SPACE
CONSULTANT LTD

PRECAST INITIATIVE

Prospects of Precast Hollow Core Slabs for Low-Rise Housing in Bangladesh

HollowCore Concrete Slab

The Hollowcore slab

- Concrete member with continuous voids
- Precast
- Prestressed
- Weighs upto 40-50% less

Uses

- Floor
- Roof deck
- Wall panels
- Spandrel members
- Seating units
- Bridge deck slabs

Application

- Residential buildings
- Schools
- Hospitals
- Offices
- Car parks
- Multipurpose centers
- Villas

Drivers

- Benefits broad range of housing stakeholders
- Changes in demography (population trends)
  - Projected increase in demand for single or small family dwellings may presage a rise in ‘starter’ size homes
- Increasing raw material (cement, rods, etc) procurement costs
- Reduction in availability of suitable sites
- Increasing impact on industry dependencies (tempered glass, tiles, etc) due to incomplete housing projects
- Lack of due diligence from new entrants (developing firms), adding to overall housing costs

Sustainability

An increasing influence on the way housing and all other buildings are procured is sustainability

- Relatively low initial energy costs for production
- Reinforcement and concrete can both be recycled
- Can be flat-packed for transport; hence less pollution through reduced transport
- Can be designed to be re-buildable
- Can be used on contaminated land
- Reduced major maintenance and repair work over life, reducing the negative impact on the environment
- Use of air-conditioning can be avoided by appropriate climatically adapted housing designs; hence reducing consumption of electrical power

Advantages in Design phase

- Offers unmatched Design flexibility
- No positive deflection for normal dead loads
- Minimum deflection for super imposed loads
- Longer span/greater loads than conventional slabs of same depth
- Integrated Service core
- Increased strength, surface quality and consistency

Design & Construct-stage assistance

- In-situ locations allow designers and contractors to respond quickly to changing client requirements
- Openings can be provided in hollow core systems by forming or sawing the openings in the plant or by installing short slabs with steel headers at the jobsite

Advantages in Construct phase

- No framework or propping for roof casting
- Electrical conduit and boxes can be cast into the walls
- Non-highly skilled workers required for installation
- Rapid construction
- Reduced on-site labor
- Reduces on-site congestion
- Savings in construction time
- Reduced material wastage
- Greater degree of control (and the lesser degree of risk) will result in a higher quality product

Diaphragms

Hollow core slabs can resist lateral loads in the form of a grouted slab assembly

- The function of a diaphragm is to receive wind loads, seismic loads and lateral earth pressures from the building elements and transmit these loads to lateral-resisting elements that carry the loads to the foundation

Advantages in Finishing phase

- Highly Durable
- Provides noise insulation
- Excellent Fire resistance
- Pre finished ceiling –Ready for textured paint or paper and backer
- Accelerates occupancy rate

Finished Ceiling

Hollow core, cast on smooth steel forms, has a finished underside

- requires only caulking of the longitudinal joints
- underside of slabs can be used as a finished ceiling as installed by applying textured paint or an acoustical spray

Competitive and Financial Analysis

Savings

Potential savings to be gained on site from reductions in time-based factors such as:

- Through intelligent dual-usage of building elements as building parts and as formwork
- Finance costs (money needs to be borrowed for less time)
- Long term maintenance and repair reduced significantly due to build quality and adaptability
- Time-related preliminaries (e.g. staff, plant, access, accommodation, power and cleaning)
- Additional overheads (e.g. rent for storage of equipment)

Cost Table

for Conventional slab and HCS

Cost comparison chart for Normal vs HollowCore slab							
	COST of 100 cft Concrete						
		Quantit	Units	Rate	Cost	Total cost	Cost Per sft
Coarse aggrigate	100 x1.5 x4/7	85.71	cft	130	Tk 11,142.86		
Coarse Sand	100 x1.5x2/7/2	21.43	cft	30	Tk 642.86		
Fine Sand	100 x1.5x2/7/2	21.43	cft	15	Tk 321.43		
Reinforcing Steel	120 x3.28/3.28/3.28x100	340.1	kg	75	Tk 25,504.74		
Assuming 15 cm Thick Slab.						Tk 37,611.89	Tk 188.06
100 cft concrete covers 200 sft slab							
Formwork & Props		200	sft	25	Tk 5,000.00		
Labourers(Carpenters & Steel benders]		200	sft	50	Tk 10,000.00		
Pouring and curing		200	sft	5	Tk 1,000.00		
						Tk 16,000.00	Tk 80.00
Administrative cost							Tk 30.00
					Cost Per Sft of normal slab		Tk 298.06
					Say		Tk 300.00
	For normal loading, Cost of 15 cm thick HOLLOWCORE Slab						Tk 220.00
	Cost Saving per sft						**36.36%**

Comparative Table
for Conventional slab and HCS

FOR SLABS OF SAME THICKNESS		
	Precast Prestressed HOLLOWCORE Slab	Conventional solid Slab
SOLIDITY	Hollowcore slab has 40 to 50% horizontal voids	100% solid prismatic slab
VOLUME of Concrete Reqd	40 to 50 % less than the Vol of the slab	100 % same as the Vol of the slab
Weight of the slab	40 to 50 % less than the conventional solid slab	100 % same as Vol X Density
Reinforcing Steel Requirement	Prestressing Tendons in one-way and is approximately 25 Kg /M3 (0.4 Kg Sft)	Reinforcing steel in two-way and is approximately 120 Kg /m3 (2 Kg/ sft)
Steel Strength Reqd	High Carbon steel Fy = 1770 N/mm2	Normal Steel fy= 250 to 460 N/mm2
Concrete Strength	Requires very special concrete fcu= 50 to 60N/mm2	requires ordinay concrete fcu= 25 N/mm2
Ready For Use	After 3 days	After 3 Week
Time between two Slab Casting	Every week one slab can be installed	4 week
Formwork and Props	Eliminated	Necessary
Cost	BTD 220 per sq. ft (33% less)	BDT 300 per sq. ft.
Heat and Noise Insulation	Superior-plaster unnecesary	Requires plaster
Depth / Thickness requirement	About 20% less for a similar span	Standard

Comparative Table
for Conventional slab and HCS

FOR SLABS OF SAME THICKNESS		
Factory Production	Produced In Factory by automatic extruder with strict quality control, high output and low manpower	Manual Production with more manpower with doubtful quality control
Rapid Construction	Immediate Work deck	
Reduced on site labour	Only a small erection crew(5 to 6) to install 600M2 per day	
Durability	Concrete Quality meets the durability requirement of the most stringent standards.Strand cover may be varied to suit particular exposure clasifications	
Long span	Hollowcore slab can accommodate long spans resulting in flexibale open space with fewer beams & supporting columns.Clear span upto 18 m(60ft) is in use in Parking & bridges	
High Load Capacity	Hollowcore slab can handle heavy loads required in factory, warehouse , storage or in Brige Decks without more floor depth or adding multitudes of columns	
Fire Registance	Fire Registance periods upto 4 hours can be provided to meet the Code requirements	
Prefinished Ceilings	Exposed hollowcore soffits can be painted directly without plaster	
Service Cores	Longitudinal core holes can be used as service ducts	

HollowCore Slab

Production

Dry cast system uses extrusion process

- Bed Preparation
  - Stressing the strands
    - Casting and Automatic Extraction
      - De-tensioning the Casting
        - Storing, Curing & Transportation
          - Erection

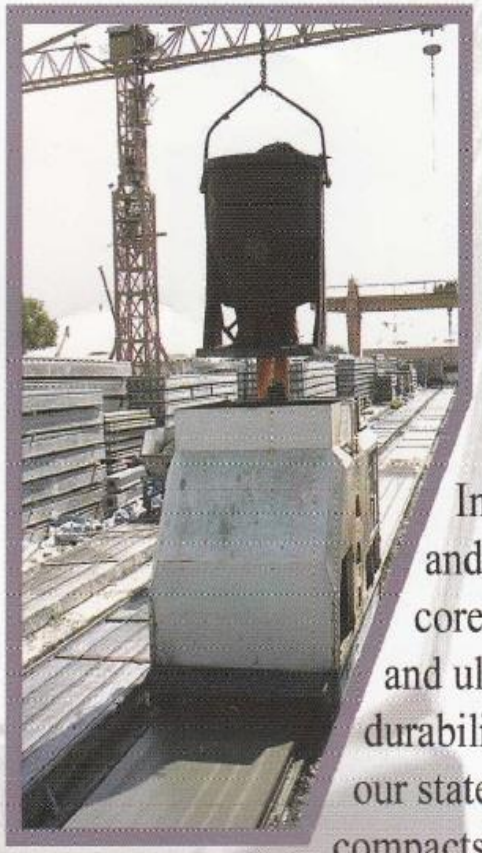
1. Bed Preparation:

The prestressing steel beds are cleaned thoroughly and slightly oiled to allow easy stripping of concrete after casting, then the steel strands are laid and fixed at both ends.

2. Stressing the Strands:

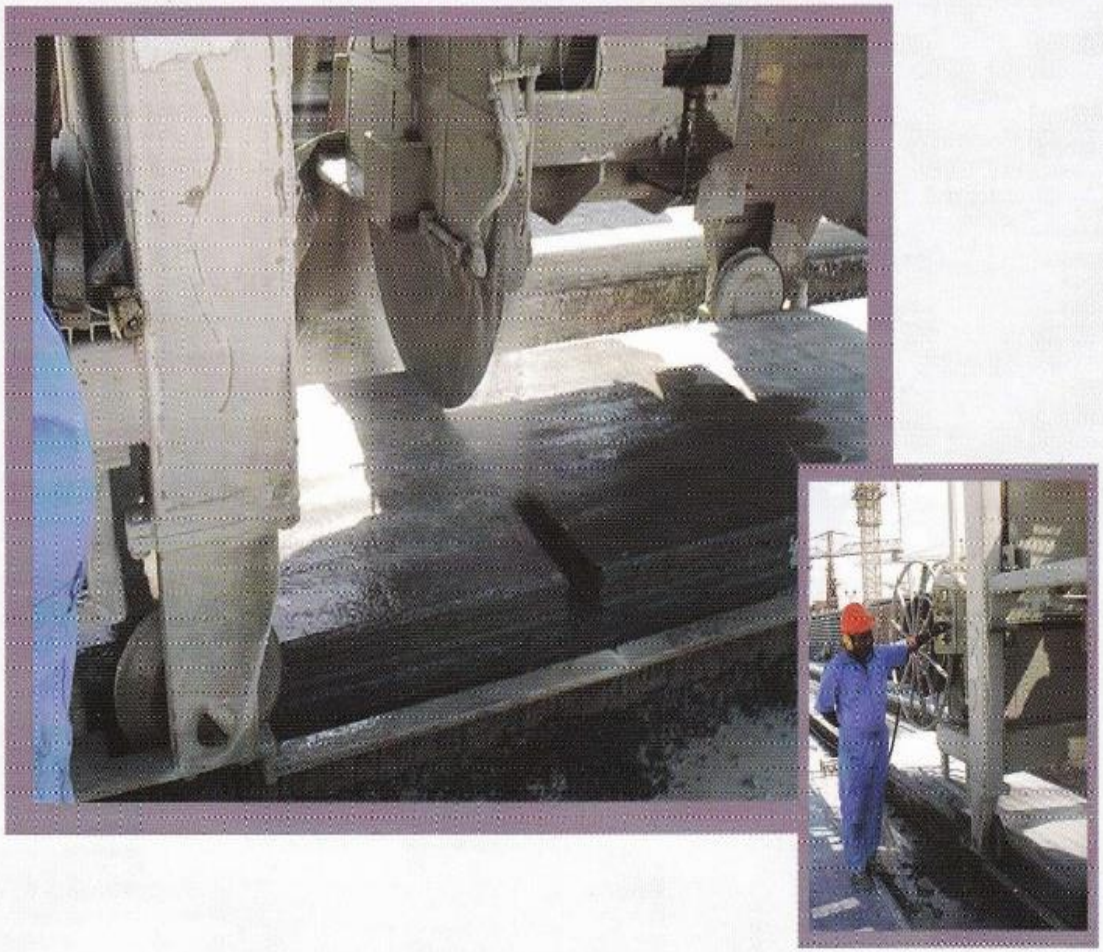
The 7-wire strands are stressed one by one, under strict Quality Control.

The stressing forces, number of strands and their position are all determined according to slab design.



3. Casting and Automatic Extrusion:

In order to meet the high durability and strength requirements for hollow core, top quality concrete (high early and ultimate strength, zero slump, high durability) is batched and transported to our state –of –the –art extruder which compacts it, then extrudes the hollow core section continuously along a 125m bed.



4. Detensioning and Cutting:

18 hours later, when quality checks confirm that required concrete strength has been reached, strands are detensioned and the precast prestressed concrete bed is cut into different elements according to design.

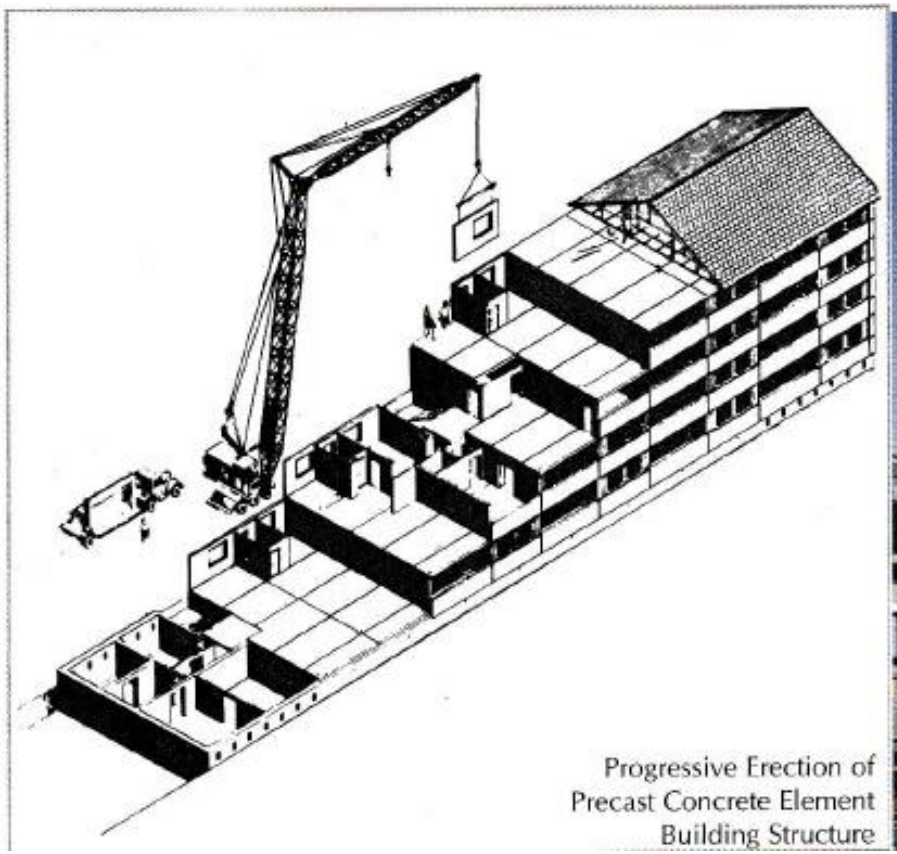
5. Storage and Curing:

Hollow core slabs are then stored and cured in the yard according to Quality Procedures and up to the Specified time.

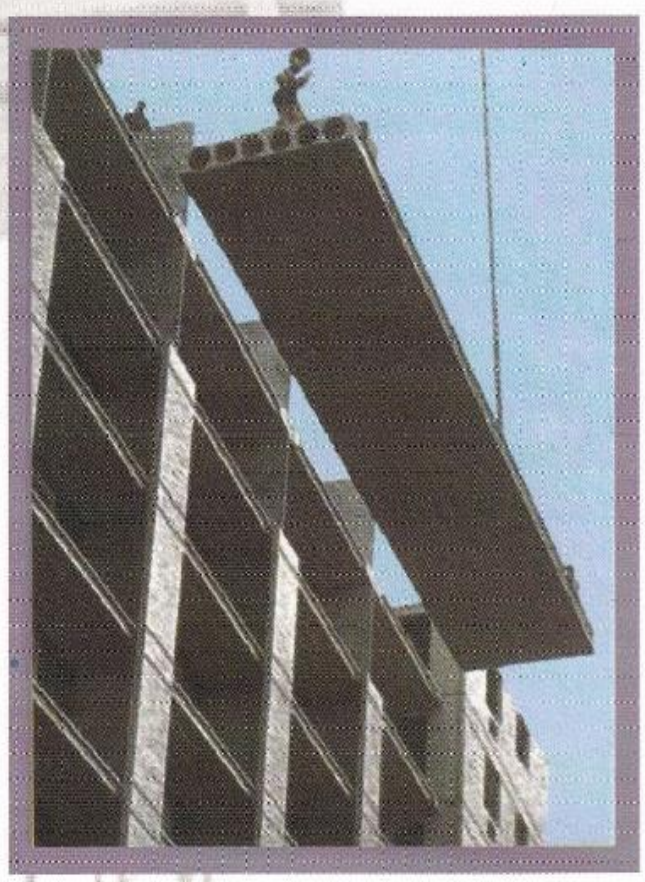
6. Transport to Site:

Transport is done by flat trailers, with hollow core slabs stacked horizontally, supported on timber planks and well secured to avoid transport damage.

Erection



Progressive Erection of
Precast Concrete Element
Building Structure



7. Erection:

Hollow core slabs are lifted from the trailers or stock on site by a special spreader beam and lifting belts, to ensure that no overstressing or damage occurs during erection.

Up to 600 m2 of hollow core slabs can be erected by one team in one day, making hollow core one of the fastest construction systems available.

HollowCore Slab Structural Details

Concrete

Cement:

- Ordinary Portland cement complying with the requirements of BS .12 AND ASTM C .150 Type 1.

Microsilica:

- Densified or undensified microsilica grade 92O D or 94O D

Water :

- Clean water with total dissolved solid contents not exceeding 700 p.p.m.

Coarse Aggregates:

- Crushed local aggregates complying with BS 882.

