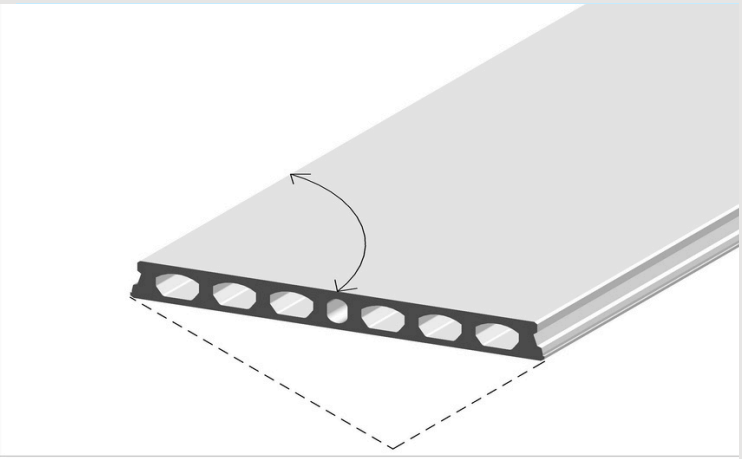
The grouting forms part of structural integrity of the slab, therefore Echo do the grouting according to a strict procedure. The side profiles provide for load distribution through the shear key provided by the grouting, from one slab to the other. The prestressed system has a wine glass shape which ensures the grout does not pop out. (This service is not offered by Topfloor).

The grout mix is a 3:1 River sand to cement ratio. The approx. quantities are as follows:

- The 120 mm, 150 mm, 170 mm and 200 mm slabs require 1 m^3 of river sand and 10 pockets of ordinary Portland cement per 100 m^2 of slab.
- The 250 mm deep slabs require 1.5 m^3 of river sand and 15 pockets of cement per 100m^2.

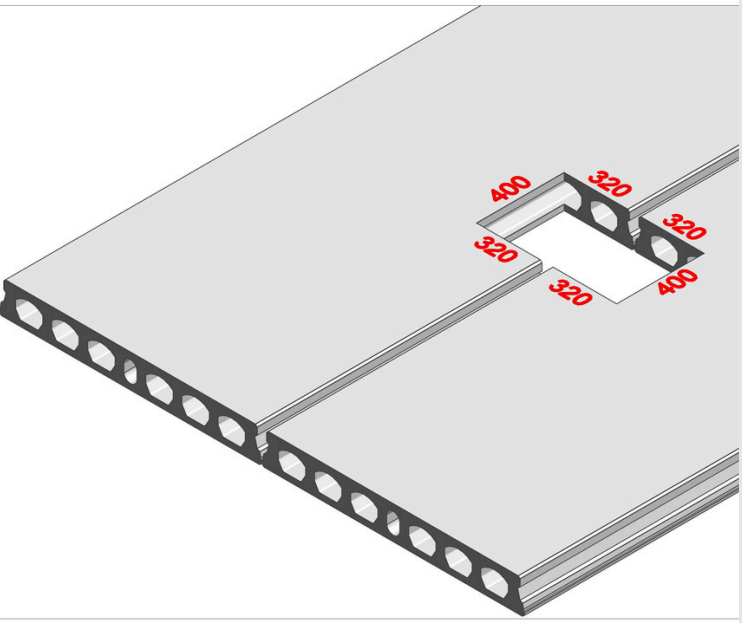
How to create

OPENINGS IN A ONE-WAY SPANNING SLAB



Steel hangers

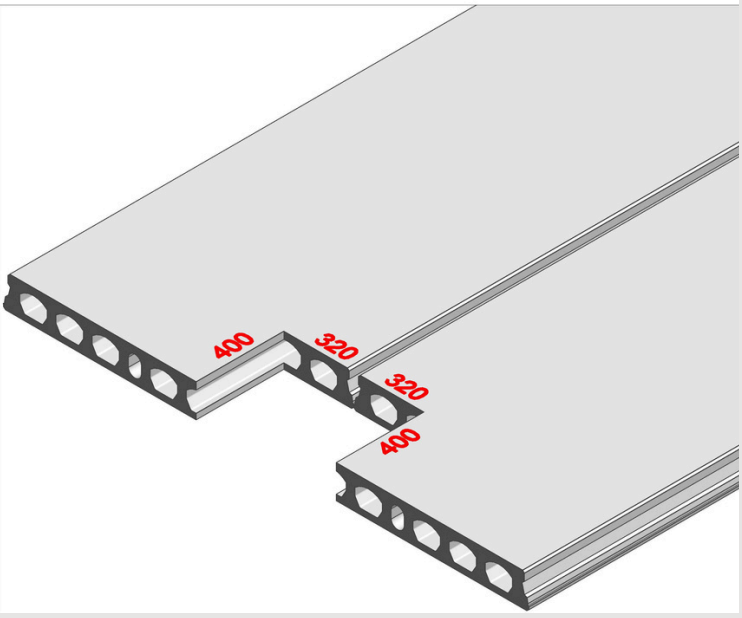
- Steel hangers are used to provide openings for walkways, staircases, skylights, etc.
- Openings can be pre-formed in the factory to accommodate services
- Small openings by coring on site



Does the coring affect the slab strength with cutting through the tendons? No.

As the tendons are embedded in the concrete, they recover their full stress in about 300 mm.

NOTE, however, there is a limit to the number of holes that can be made in a single panel.



Do all buildings have to be designed in 1200 mm increments and be rectangular? No.

The panels can be cut to non-standard widths to match on-site dimensions.

The panels can be cut in 100 mm increments up to a minimum of 300 mm wide.

Angular cuts are also possible to fit reservoirs and angular buildings.

Cantilever criteria

Cantilevers are designed to suit special loads and requirements. Avoid high loads at the ends of the cantilever, for example, on gable walls.

- 120 & 150 mm slabs: cantilevers up to a maximum of 9 times this slab depth
- 170 mm slabs: up to a maximum of 8 times this slab depth
- 200 & 250 mm slabs: up to a maximum of 7.5 times this slab depth

Span-to-depth ratio comparison

	Ratio	Span	Slab depth required
In situ:	20	5.0 m	255 mm
Beam & Block:	30	5.0 m	170 mm
Prestressed Hollow-core:	45	5.0 m	120 mm

An added benefit is that hollow-core is 30% lighter than an equivalent depth in-situ slab, which results in a reduction in dead load. Therefore, the support structure and foundations can be more economical than with in-situ.

Thermal resistance values for slabs with & without 60 mm concrete topping

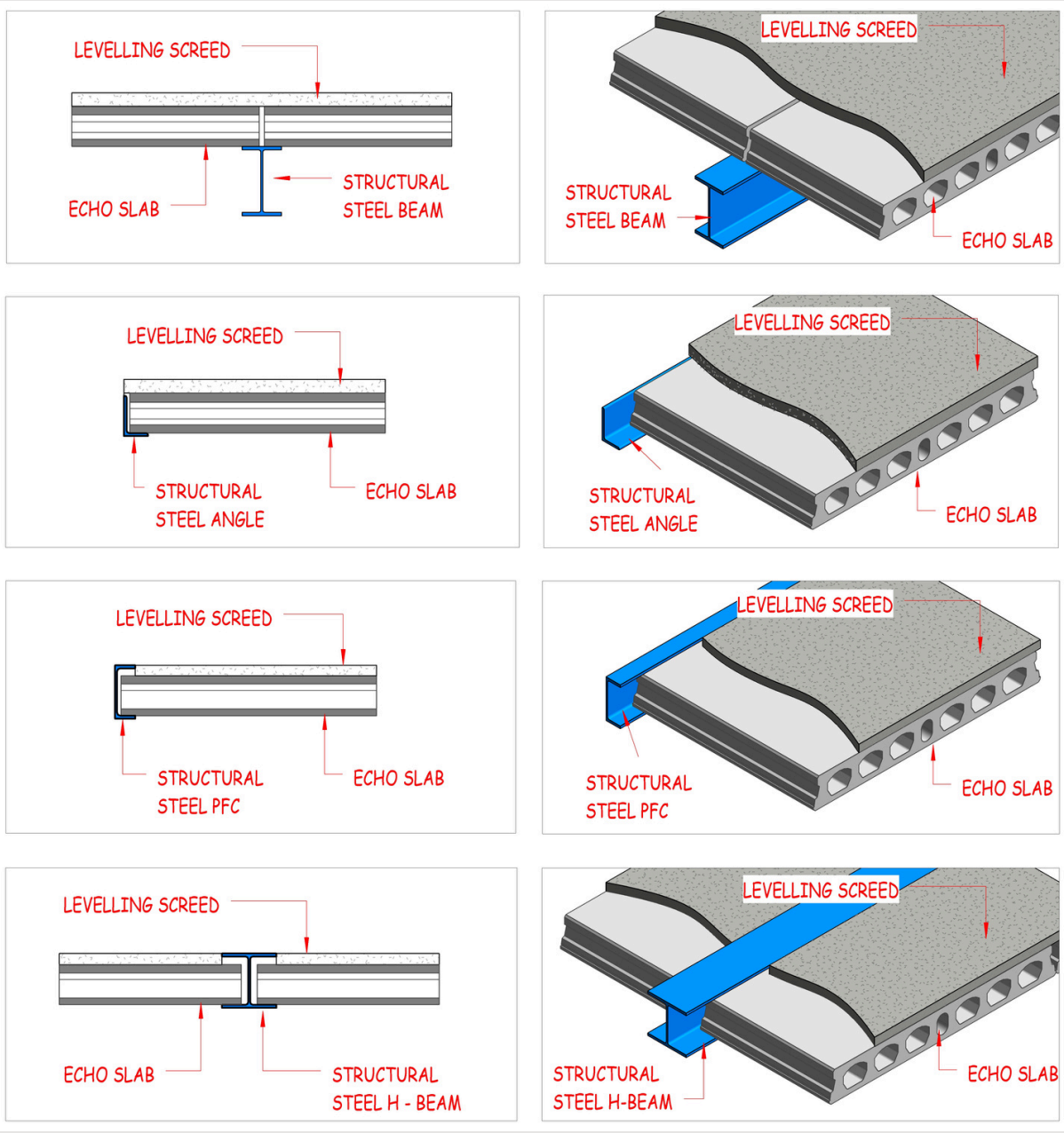
Slab depth	R value	U value	Noise reduction (db)
Hollow-core slab without concrete topping			
HCS 150	0.12	8.33	50
HCS 170	0.13	8.25	51
HCS 200	0.15	6.67	53
HCS 250	0.19	5.26	56
Hollow-core slab with 60 mm concrete topping			
HCS 150 + 60	0.16	6.25	53
HCS 170 + 60	0.17	6.15	54
HCS 200 + 60	0.19	5.26	56
HCS 250 + 60	0.23	4.35	59

