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BUILDING TECHNOLOGY 1 [ARC3514 / ARC3512]
Prerequisite: Building Structures

Project 1 – Alternative Construction Solutions

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1.0 CONTENTS

1.0 INTRODUCTION

1.1 OBJECTIVES

| OBJECTIVES OF PROJECT |

- To encourage analytical and critical study of the principles, practices and details of construction technology in the existing building.
- To encourage exploration on alternative construction systems
- To adapt and implement the alternative construction systems design.
- To develop skills in producing working drawings.

This project calls for a proposal of modification on a design construction system and building materials into an alternative, a more recent and complex construction systems that suit the local context. Modifications are to be carried out on the following building components:

i) Floor system
ii) Wall system
iii) Roof System
iv) New basement level

The modifications are facilitated by precedent studies of existing buildings which are currently employing the same systems in the proposal. All the findings are produced in a complete documentation, including report and a set of working drawings of the modified design.

NATURE APPRECIATION CENTER

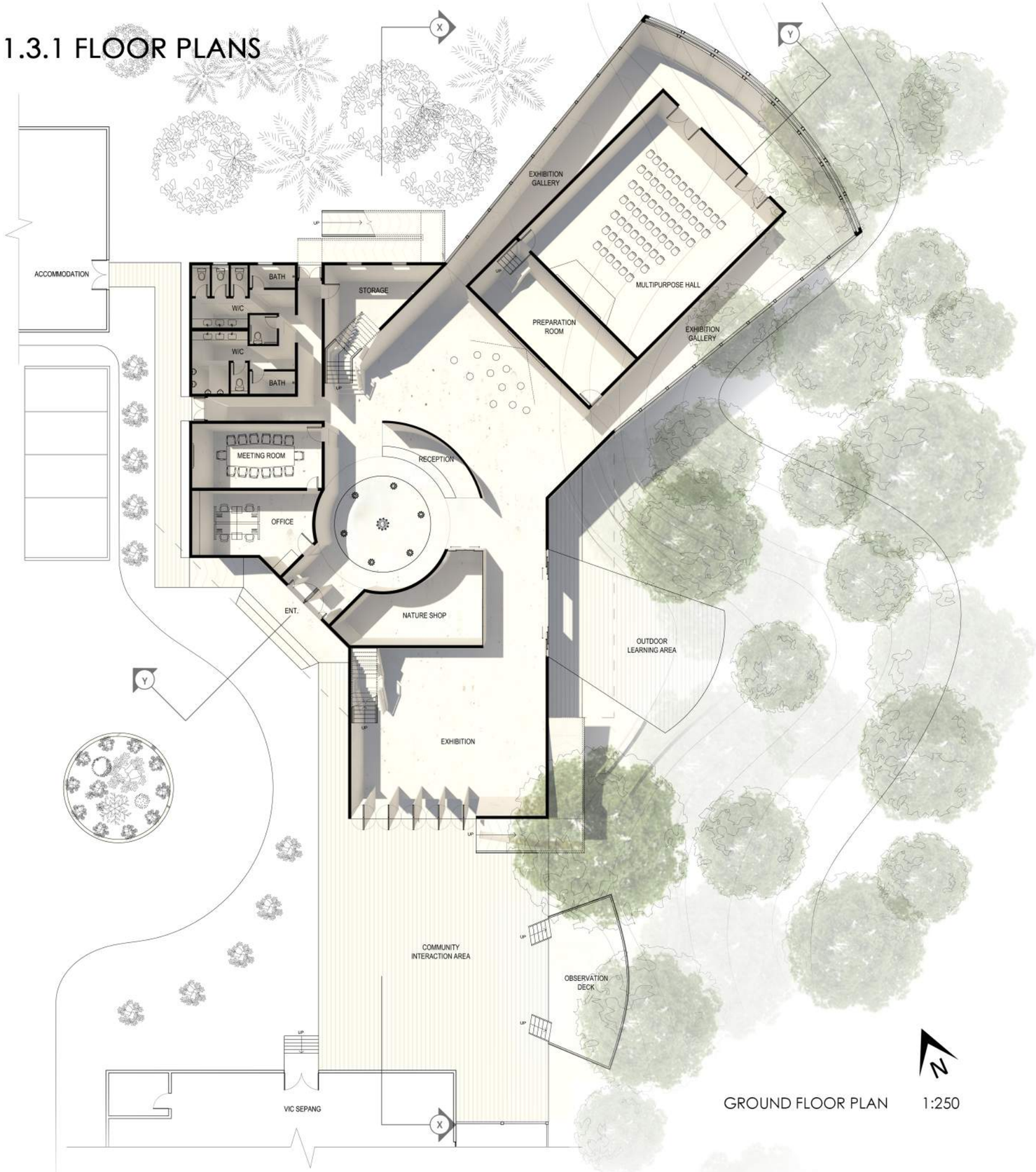
LOCATION : SEPANG GOLDCOAST, SELANGOR
FUNCTION : ENVIRONMENTAL EDUCATION
USER : MALAYSIAN NATURE SOCIETY (MNS), YOUTH & LOCAL COMMUNITY