Fine Aggregates:

- AII fine aggregates are local sand, complying with BS BB2.

Admixtures:

- Water reducing admixtures complying with ASTM C 494-80-Iype A or Type D.

Strength:

- Characteristic cube strength f.r=60 N/mm'

Control:

- Concrete is made under strict laboratory control.

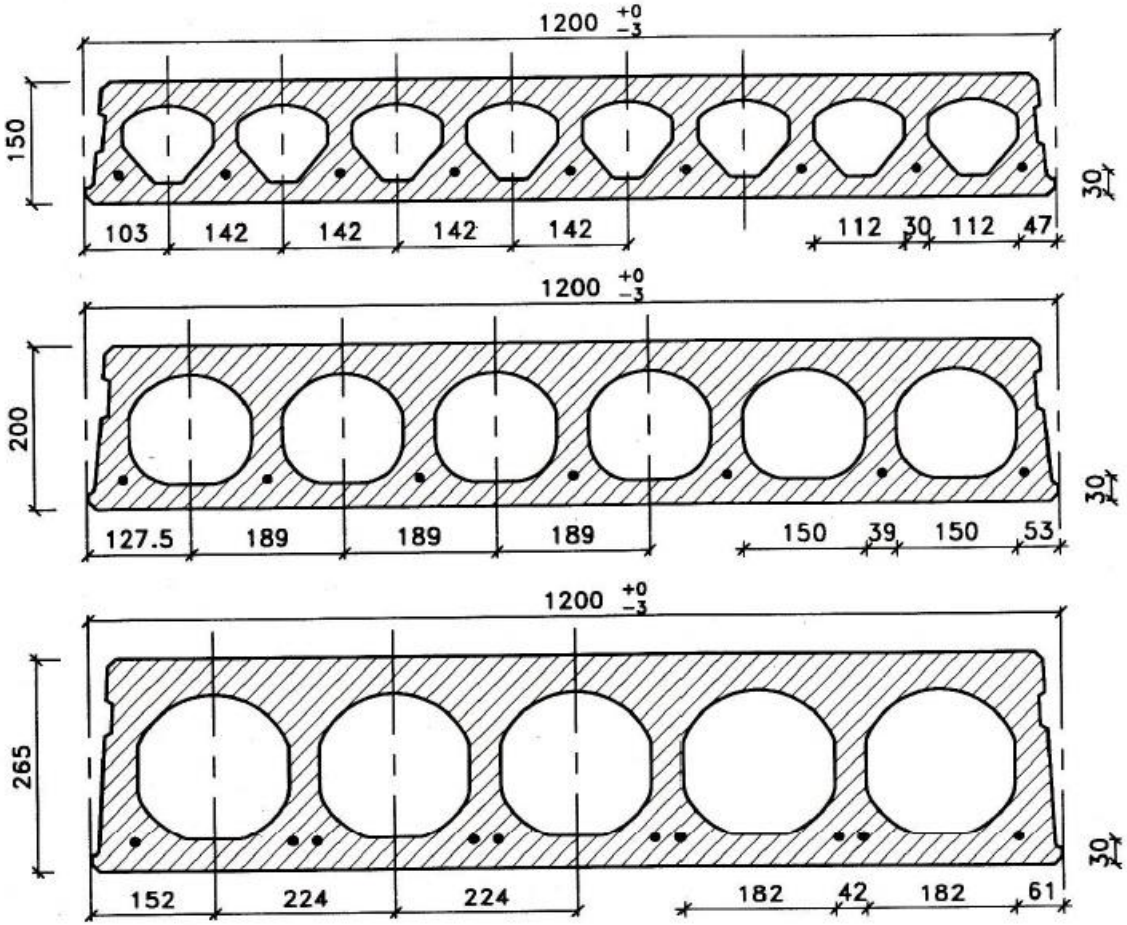
Reinforcement:

- 9.3mm or 12.5mm prestressing strands complying with BS 5895-.1980, relax class 2.
- Ultimate tensile strength: 177O N/mm'
- Modules of elasticity 185-205 kN/mm'
- Proof Strain: min.3.5o/.
- Relaxation for 70"/o initial
- load after 1000 hrs : max. 2.50%
- The strands are placed at the bottom of the
- slab with nominal cover 30mm to both cores
- and soffit in accordance with BS 8110.

Finishes:

- HOLLOWCORE SLAB elements have a light broomed top surface allowing for good bond to the floor finish or structural topping. The soffit is smooth, off steel mould finish which requires only a minimum of preparation before painting.