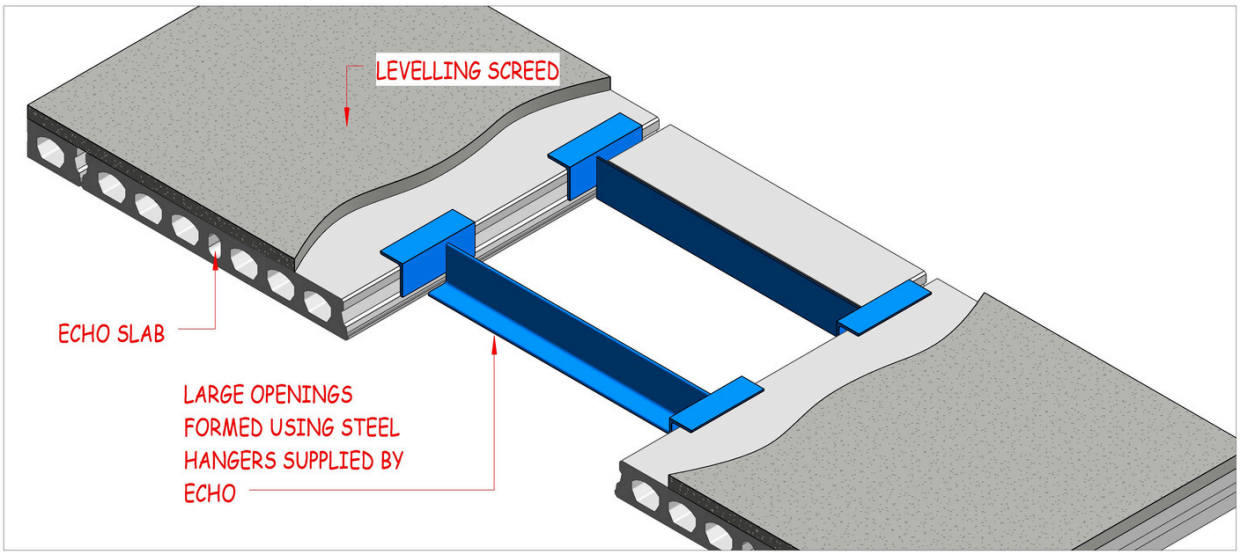
Structural

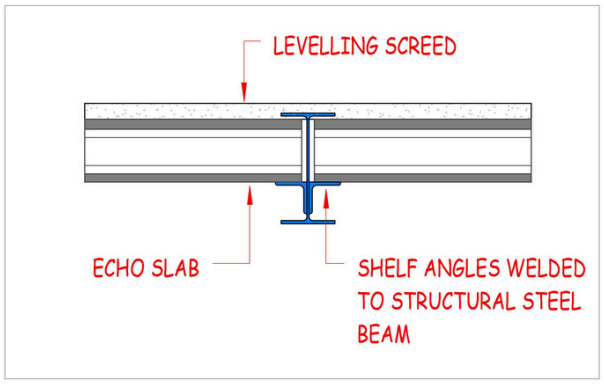
STEEL BEAMS

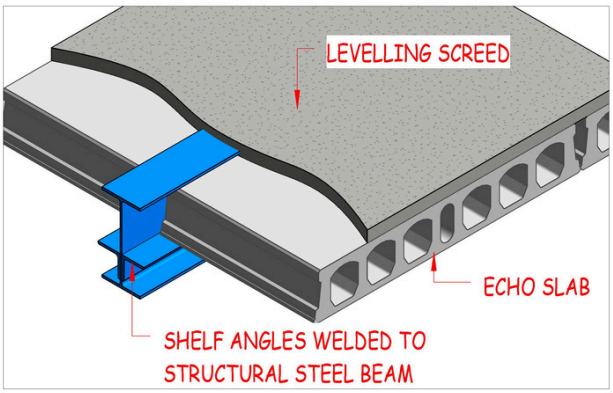
Echo use various steel sections to support the slabs over openings in load bearing walls or between load bearing columns. The steel sections and applications vary to suit the requirements on site.

We endeavour to use steel sections as unobtrusively as possible, by placing the panels into the beams flanges or by encasing the beam in the brickwork.




LEVELLING SCREED
ECHO SLAB
LARGE OPENINGS FORMED USING STEEL HANGERS SUPPLIED BY ECHO


LEVELLING SCREED
ECHO SLAB
SHELF ANGLES WELDED TO STRUCTURAL STEEL BEAM


LEVELLING SCREED
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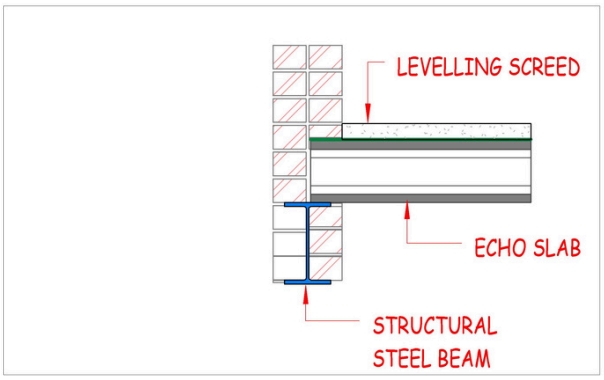
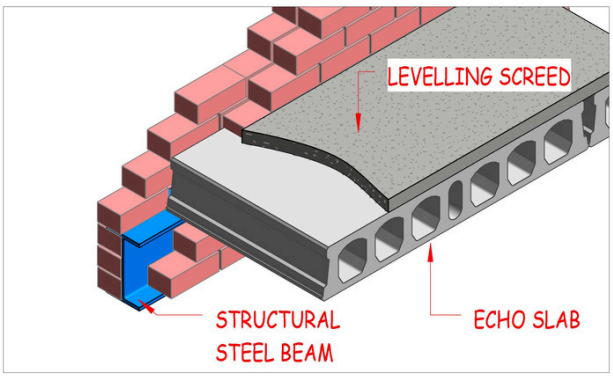
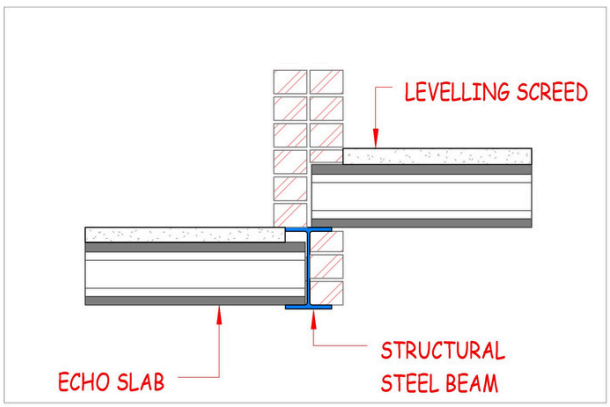