| DESIGN BRIEF |

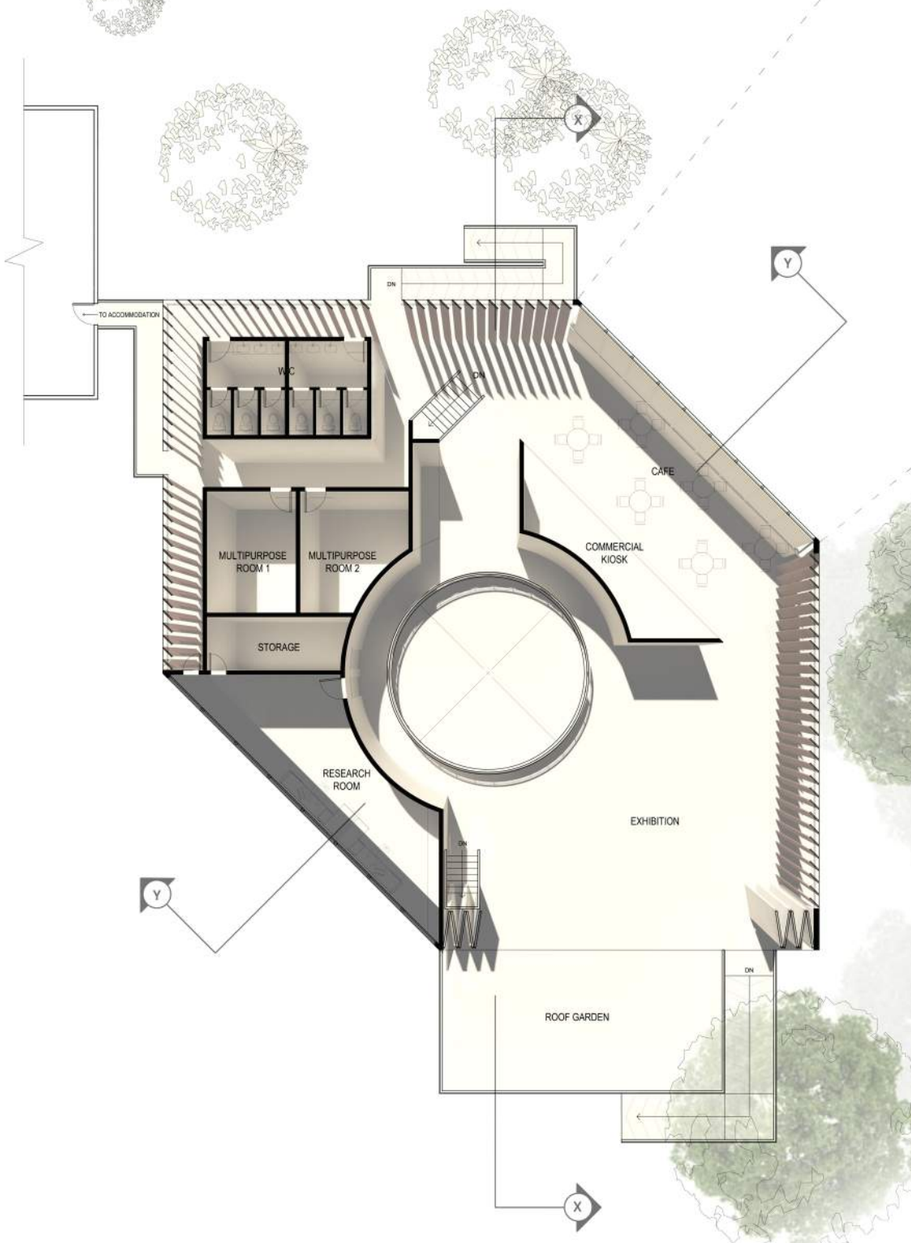
The main intention designing a Nature Appreciation Centre at Sepang is to tie human and nature relationship to instil knowledge of mangrove conservation. With the core concept "Transition", it realized the need for people to escape from urban life into natural atmosphere; creating a space connecting the two contrasting elements—artificial and natural. This idea is applied by slowing unwrapping the enclosure of space as well as user's vision. The sense of solidity and restraint from the building's external appearance gradually changed into an open and breathing building which the building enables users closer to the surrounding and communicating with the nature.

The building adopted reinforced concrete construction system with bare finish of cement render on the ground floor, whereas timber batten screens are applied on the first floor as building envelope. Considering the sustainability and life-performance of building structural system in a mangrove ecosystem, design modification are adapted to explore on contemporary building structural technology which could provide suitability while enhancing aesthetic value of the building in its site context.