Element Details 1

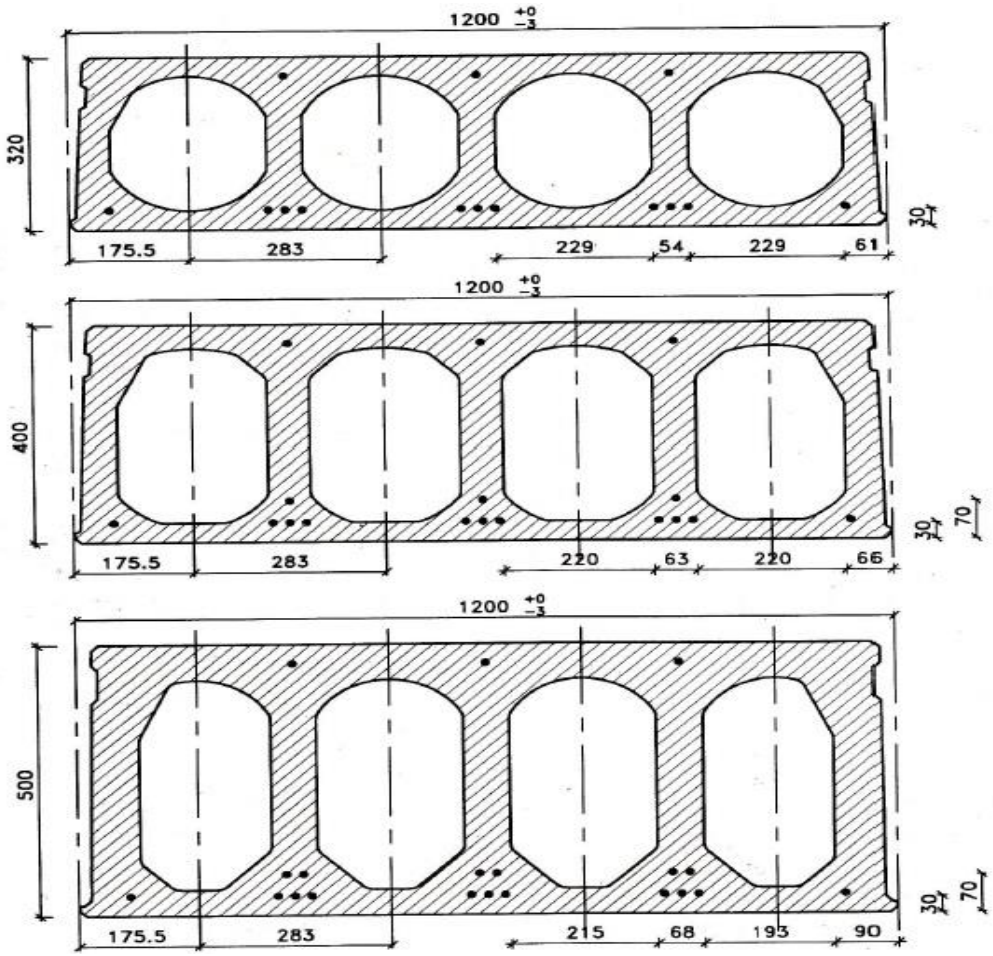


150mm STANDARD

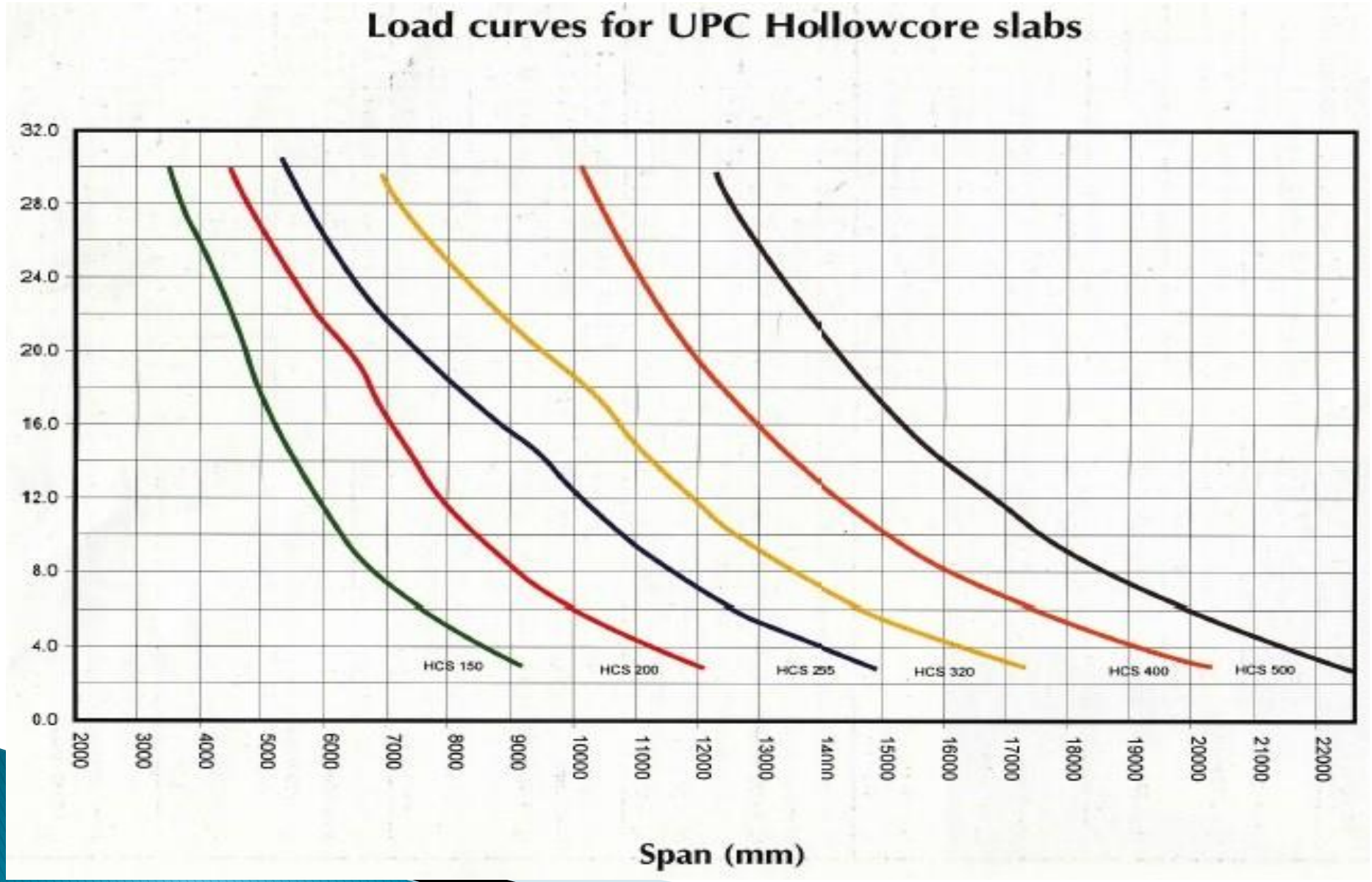
200mm STANDARD

265mm STANDARD

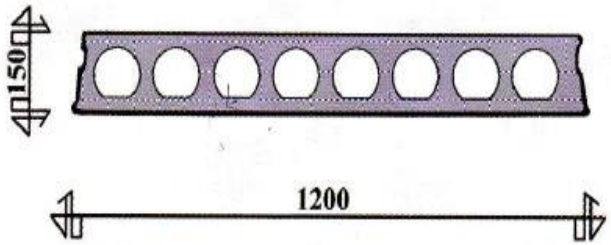
Element Details 2



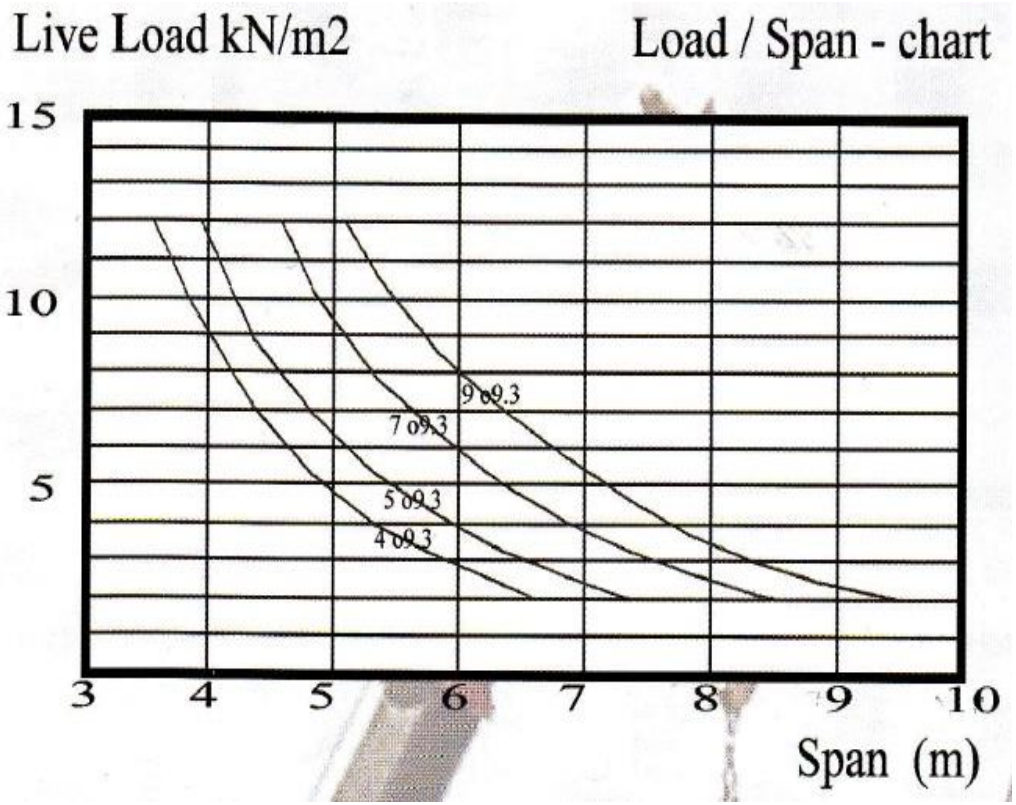
Combined Load Curve



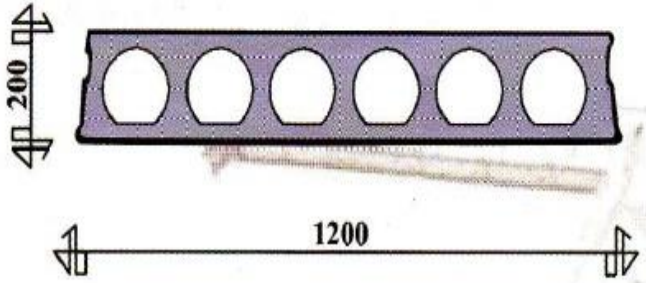
Load vs Span chart Type 1



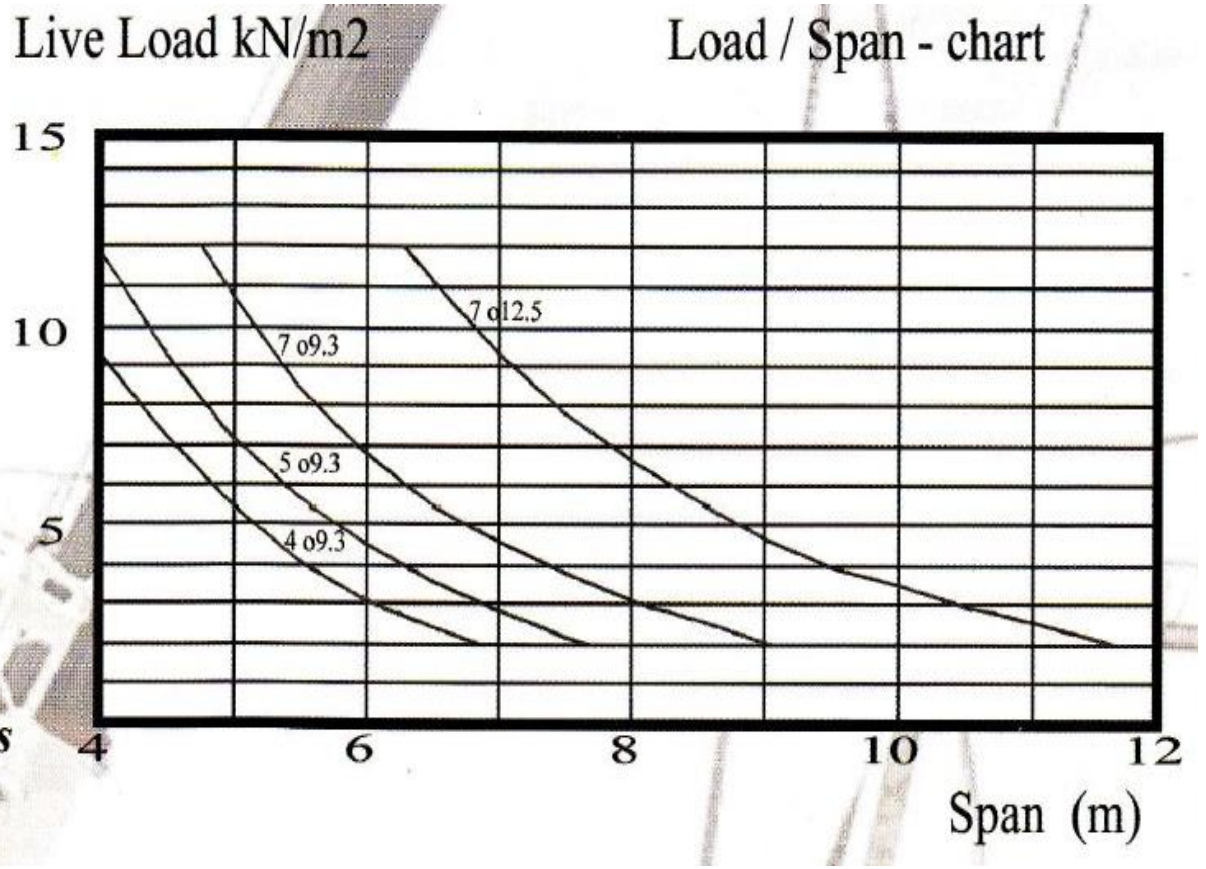
Hollow core slab 150mm thick, 8 voids



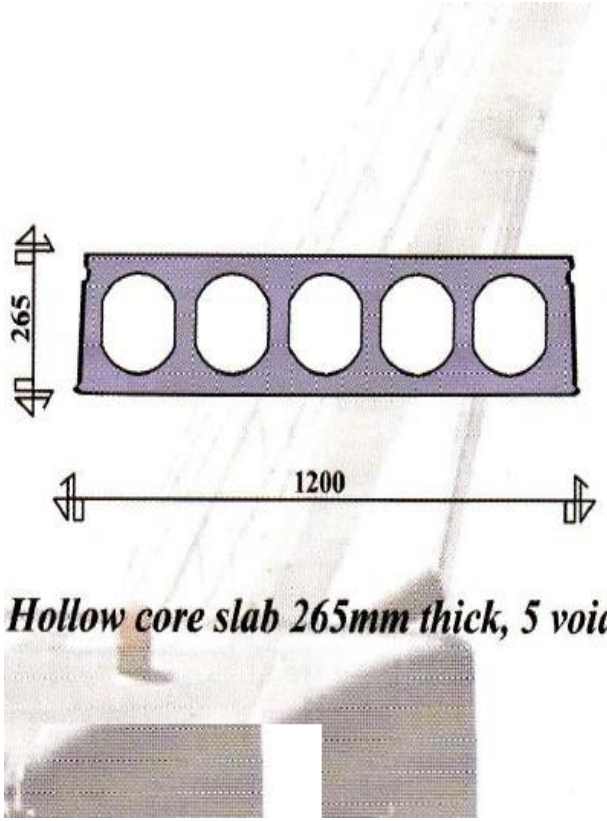
Load vs Span chart Type 2



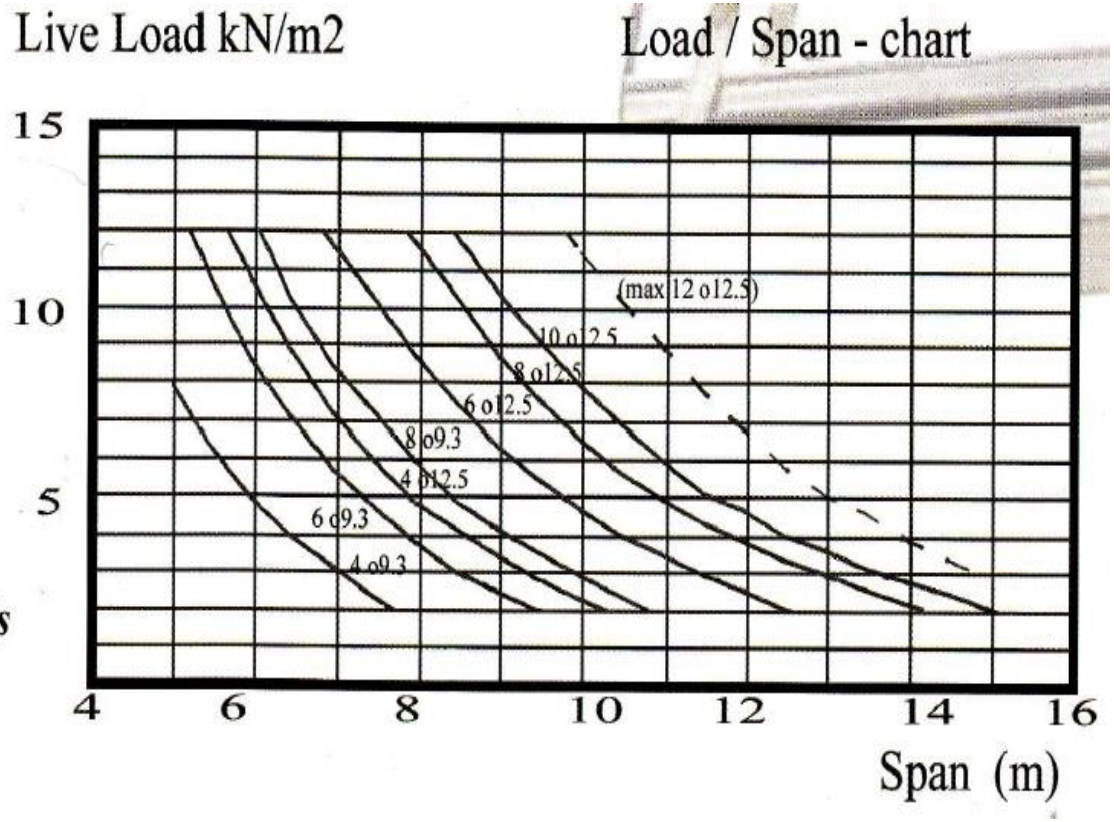
Hollow core slab 200mm thick, 6 voids



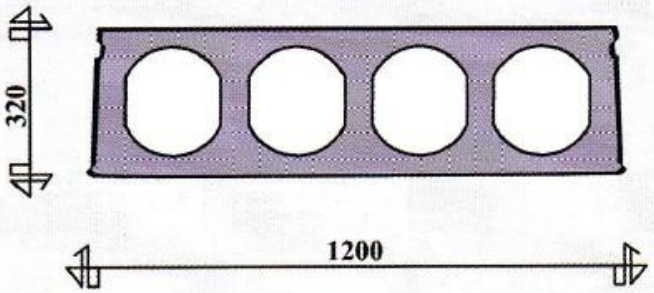
Load vs Span chart Type 3



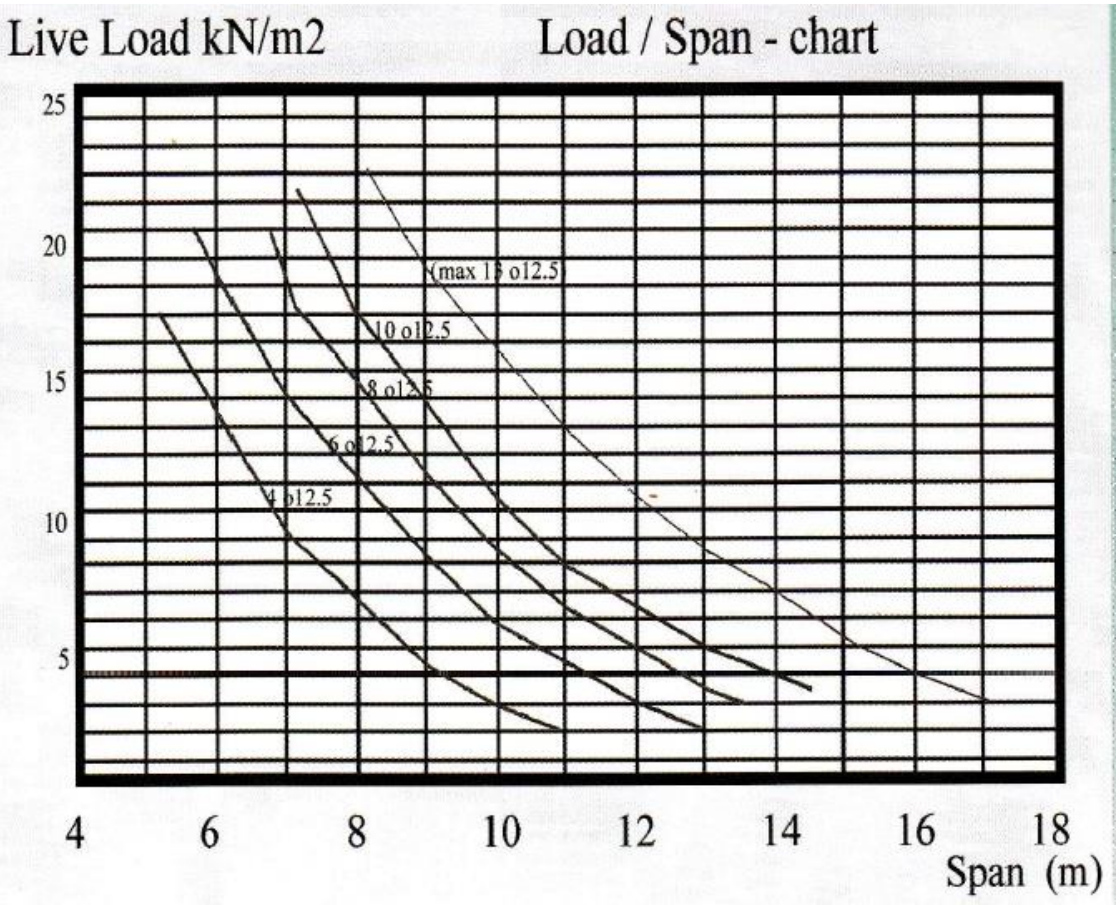
Hollow core slab 265mm thick, 5 voids



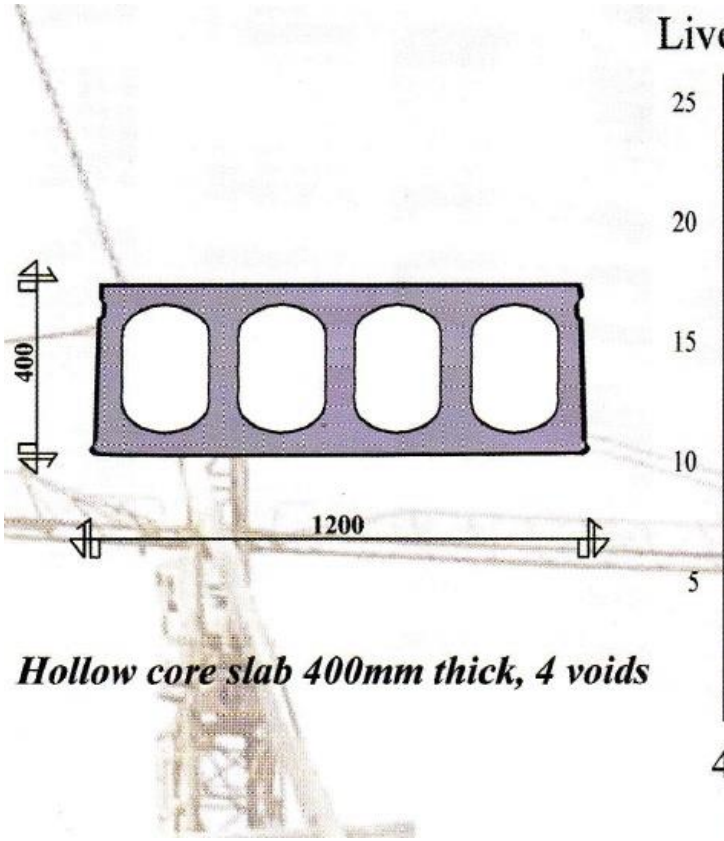
Load vs Span chart Type 4



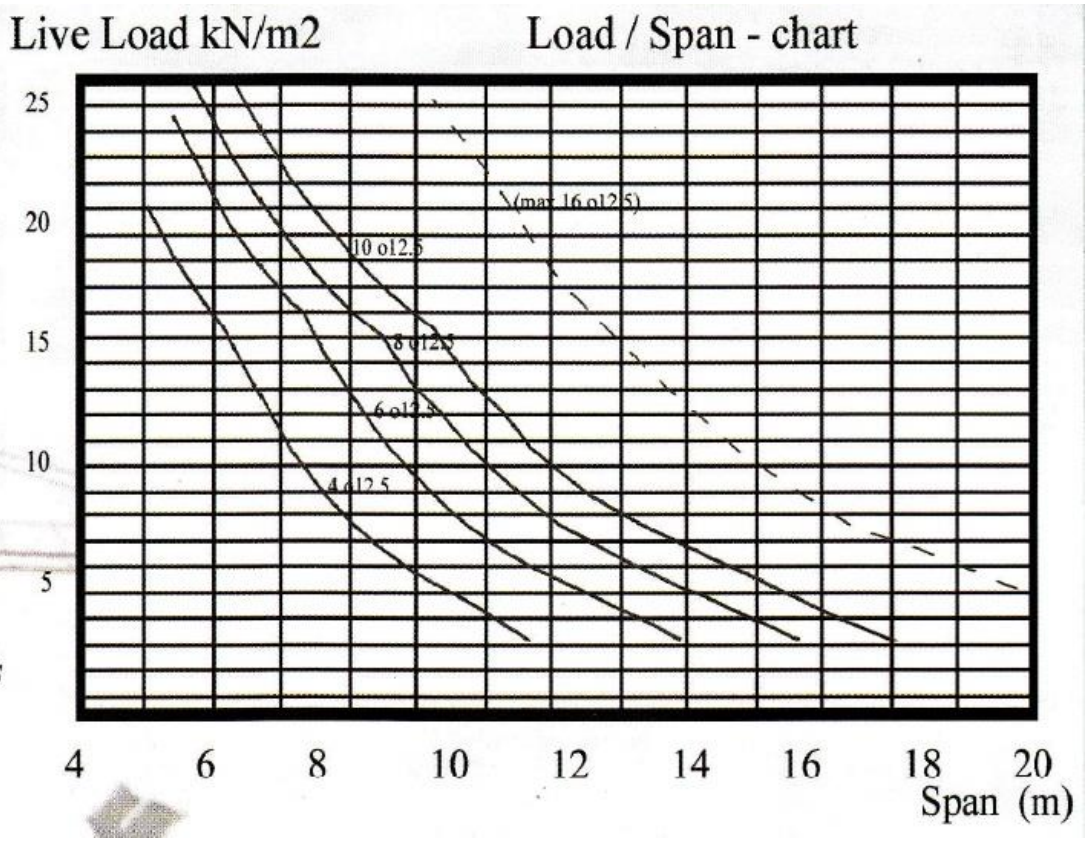
Hollow core slab 320mm thick, 4 voids



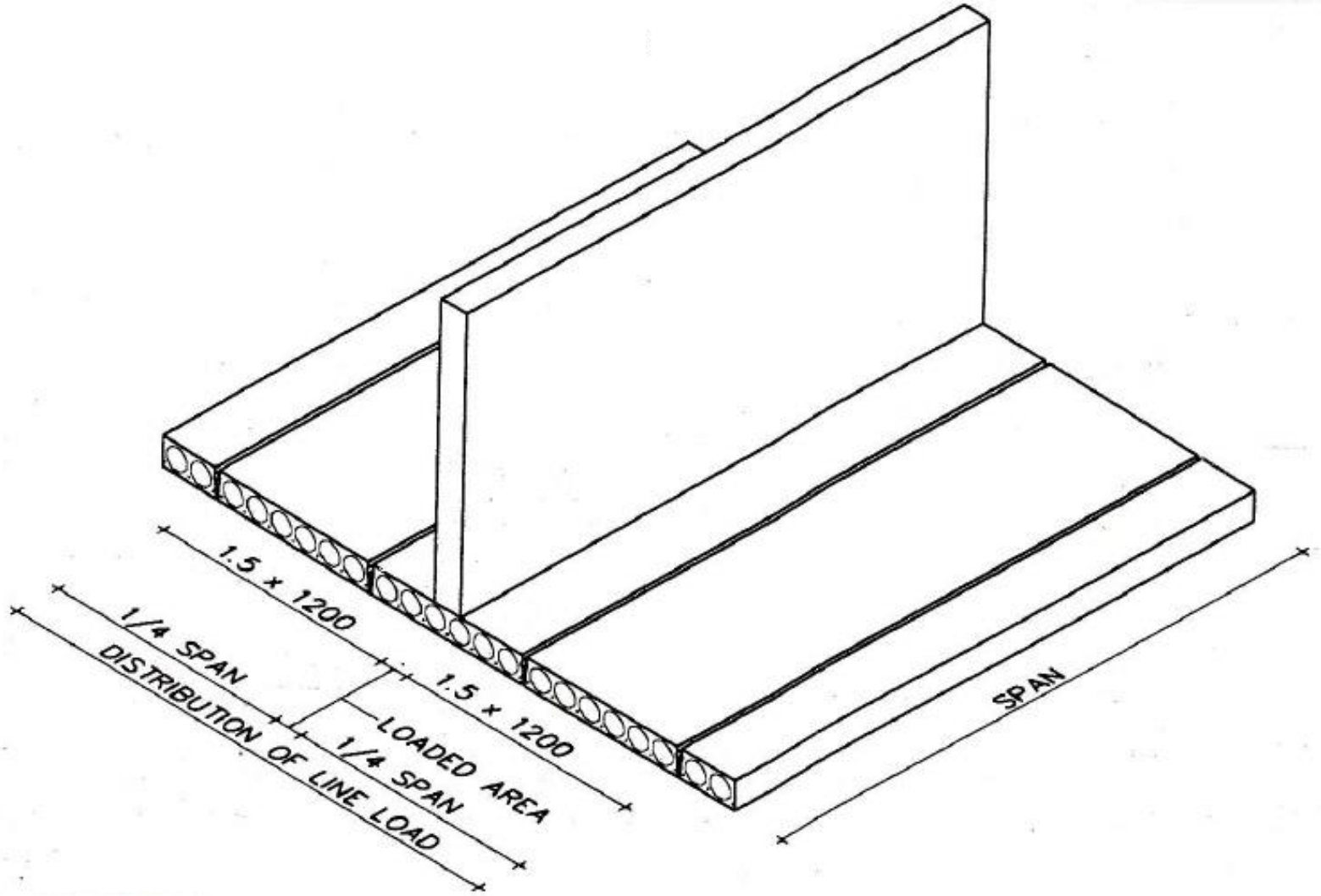
Load vs Span chart Type 5



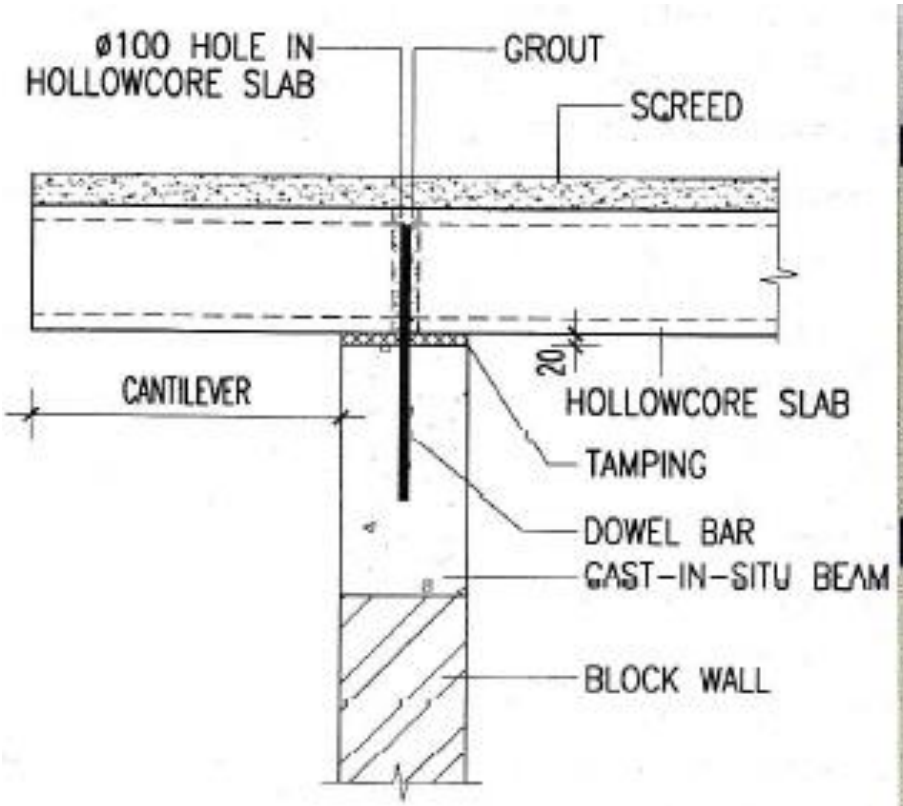
Hollow core slab 400mm thick, 4 voids