LEVELLING SCREED
ECHO SLAB
STRUCTURAL STEEL BEAM


LEVELLING SCREED
STRUCTURAL STEEL BEAM
ECHO SLAB


LEVELLING SCREED
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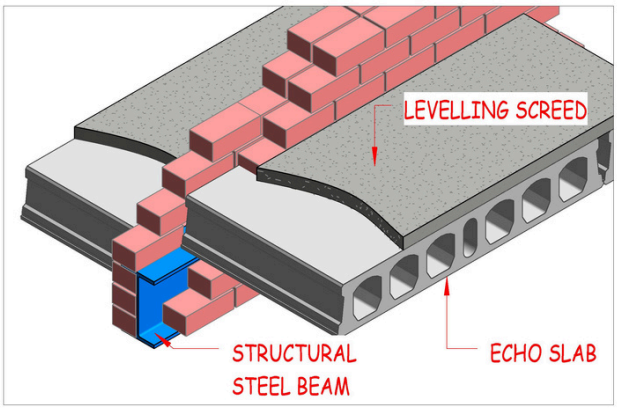
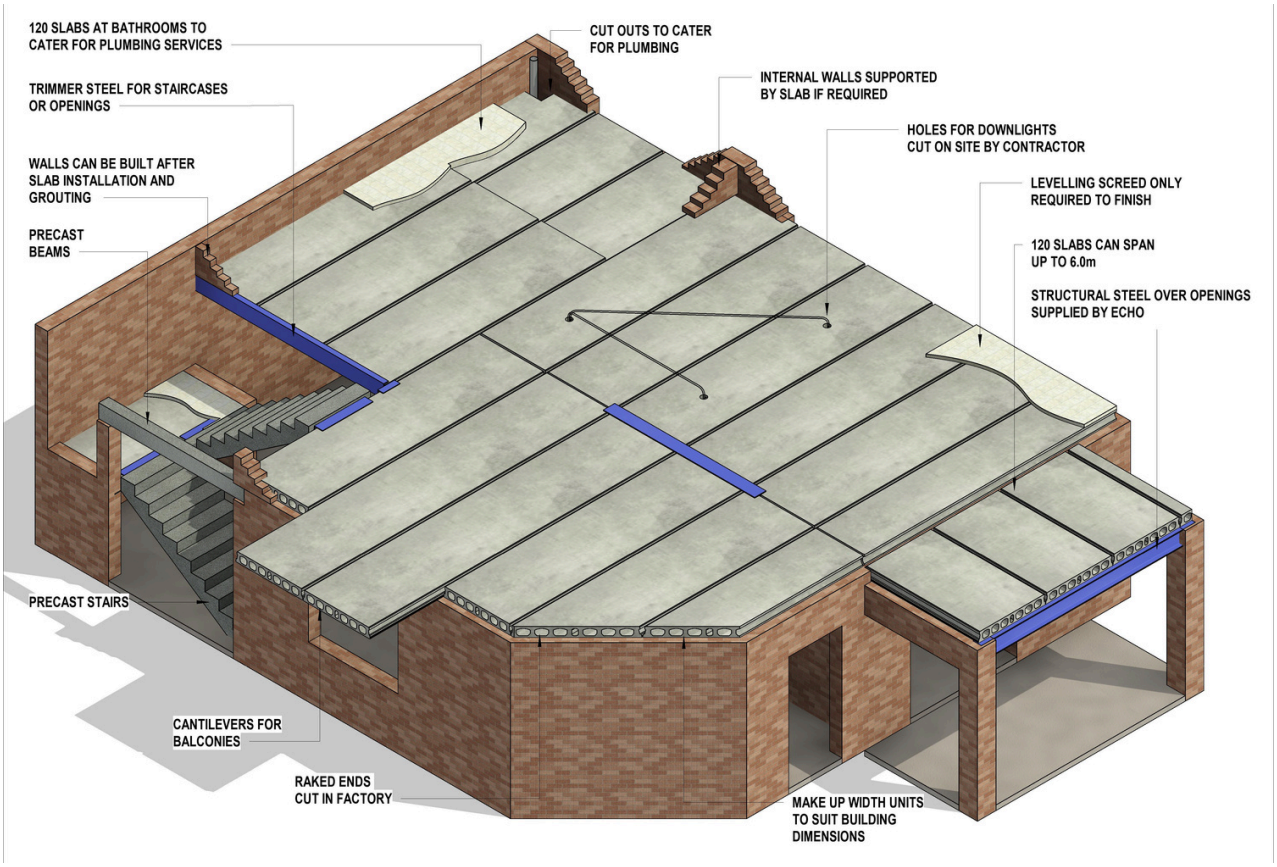
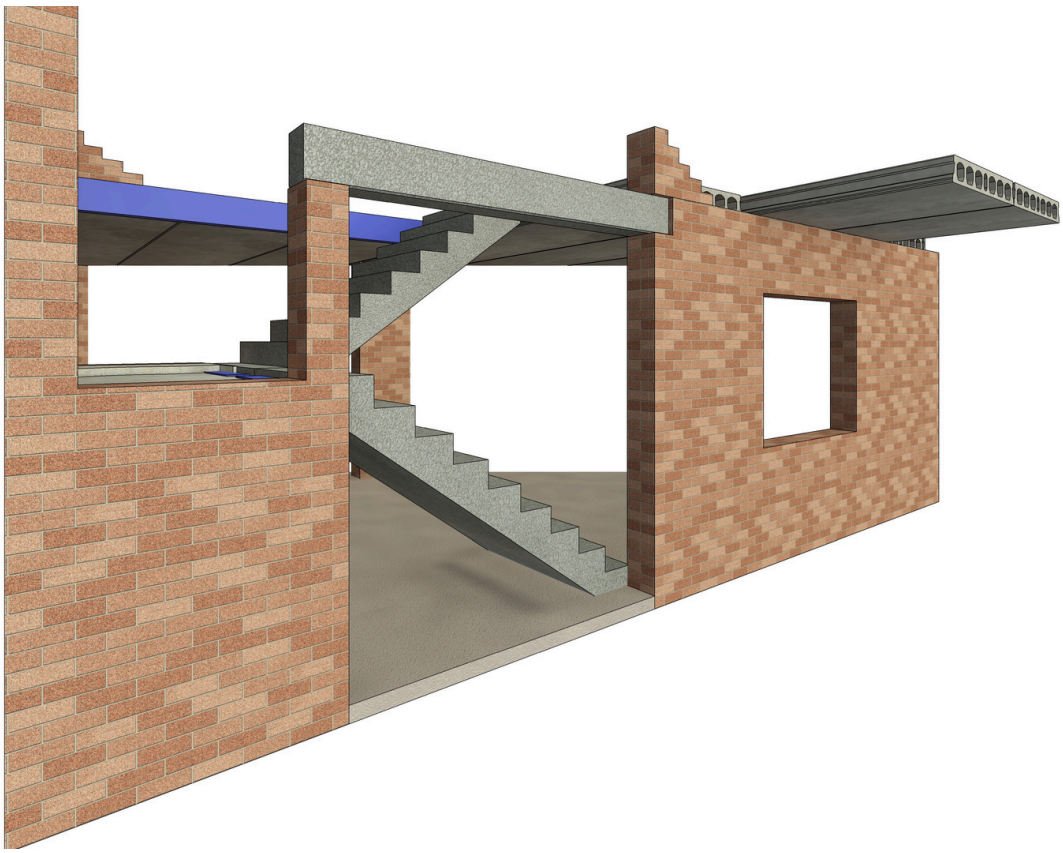
STRUCTURAL STEEL BEAM


LEVELLING SCREED
STRUCTURAL STEEL BEAM
ECHO SLAB

Typical Details using Hollow-Core



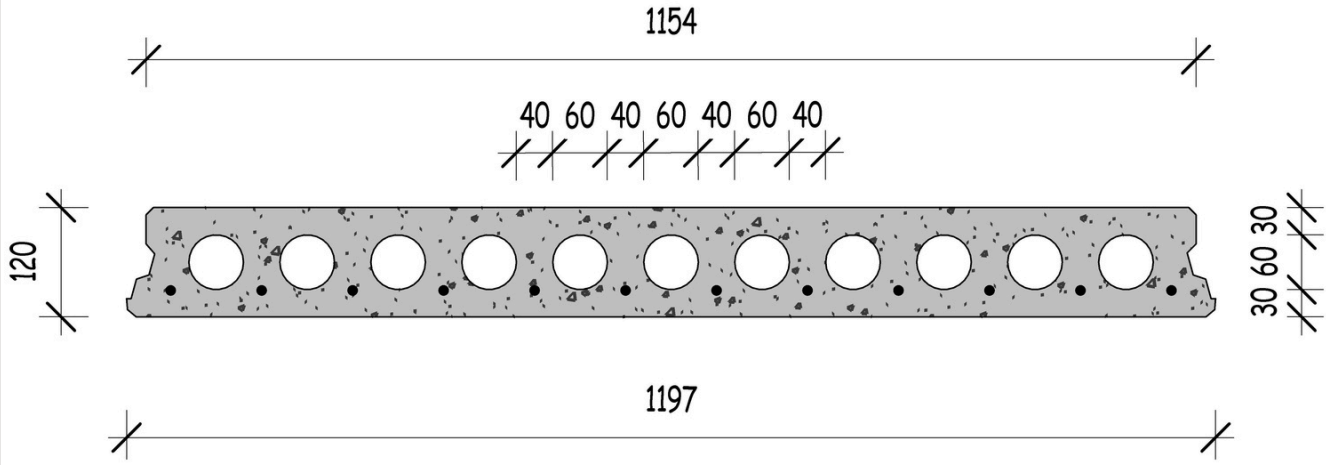
Typical Section Showing a Precast Beam, Precast Stairs and Cantilever Slab



