TAYLOR'S UNIVERSITY

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BUILDING TECHNOLOGY 1 [ARC 3512]
PROJECT 2: ADVANCED ROOF SYSTEM AND INDUSTRIALIZED BUILDING SYSTEM
[INDIVIDUAL REPORT]

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CONTENT

SEPANG MANGROVE ART & SCIENCE CENTER

1.1DESIGN BRIEF

SEPANG MANGROVE ART & SCIENCE CENTER is a center dedicate for sepang community to experience and appreciate the nature. Setting amidst of mangrove forests, there's a river flowing by, enhanced the site's view and forms an interesting biodiversity in the area.

SEPANG MANGROVE ART & SCIENCE CENTER has total 5 blocks to accommodate different activities for users. There are 1 administrative block, 2 blocks for exhibition purpose, 1 for cafeteria and another 1 for souvenir shop. An outdoor garden gallery is placed in the center. The programmes in the center include exhibition, interaction area, lab activities, art class, seed planting and other outdoor activities.

The materials used in the buildings are mostly local materials such as bricks and timber, and also low embodied energy material such as concrete to promote sustainability as well as match with the building's concept.

1.2 PROPOSED BUILDING PART TO IMPLANT ADVANCED ROOF SYSTEM & IBS SYSTEM

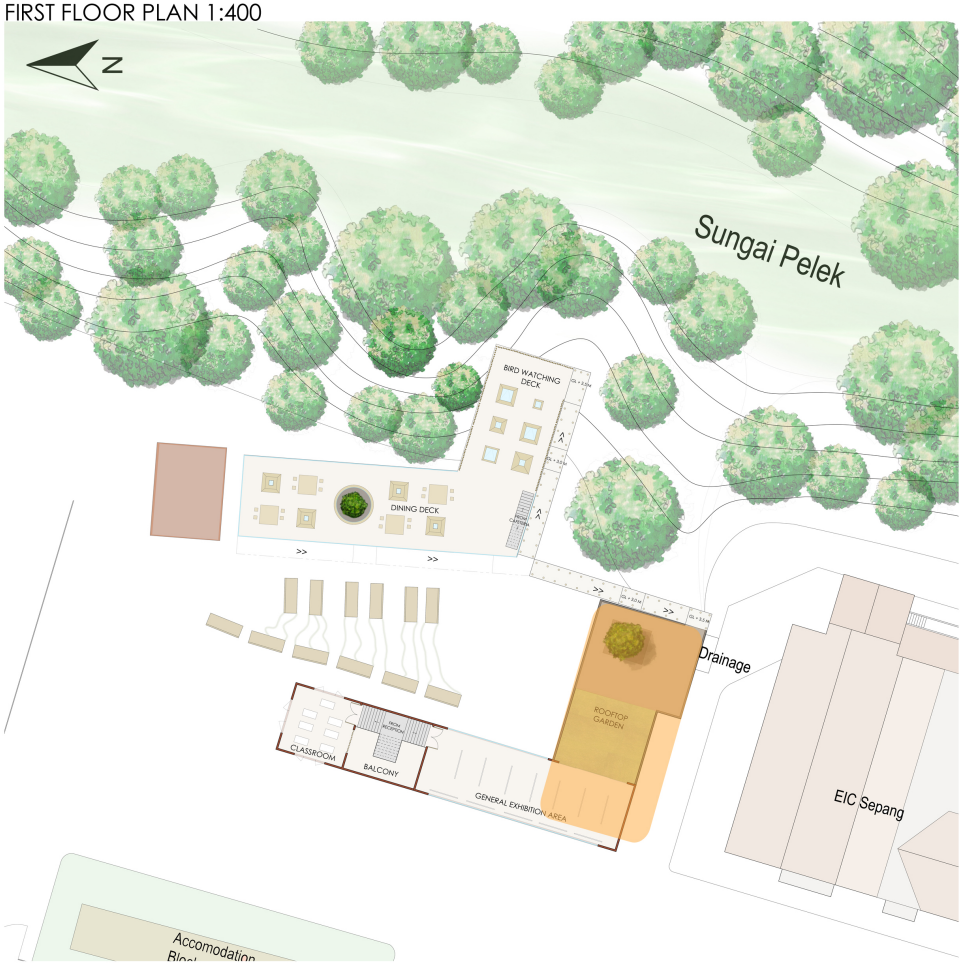
The exhibition blocks are combined into one block and are proposed to modify into IBS system building. Due to its squarish and modular design, by implanting IBS system can speed up the construction period and reduce labour fees. Besides that, by using IBS system, it is likely to reduce wastage of materials which match the sustainable concept.

The advanced roof system which the building going to employ is the tensile roof system. The fabric tensile roof is to shed the outdoor seed planting area, which provide users a well ventilated and sheltered environment for outdooe activities.

1.3 EXISTING DESIGN DRAWINGS

GROUND FLOOR PLAN 1:400

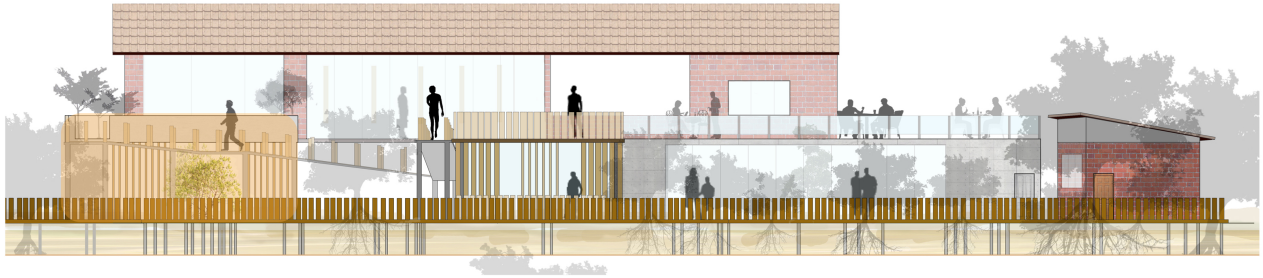
FIRST FLOOR PLAN 1:400



PROPOSED MODIFY BLOCK

1.3 EXISTING DESIGN DRAWINGS

WEST ELEVATION 1:200



EAST ELEVATION 1:200

PROPOSED MODIFY BLOCK

1.3 EXISTING DESIGN DRAWINGS

SECTION A-A 1:200

SECTION B-B 1:200

PROPOSED MODIFY BLOCK

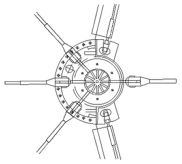
2.1 TENSILE ROOF SYSTEM

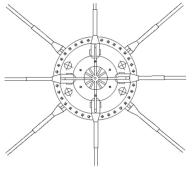
| 2.1.1 Introduction |

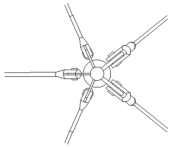
Tensile fabric shapes breathe life and excitement into a building by blending steel construction with organic forms. Tensile fabric structures provide shade and weather protection using low maintenance materials, reducing UV transmission and controlling solar gain.

The significant cost saving is the reduction in installation time required, as the support structure and fabric membrane is pre-fabricated and assembled on site.

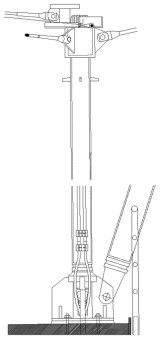
| 2.1.2 System Components |



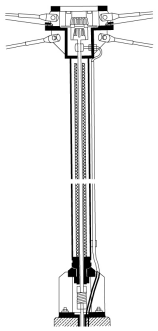




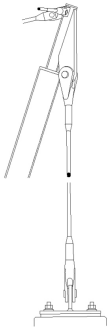
Joints
Steel cable joints for respective columns



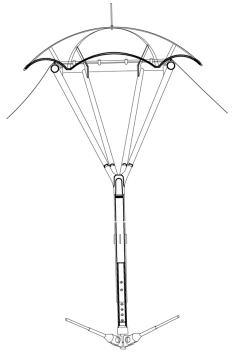
Edge Column
Connect the edge of tensile membrane, supporting the edge



Inside Column
Intermediate support connect to ground



Tension System
Steel cable transfer load to column



Top Unit
Top supporting structure which channel loads to steel cables

| 2.1.3 Design Considerations |

KEY DESIGN FACTORS:
-**Determine the loads** that will be exerted on connecting buildings and/or ground
-Calculate and l**ocate foundation pads**
-**Locate services** adjacent to foundations and re-route if required
-**Management of rainwater/** rainwater run-off
-lighting **add-ons** , bird netting **protection**

SITE CONSIDERATIONS:
- Location (wind and snow loads)
-Foundations
-Drainage
-Access

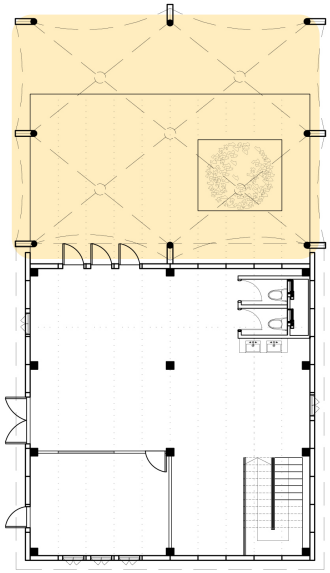
CANOPY CONSIDERATIONS:
-Acoustic performance
-Fire resistance
-Thermal values
-UV attack
-Condensation
-Translucency
-Reflectivity
-Lighting

LIFE CYCLE COSTS:
-Maintenance
-Fabric Longevity
-Steel protection
-Bird netting or security
-Vandalism

| 2.1.4 Advantages |

-**Aesthetic**, Endless possibilities in creating form
- **Lightweight and flexible** - fabric interacts with and expresses natural forces
-Tensile fabric+ structures are an **environmentally sensitive medium**
-Tension is the most efficient way of using any material, it utilises the material at **maximum efficiency** rather than just the material at the extremes of the cross sectional form, as in bending and compression loads
-Fabric structures have **higher strength/weight ratio** than concrete or steel
- **Recyclable**
-A fabric structure can be designed for almost any condition, heavier fabrics and more 3 dimensional forms will **cope with extreme wind and snow loads.**

2.1 TENSILE ROOF SYSTEM



| 2.1.5 Modified System |

The tensile roof system applied in the modified design is the closed system tensile roof. A closed system structure consists of rigid members around the edge and require smaller foundations. In a closed system the fabric edge will be supported continuously by a 'keder' fed into an extruded section, normally fabricated from aluminium.

It consists of four 1mm thick PTFE coated glassfibre membrane which sized approximately 6.6m x 5.3m and form a coverage 10.6m x 13.2m. Supporting structure wise, it consists of edge column, inside column and the tension system.

Due to the lightweight of fabric, the tensile structure able to span a long distance without occupy too much ground spaces for supporting column, this has ease of outdoor activities at the seed planting area where users can move around without much obstructions.

Tensile structure provide shelter at the same time ensure the space is well ventilated, able to reduce the high humidity at the seed planting area.

| 2.1.6 Construction Considerations |

Fitting fabric to framework:
-Provide a path for the load to easily flow into the support structure
-Allow flexibility in the connection for displacement and rotation.

During Installation process:
-Structure will probably experience loads greater than the snow and wind effects during its working life span due to uneven loads imposed as the structure is assembled and tensioned

-Some fabrics can develop creep or elongation due to the type of weave or coating on the weave, heat and moisture. This should be considered during analysis and has a direct effect on the connection system.

-Creep will induce a loss of pre-stress tension in the fabric. This loss of tension is dangerous for the stability of the structure and if not regularly maintained will lead to a failure of the structure.

-Connections from the fabric to the support system should always be adjustable. Teflon coated fabrics require re-tensioning once the fabric has settled over a period of a few weeks.

| 2.1.7 Manufacturer |

Malaysia Tensioned Fabric Structure Sdn.Bhd.

No.30, Jln.Mawar, Taman P.Ramlee,
Setapak 53000 Kuala Lumpur,Malaysia.

Tel: +603-40217197 +603-40217788
Fax: +603-40424346

Email: enquiry@tfssb.com

3.1 HOLLOW CORE FLOOR SYSTEM

| 3.1.1 Introduction |

A hollow core slab is a precast slab of prestressed concrete typically used in the construction of floors in multi-story buildings. Precast concrete popularity is linked with low-seismic zones and more economical constructions because of fast building assembly, lower self weight (less material) etc.

Precast hollow core slab system is one of the most widely and popularly used precast concrete flooring system in the building industry. Typically, it is an extruded concrete process and provides engineers and architects with a versatile precast concrete system for innovative construction.

| 3.1.2 Design and Construction considerations |

Installation:

- All slabs 4.5m and over should be propped in the centre during the casting of the joints (one prop per panel).
-All slabs over 5.0m require a structural concrete topping in addition to grout in the joints.
-Props should be left in position for a minimum of 10 days after the casting of joints and topping.
-Openings up to 1.5 metres wide in load-bearing walls can be covered by 2 lintels plus five courses (with brick force in between the courses). This is suitable for the support of slabs up to 7.8m long.
-Openings wider than 1.5 metres should be referred to the engineer for the detailing of additional structural steel support.
- Bearing for 200mm deep steel beam or channel or angle – 220mm minimum on brickwork on either side of opening. Bearing for 250mm plus deep steel beams – minimum 330mm on brickwork on either side of opening.
-Cantilevers up to 2 metres long can be done with Echo slabs with a structural topping and reinforcement.