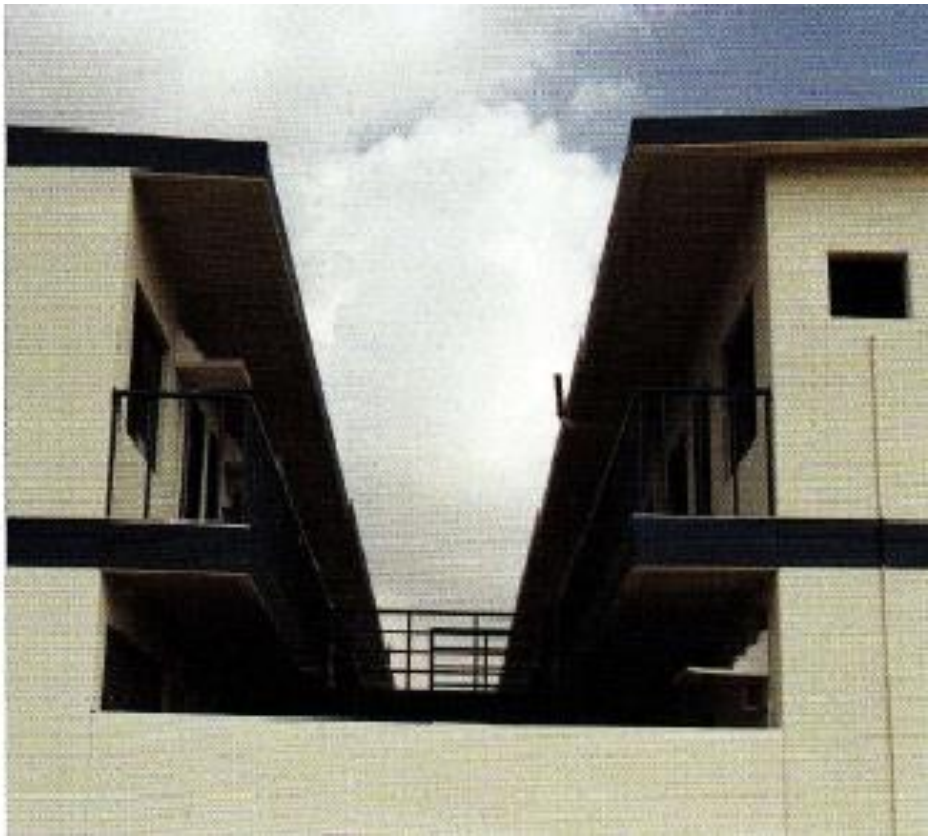


Distribution of Load from partition wall on HCS

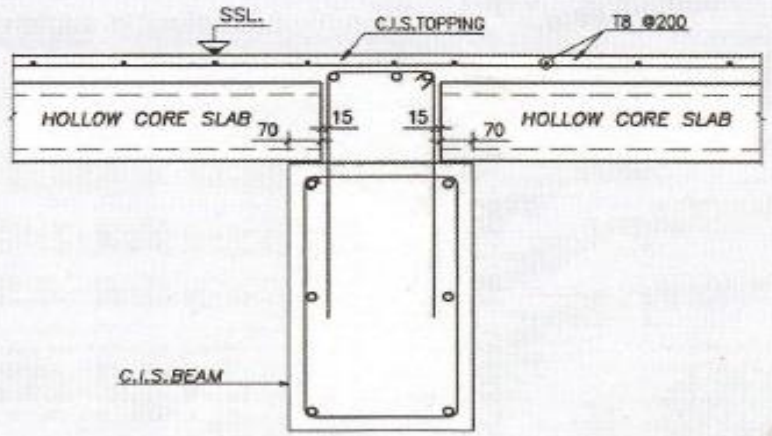


Cantilever Slabs

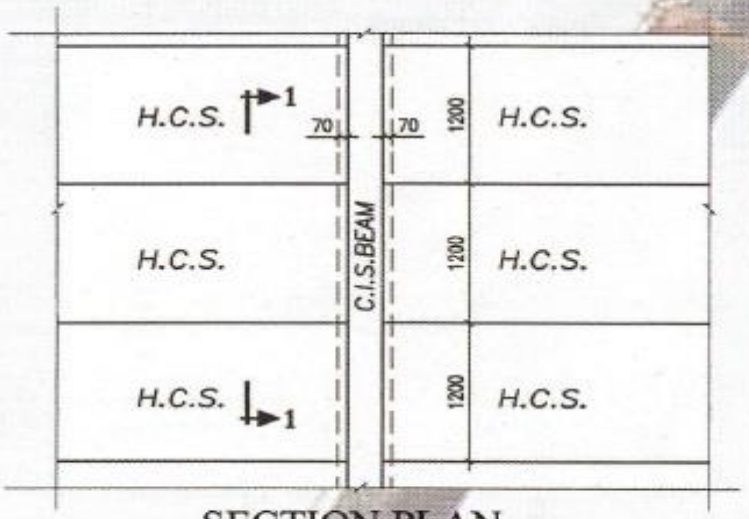




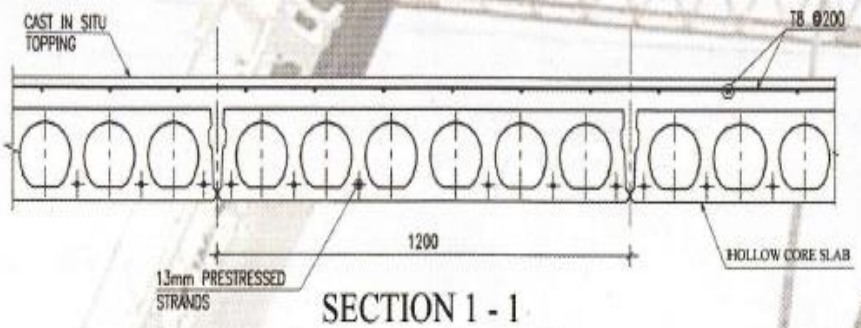
Connection Details 1



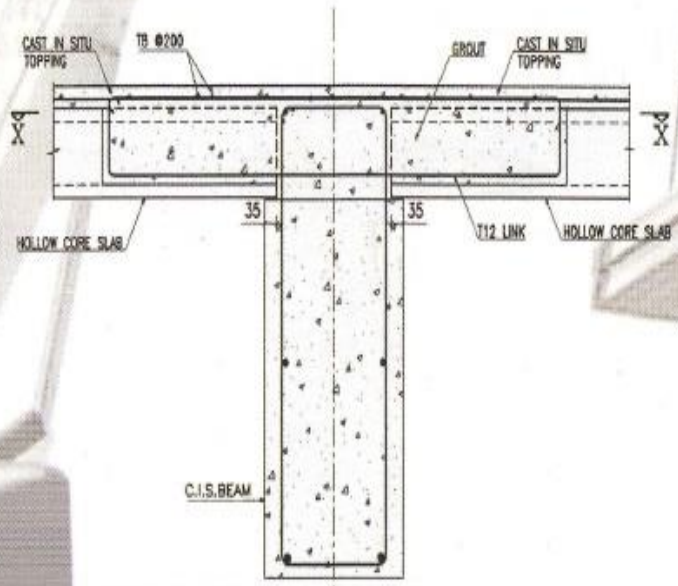
HOLLOW CORE SLAB CONNECTION DETAIL



SECTION PLAN

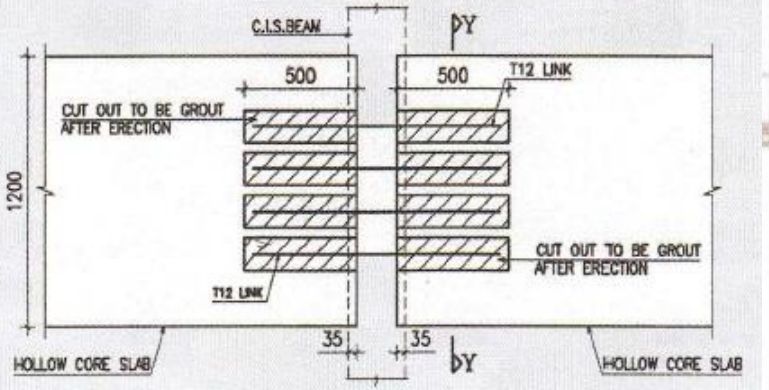


SECTION 1 - 1

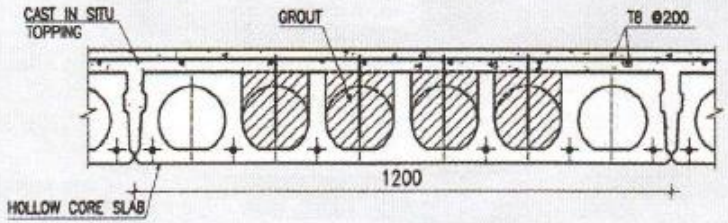


TYPICAL HOLLOW CORE SLAB CONNECTION DETAIL

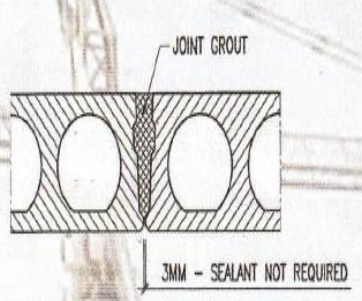
Connection Details 2



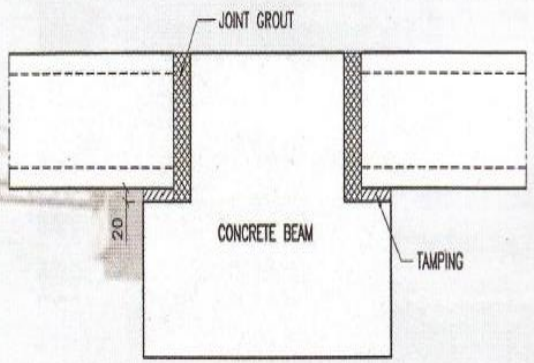
SECTION X - X



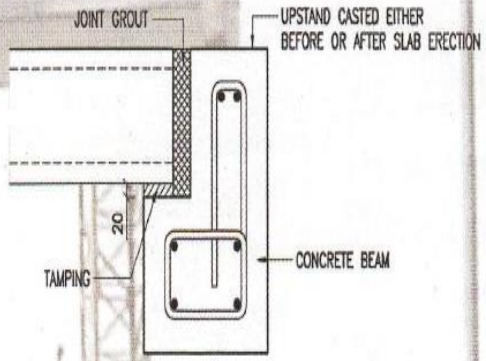
SECTION Y - Y



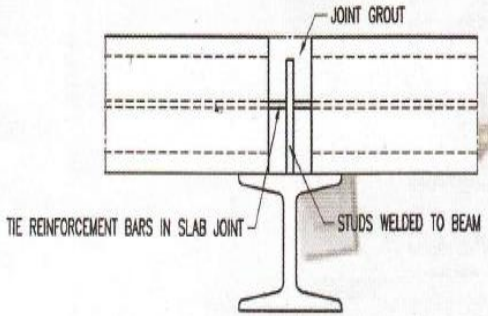
SLAB JOINT (SHEAR KEY)



SUPPORT ON CONCRETE BEAM

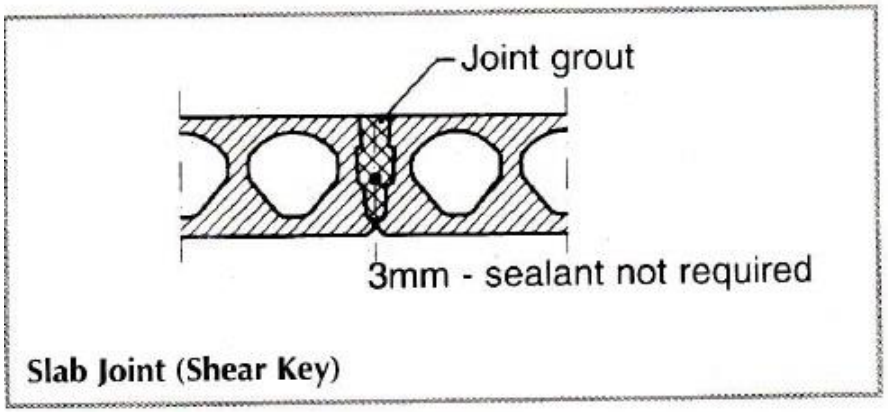


SUPPORT ON CONCRETE BEAM

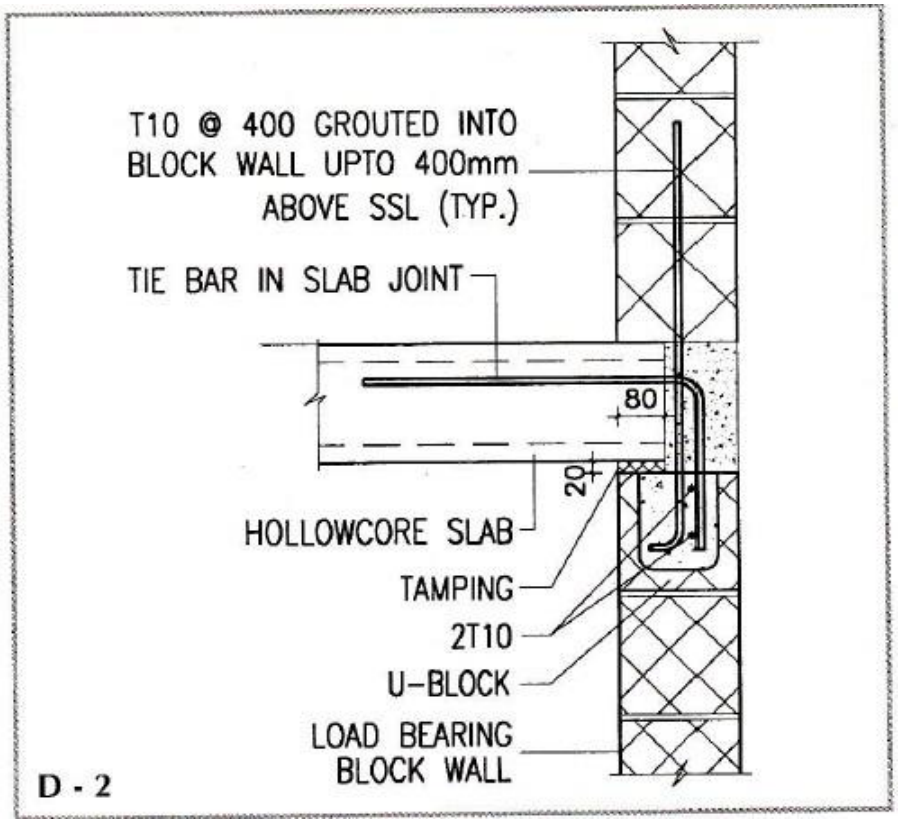


SUPPORT ON STEEL STRUCTURE

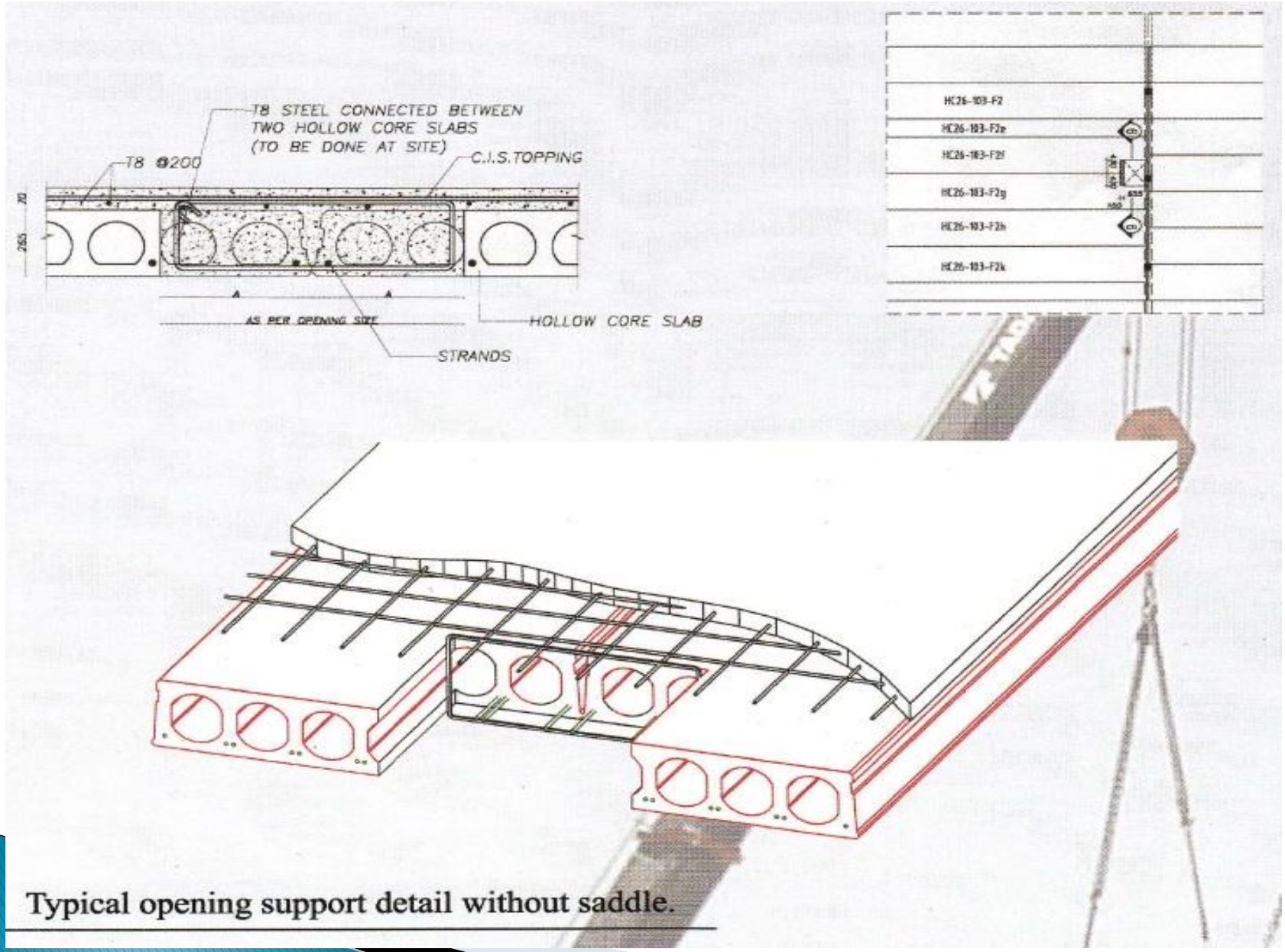
Slab Joint details



Slab Joint (Shear Key)