PRESTRESSED CONCRETE DETAILS - 120mm DEEP SLABS

CROSS SECTIONAL DIMENSIONS

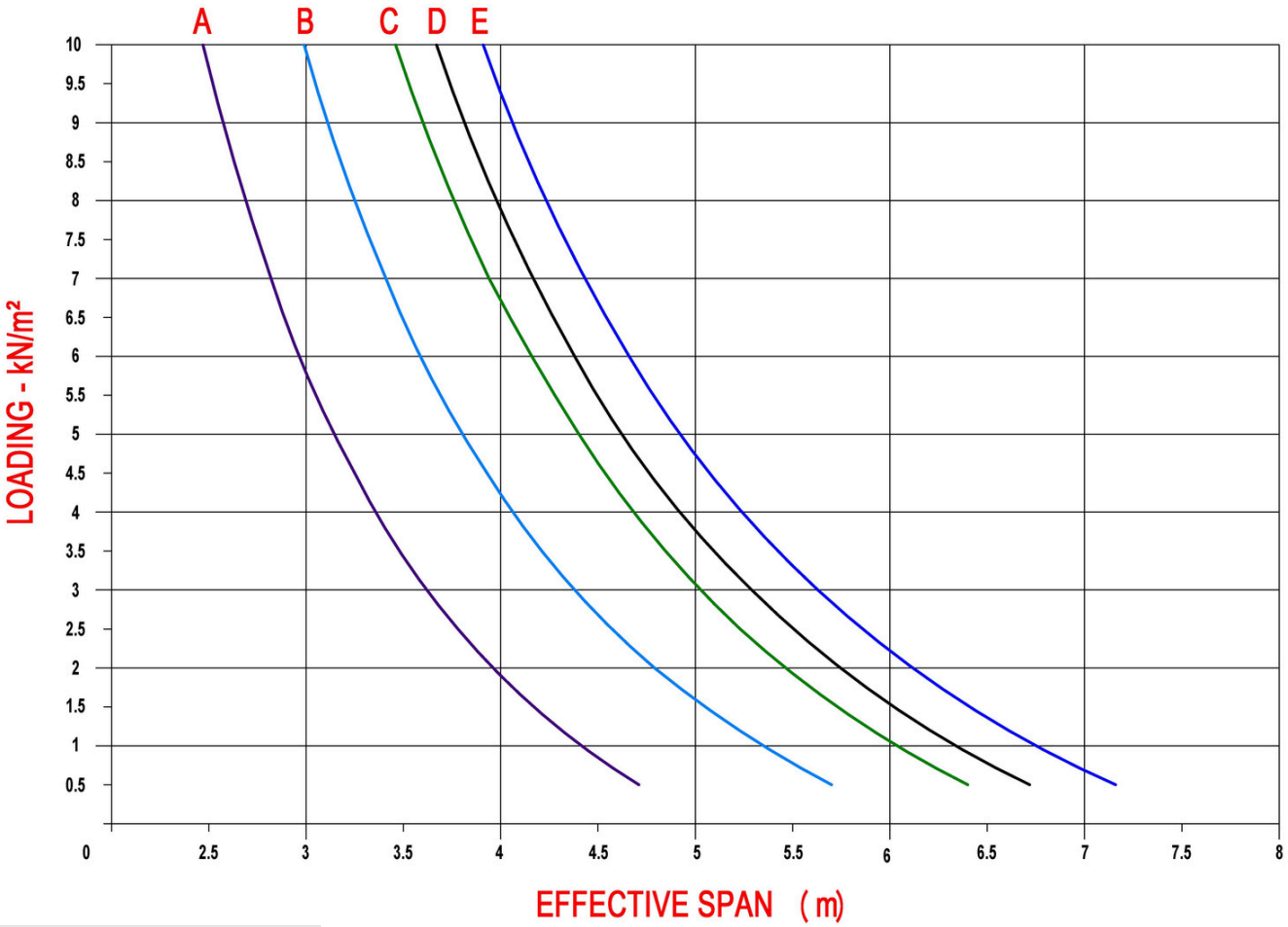
11- CORE PROFILE



CROSS SECTIONAL AREA - 0.108m²

SELF WEIGHT = 234 kg/m²

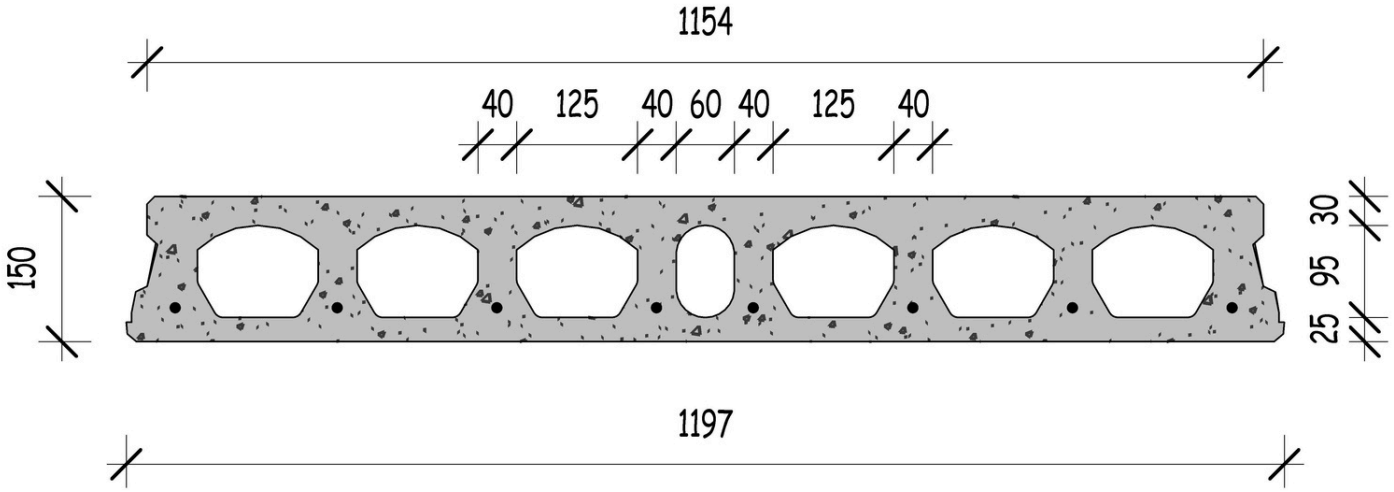
120 ECHO (11 CORE) LOAD SPAN GRAPH



PRESTRESSED CONCRETE DETAILS - 150mm DEEP SLABS

CROSS SECTIONAL DIMENSIONS

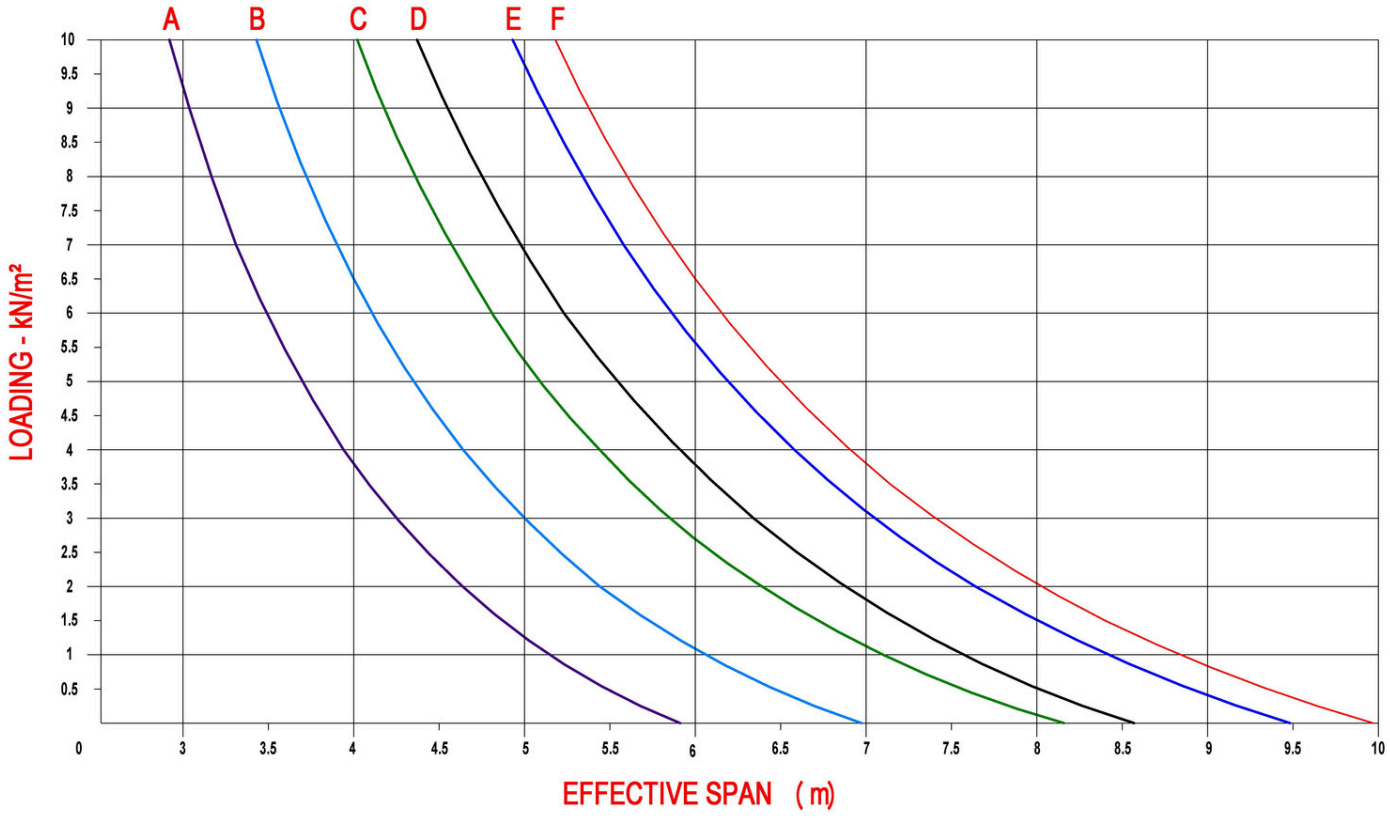
7- CORE PROFILE



CROSS SECTIONAL AREA - 0.109m²

SELF WEIGHT = 236 kg/m²

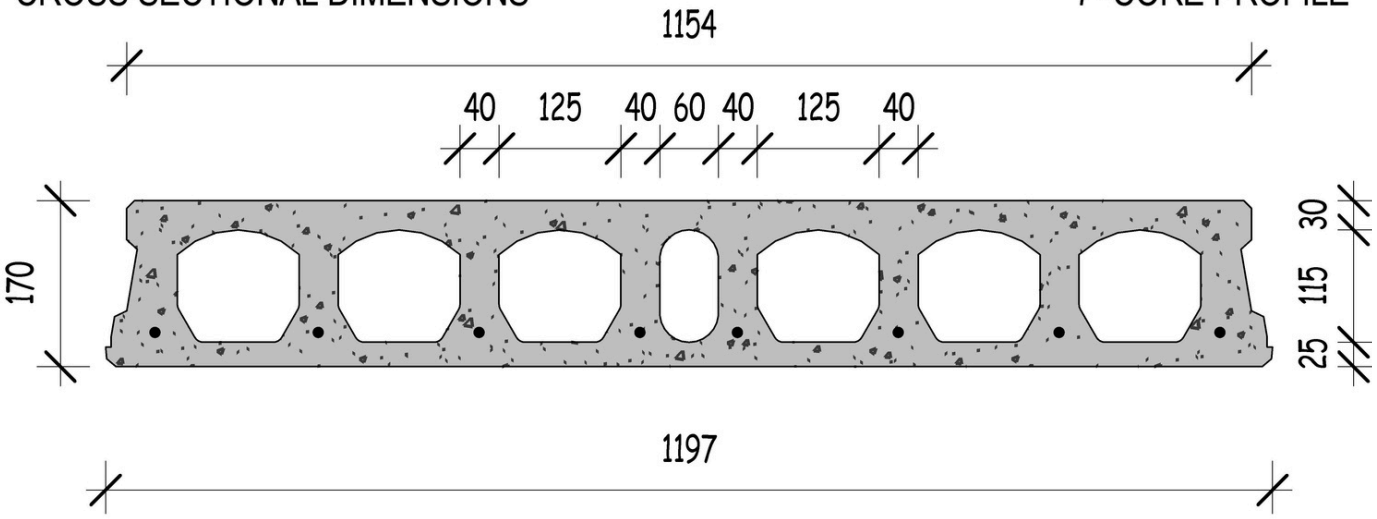
150 ECHO (7CORE) LOAD SPAN GRAPH



PRESTRESSED CONCRETE DETAILS - 170mm DEEP SLABS

CROSS SECTIONAL DIMENSIONS

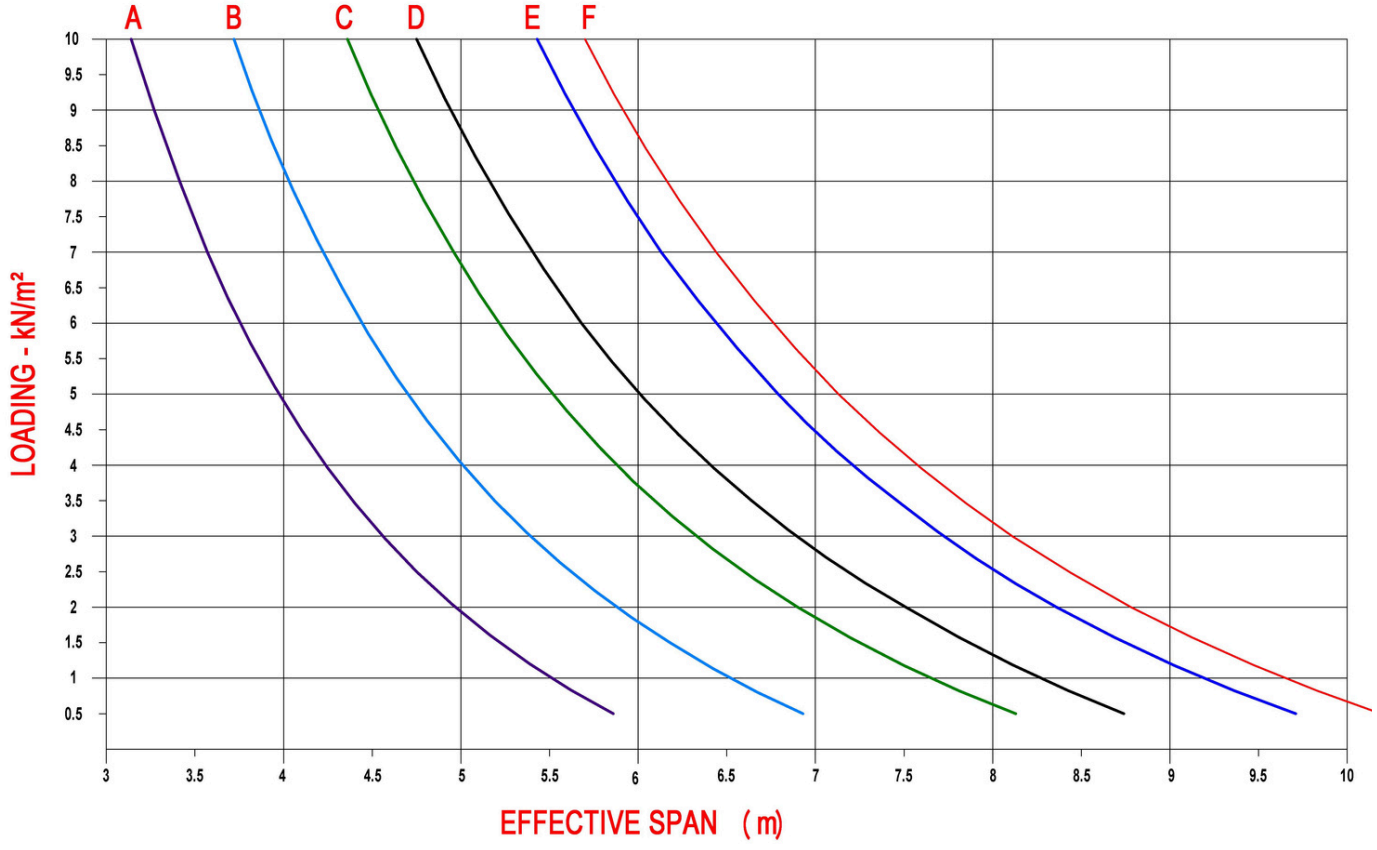
7- CORE PROFILE



CROSS SECTIONAL AREA - 0.115m²

SELF WEIGHT = 249 kg/m²

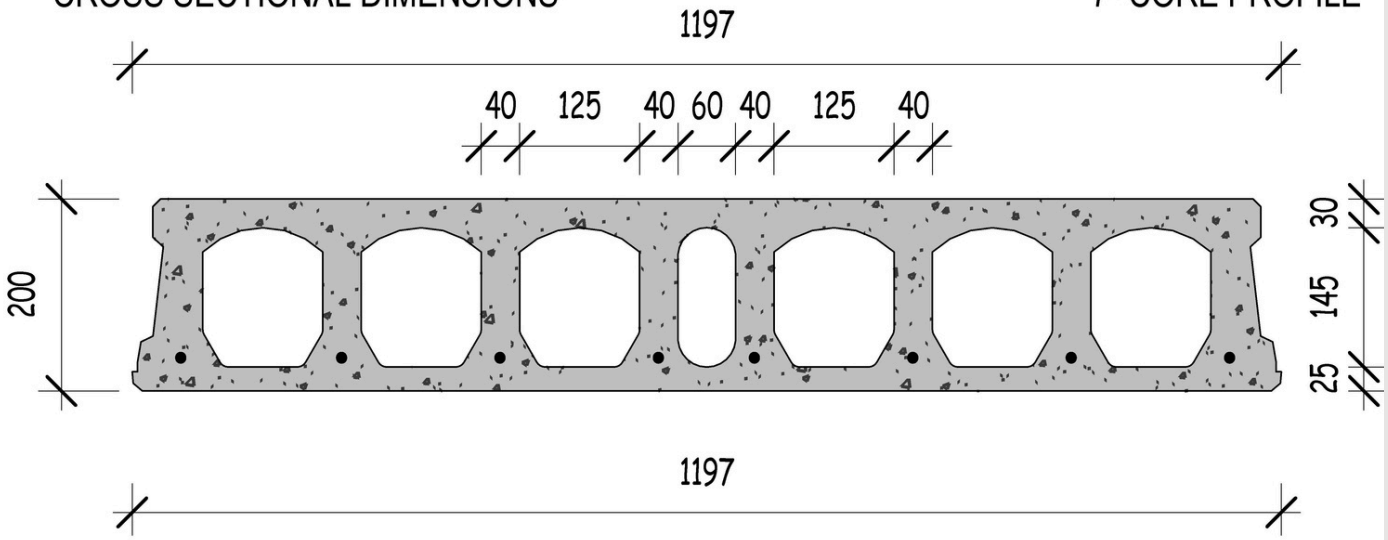
170 ECHO (7 CORE) LOAD SPAN GRAPH



PRESTRESSED CONCRETE DETAILS - 200mm DEEP SLABS

CROSS SECTIONAL DIMENSIONS

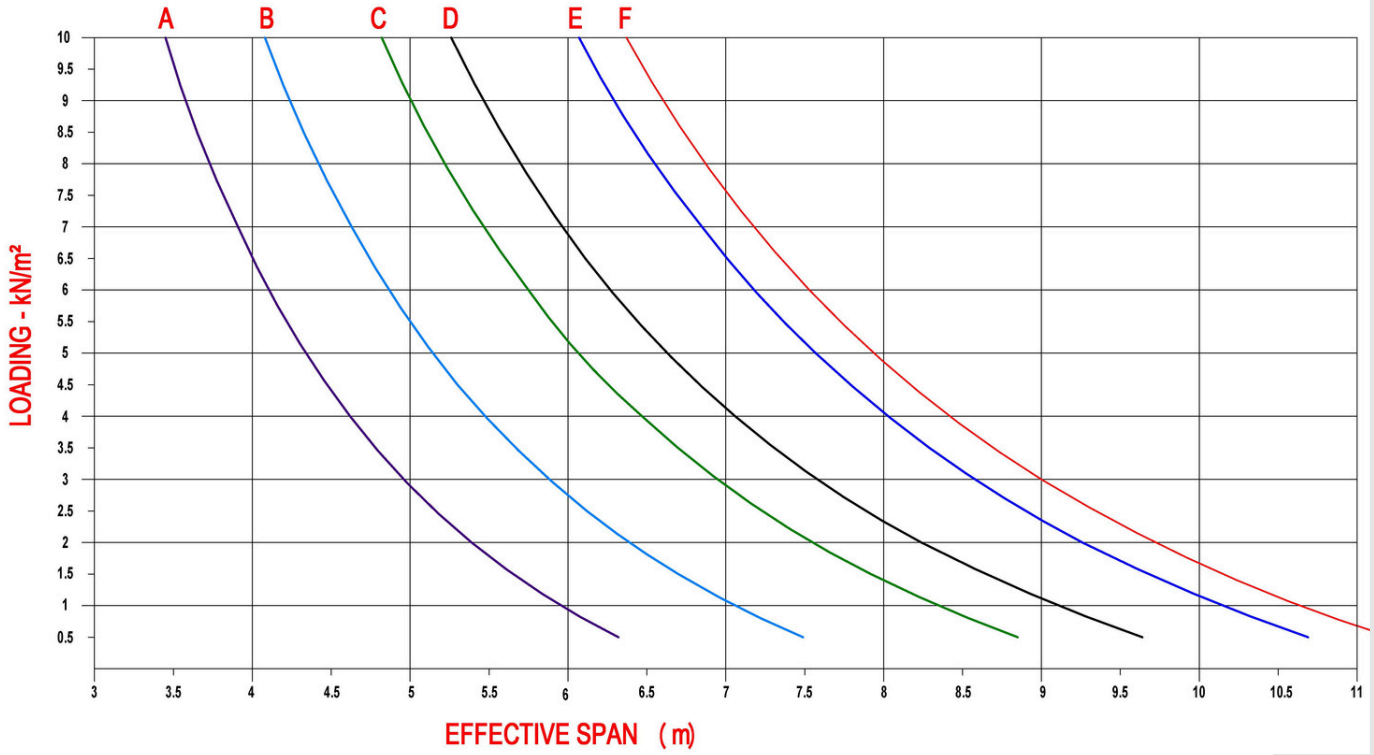
7- CORE PROFILE



CROSS SECTIONAL AREA - 0.125m²

SELF WEIGHT = 270 kg/m²

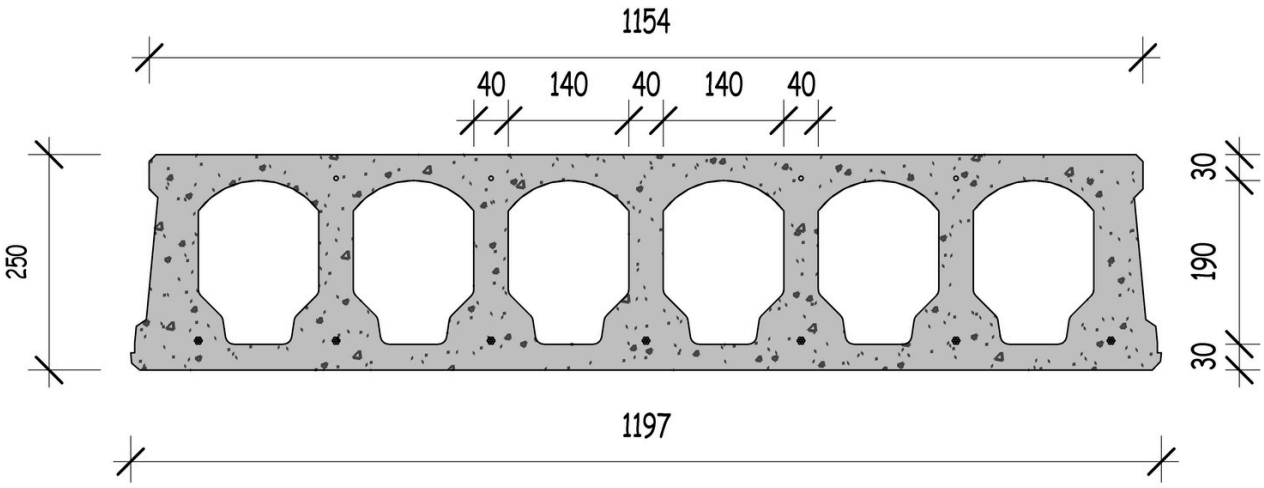
200 ECHO (7 CORE) LOAD SPAN GRAPH



PRESTRESSED CONCRETE DETAILS - 250mm DEEP SLABS

CROSS SECTIONAL DIMENSIONS

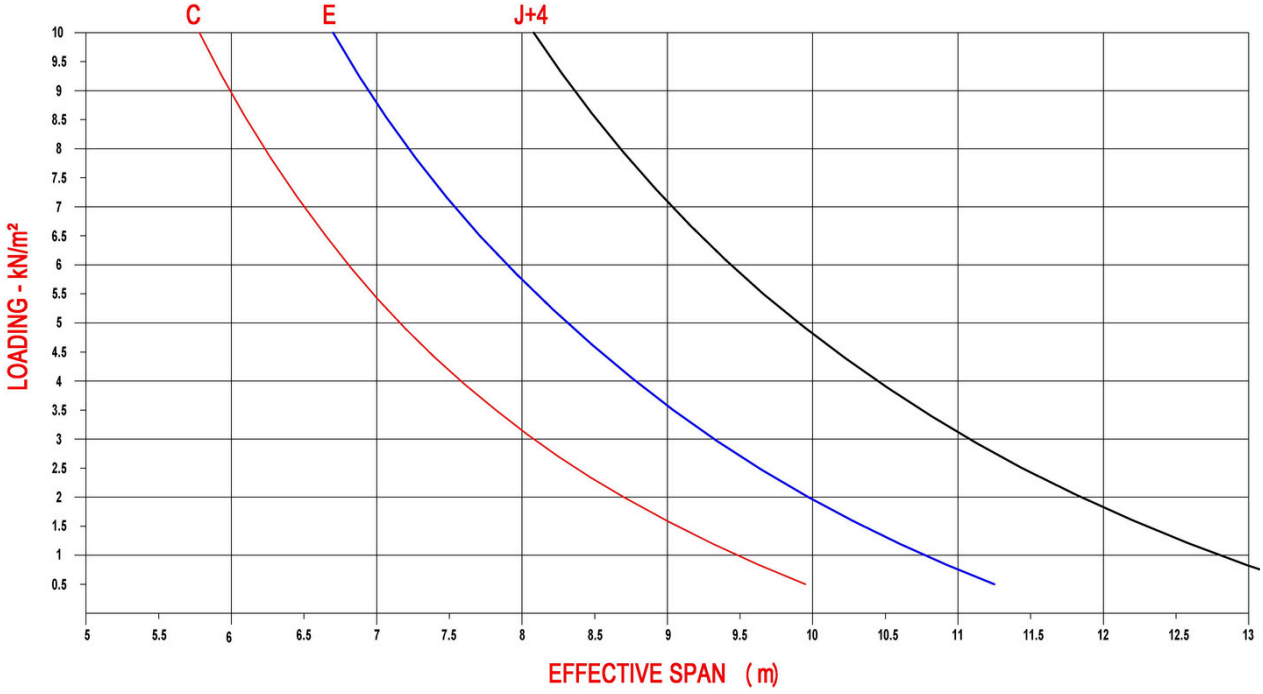
6- CORE PROFILE



CROSS SECTIONAL AREA - 0.155m²

SELF WEIGHT = 336 kg/m²

250 ECHO (6 CORE) LOAD SPAN GRAPH



Screed

The concrete institute have produced a standard specification for sand/cement screeds and concrete toppings for all types of floors. Should you require a copy please contact the Cement and Concrete SA on (011) 315 0300.
Once erected and grouted, our slabs become a monolithic slab. Electrical conduits are laid on the slab by the electrician prior to the screeding/topping being placed. A 40 - 50 mm minimum finishing screed plus up to a 15 mm additional average screed to counter any camber is required. Cambers of up to 40 mm can be expected depending on the spans and loading. The finishing screed is done as a finishing trade and not before the walls are built above the slab, unless otherwise instructed.
A safe working platform for follow - on trades, Work may continue above and below the slab – 48 hours after the grouting has been done.

Application of screed

On contracts where hollow-core slabs are used indoors and no structural topping is specified, a simple 40 - 50 mm levelling screed is necessary.