Materials :

-Cement shall comply and supplementary cementitious materials, aggregates and chemical components
- Prestressing steel shall be stress-relieved low-relaxation strand. Strand shall be clean and free of deleterious substances at the time of casting.
-Concrete shall have a minimum characteristic 28-day strength of 50MPa. Concrete strength at release of prestress shall be a minimum of 25MPa or as required by the structural design.
-Topping concrete shall have a minimum characteristic 28-day strength of 32MPa and be reinforced with a minimum SL72 mesh or as shown on the drawings. If topping concrete is used to grout the keyways, the maximum aggregate size shall be 10mm.

| 3.1.3 Advantages |

-Speed of erection
-Immediate unpropped working platform
-Long spans
-Diaphragm action
-Flexibility of design
-Preformed site services
-Structural efficiency
-Lightweight, less material

| 3.1.4 Installation Guideline |

i. Place passive fall protection or other measures as neccessary to the fitting positions

ii. After completion of the pre-lifting checklist, fit the lifting equipment to the unit.

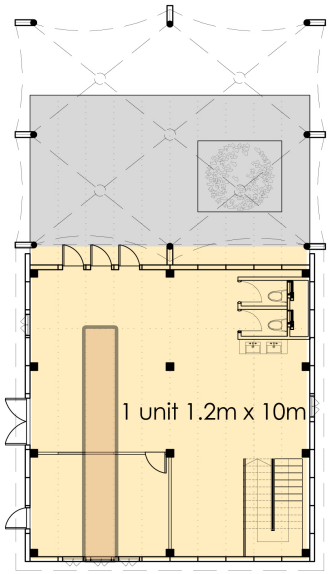
iii. Ensure that all debris is cleared from the top of units prior to lifting.

iv. Ensuring an exclusion zone is in place, lift unit to the required position. Place it as close as possible to final location to minimize barring.

v. Hollowcore units should be placed next to the previous slab so the gap between is fully closed. Final placements of units may be made with pins only or barrings if no pins are present.

Vi. If it is necessary to grount the units together using C35 concrete with 10mm aggregate.

3.1 HOLLOW CORE FLOOR SYSTEM



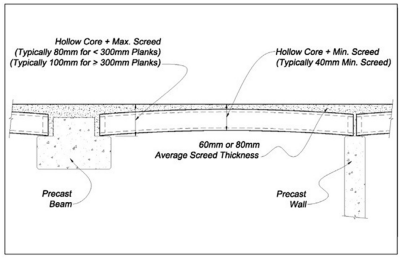
Screed finish
Ceramic tiles

|3.1.5 Modified System|

Hollow core floor slabs are applied in both ground floor and first floor of the building.

The standardized floor slabs used are 1.2m x 10m with the thickness 200mm. The concrete grading is 650Mpa and the fire rating is 2 hours. It weighs 2.43 kN/m2.

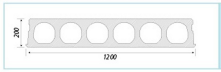
Finishings have been applied on it. For indoor area, there are ceramic tiles topping on the hollow core floor slabs whereas for the outdoor area there are screed finishings on the floor slabs. For exhibition area on first floor, ceramic tiles has been used as finishing material as well.



SCREED GEOMETRY
- 60mm average topping is used for 200 - 220deep units
-80mm for 300mm deep units and above.
- If the topping concrete is to be used to grout the keyways, the maximum aggregate size be 10mm.

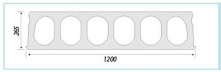
|3.1.6 Product Specification and Tolerances |

200mm Thick 6 Core HC Slab



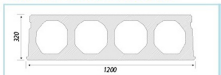
Slab Code	: SPC6-200
Concrete Grade	: G50Mpa
Fire Rating	: 2 hrs
Self Weight	: 2.43kN/m²

265mm Thick 6 Core HC Slab



Slab Code	: SPC6-265
Concrete Grade	: G50Mpa
Fire Rating	: 2 hrs
Self Weight	: 3.09kN/m²

320mm Thick 4 Core HC Slab



Slab Code	: SPC4-320
Concrete Grade	: G50Mpa
Fire Rating	: 2 hrs
Self Weight	: 3.78kN/m²

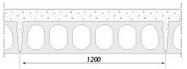
400mm Thick 4 Core HC Slab

Slab Code	: SPC4-400
Concrete Grade	: G50Mpa
Fire Rating	: 2 hrs
Self Weight	: 4.31kN/m²

500mm Thick 4 Core HC Slab

Slab Code	: SPC4-500
Concrete Grade	: G50Mpa
Fire Rating	: 2 hrs
Self Weight	: 5.23kN/m²

Standard SPC Precast Hollow Core Slabs (Note: Standard width shall be 1200mm)



Typical longitudinal joint profile

Note: Details are intended for general information only. Specific project details and data may vary, SPC Industries Sdn Bhd reserved the rights to amend or change the design data without prior notice, please contact our technical department for further assistance.

TOLERANCES
Floor planks shall be supplied in accordance with the following tolerances:

- Length +10mm -10mm

-Width +3mm -6mm

-Thickness +3mm -3mm

- Squareness of end +6mm -6mm

-Bow / Wind 10mm per 3000mm

- Location of inserts +20mm -20mm

-Cover to strand +3mm -3mm

-Differential Camber adjacent units 2mm/m span but not greater than 15mm

|3.1.7 Manufacturer |

SPC Industries Sdn. Bhd.
21M/S, Jalan Pontian, 81150 Ulu Choh, Johor, Malaysia.

Tel +(60)7-699 6208
+(60)16-771 6208
Fax +(60)7-699 4137
Email info@spcind.com,
spc888@spcind.com

3.2 HOLLOW CORE WALL SYSTEM

| 3.2.1 Introduction |

Hollowcore wall panels are cast on long line casting beds and are cut to length to suit the wall height – or span in the case of horizontal panels.

In developing a framing plan using hollowcore wall panels the principal considerations are the span and the modular width. The panel thickness depends on the structural requirements of the loading and the span. The fire resistance period also determines the required effective thickness of the panel.

| 3.2.3 Advantages |

-Speed of erection
-Structural efficiency
-Lightweight, less material
-High fire resistance - with fire ratings up to 3 hours
-Maintains constant temperatures and enhances comfort
-Minimizes more noise

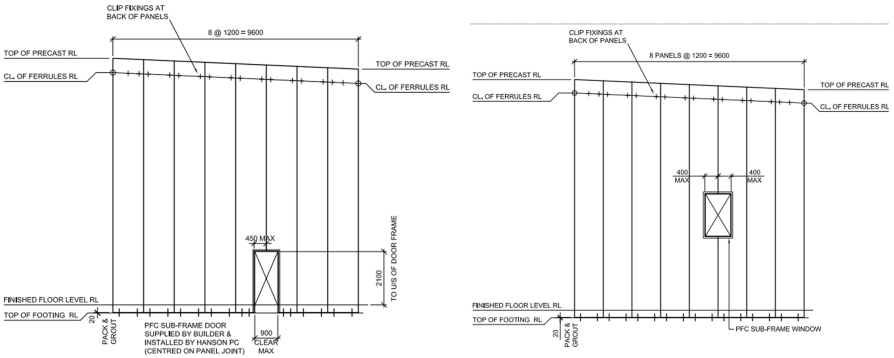
| 3.2.2 Design & Construction Considerations |

Dimensions:
Hollowcore wall panels are a nominal 1200 wide by 150, 200 or 250 thick.
-Designed to fit into a 1200mm grid layout
-Closing panels of non modular dimensions are accommodated using special width panels made by longitudinal sawing or by purpose casting of a panel.

Cantilevers:
-Hollowcore wall panels may be used for cantilevers projecting above the structure and roof line to form parapets
-Extent of any cantilever is limited by the stresses induced in the cantilever under lateral load

Fire resistance:
-Protection of the steel supporting structure and the panel connections against heat caused by fire may be necessary dependent on the building design

Door frame & window frame placement:



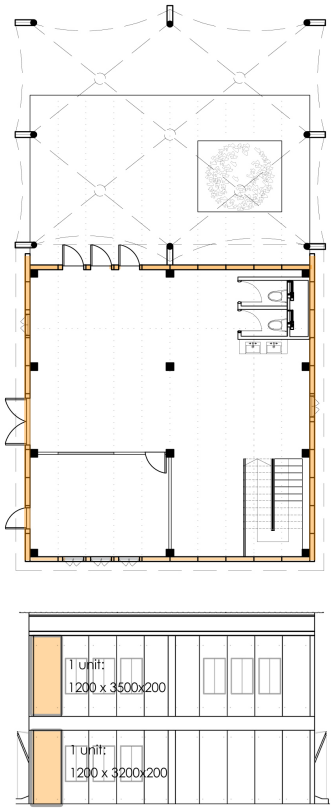
| 3.2.4 Dimension Guideline |

MAXIMUM RECOMMENDED PANEL LENGTHS

PANEL TYPE	PANEL SPAN	9.5mm Dia STRAND					
		6 STRAND		8 STRAND		10 STRAND	
		ϕM_r (kNm)	MAX LENGTH	ϕM_r (kNm)	MAX LENGTH	ϕM_r (kNm)	MAX LENGTH
W,150;90/90/90	HORIZONTAL	25.3	7500	33.0	8000		
	VERTICAL		7500		8000		
W,200;240/240/180	HORIZONTAL	37.5	9500	49.2	10500	60.6	11500
	VERTICAL		9300		9900		10500
W,200;240/240/240	HORIZONTAL	37.5	9500	49.2	10500	60.6	11500
	VERTICAL		8500		9300		9800
W,250;240/240/240	HORIZONTAL	49.7	12000	65.5	13000	80.9	14000
	VERTICAL		9000		10000		11000

PANEL TYPE	PANEL SPAN	12.7mm Dia STRAND			
		8 STRAND		10 STRAND	
		ϕM_r (kNm)	MAX LENGTH	ϕM_r (kNm)	MAX LENGTH
W,200;240/240/180	HORIZONTAL	83.9		102.1	
	VERTICAL		11000		11500
W,200;240/240/240	HORIZONTAL	83.9		102.1	
	VERTICAL		10500		11000
W,250;240/240/240	HORIZONTAL	113.2		138.6	
	VERTICAL		12000		13000

3.2 HOLLOW CORE WALL SYSTEM



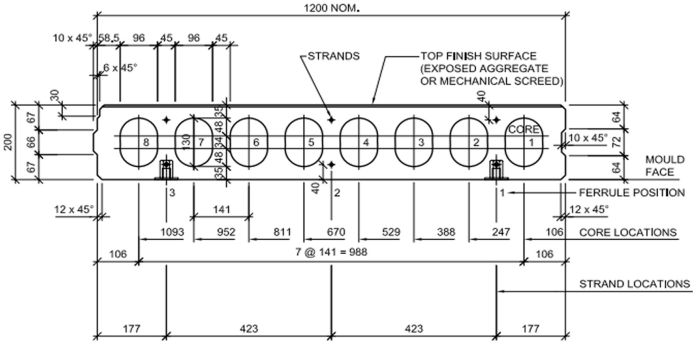
| 3.2.5 Modified System |

According to table in 3.2.4, the nominal dimension of 200m hollow core wall panel for the building is 6 strand (9.5mm dia.) hollow core panel. The maximum span is 9.5m in horizontally and 9.3m vertically. The fire rating is 240/240/180.

For ground floor the dimension of wall panel is200x1200mmx3200mm whereas the dimension of wall panel of first floor is 200mmx1200mmx3500mm.

| 3.2.6 Product Specification and Tolerances |

Typical 6strand (9.5mm dia.) Hollow core wall panel



TOLERANCES
Length ± 10 mm
Width (1200mm) + 3 mm - 6 mm
Cut width ± 10 mm
Thickness (average) ± 3 mm
Squareness of end ± 6 mm
Ferrule location ± 20 mm
Strand location ± 3 mm
Differential bowing between adjacent panels of the same length ± 15 mm

Openings location ± 20 mm
dimension ± 20 mm
squareness ± 10 mm

| 3.2.7 Manufacturer |

Hanson Concrete (M) Sdn. Bhd.

W501 5th Floor West Tower
Wisma Consplant 1
No.2 Jalan SS16/4,
47500 Subang Jaya,Selangor,
Malaysia.

Tel: 6(03) 58858888
Fax: 6(03) 58858900

Email: info@Hanson.com

3.3 CLIP LOCKING METAL ROOF SYSTEM

| 3.3.1 Introduction |

TH CLIP 710 Clip Locking System is specially designed for added strength on the roof. In addition, the higher rib height (39mm) enable tighter gap coverage which significantly minimizes water leakage between roof sheets.