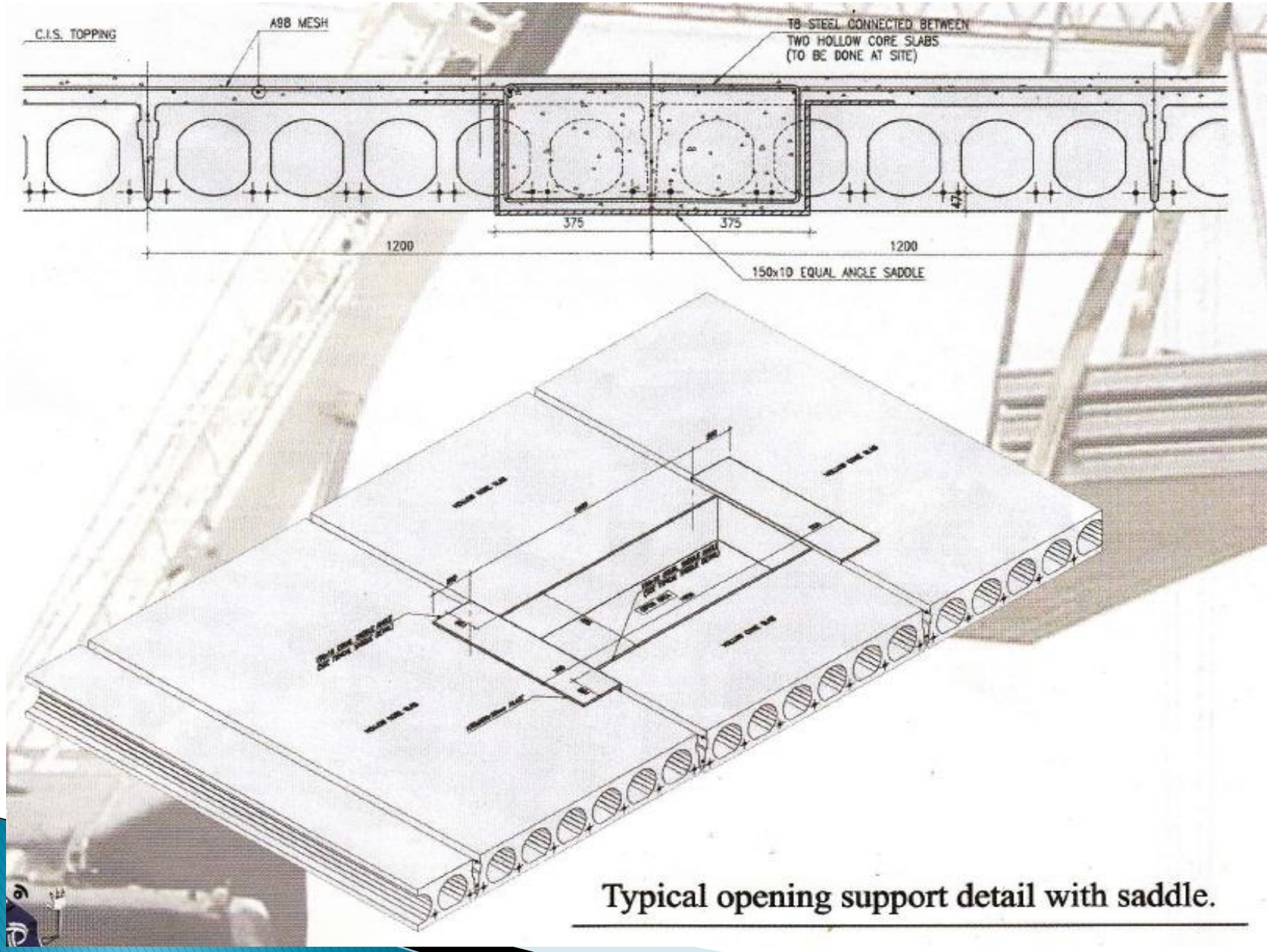


Opening Support Details 1



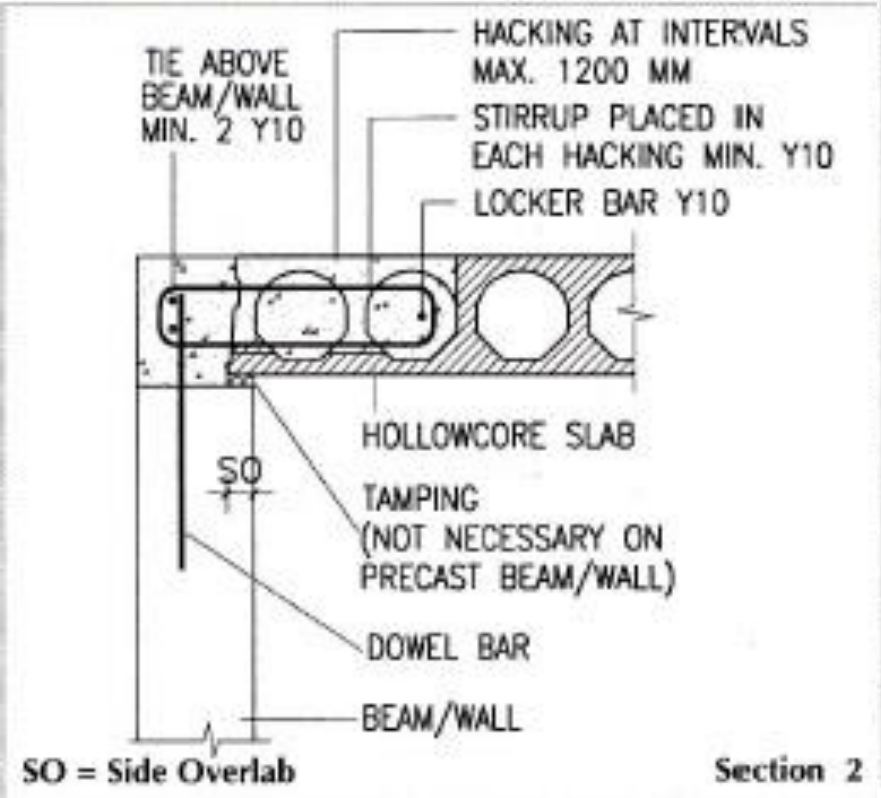
Typical opening support detail without saddle.

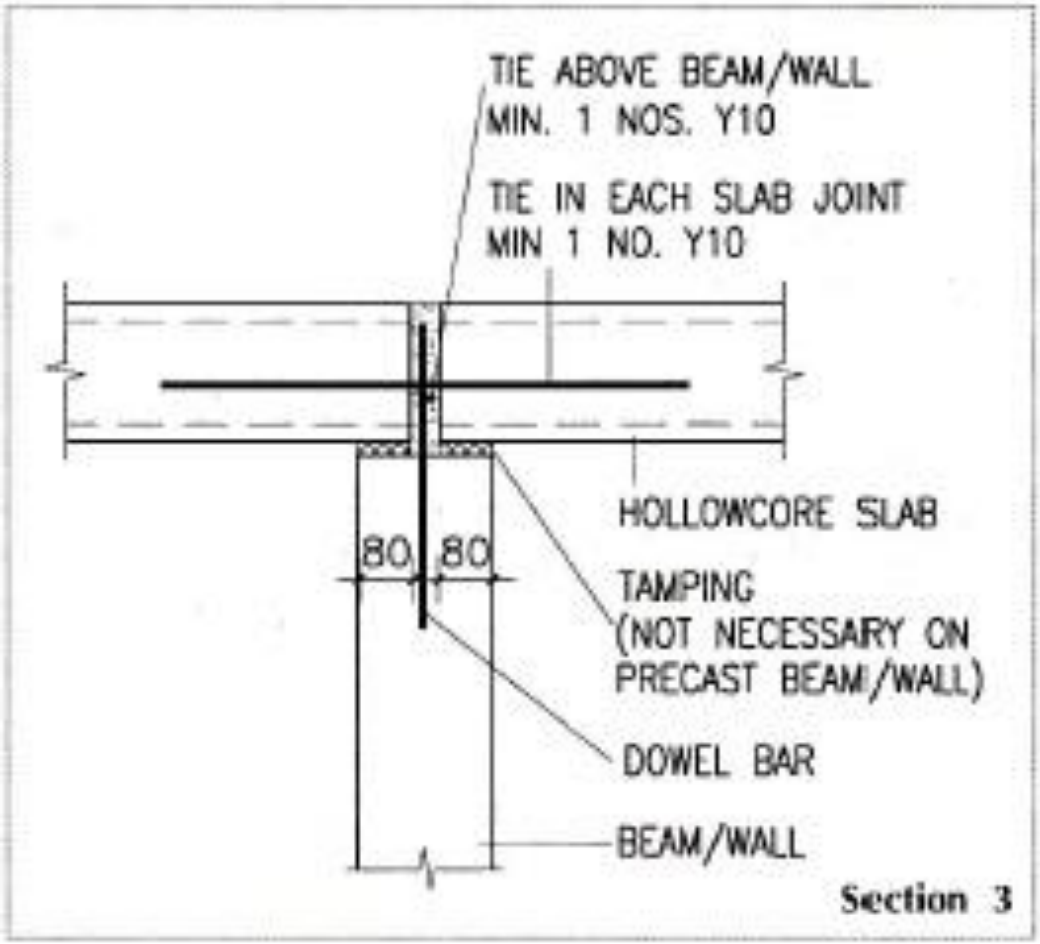
Opening Support Details 2



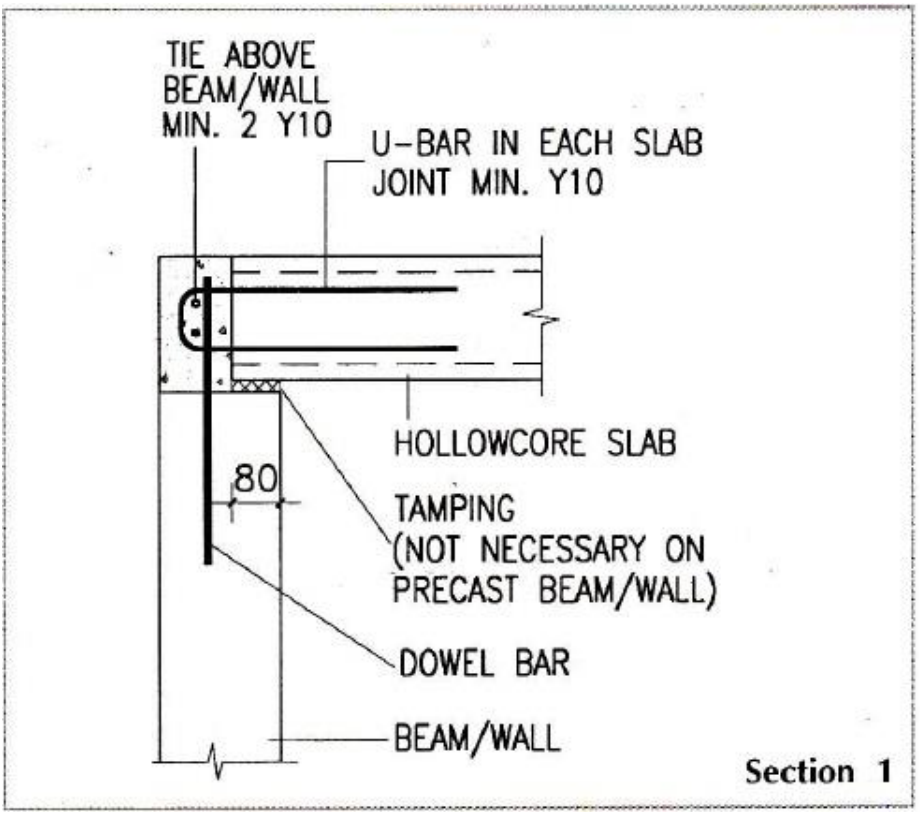
Typical opening support detail with saddle.

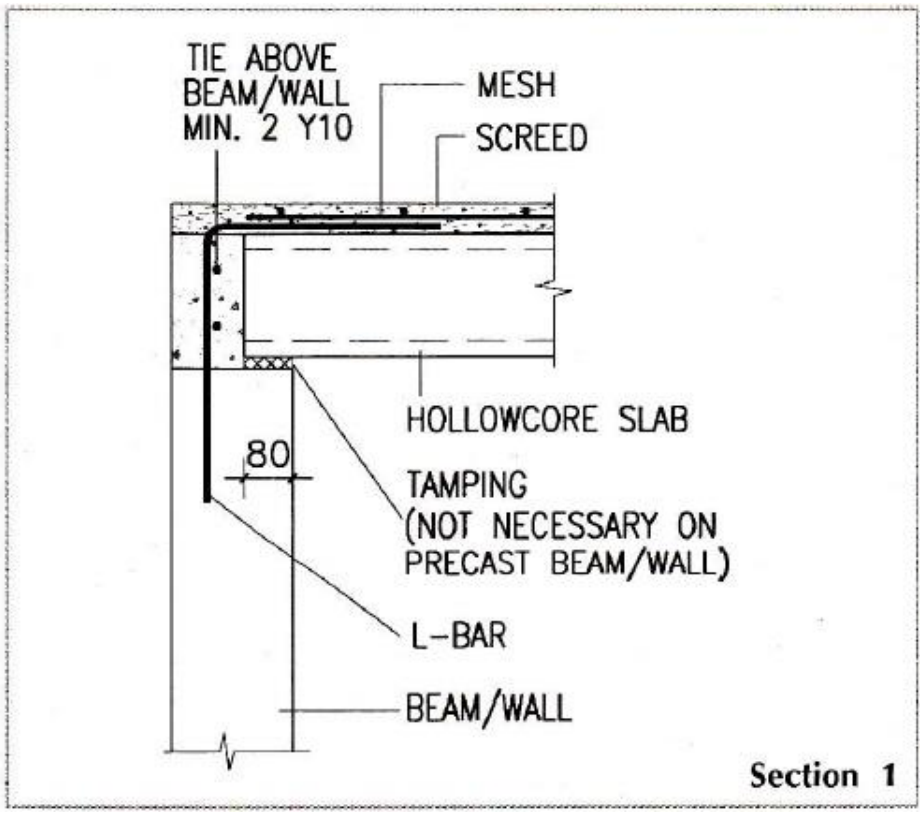
Diaphragm Action





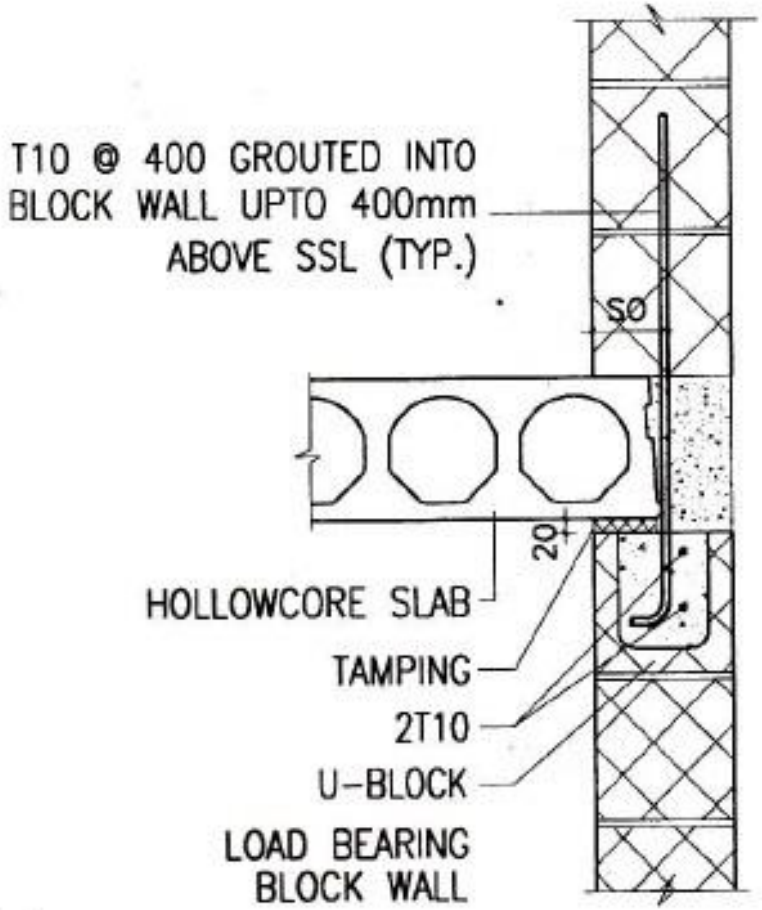
Diaphragm Action with and without Topping