All loose materials are to be removed from the tops of the slabs. The slabs should be thoroughly wetted, and screed applied immediately. The levelling screed should comprise of 1:3 mix by volume of cement to clean river sand. Water should be added to the mixture to an extent that the mixture is relatively dry but remains easy to float finish. The screed should be laid to approximate thickness of 40 - 50 mm (note again that when screeding a Prestress slab that additional screed may be necessary to level out the camber in the units).
After laying the screed it should be steel floated and then wetted for 48 hours to prevent shrinkage cracks.

Structural topping:

The surface of the slab is to be swept clean, free from dust and any other foreign matter. The slab is then to be thoroughly wetted without any ponding.

The structural topping must have a 28-day compressive strength of not less than 25 MPa. The aggregate used must not be larger than 12 mm.

The structural topping should be vibrated into open cores and joints to ensure monolithic action with the precast elements. This is vital for composite action.

The structural topping must be cured by wetting for at least 4 days prior to opening to any traffic.

Placing steel mesh in floor topping prior to tiling controls cracking.

Why we specify

MESH

In certain areas, namely, balconies, roofs, walkways, tiled areas, car parks and areas where the screed is to be left unfinished, the specification changes slightly...

On balconies, roofs, walkways, i.e., all areas where our slabs are exposed to the elements, a Ref 100* mesh must be placed in the levelling screed to counteract the transverse forces created by large temperature differences. After removing the loose material from the top of the slab follow the specified screeding procedure for the laying of the screed. Under no circumstances must any form of cover blocks be placed between the slab and the mesh.

Where tiles are used on the slab, a Ref 100* mesh must be placed in the levelling screed as for the balconies, roofs and walkways. Where the tiled area is to exceed 16 m², expansion joints should be allowed in the tiles every 4 meters and particularly where the section alters shape such as at doorways. It is recommended a flexible tile adhesive be used.

On car parks, a Ref 193** mesh must be placed in a structural topping of not less than 50 mm thick to help spread the load from one panel to the next. The screed can be left rough to suit the client's requirements.

In areas with exposed screed/topping, a Ref 100* mesh is required to control shrinkage/drying stresses.