As the name Clip Locking suggest, the higher rib roofs also act as inter locking mechanism between roof sheets. This not only simplify the installation process, the innovative design also ensures each roof sheets are accurately aligned to each other.

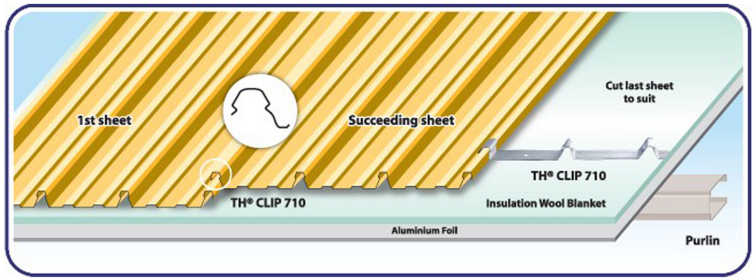
| 3.3.2 Materiality |

High grade steel sheets with strong anti-corrosion properties such as Zincalume, and Clean Colorbond are used to fabricate the metal roof. Cold Roll Form process is used to ensure material quality consistency and strength, resulting high tensile condition throughout the entire sheet hence allows fabrication of long span metal roofing.

| 3.3.3 Advantages |

- Sizes can be tailored to building requirements
- Long length high tensile metal roofing
- Combines with smart fluted spans and a lock-action rib design
- Steel substrate protected with corrosion inhibitive treatment
- Wider effective cover width of 710mm and rib height of 39mm
- Suitable for low pitched roof where minimum roof pitch is 1 degree
- Concealed fixing method with clip and locking system
- Easy assemble and disassemble, reduce carbon footprint

| 3.3.4 Installation Method |

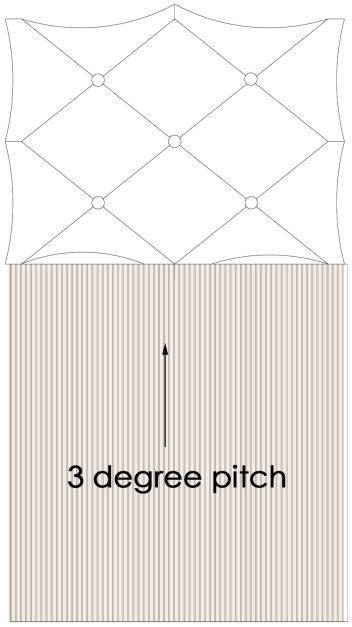


i.The first sheet is positioned and then pressed over the fixing clip which must be accurately aligned and fixed to ensure positive engagement between the roof sheet and the fixing clips.

ii.A 'click' indicates a positive lock.

iii. The second and subsequent sheets are laid each time after a new set of fixing clips have been placed firmly over the male rib of the preceding sheets.

3.3 CLIP LOCKING METAL ROOF SYSTEM

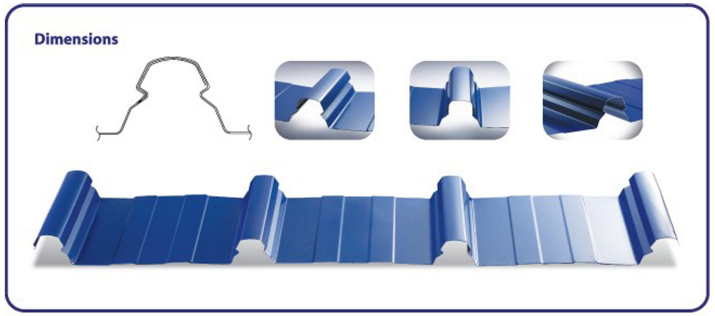


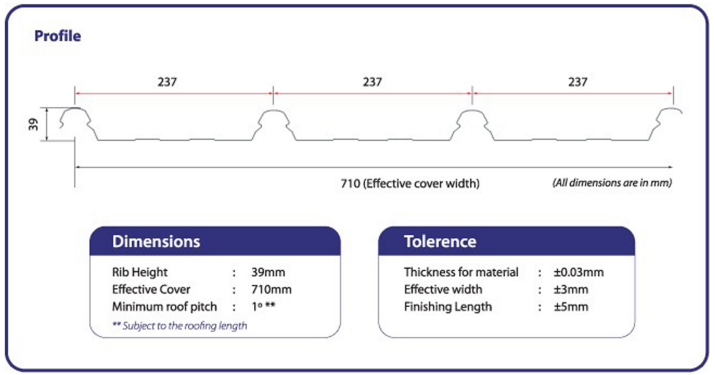
| 3.3.5 Modified System |

The modified roof system is a 3 degree monopitch roof. Clip locking method is used to held the roof on building.

The rib height is 39mm and the effective cover is 710mm.

| 3.3.6 Product Specification and Tolerance |





| 3.3.7 Manufacturer |

THUNG HING METAL INDUSTRY SDN BHD (co. No. 395096-D)
THUNG HING INDUSTRIAL TRADING SDN BHD (co. No. 264902-P)
THI HARDWARE TRADING SDN BHD (co. No. 567864-W)

Lot P.T 1353, Jalan Mohd Taib, Kawasan Industrian Sg. Choh,
48000 Rawang, Selangor Darul Ehsan, Malaysia
Tel: (603) 6099 9999 (Hunting Line)
Fax: (603) 6093 3333
(603) 6099 9922
Email: enquiries@thunghing.com

3.4 Precast Staircase System

| 3.4.1 Introduction |

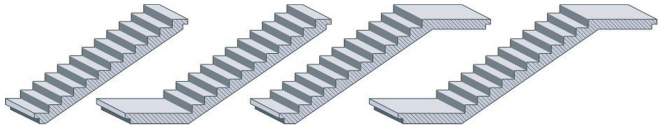
The proposed standard precast concrete staircase is designed for use in residential, commercial and institutional developments.

Once the floor height is determined, the contractor can then buy these components off the shelf from the precaster. Using components would also eliminate the frequent construction errors in riser height in in-situ construction.

Concrete stairs offer a fast, efficient and cost effective option, reducing labour on site, being fast to install and providing immediate access to all floor areas.

It also allows excellent water discharge capability even at a minimum roof pitch of just 1 degree.

| 3.4.2 Varieties of Components |



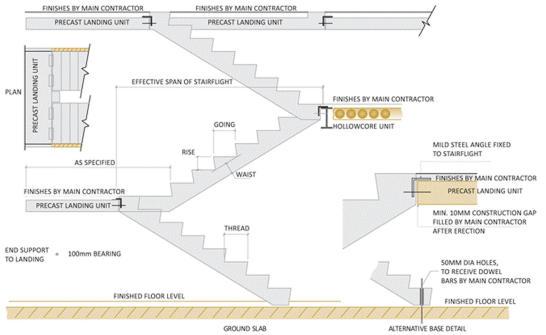
i. Flight of stairs, mounted on a ladder platform
ii.Flight of stairs with the lower ladder platform
iii.Flight of stairs with the top ladder platform
iv.Flight of stairs with the lower and top ladder platform

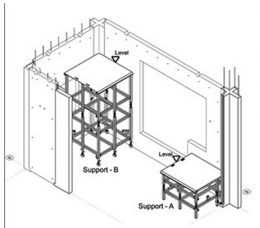
| 3.4.3 Advantages |

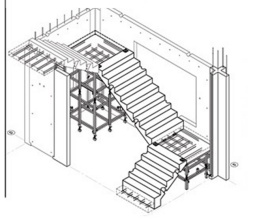
-Quality finish- manufactured in a controlled factory environment, using bespoke moulds gives a premium quality finish.
-Immediate access improves site safety and efficiency.
-Ease of programming manufactured offsite and delivered and installed to meet your build programme.
-Landings can incorporate any detail that the design demands such as curves.
-Landings can be detailed for progressive collapse if required.
-Increased fire protection
-Increased commercial or industrial loadings can be accommodated
-Precast concrete stairs do not squeak or creak

| 3.4.4 Installation Method |

Indoor stairs:
i. Set a level for landing slabs.
ii. Straighten the starter bar to position
iii. Install the landing support by pushing them in position
iv. Install the precast by crane.





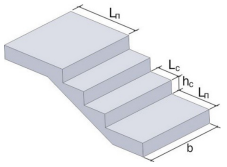


| 3.4.5 Product Specification |

Possible variants of step sizes

Step height (hc), mm	Step depth (Lc), mm
150	300
172,5	290
174	280
182,5	270
187,5	260
192,5	250

Parameter	Symbol	Value
Width of span, mm	b	1000 - 2700
Height of span, mm	h_c	150 - 200
Depth of step , mm	L_c	250 - 300
Number of steps, pcs.	-	3 - 18
ДThe length of staircase (top / bottom) mm	L_n	300 - 1500



| 3.4.6 Manufacturer |

Precast StaircaseHC Precast System Sdn Bhd (586697-M)
No.23, Jalan Seri Sarawak 20B/KS2,
Taman Seri Andalas,
41200 Klang,
Selangor Darul Ehsan.
Phone : 603-3323 3993
Fax : 603-3324 3993
Email : enquiry@hcprecast.com

3.5 Prefabricated Toilet Pod System

| 3.5.1 Introduction |

The prefabricated toilet pod system is constructed using dry installation method.The unit is pre-assembled in factory and delivered to site for installation.

The prefabricated units are delivered to site in following forms:
(i) Wall panels and floor tray are pre-assembled in the factory as a complete unit
(ii) The wall panels and floor tray are fabricated separately in factory and assembled on site.

| 3.5.2 Design Considerations |

i. The location of the service shaft
-To ease future maintenance, must be easily accessible

ii. The type of the floor trap
--Shallow floor trap eases future maintenance as no pipes protruding to dwelling unit below

iii. Joints and waterproofing

| 3.5.3 Advantages |

Save time
- Construction time can be shortened as fabrication of toilet pod system can proceed in parallel in the factory while other worksite activities are ongoing

Reduce the need for skilled workers

High quality and many choices of finishes
- Stringent quality control in factory ensures uniform and superior quality
- Inspection and approval of the prototype eliminates potential quality and site installation problems.
- Wide selection of materials to suit all homeowners

Readily install

| 3.5.4 Construction and Installation |

Work trades included:
Bricklaying, Plastering, Waterproofing, Sanitary works, Plumbing works, Electrical works, Painting, Ceiling, Tiling ,Joinery Works, Door, Window, Shower screen

Stage 1:
1.Casting of concrete shell
2. Curing of concrete and storage
3. Laying of waterproofing system to floor and wall

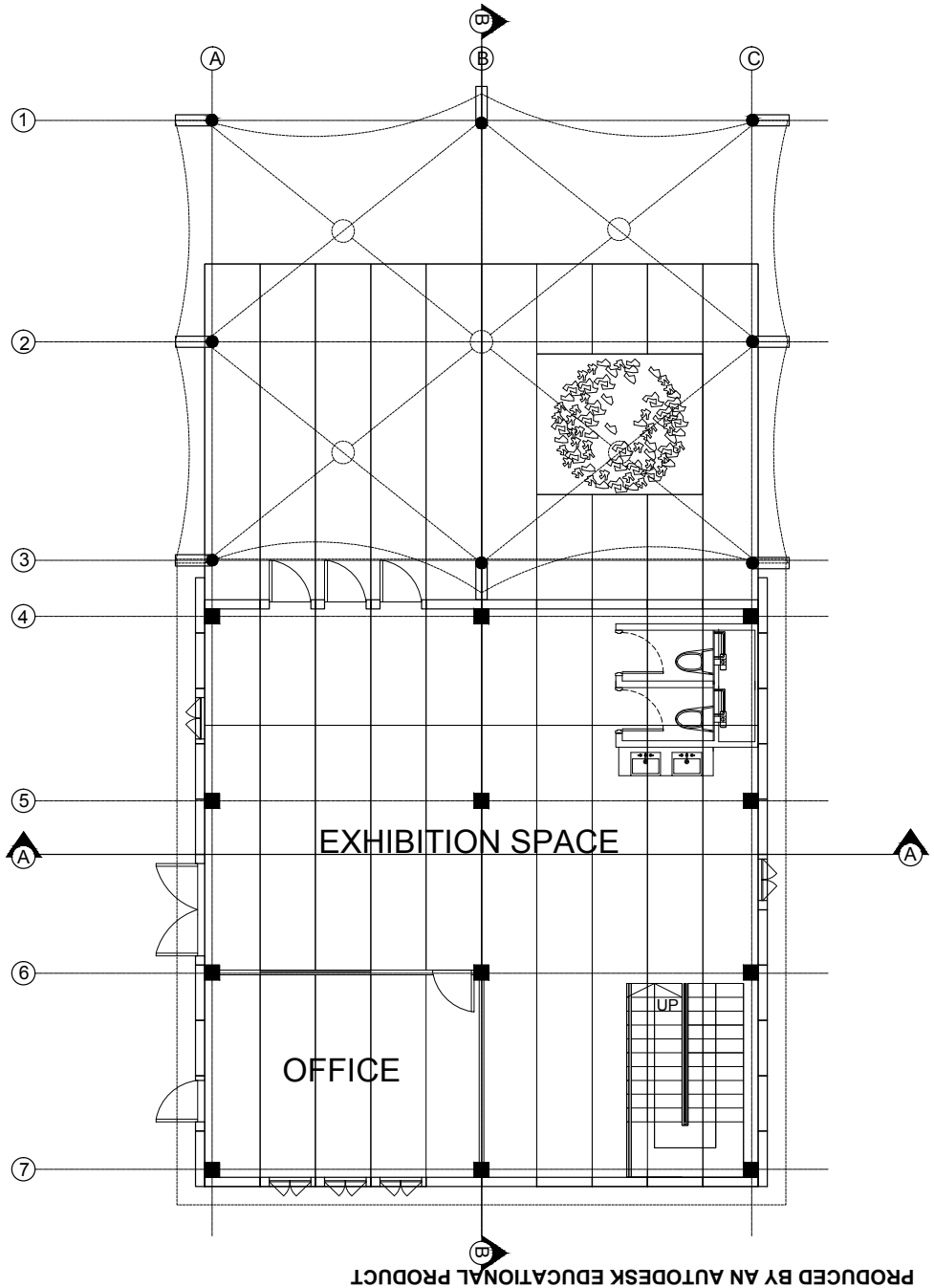
Stage 2:
1. Installing the Mechanical and Electrical (M&E) system.
2. Tiling