1.3.1 FLOOR PLANS

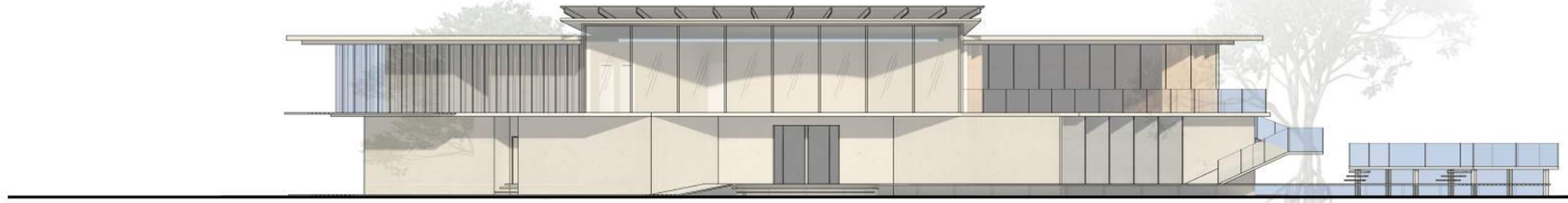


GROUND FLOOR PLAN 1:250



FIRST FLOOR PLAN 1:250

1.3.2 ELEVATIONS



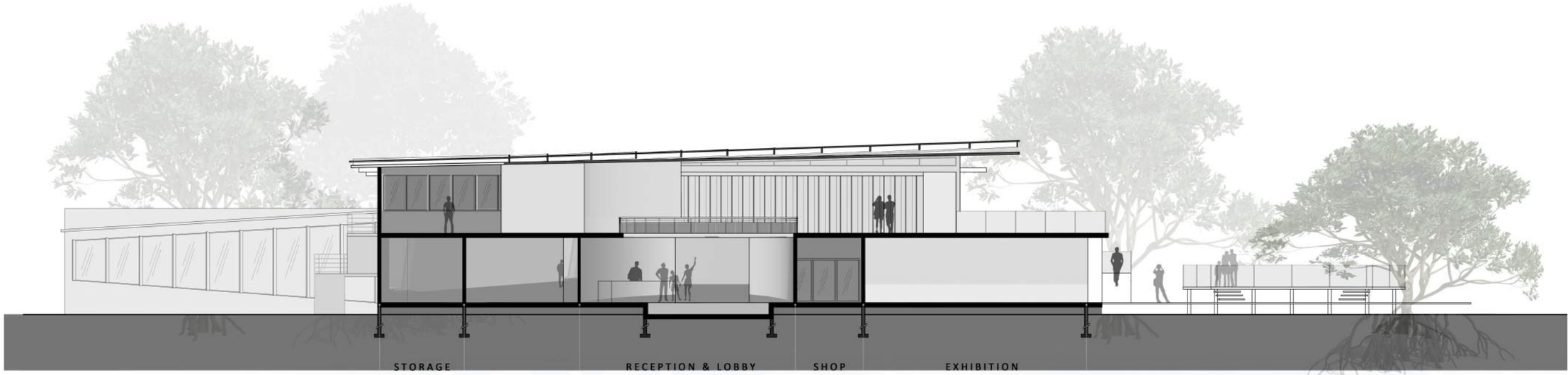
SOUTH WEST ELEVATION 1:250

SOUTH EAST ELEVATION 1:250

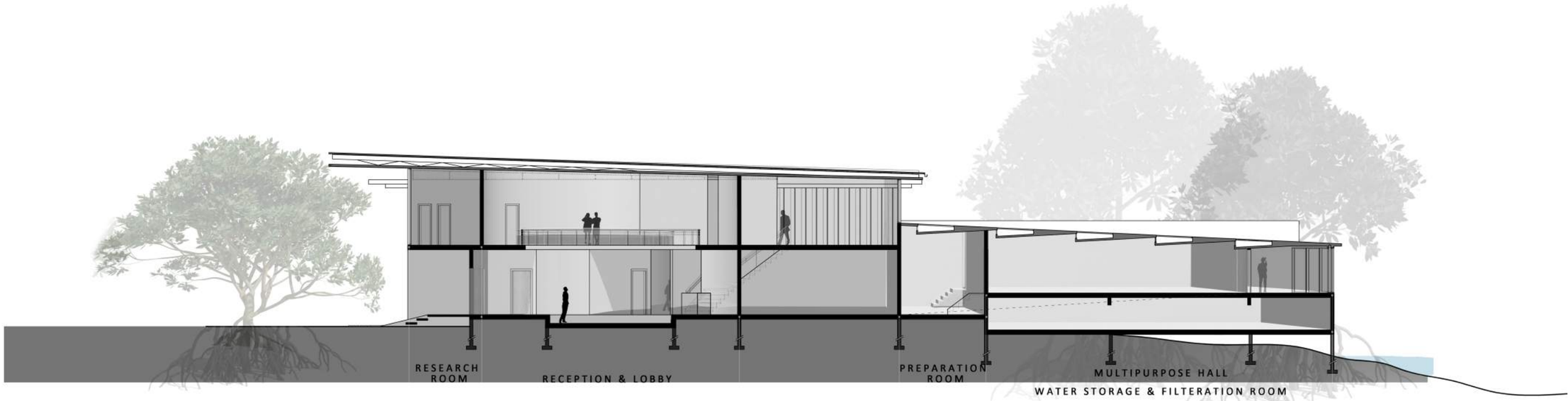
NORTH EAST ELEVATION 1:250

NORTH WEST ELEVATION 1:250

1.3.3 SECTIONS

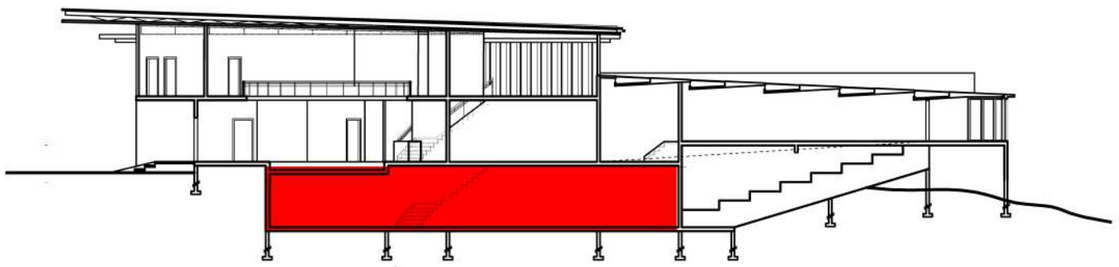


SECTION A-A 1:250

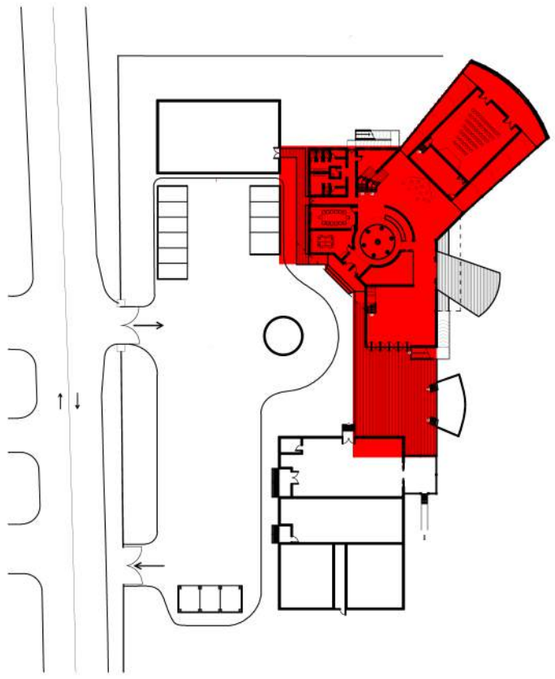


SECTION B-B 1:250

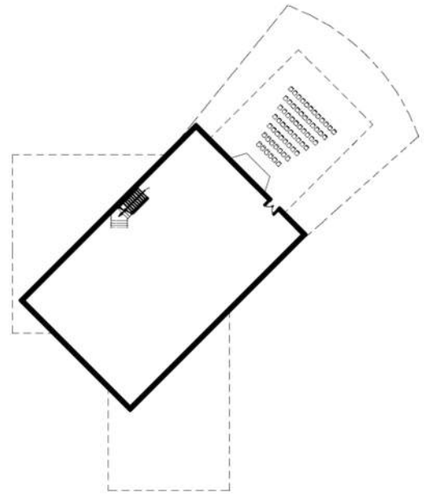
2.0 BASEMENT
2.1 BASEMENT INTRODUCTION



KEY SECTION
1:300



KEY PLAN
1:1000



BASEMENT FLOOR PLAN
(N.T.S)

2.1.1 INTRODUCTION
| DESCRIPTION |

A basement or cellar is one or more floors of a building that are either completely or partially below the ground floor. Basements are typically used as a utility space for a building where such items as the boiler, water heater, breaker panel or fuse box, car park, and air-conditioning system are located; so also are amenities such as the electrical distribution system, and cable television distribution point.

| TYPES OF BASEMENT |

Grade	Basement usage	Performance level