Placing of mesh where the screed/topping thickness is 50 mm or less the mesh should be laid flat on top of the slab and the screed/topping placed on top. Where the screed/topping depth exceeds 50 mm the mesh should be placed 20 mm from the top surface of the screed/topping.

Providing the above procedure is followed, the screed will adhere extremely well to the prepared surface of the slab. Experience has shown that it is impossible to remove the levelling screed from the top surface of the slab after a few days.

*Ref 100 mesh is 4 mm wire in a square patten at 200 mm centres.
**Ref 193 mesh is 5.6 mm wire in a square pattern at 200 mm centres.

Fitting

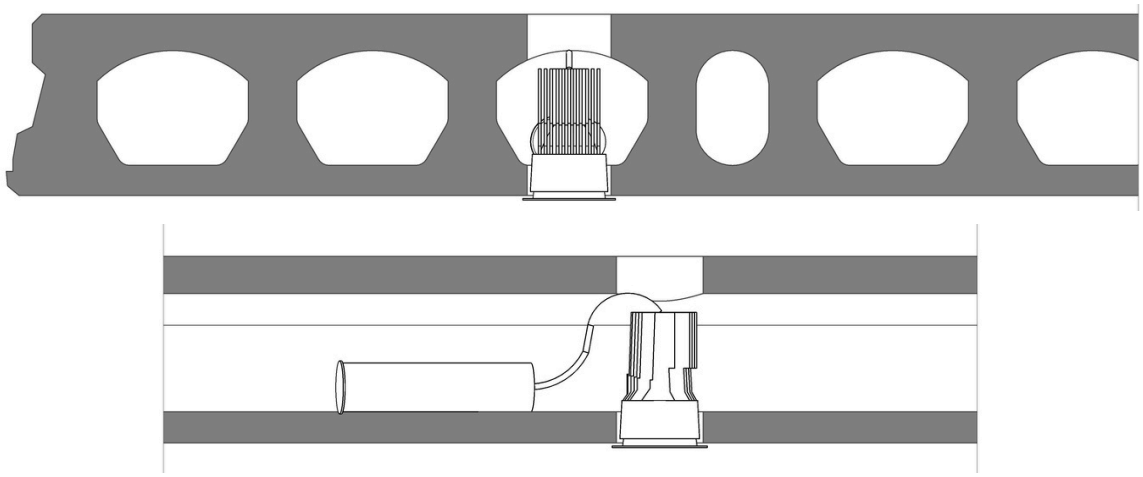
DOWNLIGHTS

The fitting of downlights into slabs is fast becoming the preferred lighting solution thanks to the increasing use of precast hollow-core concrete floor slabs and improved lighting technology, the latter having led to smaller lights and enhanced performance.
Other factors influencing the swing to downlights include the recent changes to municipal requirements both for large concrete light boxes and for single transformer units.
We have noted that, compared to fitting light boxes and conduits using the more traditional in-situ floor casting method, installing down lighting in hollow-core slabs offer several advantages.

Light points are far simpler and easier to place than in in-situ floor construction. This now requires much larger transformer boxes to be positioned between steel reinforcement, and the boxes are also difficult to position accurately.

Costs are also lower as electrical wiring and single light transformers can be installed the day after installation. The traditional method involves fitting larger light boxes which are now more expensive than coring costs and placing conduits before concrete is poured. Furthermore, electrical wiring can only begin once shuttering and scaffolding have been removed some 2 - 3 weeks later.
Downlight coring is simple and accurate and far more economical than the installation of light boxes. Larger holes can be factory-formed subject to a maximum diameter of 560 mm and any edge chipping can be easily repaired with rhinolite or a similar material.
Modern lighting equipment is a lot more compact, allowing for ancillary equipment to be stored in slab cores.
A 12-volt single light transformer requires a minimum core of 70 mm. This allows for short cylindrical transformers to be easily removed and replaced during maintenance.
Longer transformers require larger cores. Smaller cores of 50 mm or less can be used for 230-volt downlights, which do not need transformers.