Stage 3:
1. Installing finishes and fittings
2. Quality checks
3. Completed unit

Stage 4:
1. Delivery to site
2. Hoisting of PBU into location
3. Final adjustment
4. Installed

| 3.5.5 Manufacturer |

Eastern Pretech Ptd
15 Sungei Kadut Street 2, Singapore 729234
Tel: +65 6368 1366
Fax: +65 6368 2256



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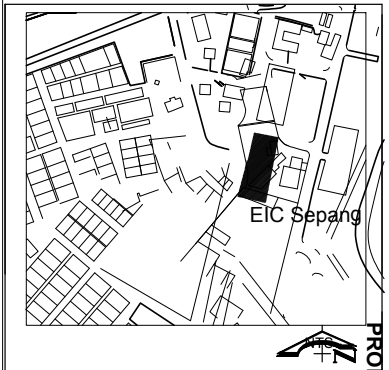

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
GROUND FLOOR PLAN

SCALE
1:100

SIZE
A3

DATE CREATED
21 NOV 2014

DRAWN BY
HOO ZHI XIN

TUTOR
MS CHERYL NGIAM

REMARKS

DRAWING NUMBER
A001

SHEET NUMBER
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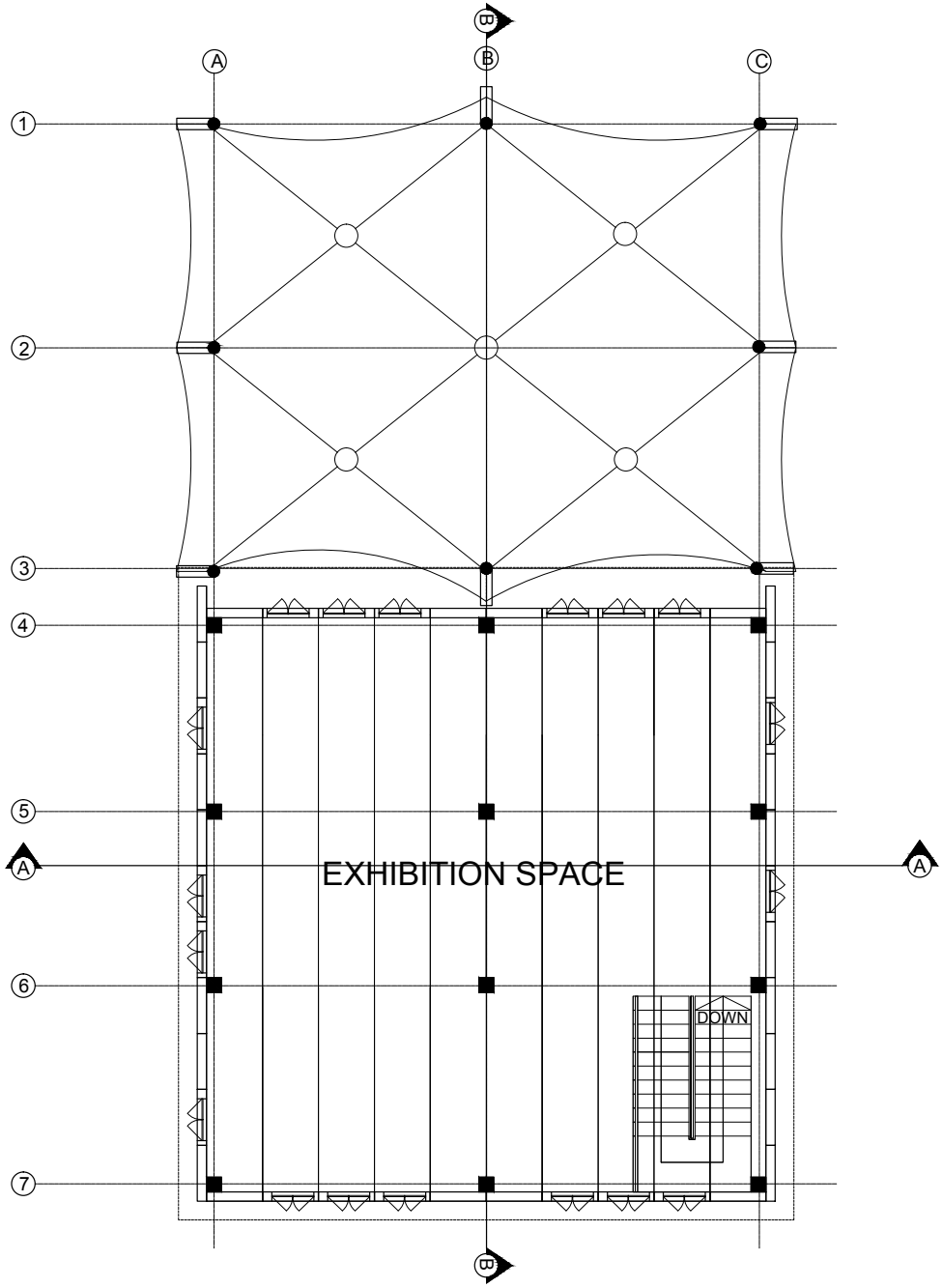

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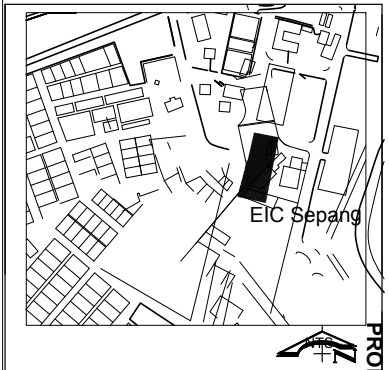

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
FIRST FLOOR PLAN

SCALE
1:100

SIZE
A3

DATE CREATED
21 NOV 2014

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MS CHERYL NGIAM

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02/18

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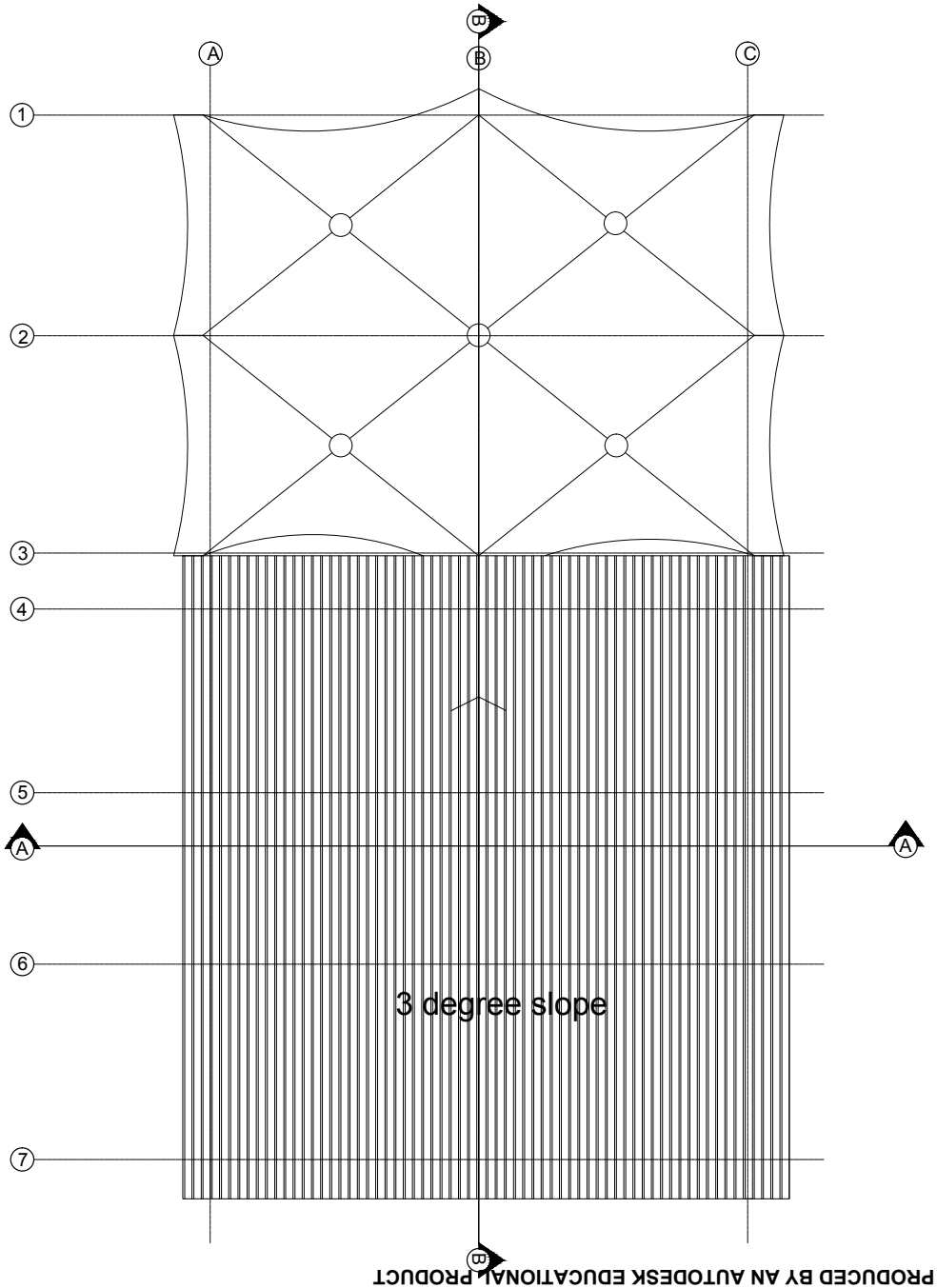

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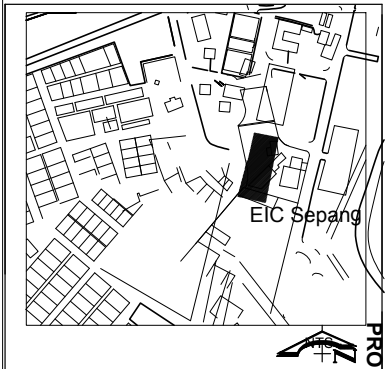

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
ROOF PLAN

SCALE
1:100

SIZE
A3

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MS CHERYL NGIAM

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03/18

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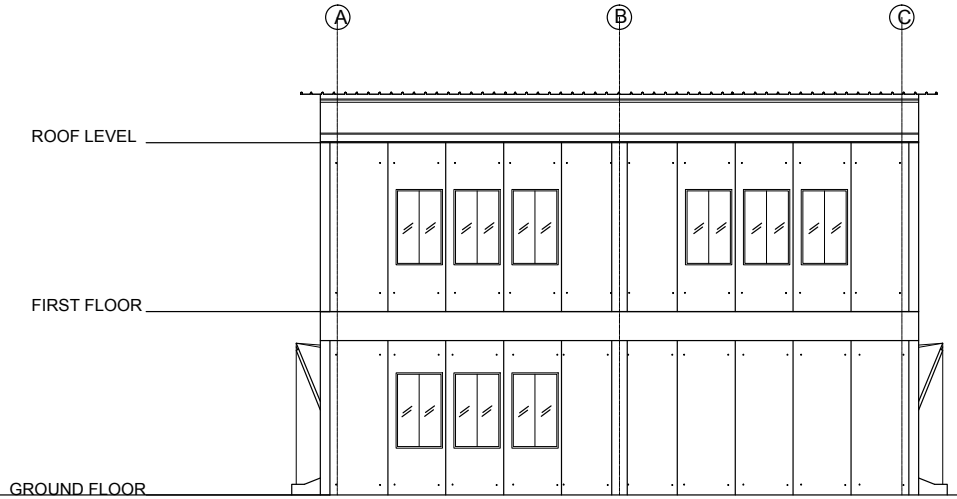