1	Car parking: plant rooms (excluding electrical equipment); workshops	Some seepage and damp patches tolerable
2	Workshops and plant rooms requiring drier environment; retail storage areas	No water penetration but moisture vapour tolerable
3	Ventilated residential and working areas including offices, restaurants etc., leisure centres	Dry environment
4	Archives and stores requiring controlled environment	Totally dry environment

In this case, basement proposed is considered as Grade 3. It needs to achieve a dry environment to function well. For construction wise, retrofit is the construction method that is adopted. Therefore, to create a habitable space for users in NAC.

Table 2: Types of basement
(Source: Alan Tovey, n.d.)

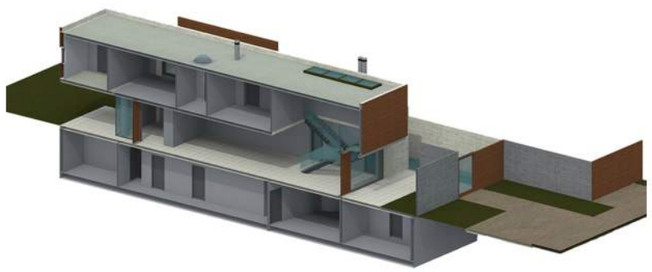
| BASEMENT CONSTRUCTION OPTIONS |

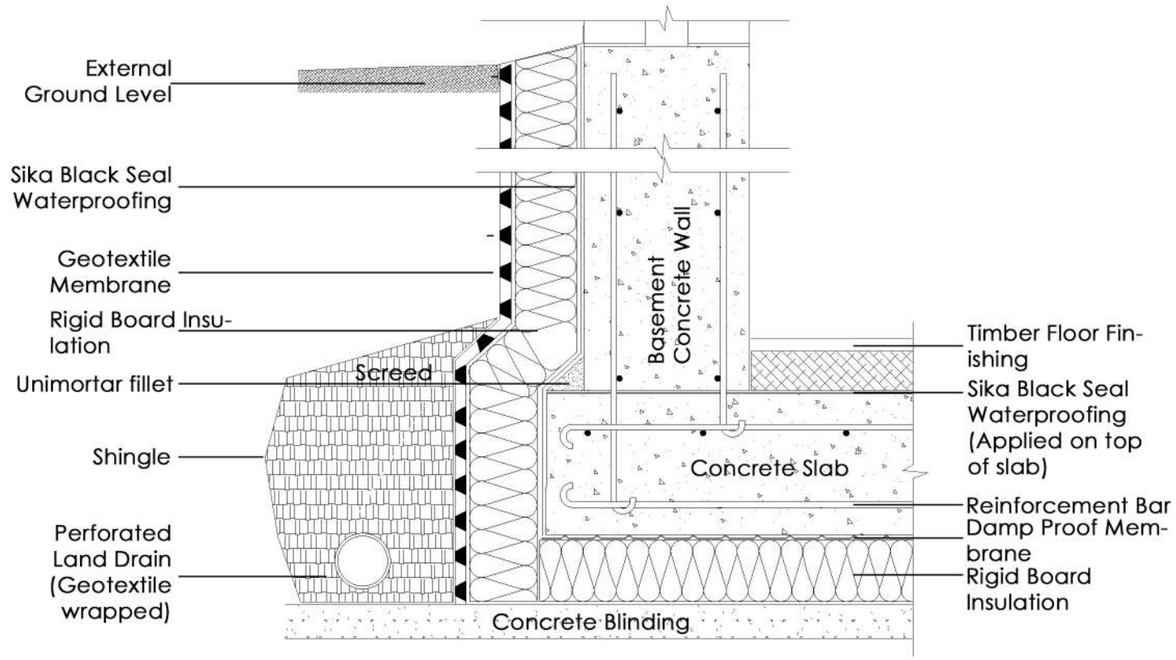
-Under House (Retrofit):
To build below the whole footprint of existing building, or just under a specific area, to construct the ideal amount of space needed.
-Sub-Basement:
Construction is not restricted to a single level basement.
-Under Garden (Open Excavation):
Basement that is constructed below garden.