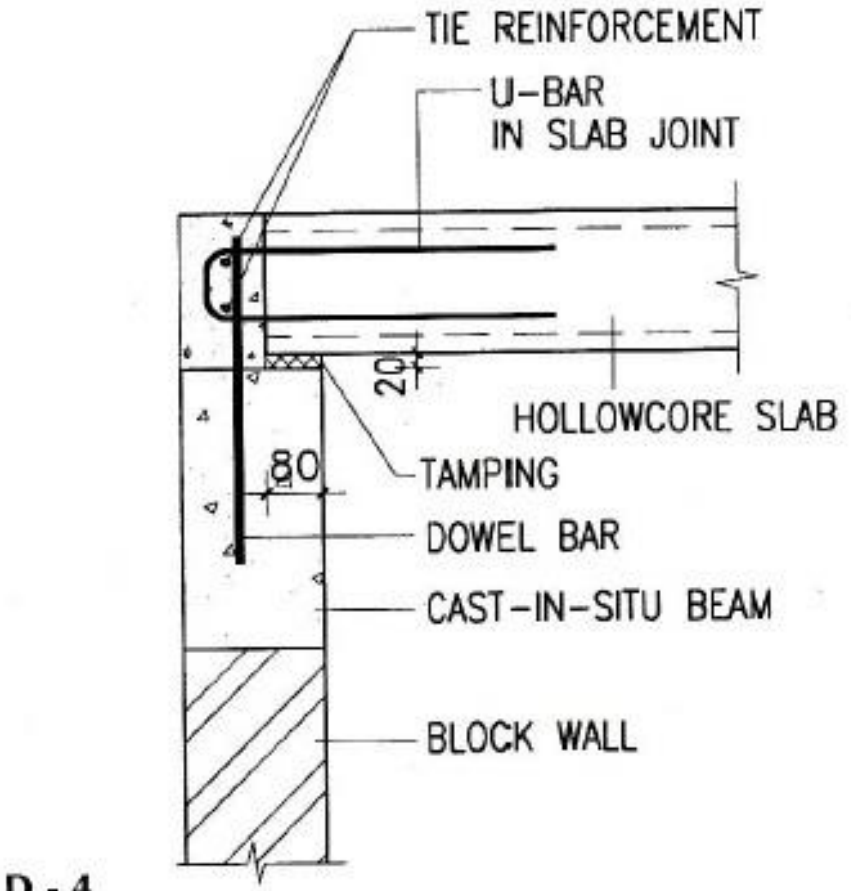


HCS supported on

load bearing blockwork walls and on concrete beams

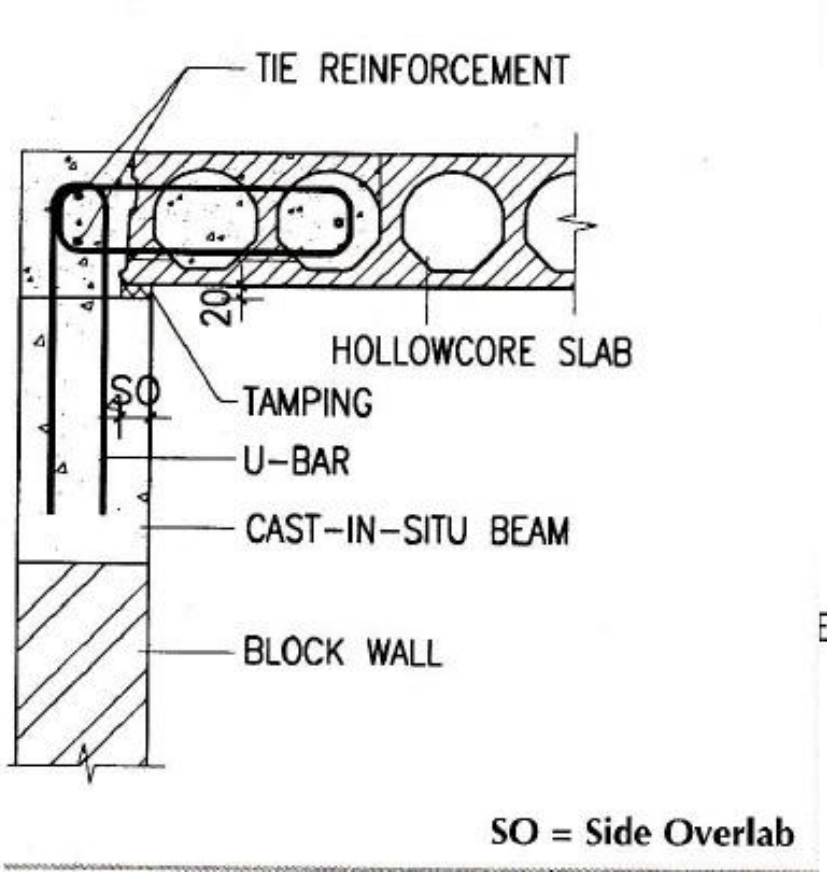


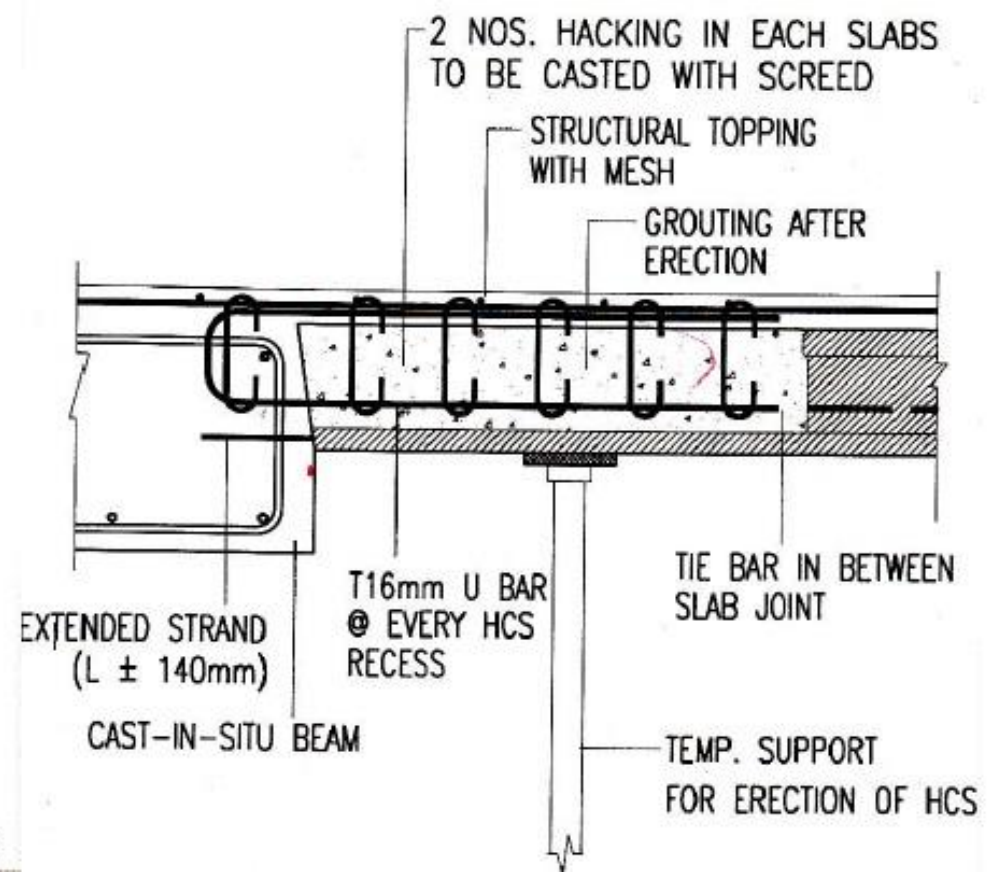
D - 1



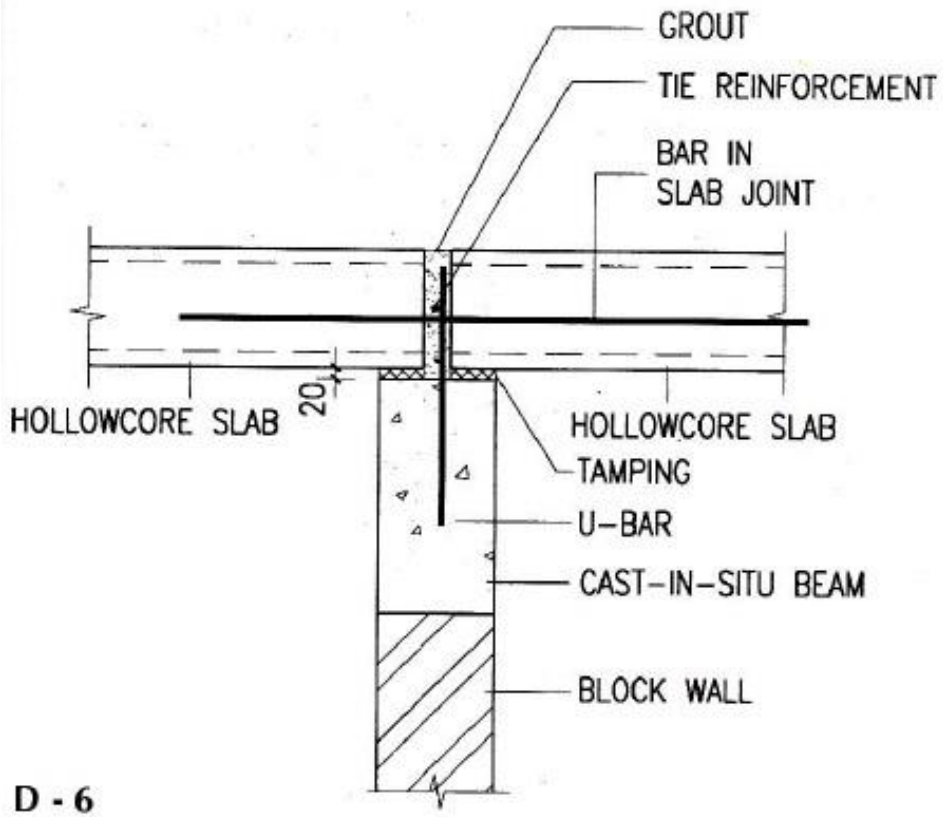
D - 4

HCS with Tie Reinforcement

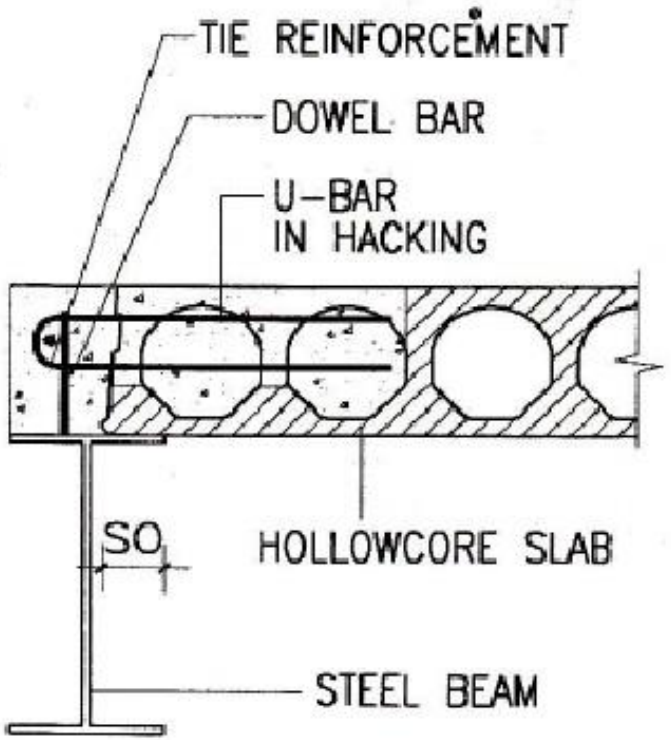




HCS supported on Steel Structures 1

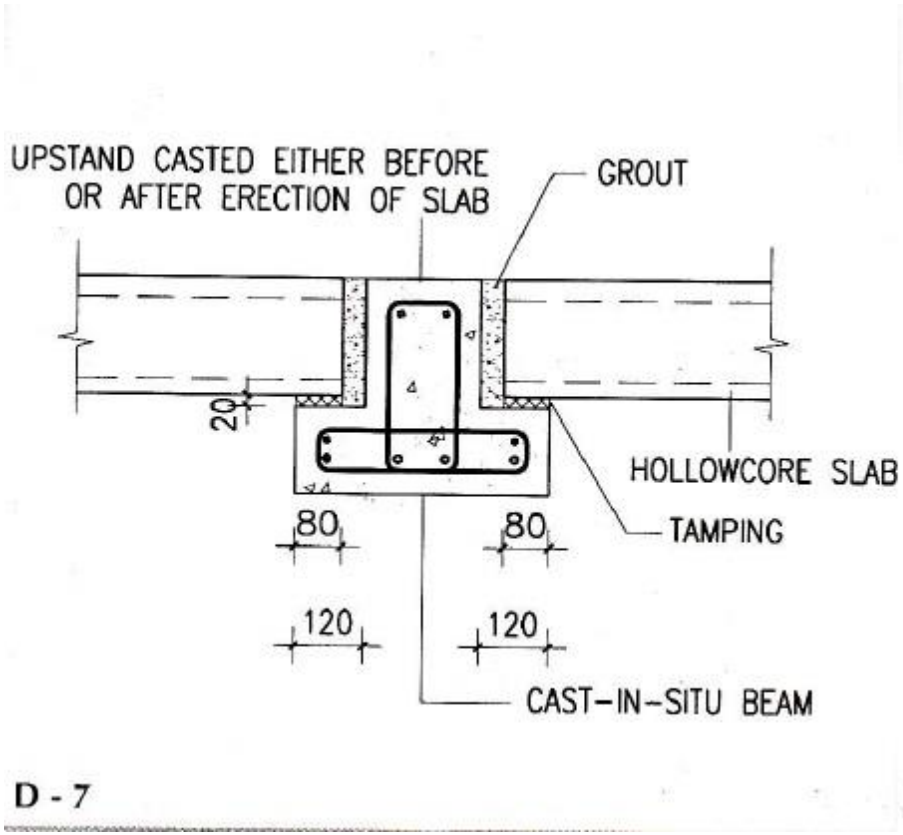


D - 6

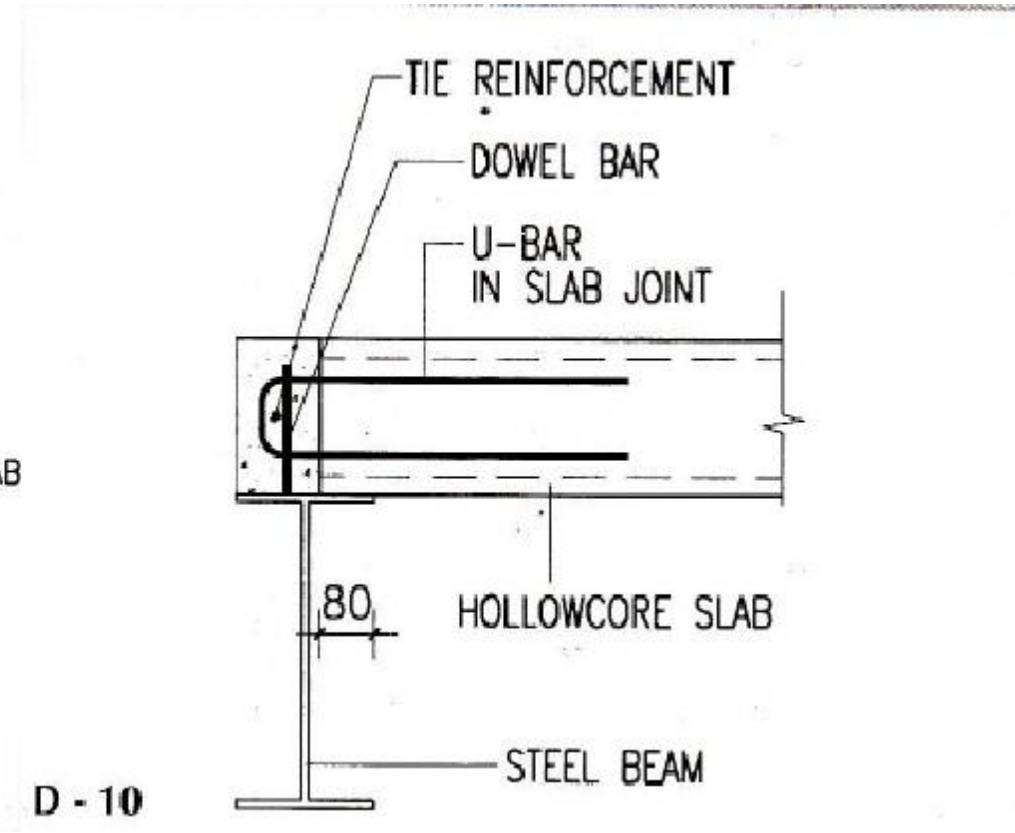