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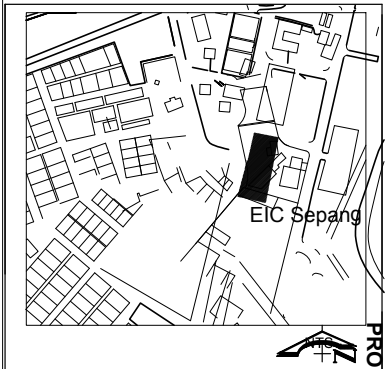

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
NORTH ELEVATION

SCALE	SIZE
1:100	A3

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MS CHERYL NGIAM

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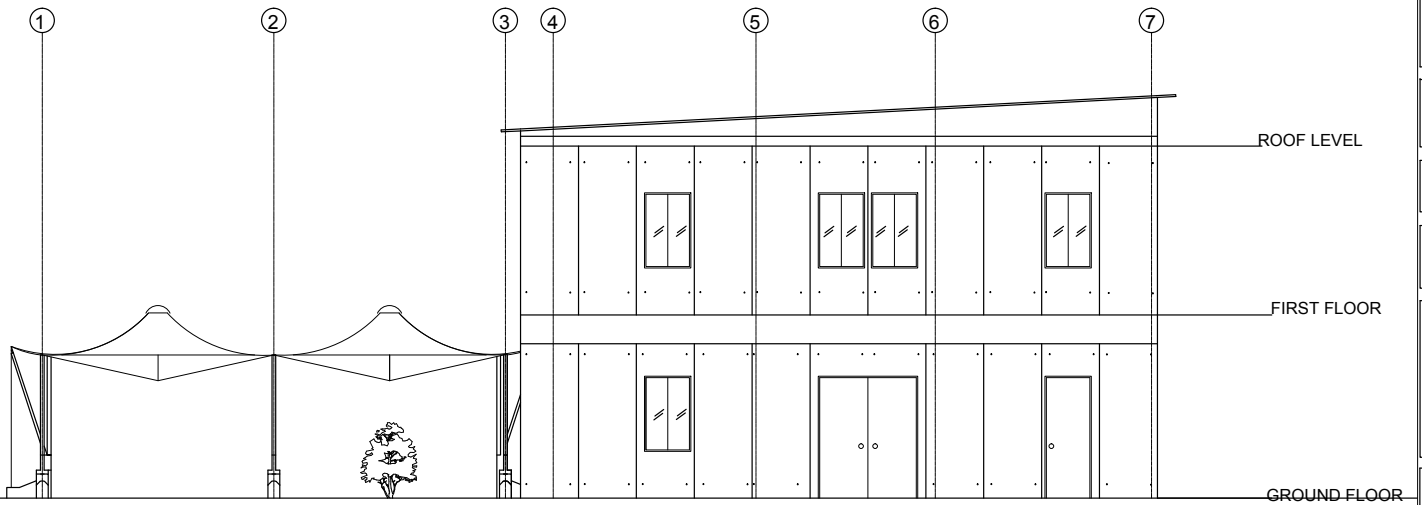

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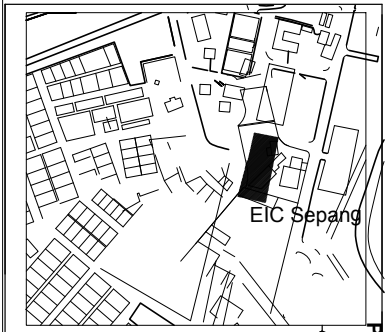

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ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
WEST ELEVATION

SCALE
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SIZE
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21 NOV 2014

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MS CHERYL NGIAM

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SHEET NUMBER
05/18

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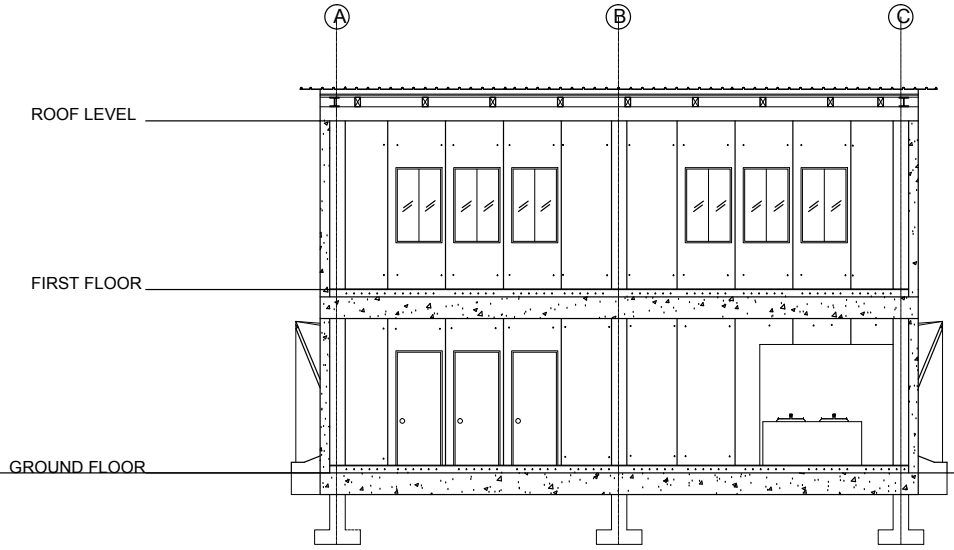

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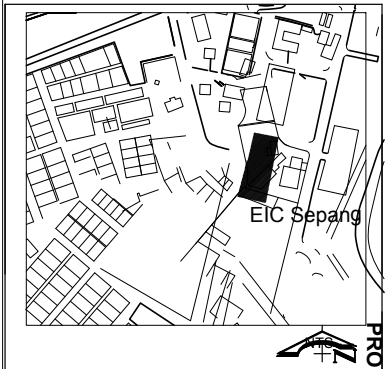

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
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SCALE
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SIZE
A3

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21 NOV 2014

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HOO ZHI XIN

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MS CHERYL NGIAM

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A006

SHEET NUMBER
06/18

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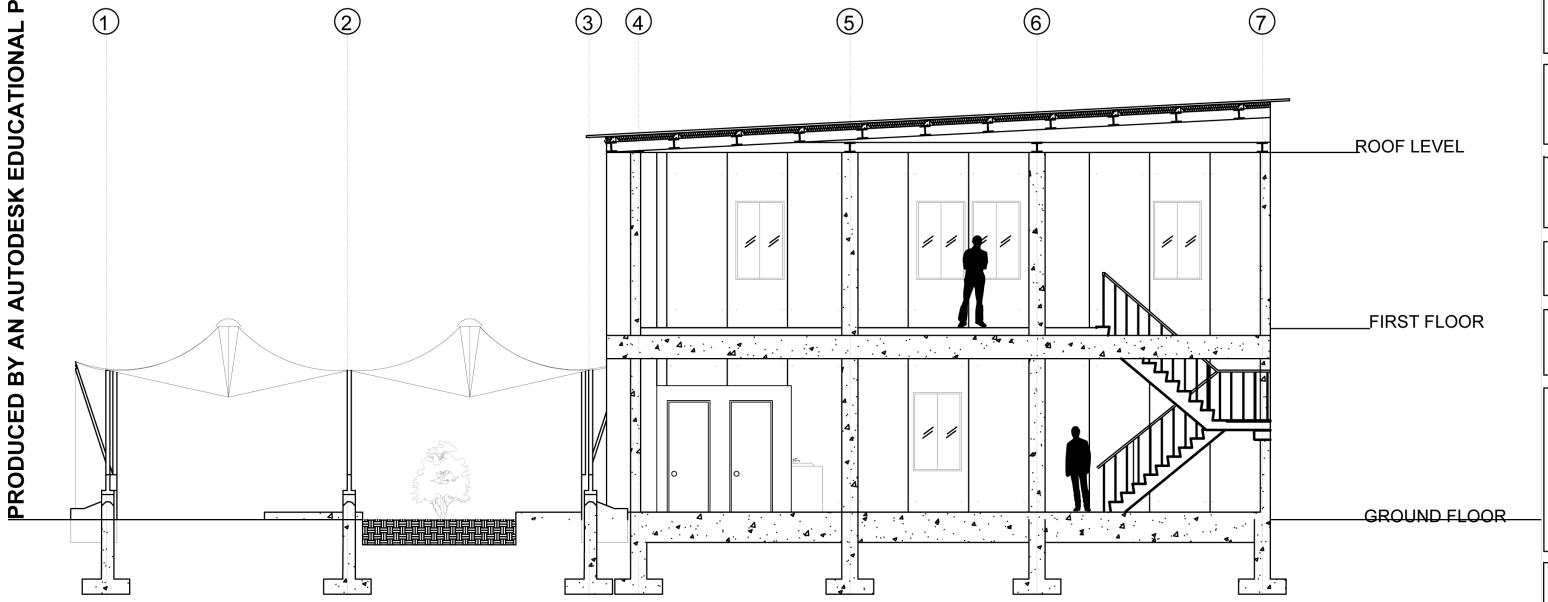

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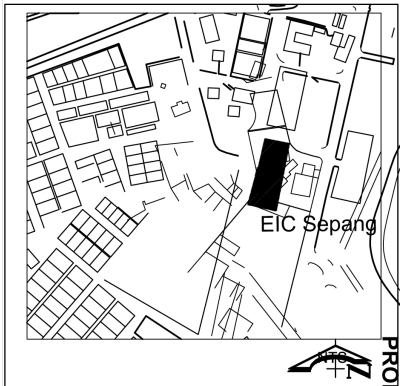

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
LONGITUDINAL SECTION B-B

SCALE
1:100

SIZE
A3

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21 NOV 2014

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TUTOR
MS CHERYL NGIAM

REMARKS

DRAWING NUMBER
A007

SHEET NUMBER
07/18

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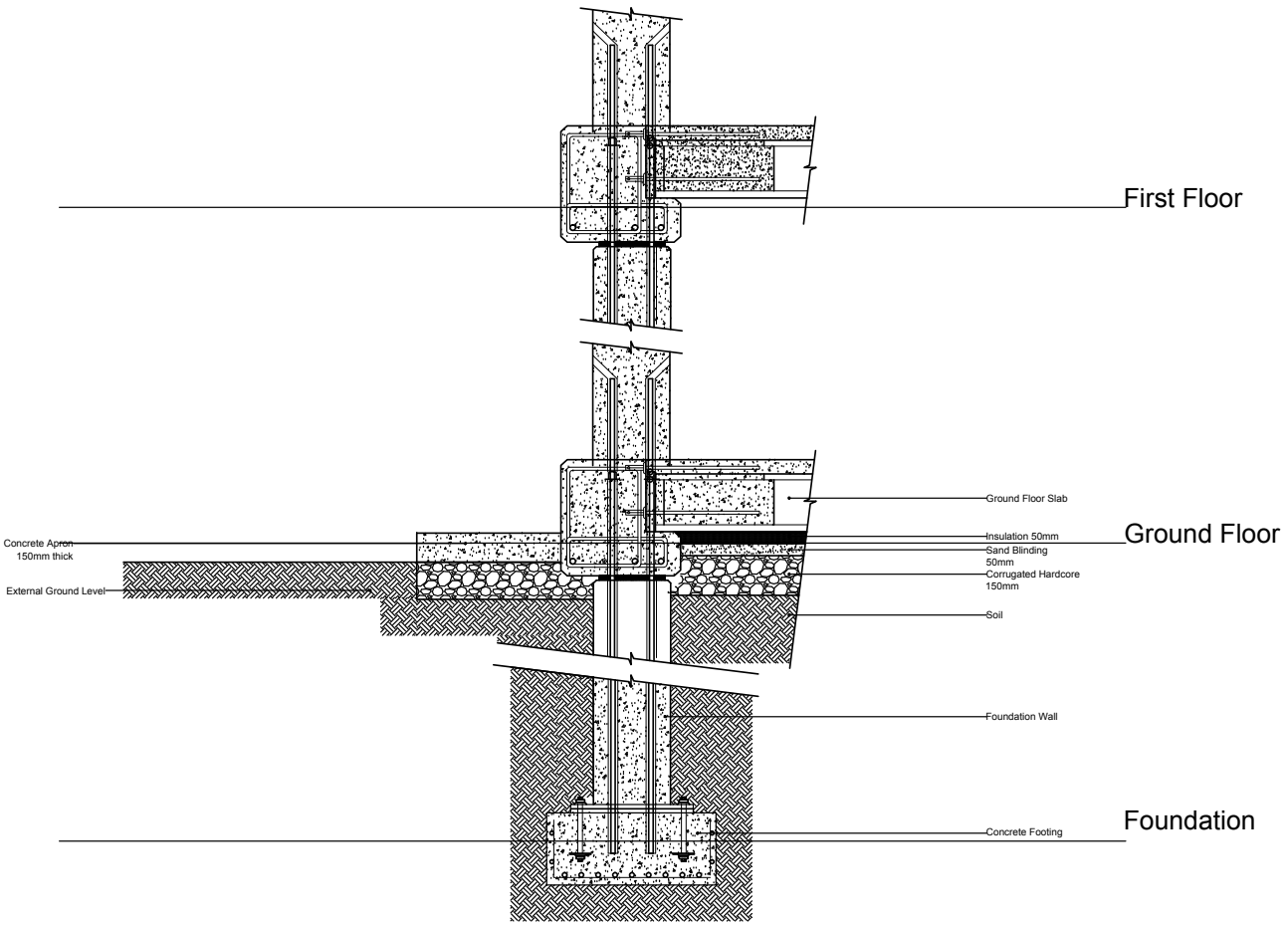