2.1.2 PROPOSED BASEMENT

A basement with concrete wall and floor as finishes is proposed for this NAC. The location of basement is at the bottom of gathering space. A staircase is built to allow users to enter the basement. This basement will serve as a storage. Therefore, only the staff of this NAC are allowed to enter this space.Considering the site as an environmentally sensitive area, concrete is an optimal material to be selected due to its high durability and compressive stength to serve as a barrier to exterior surounding. Furthermore, concrete is considered as one of the most durable builing material, hence it does not require too much of maintenance.

2.2.1 RESIDENCE IN LARISSA
NAKAIA, LARISSA, GREECE
POTIROPOULOUS D + L ARCHITECTS





DETAIL BASEMENT SECTION SCALE 1:10

| DESCRIPTION |
The concept refers to the agricultural landscape of the Larrisa's plain which reminds of a multicoloured orthogonal puzzle. Both the austere shape of the building volume, as well as the design discipline of the surrounding garden – which is organised in geometrical areas of different plant species.The design of the building and the surrounding landscape is based on overlapping movements of transitions with the landscape as a permanent backdrop. The raw materials used on the shell – exposed concrete and wood, amplify the symbiotic affinity between building and nature whilst the rhythm of the vertical and horizontal openings encourages the dialogue with the natural light, providing in parallel conditions of desirable privacy.

| CONCRETE BASEMENT |
In this case study, retrofit method of construction is being used. Spaces in basement of Larissa Residence including garage, multipurpose rooms and toilet, which are mostly habitable spaces for user to live with. Therefore, waterproofing system is important to avoid moisture leakage into this space. In addition, the material used are exposed concrete wall and timber flooring. Timber floor is being well treated to prevent dampness that will affect human comfort. Furthermore, shingle is being use as the material for backfill in this temperate climatic country.

2.3.1 SITE INSTALLATION

1. EXCAVATION

2. CONCRETE FOOTING
- Monolithic solid concrete base for the beginning of the concrete block basement system.
- Soil bearing capacity must be a minimum of 1,500 psi.

3. CONCRETE BLOCK
- Henner G5 Concrete Block

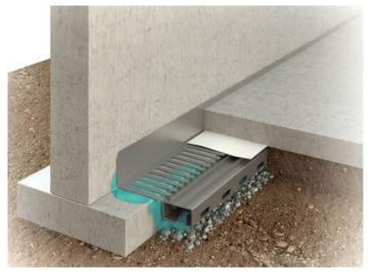
4. REINFORCING STEEL & GROUTING
- When required, reinforcing steel should be placed in the proper position in the block.

5. MORTAR
- Type S or M mortar

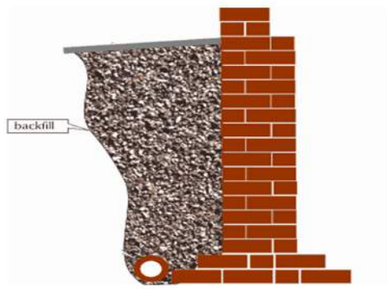
6. DAMP - PROOFING / WATERPROOFING
- Must be applied to the exterior of the wall from the top of the footing to the finished grade.
- Sika Black Seal Water proof

7. INSULATION
- If insulation is required, it can be easily installed on the interior, exterior or inside of the concrete block wall.

8. DRAIN TILE & STONE FILTER FABRIC
- Helps keep the water away from the foundation and must be below the top of the footing.



9. BACKFILL
- Use clean backfill and slope grading away from the house



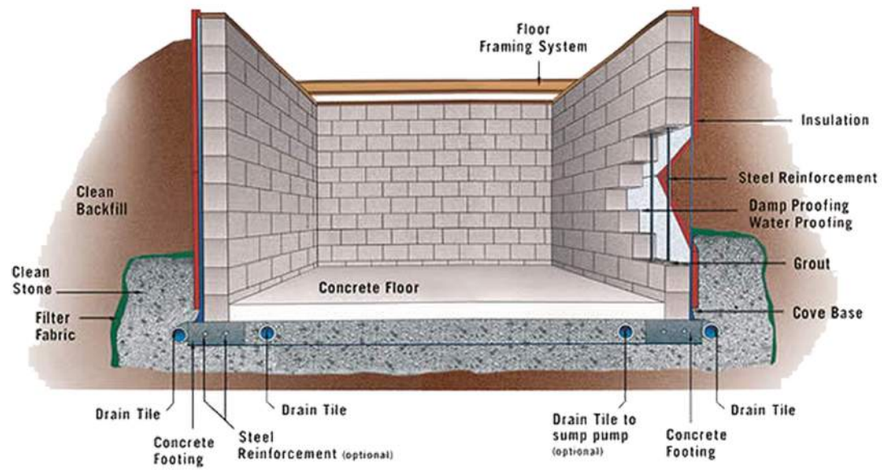
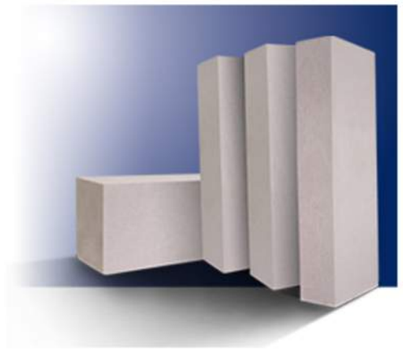


Figure: Basement Construction Specifications

Construction method of NAC follows the steps of under house(retrofit) method because proposed basement is constructed under the ground floor of existing NAC.