SO = Side Overlab

HCS supported on Steel Structures 2

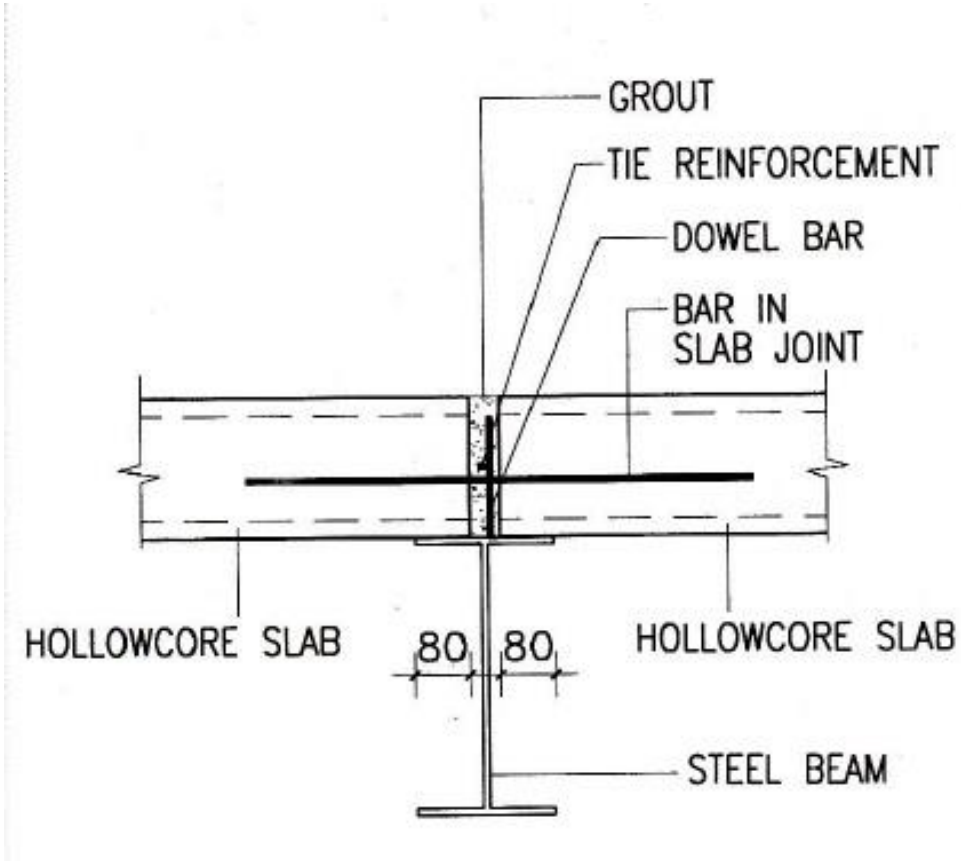


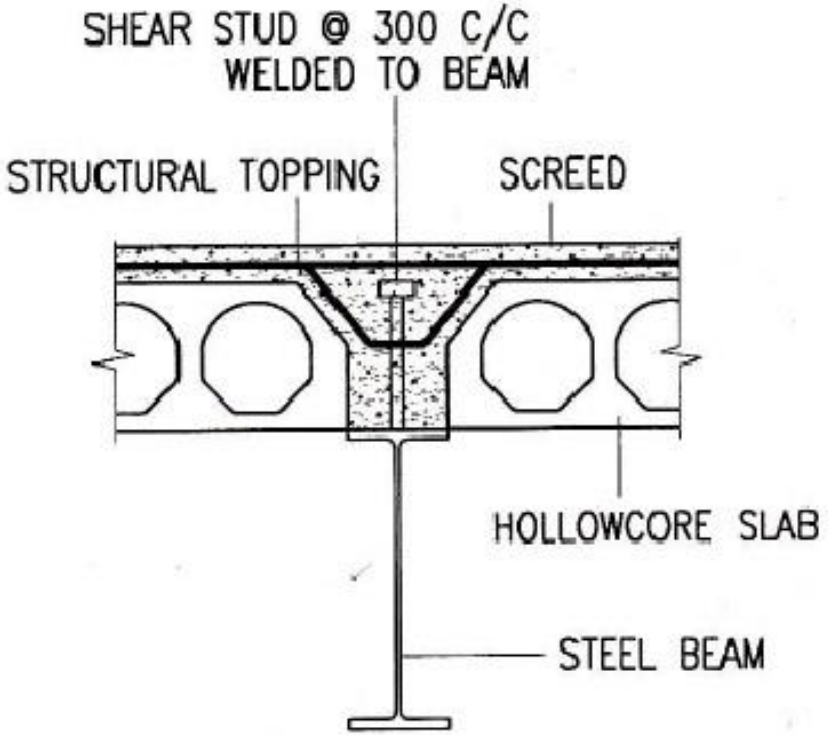
D - 7



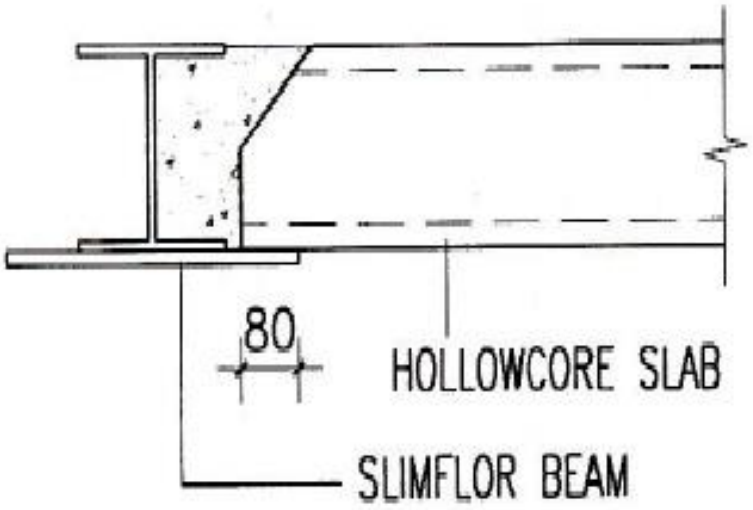
D - 10

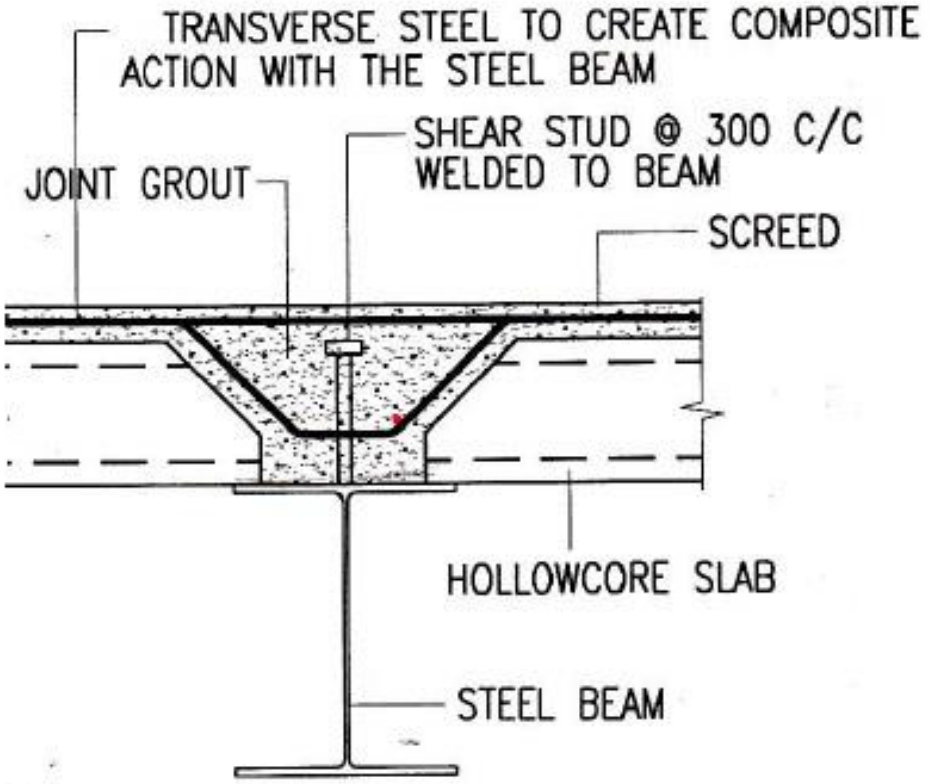
HCS supported on Steel Structures 3



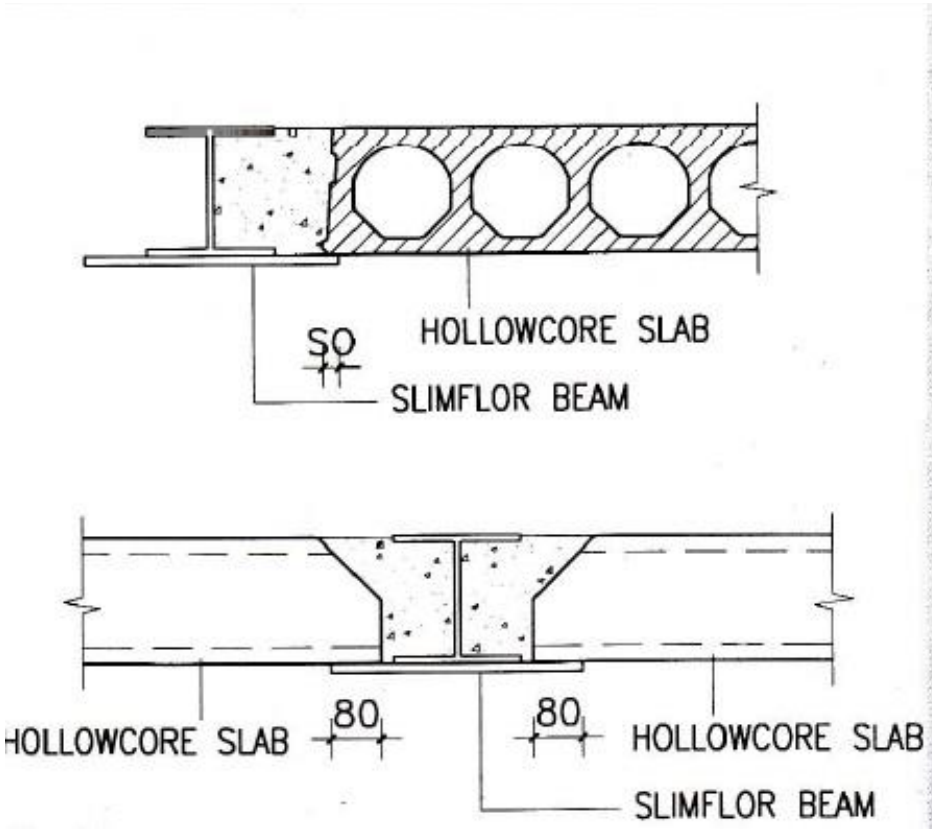


HCS supported on Steel Structures 4

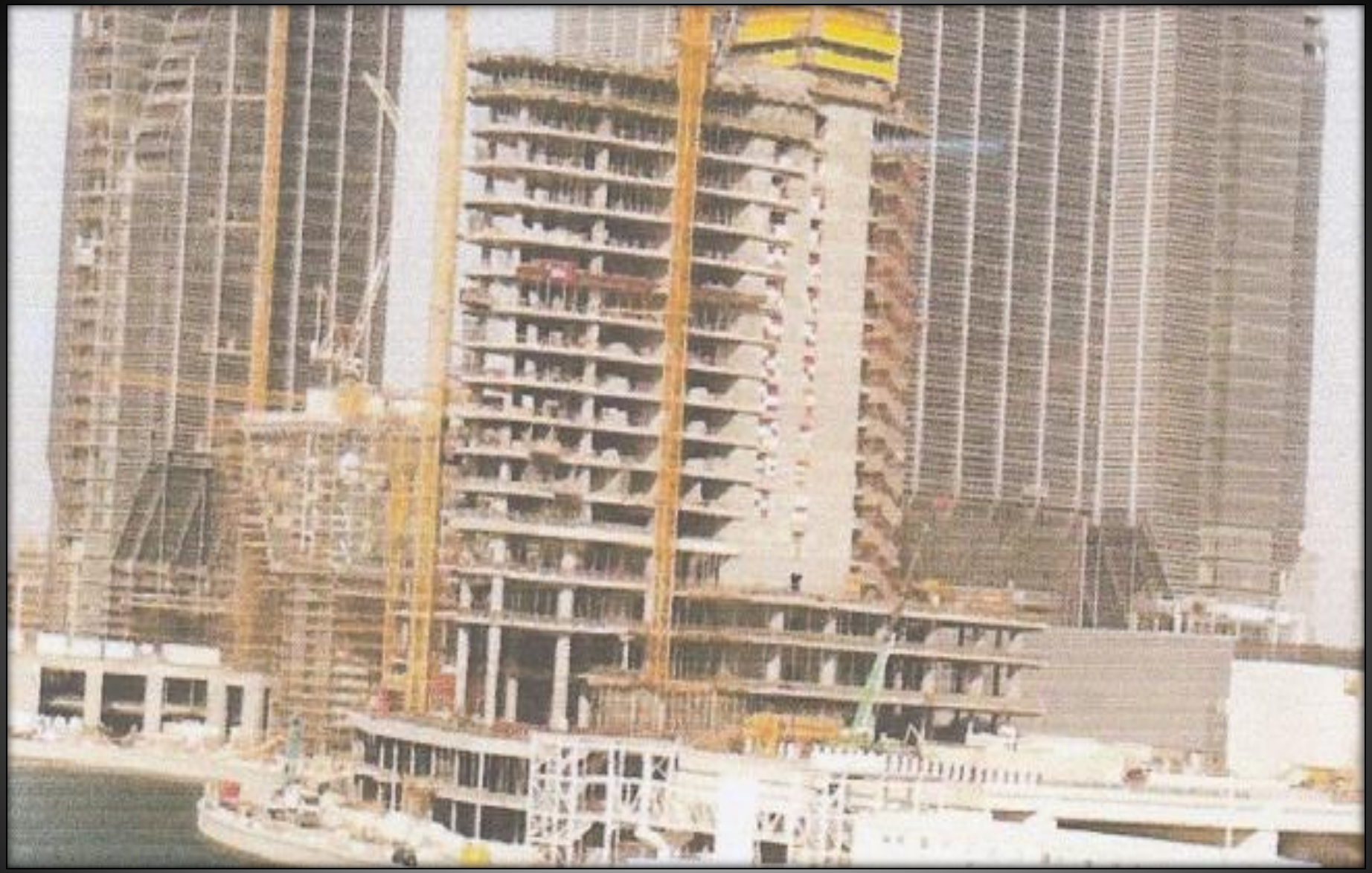


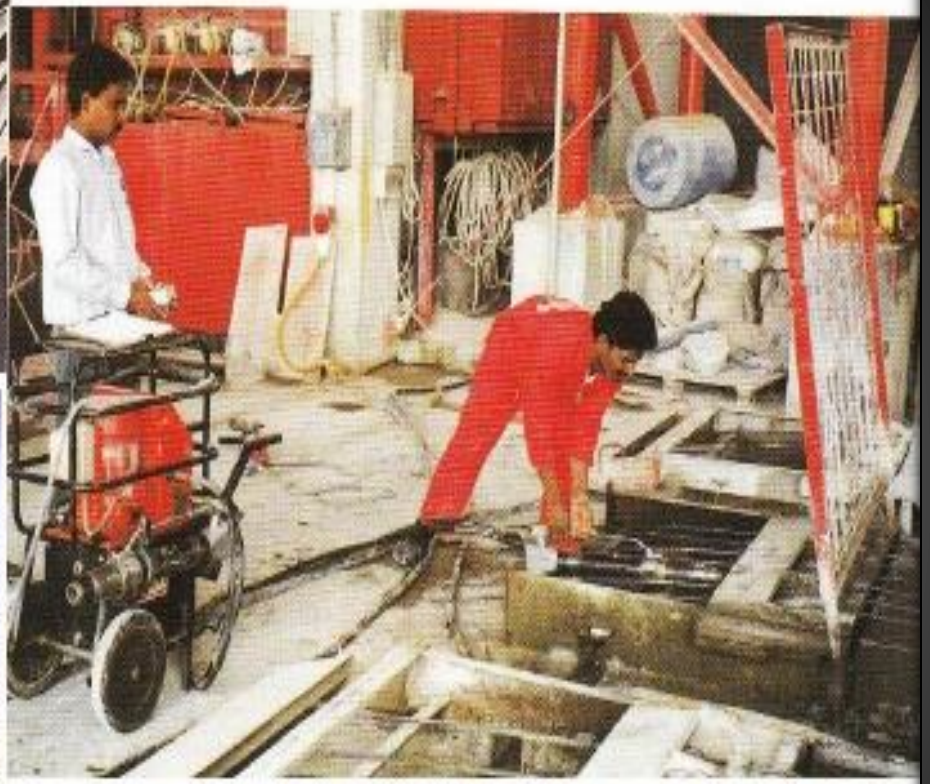