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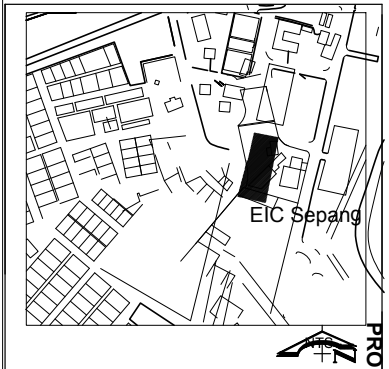

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

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DETAIL DRAWING:
EDGE BEAM- COLUMN- HOLLOW CORE SLAB

SCALE	SIZE
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DATE CREATED
21 NOV 2014

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MS CHERYL NGIAM

REMARKS

DRAWING NUMBER	SHEET NUMBER
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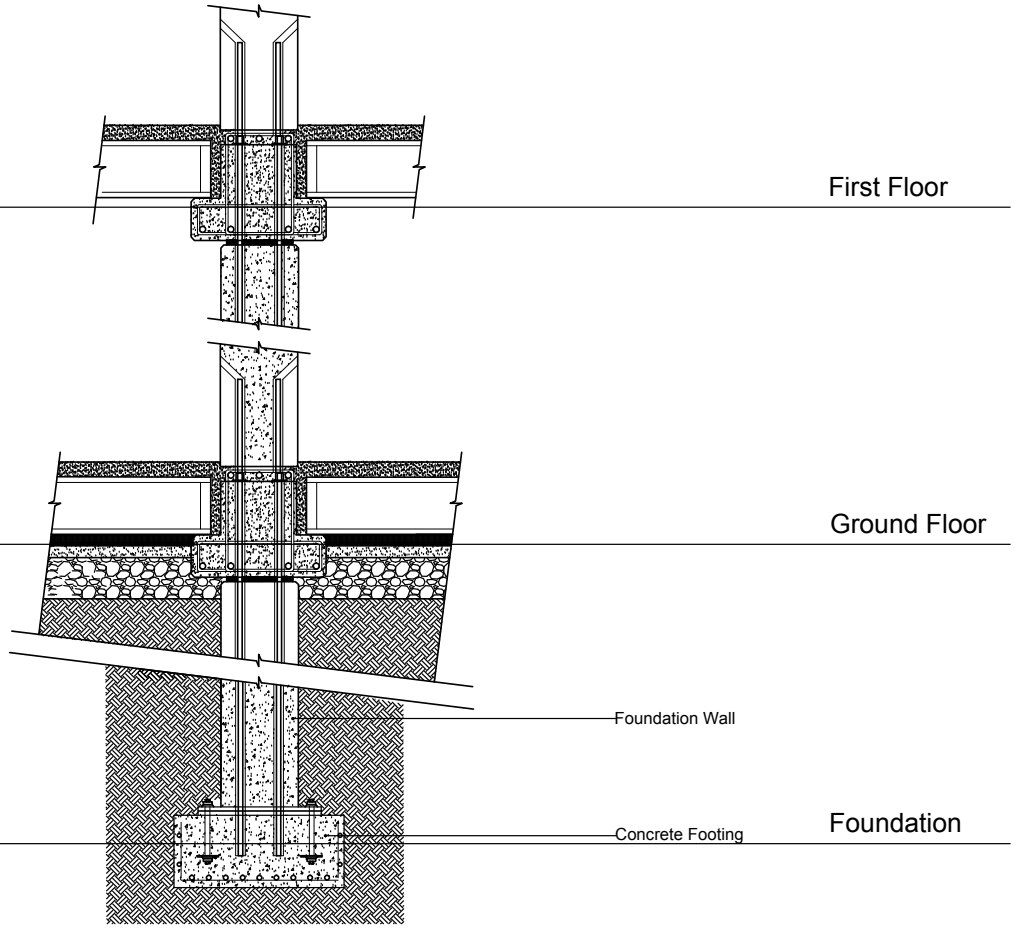

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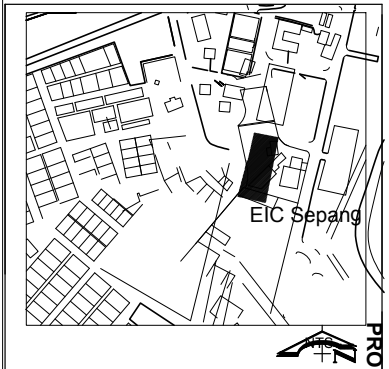

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
DETAIL DRAWING:
INTERMEDIATE BEAM- COLUMN- HOLLOW CORE SL

SCALE
1:20

SIZE
A3

DATE CREATED
21 NOV 2014

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HOO ZHI XIN

TUTOR
MS CHERYL NGIAM

REMARKS

DRAWING NUMBER
A009

SHEET NUMBER
09/18

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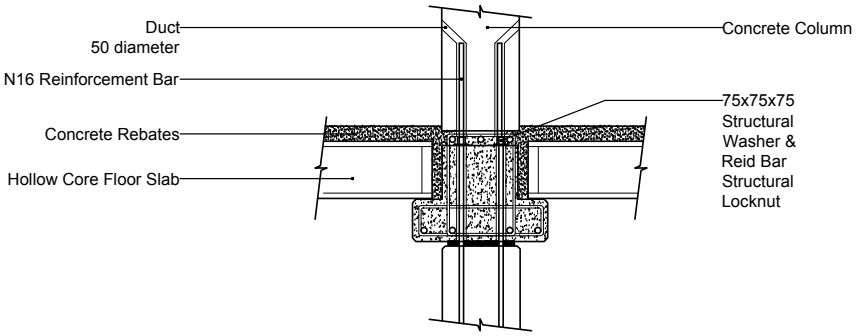

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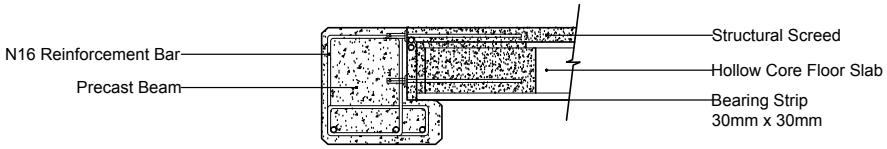
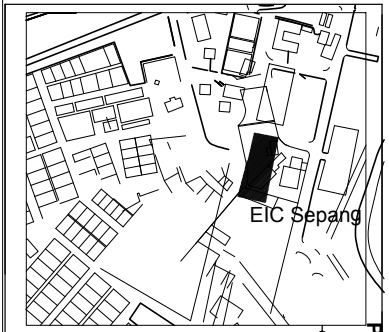


Edge Beam

LOCATION PLAN



PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
DETAIL DRAWING:
INTERMEDIATE COLUMN & EDGE BEAM DETAIL

SCALE
1:20

SIZE
A3

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21 NOV 2014

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MS CHERYL NGIAM

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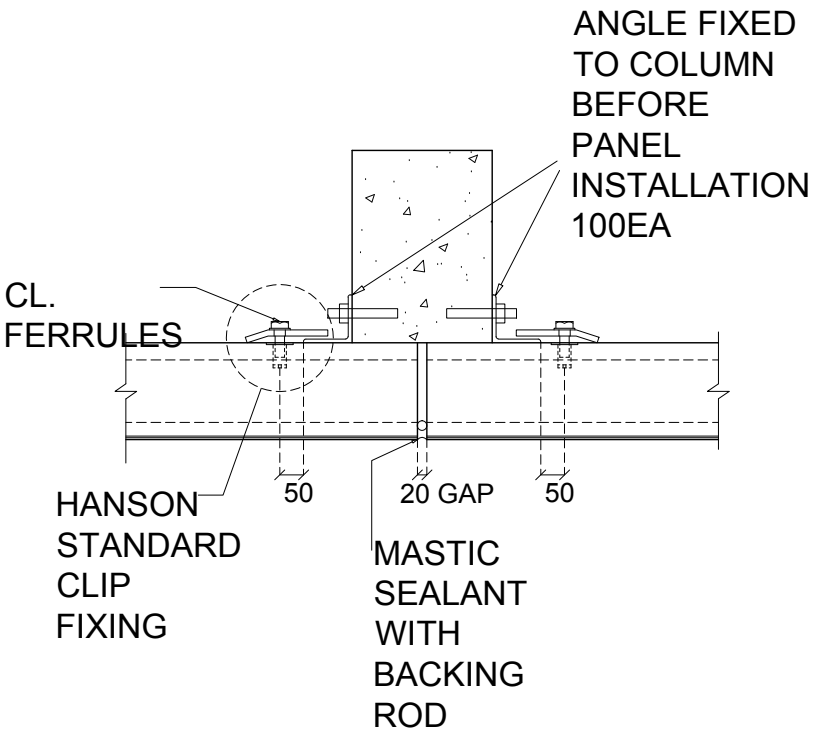

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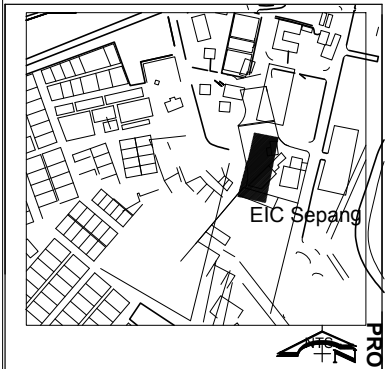

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
DETAIL DRAWING:
COLUMN- HOLLOW CORE WALL CONNECTION

SCALE
1:10

SIZE
A3

DATE CREATED
21 NOV 2014

DRAWN BY
HOO ZHI XIN

TUTOR
MS CHERYL NGIAM

REMARKS

DRAWING NUMBER
A011

SHEET NUMBER
11/18

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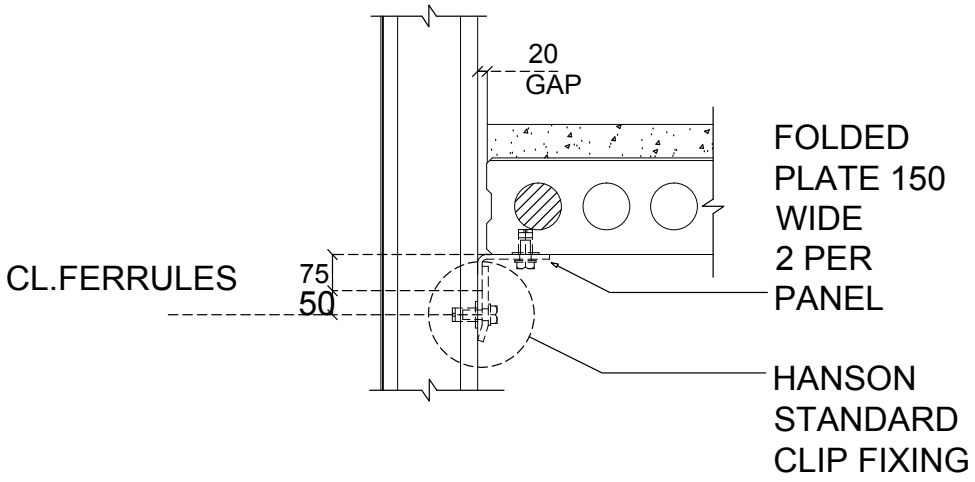

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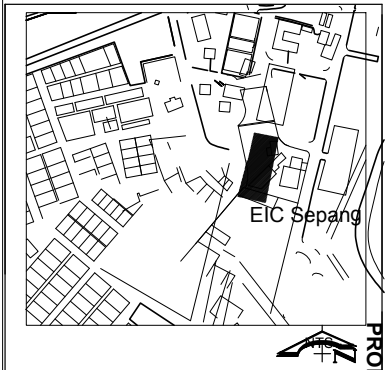