A scientifically monitored experiment has proved that drilling core holes through the steel reinforcement of hollow-core slab does not adversely affect performance. During the experiment, slabs were loaded and deflections measured. A professional civil engineer assessed the results and found the slabs to be well within allowable tolerances. Refer to SANS 1879-2021.



Tiling

Tiling is to be done in accordance with SANS 10107.
Fixing of ceramic tiles onto precast hollow-core suspended floor slab systems, or onto any concrete suspended floor slab, requires special attention if cracking is to be avoided. Flexible adhesive is the answer, nevertheless, several basic rules must be followed to ensure success.

These rules include:

- All new concrete work or screeds must cure fully before any tiling proceeds. Surfaces must be clean and free of all traces of curing agents, laitance, loose particles and sand, or any other surfaces contaminants.
- Power-floated or steel-trowelled surfaces must either be scarified or keyed with slurry consisting of a cement and a “Key coat” type product. Specifications are obtainable from various adhesive manufacturers. The adhesive must be applied while the slurry is still “tacky”.
- The adhesive itself should always remain flexible to counter the possibility of cracking, whereas rigid adhesives - as most are - will transfer any minor cracking through to the tile. To obtain this type of flexible adhesive, manufacturers have developed liquid bonding additives which replace water when mixed with the cement-based power adhesive. Alternatively, high-polymer cement-based adhesives are suitable for use where extra flexibility, high strength or water resistance is required. These adhesives require no additives; they are simply mixed with water and will maintain the necessary flexibility to avoid cracks.
- Adhesives should be at least 5 mm thick and spread in 1 m² batches. This prevents the adhesive drying. Only dry tiles - not soaked - must be bedded into the wet adhesive, by twisting slightly and lightly tapping home with a rubber mallet.
- Grouting must not be carried out until a sufficient strong bond has developed between the bedding mix and the tiles to prevent disturbance of the tiles during the grouting operation.
- Grouting should, therefore, not commence until 1 - 3 days after tiles have been laid. Joints exceeding 8 mm require a different grout mix (consult with the manufacturer on specifications).
- To further ensure tiles on suspended floors do not crack, movement joints must be left across door openings and at interfaces of concrete and brickwork, and directly above any structural ground floor walls.
- ·Movement joints must be located around any fixtures protruding through the tiled surface, such as columns or stairs.
- Joints should be at least 5 mm wide and extend through the tile and adhesive layers to the surface. The bulk of the joint depth can be fitted with an inexpensive compressible material such as polyethylene foam strips. Seal the joint using a suitable resilient sealant according to the manufacturer’s instructions. It is important that the joint sealant is only bonded to the sides of the movement joint.
- These tiling procedures have proven successful when effectively implemented. Ensure that the specification is given to the tiling contractor and indicate to the contractor where joints are required to enable the planning of the tile layouts.

Plastering

At the design stage a consulting engineer/architect should allow adequate expansion joints in the building; too many is better than too few.

It is important that the job is erected carefully.

All cut joints must be on top of walls as the lack of castellations in a grouted joint can cause cracking.

The joint between the slab and the top of the wall must be effectively “dry packed” with the material forced into the joint before brickwork continues on top of the slab and obviously before ground floor walls are plastered. This part is essential and is easily forgotten.

Joints must be well cleaned and wetted before grouting. Joints must be grouted with a good quality river sand cement mix.

A Ref 100 mesh must be placed in the levelling screed or topping.
Plaster key should be applied in the V joints and plastered flush, preferably with a flexible filler. When the filler in the V joints is dry ± 2 days later, plaster key should be applied to the whole soffit and a skim coat of plaster/rhinolite applied for a smooth finish.

If these specifications are followed, there is no reason why, under normal circumstances, cracks will form in the plaster.

As an extra precaution, a fiberglass bandage can be painted over the V joint area before skimming the ceiling.

Painting

A small amount of rhinolite should be “thumbed” into the top of the joint between the panels and then finished off with a piece of plastic conduit to round the top of the joint.

A bonding liquid (plaster key or similar) or a good quality undercoat should be applied to the soffits prior to painting. While the use of a textured paint is recommended the possible use of two coats of PVA is up to the customer.

Hollow-core

ADVANTAGES

- There is only one supplier of the entire slab, not a series of sub-contractors.
- 30+ years of expertise; hollow-core has been available in S.A. since 1983.
- Green advantages:
- 100% Recyclable
- 100% Recoverable out of a building
- 30% lighter than a solid slab of equivalent depth, and
- the added advantages of a favourable span-to-depth ratio means a lighter structure and the foundation size may be reduced.
- Expensive formwork and temporary props are eliminated.
- Smooth soffits require no plastering, merely a textured paint or a good PVA is required.
- Speed: 200 - 400 m² installed per day per installation team. We currently have 5 teams.
- It is recommended that all buildings are measured prior to manufacture.
- This ensures a fast and efficient installation process, as all panels are purpose-made.
- Once grouted, hollow-core provides an immediate safe working platform for other trades (added health and safety benefit as well as speeding up the follow-on trades).
- Prestressed hollow-core slabs achieve long slabs resulting in flexible open spaces with fewer beams, walls and supporting columns.
- Quality assurance is guaranteed, as hollow-core products are manufactured in a factory-controlled environment according to SANS 1879-2021 and quality assurance of management systems similar to ISO 9001 2015.
- Clean, hassle-free operation.
- No on-site storage is required.
- Hollow-core is a solution to the skills shortage.
- Reduced supervision by the project engineer.

The best qualities of our hollow-core slabs

Prestressed hollow-core

SECURITY WALLS

Introduction

The product is cast in the same manner as the floor slabs except prestressed 5.0 mm triple indented wire is used top and bottom of the slab, the wall panel is designed in this manner to avoid the traditional upward camber. The side formation is also changed to a tongue and groove configuration.

The security walls are:

- Robust
- Secure
- Vandal-resistant

The handling orientation:

- Vertical into a fountain
- Horizontal between columns

The walling panels are best suited to industrial commercial applications:

- Prisons
- Airports
- Military bases
- Industrial and commercial parks
- Mines
- Any operation that requires high-end security

The design consideration which determines the handling orientation (vertical or horizontal):

- The soil quality
- Impact resistance required for the application
- Wind resistance
- Water drainage requirements
- Method of installation
- Walling accessories
- The height of the specification

Provision for water drainage

The preferred method of construction is 120 - 150 mm deep hollow-core wall panels installed into the flanges of steel columns, typically 203 x 203 or 152 x 152 column sections, or 203 x 133 I-beam sections – provision for water drainage is provided by means of core drilled holes – structural steel grills of various sizes depending on the volume of water expected.

Security wall using a precast foundation:

Typical designs:

3.6 m high wall:
0.6 m below ground
3 m above ground

Steel or concrete columns

Security & Retaining Wall

BENEFITS

- Increases productivity/ reduced on site labour. If cast in-situ, approx. 8 m of walling can be constructed per day. If the P.C. hollow-core method of construction is used, approx. 30 m of walling can be constructed per day.
- Efficient lightweight section - the thickness and the wiring/strand pattern can be varied to suit the wall height and load requirements.
- Service openings/retaining walls for air conditioning units, ducts etc. can be accommodated without difficulty.
- Finished surfaces: pre-finished in a factory to give a durable and aesthetically-pleasing appearance.
- Earth retaining: the structural capacity of the panels can be utilised to retain fill material.
- Complete package for both security and retaining walls: we offer a full turnkey package from the civil work to the wall panel installation, using a series of subcontractors.

Why would you want our security walling?

Prestressed hollowcore

RETAINING WALLS

There are two types of retaining walls offered by us (and that refers to the method of construction):

1. Gravity method
2. Cantilever method

1. Gravity walls

Are constructed of soil that is stabilised by man made materials. This type of hollow-core structure is able to retain the earth behind it by virtue of its own weight. Gravity retaining walls are typically the most economical to construct. In addition, they have a degree of flexibility that allows them to adjust to minor differential settlement without incurring structural damage.

Before analysing any retaining wall, make sure you have an accurate assessment of the site and soil conditions. Every retaining wall must be engineered to withstand the pressure from the soils and other loads behind and above them. Standard gravity wall analysis considers sliding, bearing and overturning forces. On sites with slopes or surcharges, a global stability check will also be necessary.

Sliding

The ability of the retaining wall structure to overcome the horizontal force applied to the wall.
Factor of safety = 1.5 or (FSsl = 1.5)

Bearing capacity

The ability of the underlying soil to support the weight of the retaining wall structure.
Factor of safety = 2.0 or (FSbc = 2.0)

Overturning

The ability of the retaining wall structure to overcome the overturning moment created by the rotational forces applied to the wall.
Factor of safety = 1.5 or (FSot = 1.5)

Global stability

The ability of the internal strength of the soil to support the complete soil mass.Contact a geotechnical engineer to determine the soil conditions of your site.
Factor of safety = 1.5 or (FSg = 1.5)

2. Cantilever walls

This concept is a freestanding wall without lateral support at its top. These types of walls cantilever the loads to a large structure footing, converting horizontal pressures from behind the wall to vertical pressures on the ground. These walls require rigid concrete footings below ground and are cast with a heel or a toe or both, this is required to resist its overturning moment.

The most important consideration in proper design and installation of retaining walls is to recognise and counteract the tendency of the retained material to move downslope due to gravity. This creates lateral pressures behind the wall which depends on the angle of internal friction (Phi) and the cohesive strength of the retained material, as well as the direction and magnitude of movement the retaining structure undergoes.

Lateral earth pressures are zero at the top of the wall and in homogenous ground - which increases proportionally to a maximum value at the lowest depth. Earth pressures will push the wall forward or overturn it if not property addressed. Also, any groundwater behind the wall that is not dissipated by a drainage system causes hydrostatic pressure on the wall. The total pressure or thrust may be assumed to act at one third from the lowest depth for lengthwise stretches of uniform height.

Unless the wall is designed to retain water, it is important to have proper sub-soil drainage behind the wall to limit the pressure to the wall's design value. Drainage material will reduce or eliminate the hydrostatic pressure and improve the stability of the material behind the wall.