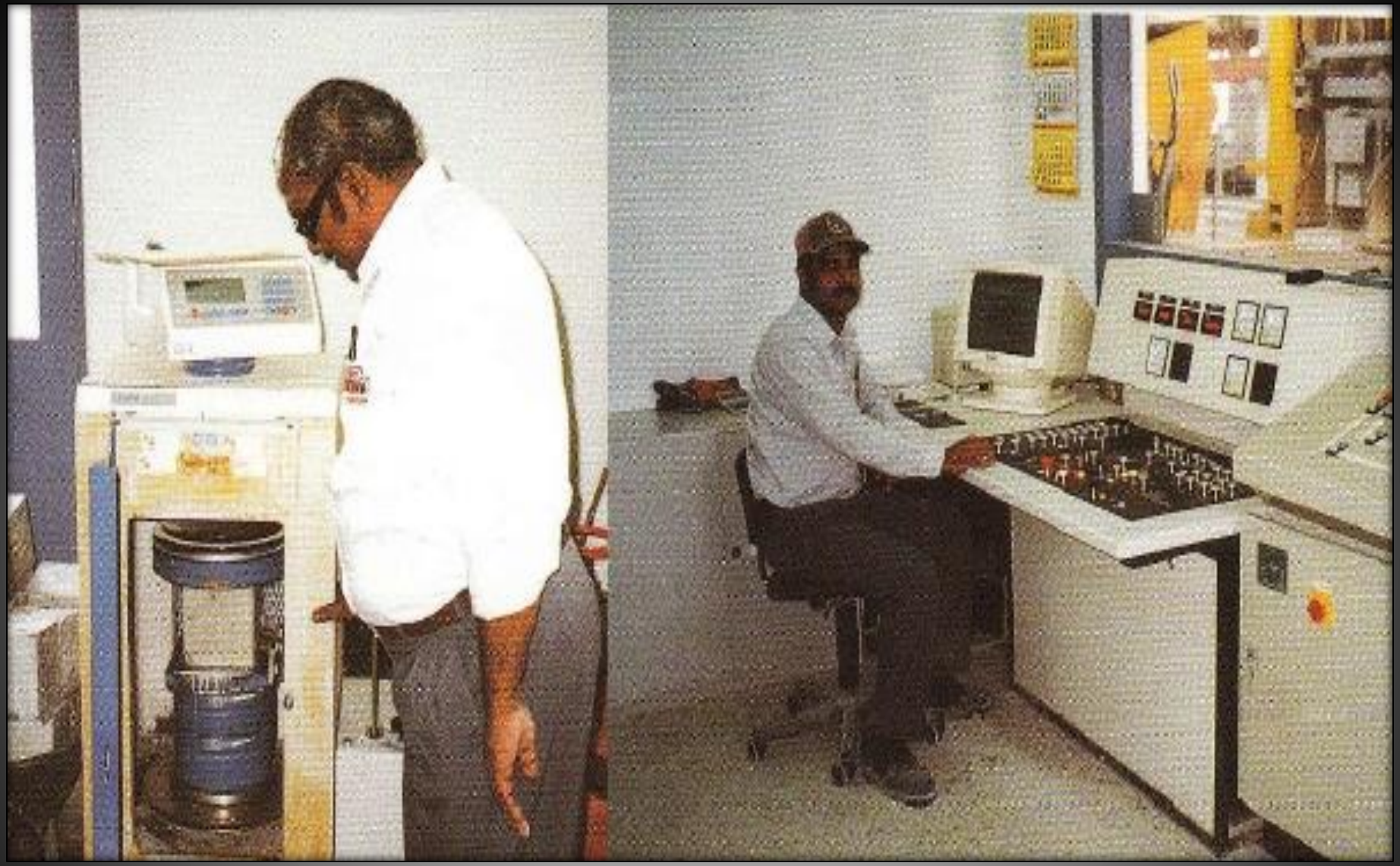
HCS supported on Steel Structures 5



Ongoing and Completed Projects using HCS in Abu Dhabi and Dubai





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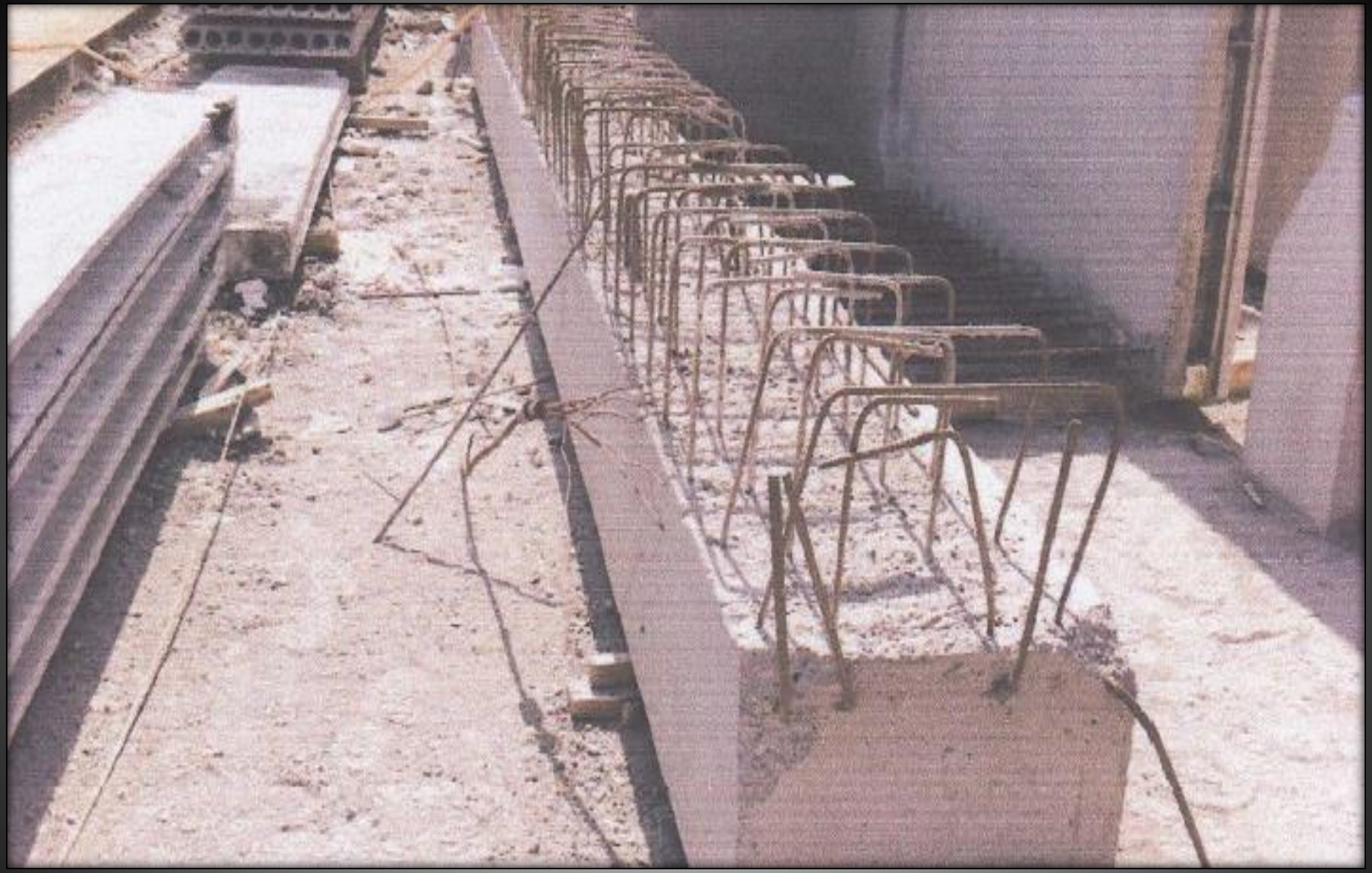

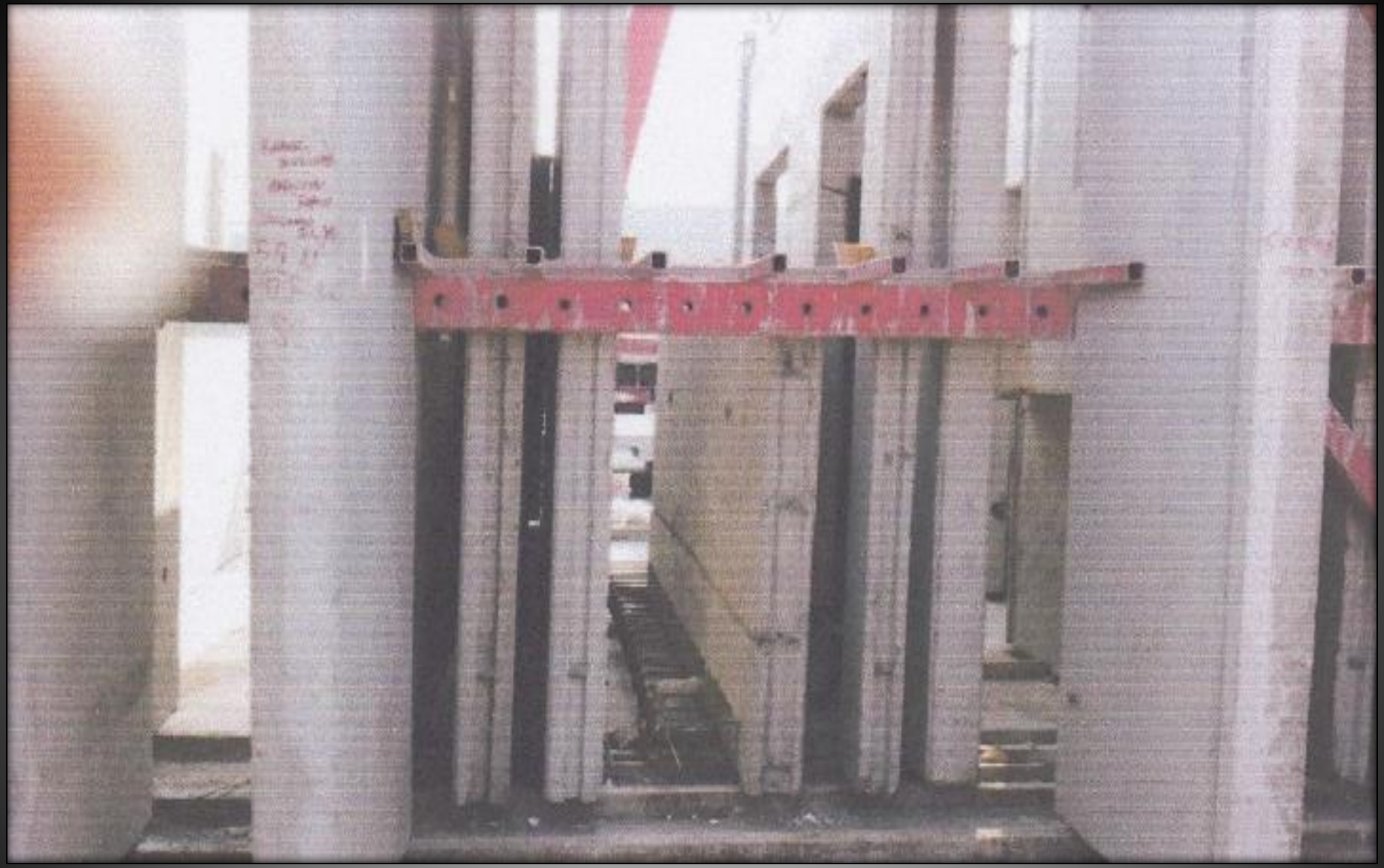

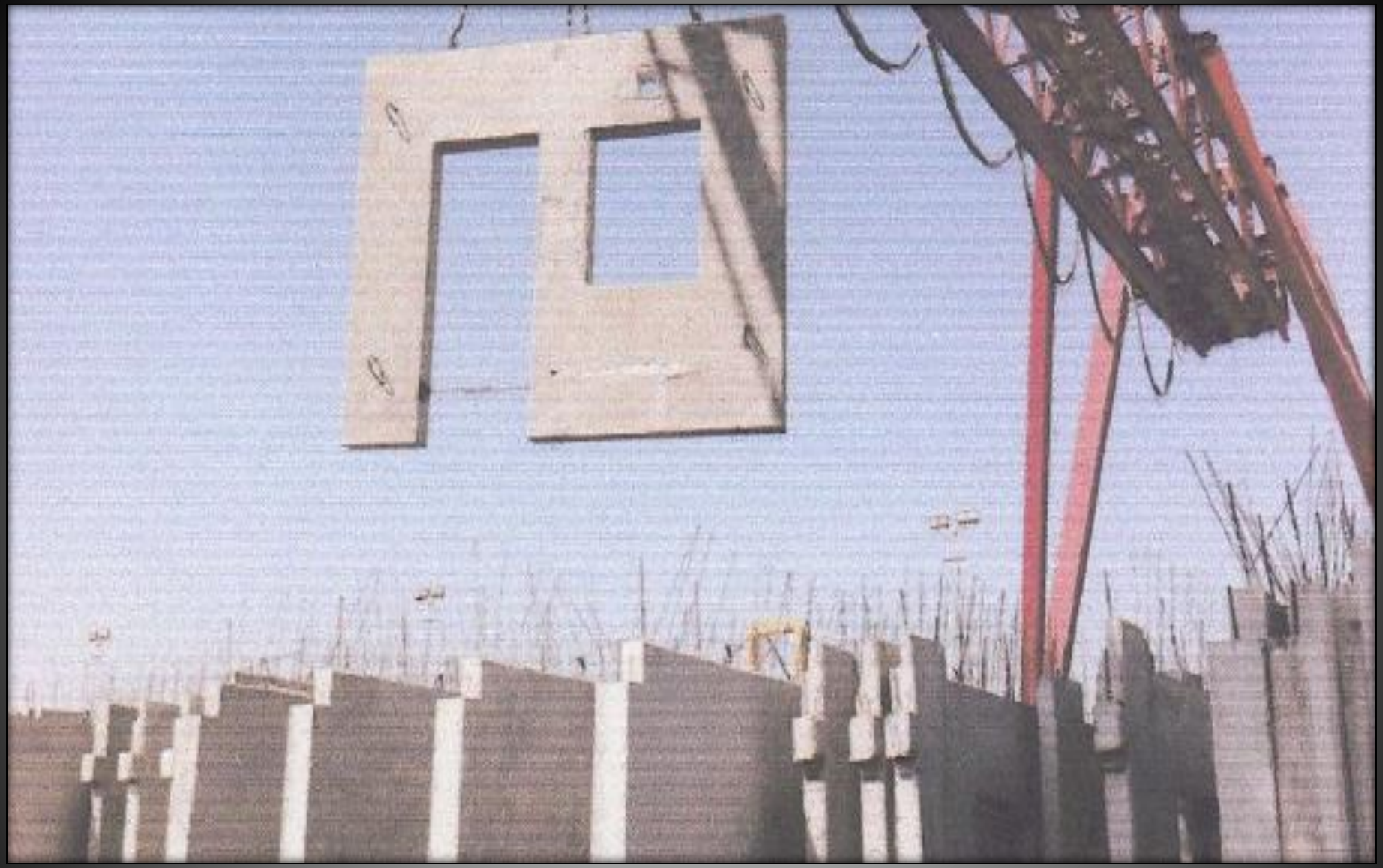

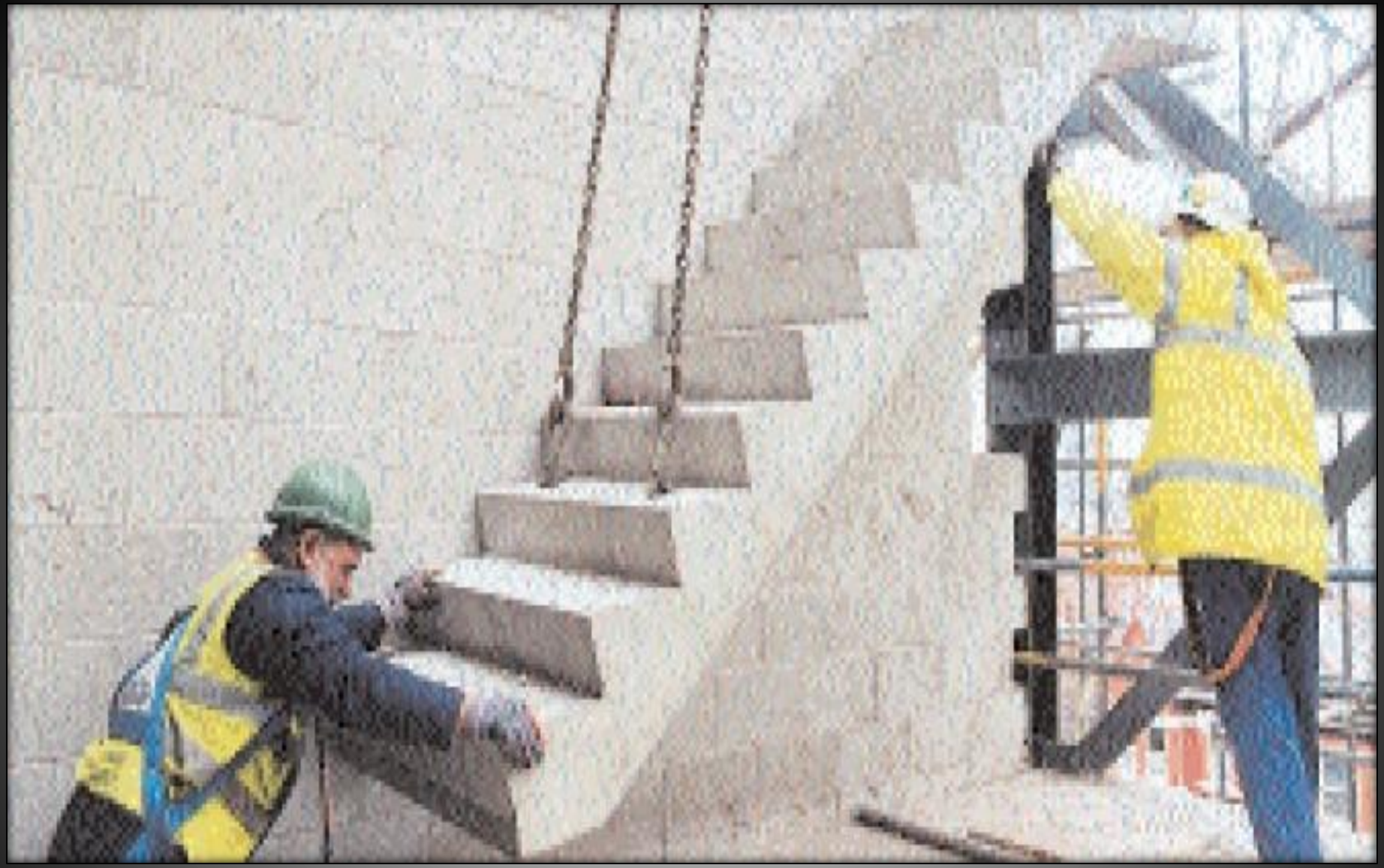

SPACE
CONSULTANT LTD

CONNECT

Engr. Arif M. Khan
+880 17 5568 0801
opusakhan@gmail.com