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
DETAIL DRAWING:
HOLLOW CORE FLOOR TO WALL CONNECTION

SCALE
1:10

SIZE
A3

DATE CREATED
21 NOV 2014

DRAWN BY
HOO ZHI XIN

TUTOR
MS CHERYL NGIAM

REMARKS

DRAWING NUMBER
A012

SHEET NUMBER
12/18

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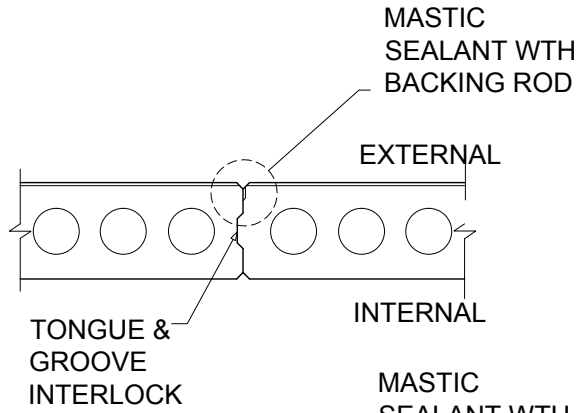

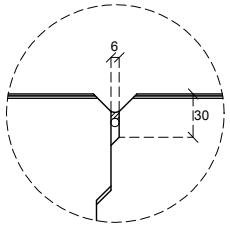

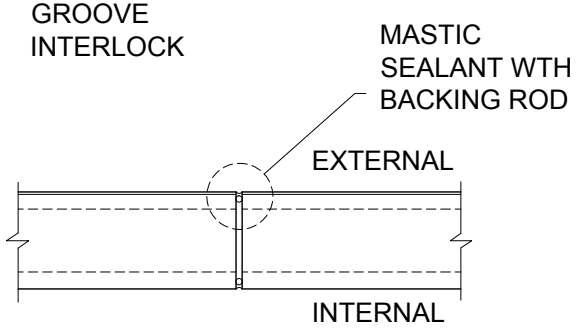

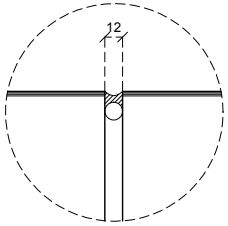

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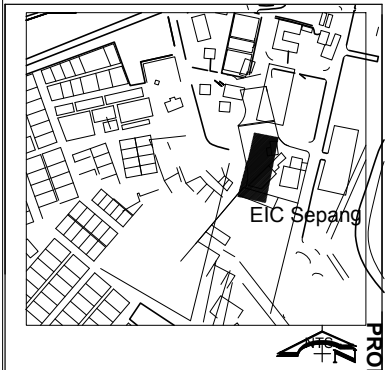

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
DETAIL DRAWING:
WALL TO WALL CONNECTION

SCALE
1:10

SIZE
A3

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21 NOV 2014

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DRAWING NUMBER
A013

SHEET NUMBER
13/18

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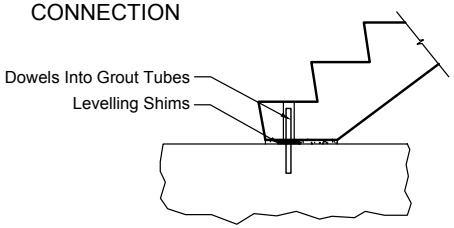
PRECAST
STAIR
TO
FOOTING
CONNECTION



PRECAST
STAIR
TO
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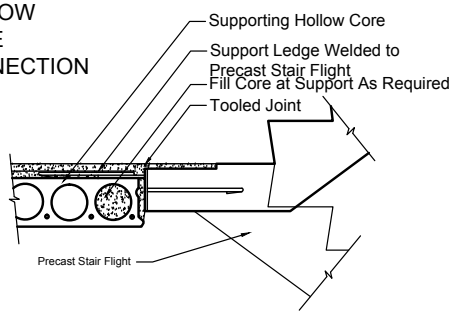
CORE
CONNECTION



PRECAST
STAIR
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WALL
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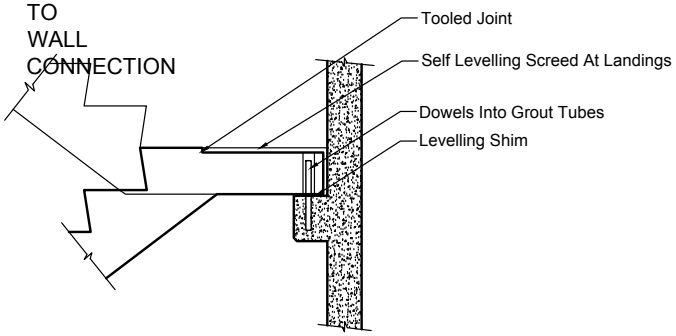

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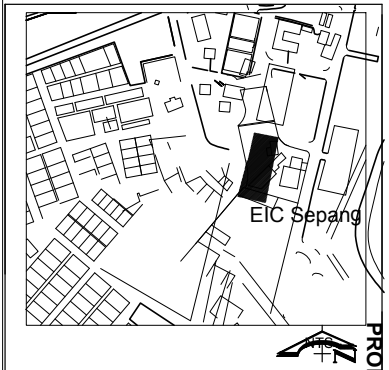

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
DETAIL DRAWING:
STAIRCASE DETAIL

SCALE
1:20

SIZE
A3

DATE CREATED
21 NOV 2014

DRAWN BY
HOO ZHI XIN

TUTOR
MS CHERYL NGIAM

REMARKS

DRAWING NUMBER
A014

SHEET NUMBER
14/18

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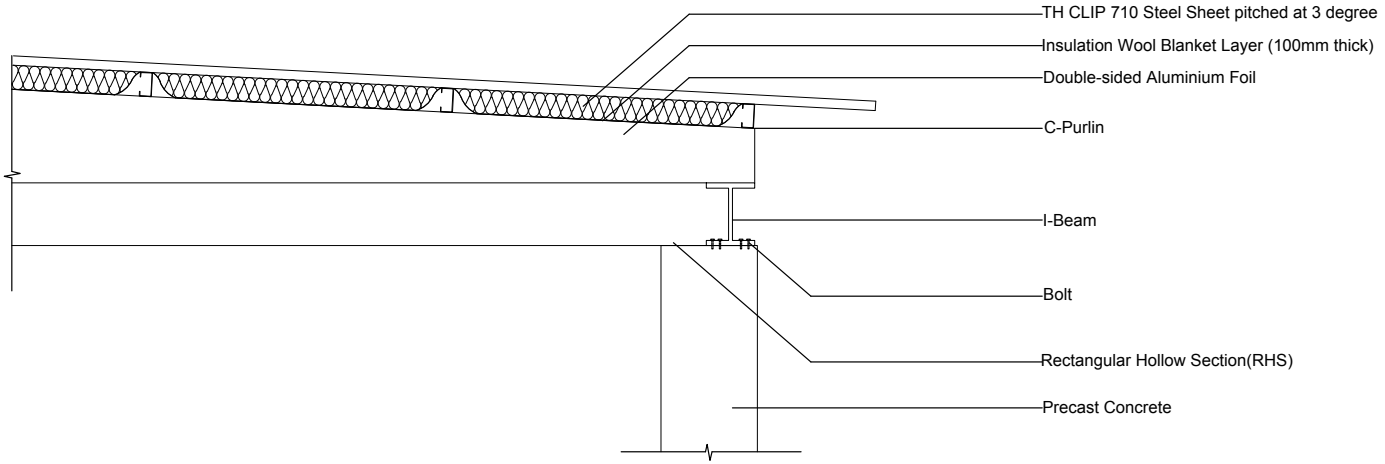

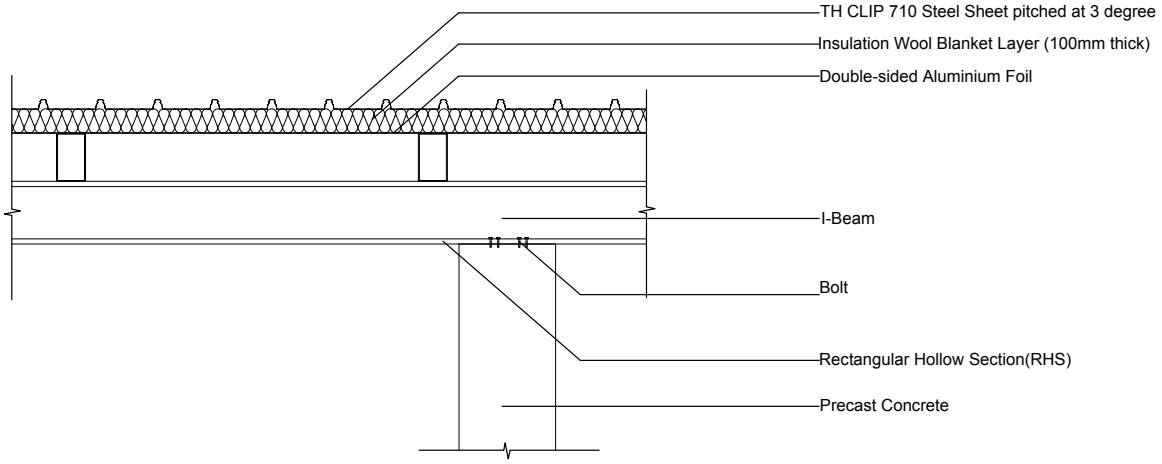

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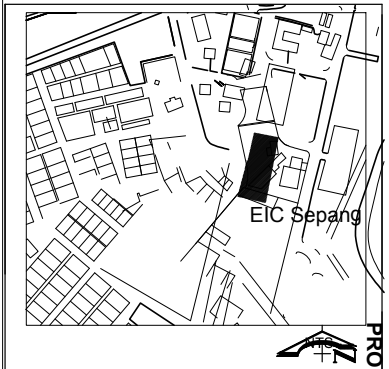

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
DETAIL DRAWING:
METAL ROOF SYSTEM DETAIL

SCALE
1:20

SIZE
A3

DATE CREATED
21 NOV 2014

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DRAWING NUMBER
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SHEET NUMBER
15/18

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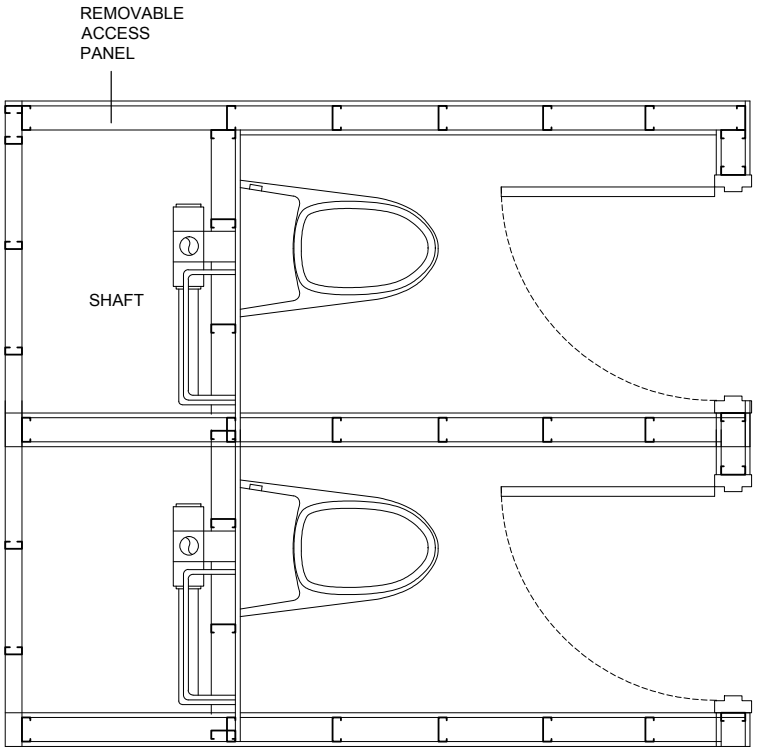
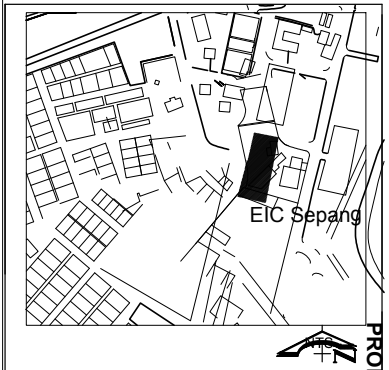


LOCATION PLAN



PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
DETAIL DRAWING:
TOILET POD SYSTEM DETAIL