2.4.1 MATERIAL SPECIFICATIONS

| HENNER CONCRETE BLOCK |



| CHARACTERISTICS & ADVANTAGES |

-Fast construction duration
-Versatile
-Durable
-Fire proof
-Resistance against acoustic
-Low maintainence fee
-Environmental friendly

| SIZES & SPECIFICATIONS |

-Widths: 200mm
-Length: 600mm
-Height: 200mm
-Mean Compressive Strenth(MPa): 5.2

| SUPPLIER |

Saint-Gobain AAC Sdn Bhd. (67579-A)
Unit 3.1, Level 3, Block E Peremba Square, Saujana Resort, Seksyen U2, 40150 Shah Alam, Selangor Darul Ehsan, Malaysia
Telephone: (603) 7846 4039
Fax: (603) 7842 1668
Email: henner@saint-gobain.com

| SIKA BLACK SEAL WATERPROOFING |

| CHARACTERISTICS & ADVANTAGES |

-Easily installed using flame torch methods
-Excellent stability
-Resistant to heat
-Good chemical resistance
-Water and vapour proof

| SIZES & SPECIFICATIONS |

-Thinkness: 3mm
-Colour: Black and sand finish

| SUPPLIER |

Terreal Malaysia Sdn Bhd (202237-P)
No. 39 & 41-1, Jalan TPK 2/8,
Taman Perindustrian Kinrara, Seksyen 1,
47180 Puchong, Selangor Darul Ehsan.

Telephone:(603)8075 4010 / 4020 / 4060
Fax:(603)8075 1090
Email:contact@terreal.com.my

2.4.2 UBBL REQUIREMENT

LAWS OF MALAYSIA, ACT 133
72 (3):
In the design of basement floors and similar stuctures underground, the upward pressure of water, if any, shall be taken as the full hydrostatic pressure applied over the entire area.

234:
All underground structures, windowless buildings depending on the type of occupancy, storage, processes or type of protection installed shall be provided with foam inlets as may be required by the Fire Authority.

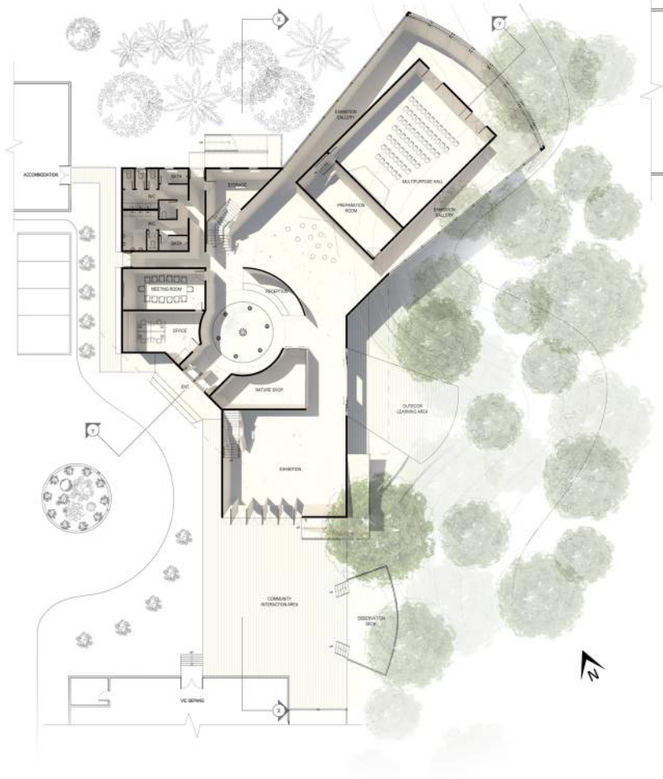
| SUITABILITY |

Due to the location of site, the new propoesed basement of this NAC is constructed with concrete blocks and treated with layers of insulation and waterproofing system. The dampness and moisture of site will affect the sustainability of basement in long term. Therefore, concrete block is the main material of basement due to its durability and ability in fire proofing. Other than that, Sika Black Seal Waterproofing system is used at the both interior and exterior side of basement construction to prevent leakage of moisture. For the backfill material for drainage pipe, lean concrete is used instead of shingle due to the larger amount of moisture at the ground of tropical climatic zone.