The South African National standards requires retaining walls to be designed to ensure stability against overturning, sliding, excessive foundation pressure and water uplift, and that the walls be designed for a safety factor of 1.5 against lateral sliding and overturning.

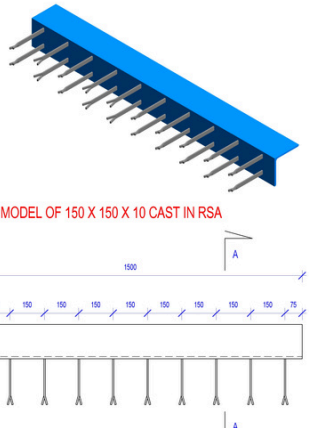
The example shown in the cross section attached have steel starter bars protruding from the foundation, the prestressed hollow-core retaining wall panel is installed over the reinforcing which aligns with the hollow-cores - see sketch for the openings created for non-shrink epoxy grout (Sika 212), or similar, to be poured into the openings, creating a moment connection between this wall and the footing. The moment connection is usually equal to one third of the height of the wall. This design method is also called an inverted T-shaped wall.

Details of gravity retaining walls

Mechanical stabilisation

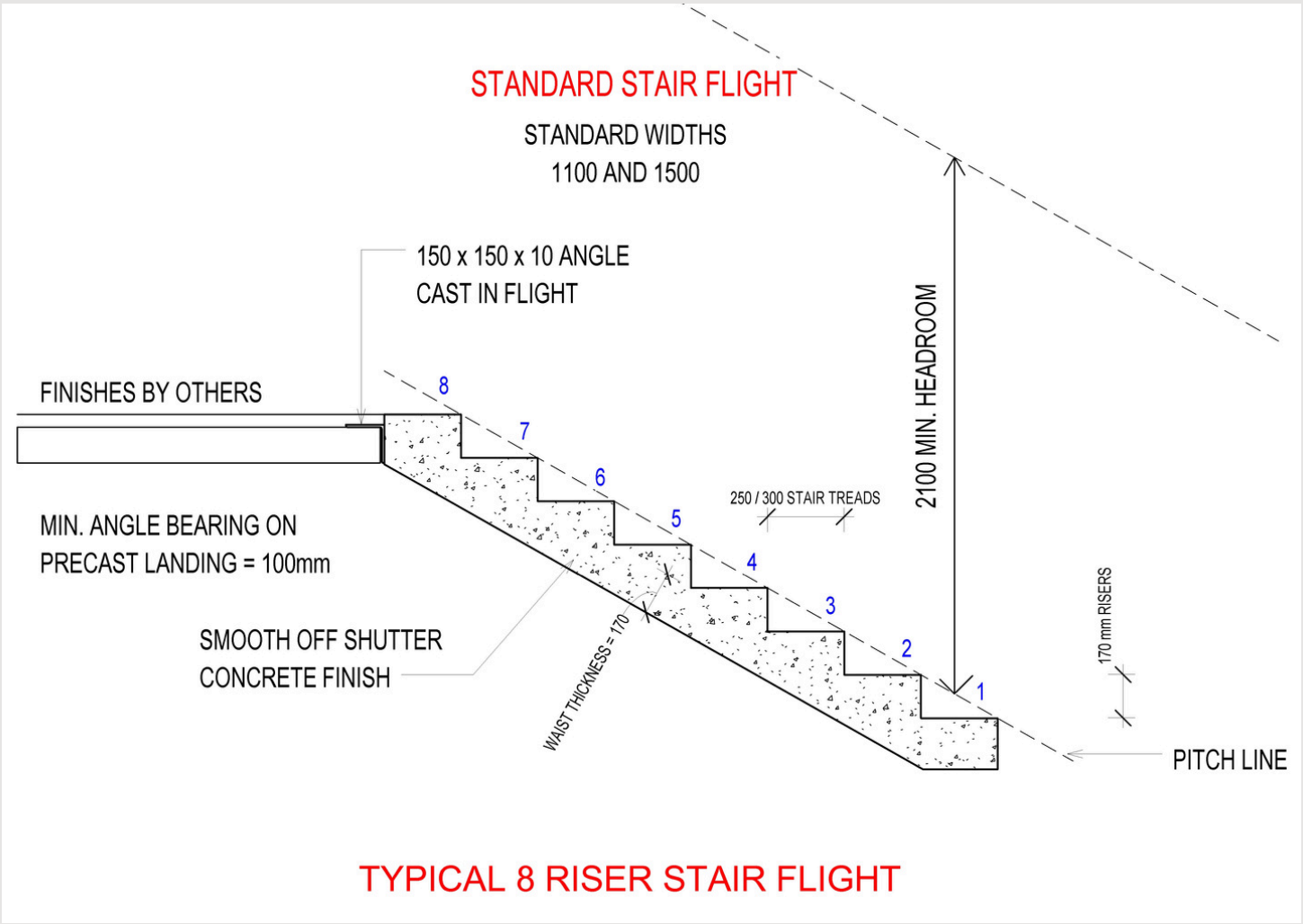
Mechanical stabilisation or MSE, is soil constructed with artificial reinforcing via layered horizontal mass (geosynthetics) fixed at their ends. These mats provide added internal shear resistance; our hollow-core retaining walls are ideal for the fixing of the geofabric as they can be fixed (sandwiched between the panels) or bolted on with small steel angles (details available on request). The theory is similar to retaining wall block designs.

In all retaining wall designs careful consideration should be given to sub-soil drainage, a specialist should be employed.



Stairs

DETAILS



TYPICAL 8 RISER STAIR FLIGHT

Stairs

STANDARD SIZES

STANDARD UNIT SIZES

RISER RANGE	TREAD RANGE	WIDTHS	MAX RISERS
170mm	250 AND 300	1100 / 1500	10

TOLERANCES

Cross– sectional tolerances are within limits set out in clause 6.2.8.3 of BS8110:1997.EC2 ACP (Concrete) Ltd acceptable tolerances for standard prestressed units are as follows below:

PROPERTY	ACCEPTABLE TOLERANCES FOR STANDARD PRESTRESSED UNITS
LENGTH	-5 mm to +10 mm
WIDTH	-0 mm to + 5 mm
THICKNESS	-2 mm to + 6 mm
SQUARENESS	12 mm difference between diagonals
LIFTER POSITION	- / + 100 mm

CAMBER

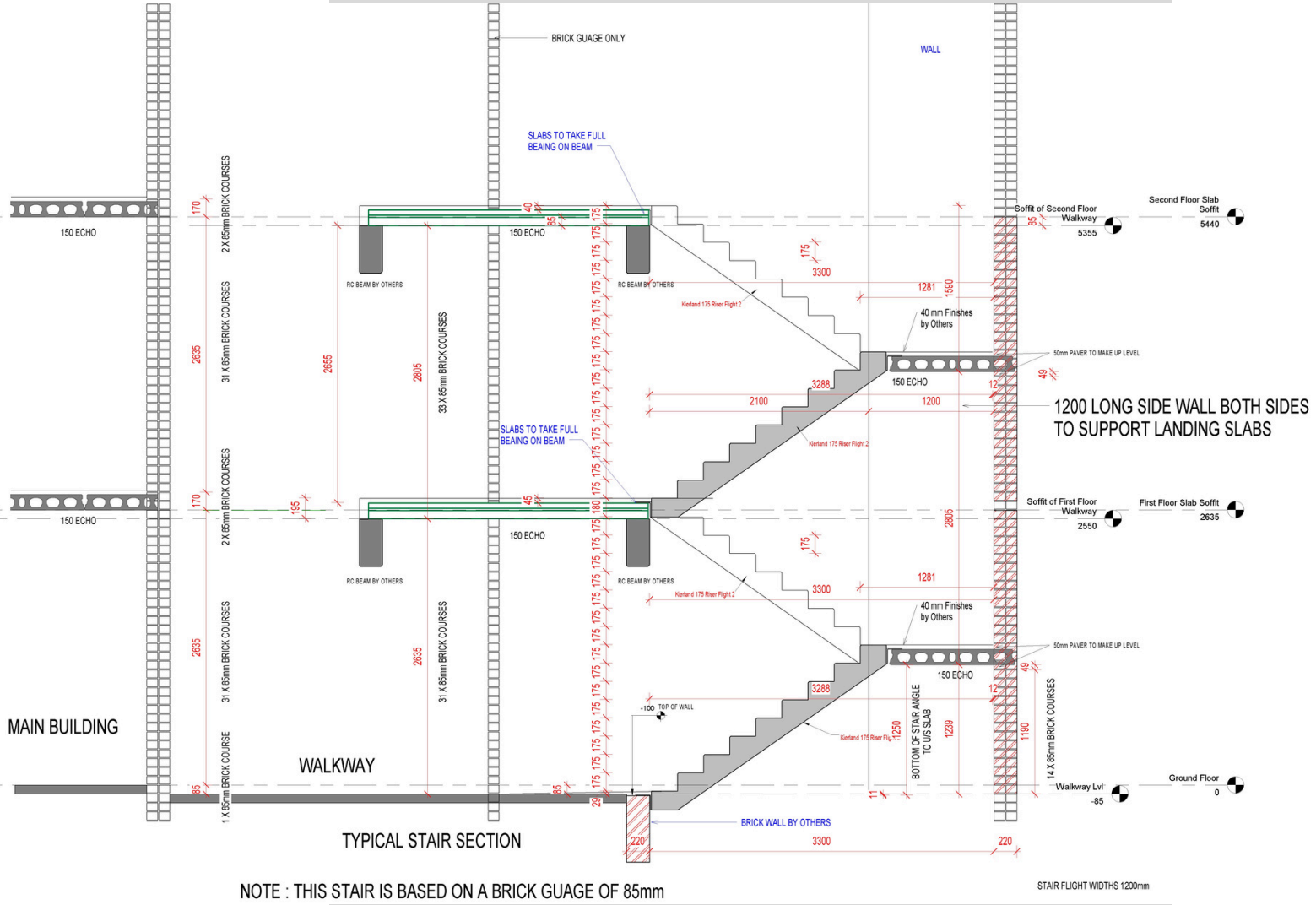
UNITS HAVE LITTLE OR NO CAMBER

Stair
HANDLING

STAIR LIFTING AND INSTALLATION

Stair

CROSS SECTION



Hybrid Construction

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