SCALE
1:20

SIZE
A3

DATE CREATED
21 NOV 2014

DRAWN BY
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REMARKS

DRAWING NUMBER
A016

SHEET NUMBER
16/18

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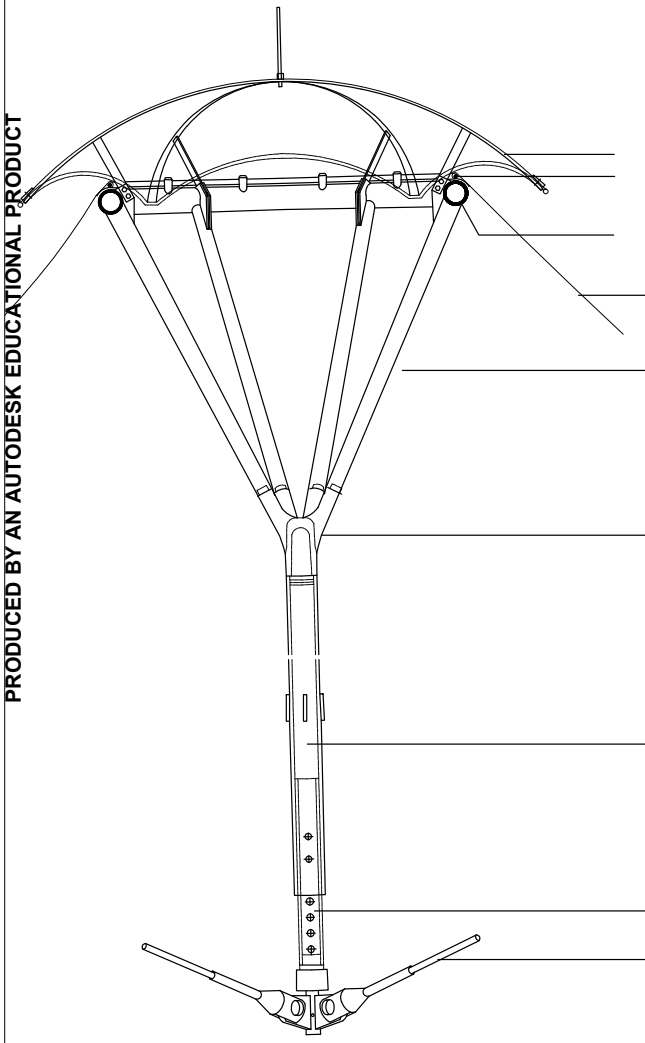
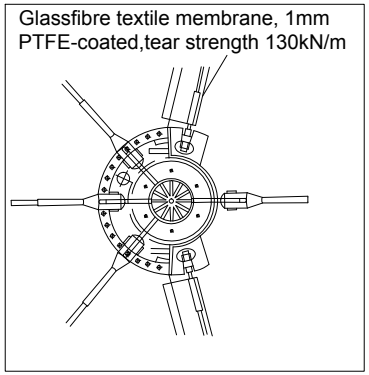
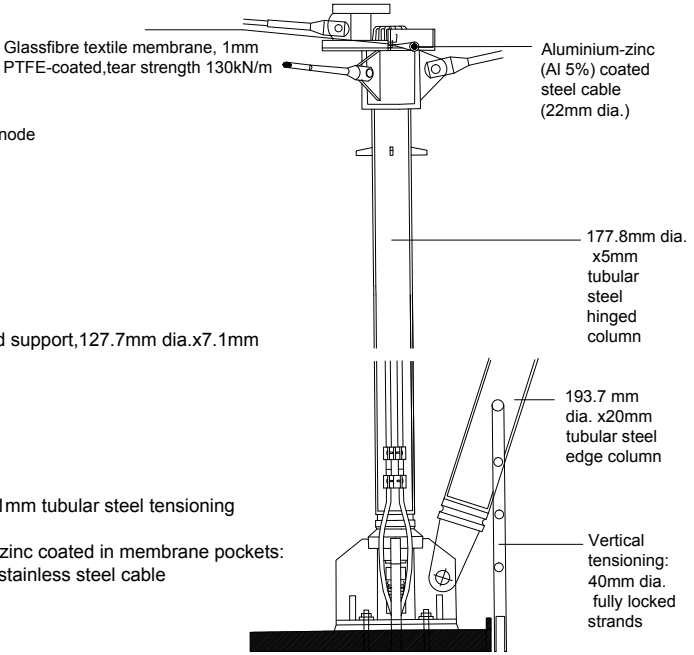


Horizontal tensioning:
22mm dia. open spiral strands





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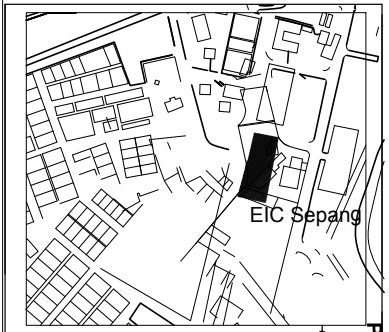

PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
DETAIL DRAWING:
TENSION SYSTEM DETAIL

SCALE
1:20

SIZE
A3

DATE CREATED
21 NOV 2014

DRAWN BY
HOO ZHI XIN

TUTOR
MS CHERYL NGIAM

REMARKS

DRAWING NUMBER
A017

SHEET NUMBER
17/18

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

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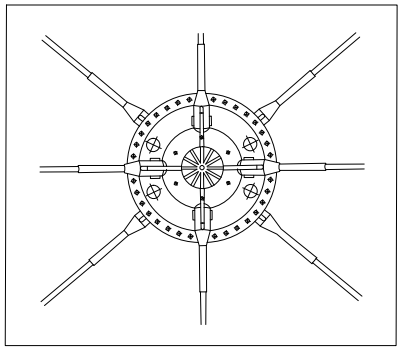
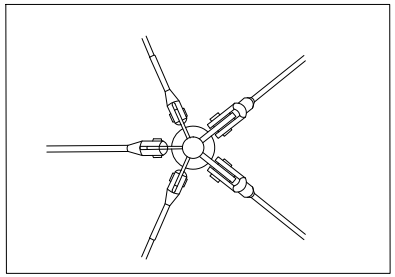
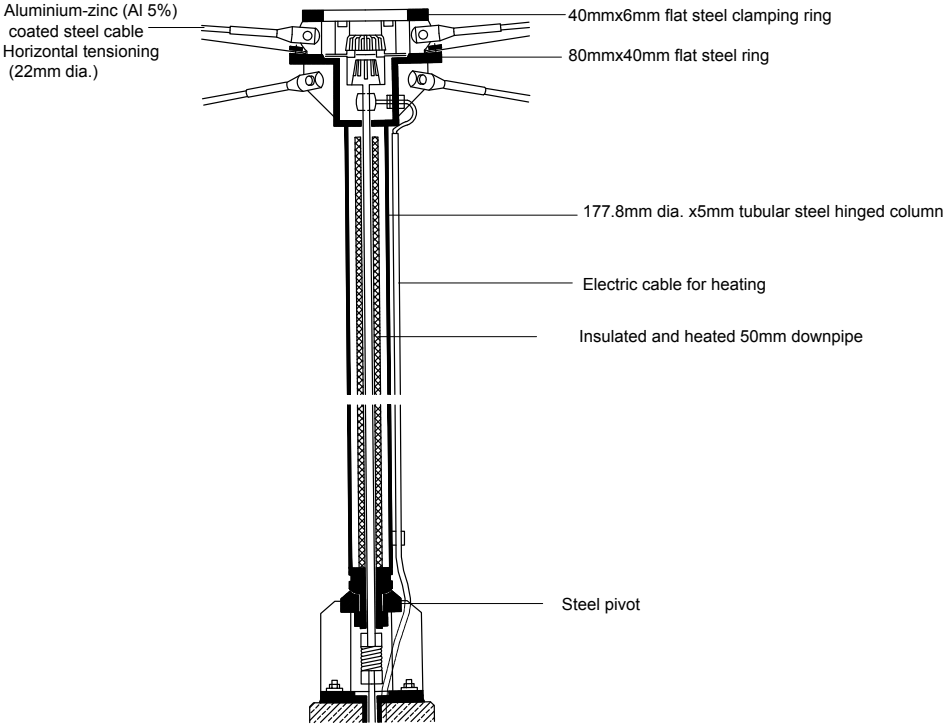
22mm dia. open spiral strands

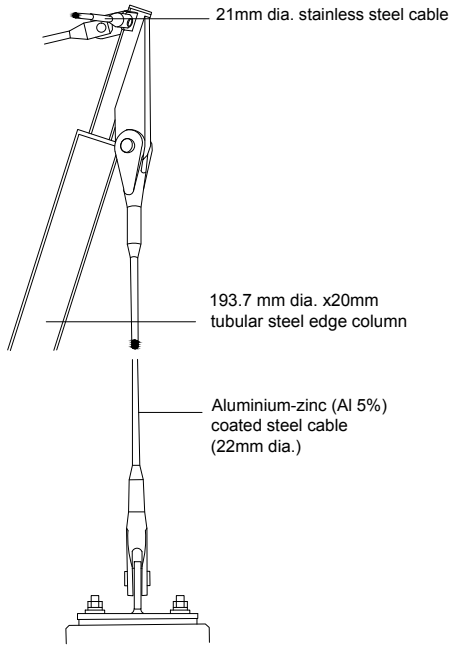


In membrane pockets;
21mm dia. stainless steel cable



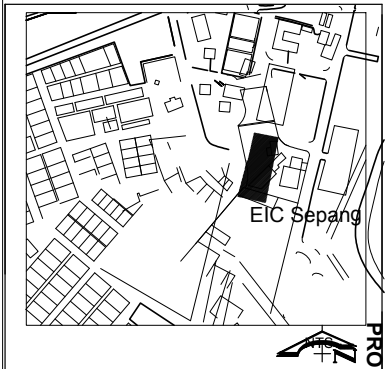


INSIDE COLUMN



TENSION SYSTEM

LOCATION PLAN



PROJECT TITLE
BUILDING TECHNOLOGY 1
ADVANCED ROOF SYSTEM & IBS SYSTEM

DRAWING TITLE
DETAIL DRAWING:
TENSION SYSTEM DETAIL

SCALE
1:20

SIZE
A3

DATE CREATED
21 NOV 2014

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REMARKS

DRAWING NUMBER
A018

SHEET NUMBER
18/18

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5.0 Embodied Energy Calculation

Type of beam/column		Length (mm)	Width (mm)	Height (mm)	Volume (m^3)	Qty	Volume of component in plan (m^3)
Main Beam(s)		12320	450	600	3.3264	12	39.9168
Secondary Beam(s)		12000	450	600	3.24	24	77.76
Column(s)		320	320	3500	0.3584	24	8.6016
						Total Volume (m^3)	126.2784

Table 1 : Volume calculation of beams & columns

Input	Length (m)	Area (m^2)	Volume (m^3)	Density (kg/m^3)	Mass (kg)	Energy Coefficient (MJ/kg)	Embodied Energy (MJ)
Column & Beam	*refer to table 1		126.2784	2400	303068.16	1.7	515215.872
TOTAL EMBODIED ENERGY							**180564.48**
Floor Component	**Thickness (m)**						
Hollow core slab	0.2	447.77	89.5536	2400	214928.64	1.9	408364.42
Screeding	0.1	447.77	44.7768	2400	107464.32	1.7	182689.34
Tiles	0.013	274.43	3.567564	2000	7135.128	5	35675.64
TOTAL EMBODIED ENERGY							**626729.40**
Wall Component	**Thickness (m)**						
Precast concrete wall	0.2	286.44	57.288	2400	137491.2	1.9	261233.28
Glass window	0.08	34.5	2.76	2500	6900	12.7	87630
TOTAL EMBODIED ENERGY							**348863.28**
Staircase Component	**Thickness (m)**						
Concrete step & landing	0.18	21.252	3.82536	2400	9180.864	1.9	17443.64
TOTAL EMBODIED ENERGY							**17443.64**
Prefab Toilet	**Thickness (m)**						
Fiber glass wall	0.15	35.06	5.259	1522.39	8006.24901	28	224174.97
TOTAL EMBODIED ENERGY							**224174.97**
Roofing	**Thickness (m)**						
Rectangular Hollow Section	0.004	36.96	0.14784	2700	399.168	34	13571.712
Aluminium sheet	0.001	274.44	0.27444	2700	740.988	170	125967.96
Wool blanket	0.1	137.22	13.722	1000	13722	90	1234980
Metal sheet	0.005	184.8	0.924	2700	2494.8	34	84823.2
Purlin	0.002	25.92	0.05184	2700	139.968	34	4758.912
TOTAL EMBODIED ENERGY							**1464101.784**
TOTAL VOLUME OF BUILDING			**348.428844**				
TOAL MASS OF BUILDING					**811671.485**		
TOTAL EMBODIED ENERGY OF BUILDING							**2861877.558**

Table 2 : Embodied Energy Calculation

6.0 Conclusion

Through the embodied energy calculation, it is to say that IBS system had reduced significant amount of materials' embodied energy.

It is because the manufacturing process of IBS system components are modular and through that it reduced the manufacture energy and avoid wastage of materials. Besides that, precast concrete is durable and have long life span, hence it is very sustainable.

By employing low embodied energy materials can successfully reduce carbon emission hence creating a sustainable environment by reducing carbon footprint to the earth.

IBS system has a lot of benefits such as require less labours, result in cutting costs in project. Besides that,the speed of construction also can speed up since the components are all prefabricated.

In conclusion, architects are encouraged to implement IBS system in modular designs, to create a more sustainable environment.

7.0 References

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