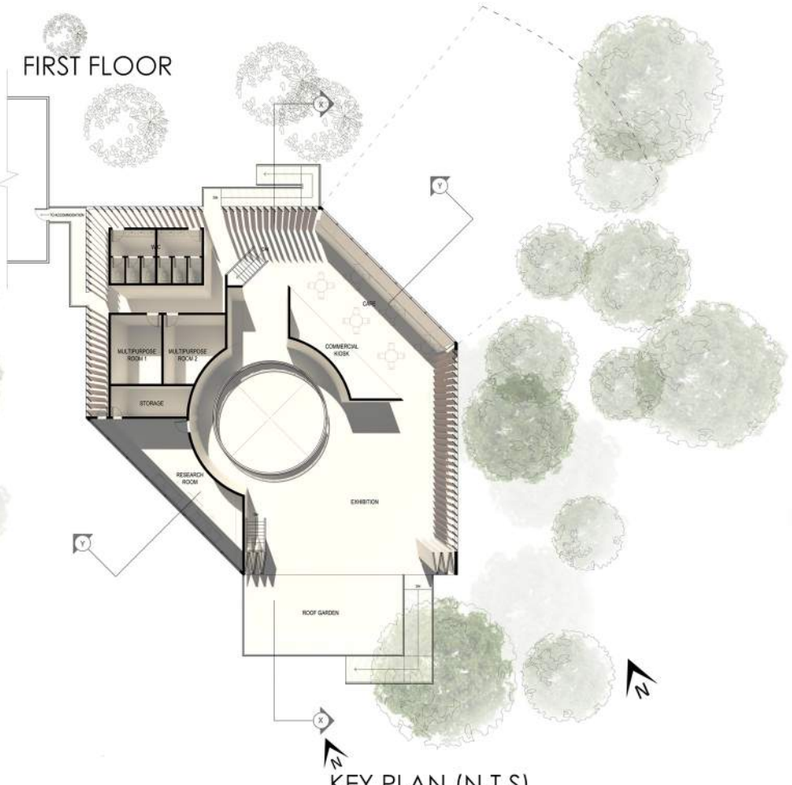
3.0 FLOOR SYSTEM

3.1 EXISTING FLOOR SYSTEM

GROUND FLOOR



FIRST FLOOR



KEY PLAN (N.T.S)

INTERIOR RENDERING

3.1.1 CAST-IN-SITU REINFORCED CONCRETE SLAB

| DESCRIPTION |

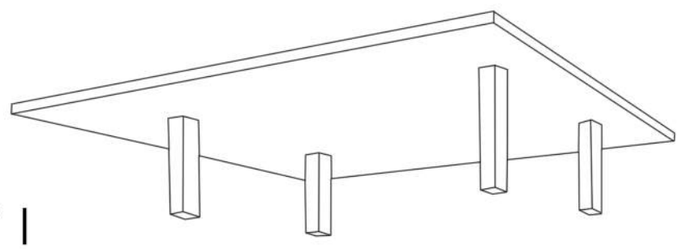
Cast-in-situ concrete slabs are built on the building site using formwork. For a suspended slab, the form-work is shaped like a tray, often supported by a temporary scaffold until the concrete sets. Rebars are positioned within the formwork before the concrete is poured in to act as reinforcement of the slabs. To ensure the reinforcement is completely being enveloped by concrete, plastic tipped metal, or plastic bar chairs are used to hold the rebar away from the bottom and sides of the form-work. Cast in-situ concrete is a common material of choice for slabs and foundations of its long-term durability and structural support.

| ADVANTAGES |

-Easy transportation of wet concrete
-Flexible when it comes to geometric shape
-Relatively easy to do late changes to structure
-Structure becomes monolithic

| DISADVANTAGES |

-Produced in an unprotected environment
-Additional time required for drying out process
-Requires more temporary work
-Complex process with many inputs and flows



| SUSTAINABILITY |

Concrete is ordered and placed as needed and does not need to be trimmed or cut after installation. Wash water is frequently recycled using trucks equipped with devices that collect wash water and return it to the drum where it can be returned to the ready mixed concrete plant for recycling. Extra concrete is often returned to the ready-mix plant where it is recycled or used to make jersey barriers or retaining wall blocks; or it can be washed to recycle the coarse aggregate. Special set retarding admixtures can be added to returned concrete to allow for storage and future use.

| TEXTURE |

Concrete can take the applied textures to it by controlling the texture and design of concrete formwork. This process can be achieved by in-situ concrete or precast concrete (Hall, 2012). The final product of this process may have various texture patterns: soft, hard, small and complex texture.

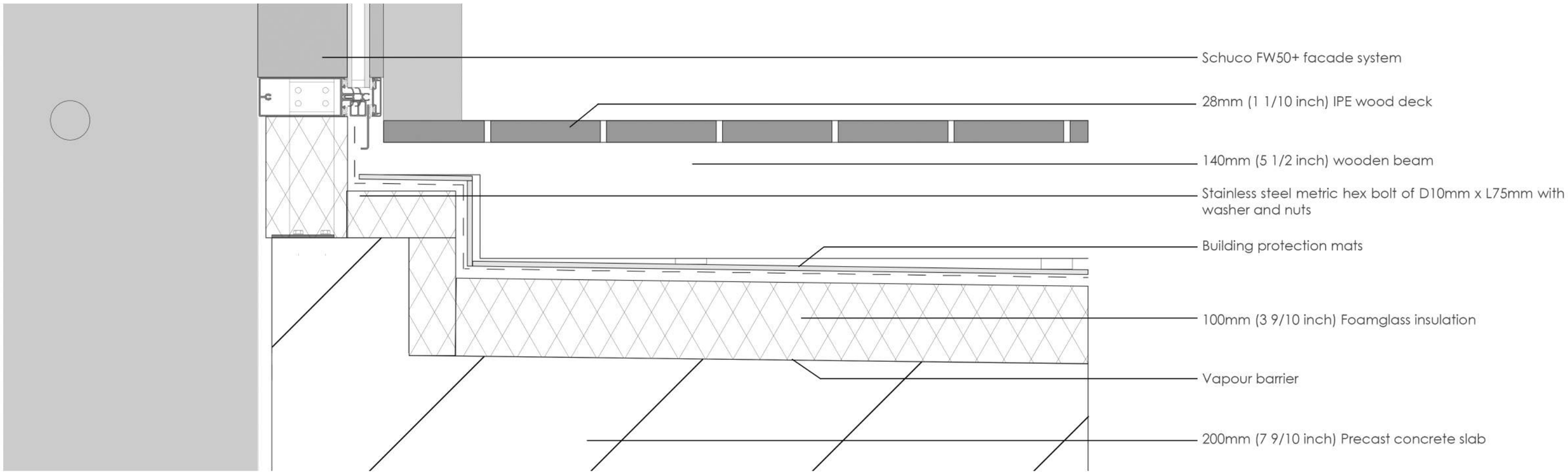
3.2.1 HOUSE F
RAMELDANGE, LUXEMBOURG
PAUL BRETZ ARCHITECTES





| DESCRIPTION |
The split-level layout developed for this long, narrow hillside property sees House F rise in correlation with the slope it stands on.
Three one-piece architectural concrete walls extend lengthwise into the slope to form the basic framework of the house and its garden. These walls are primarily plain, and only feature those apertures necessary for the letting in of light or the provision of access around the property.

| GROUND FLOOR WOOD LAYERING ON CONCRETE SYSTEM |
28mm IPE wood deck cladding over concrete floor slab under the support of 140mm wooden beam with foamglass insulation, vapour barrier and building protection mat installed in between. The concrete floor acts as a thermal heat storage mass, providing cooler spaces under higher temperature climate, minimizing the consumption of energy. The wooden deck is soft under feet and is eco-friendly when renewable or recycled timber is being used.



FLOOR SECTION DETAIL SCALE 1 : 5

3.3.1 WOOD DECKING ON CONCRETE FLOOR SYSTEM

| DESCRIPTION |

28mm Chengal wood deck cladding over concrete floor slab under the support of 140mm wooden beam with foamglass insulation, vapour barrier and building protection mat installed in between. The concrete floor acts as a thermal heat storage mass, providing cooler spaces under higher temperature climate, minimizing the consumption of energy. The wooden deck is soft under feet and is eco-friendly when renewable or recycled timber is being used.

| REASON TO MODIFY |

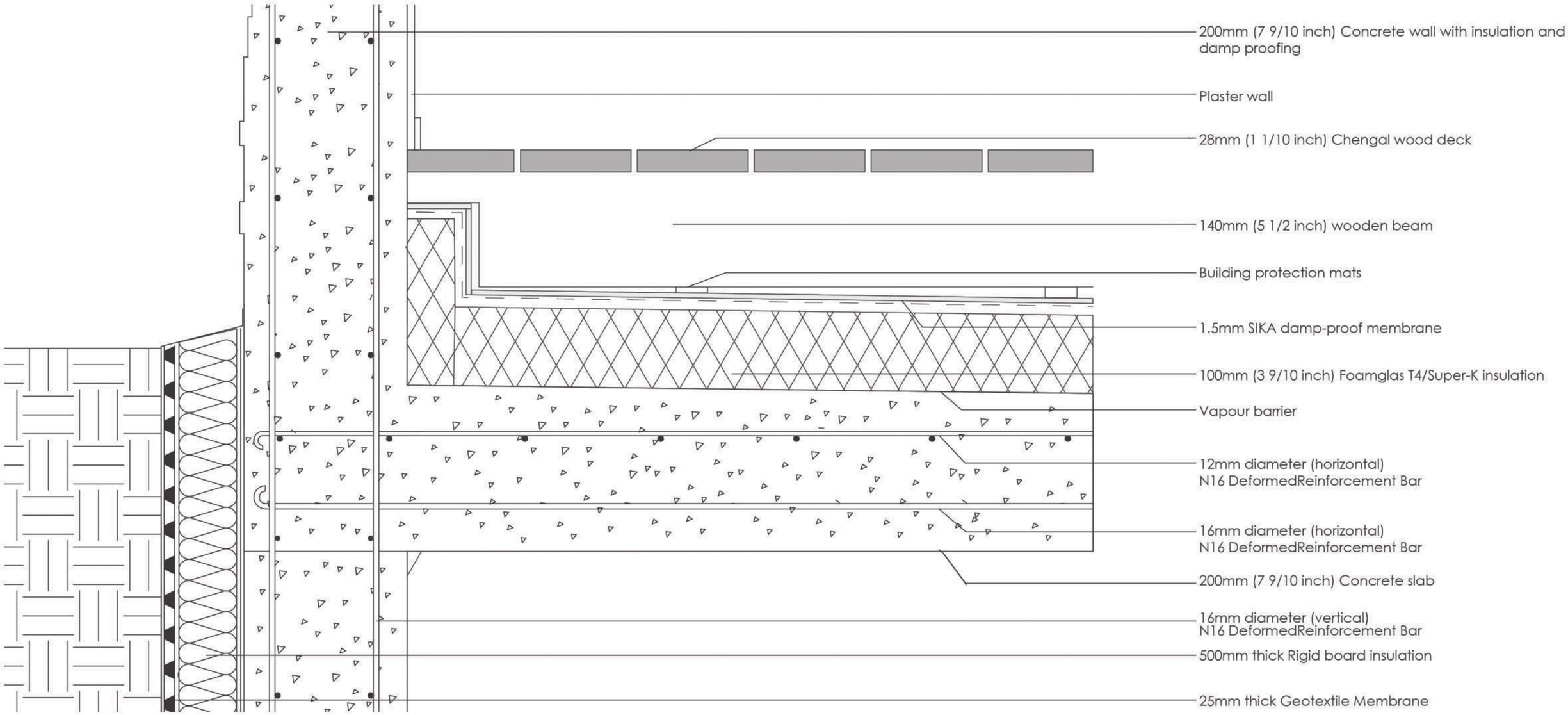
- provide the users ease and a better sensation while exploring around the ground floor level.
- A stronger relationship in terms of the man-made building and the surrounding nature context.

| ADVANTAGES |

- The Chengal wooden deck is soft under feet and also produces a thin crisp sound when making steps, giving the users a building friendly experience.

- The color of wood material harmonizes wih the surrounding mangrove environment, emphasize on contextual relationship.

- It is eco-friendly when renewable or recycled timber is being used.



WALL TO FLOOR SECTION DETAIL SCALE 1 : 5

3.3.2 MATERIAL SPECIFICATION

SIKA BLACKSEAL-1500 MY/-2000 MY

| Description |

Sika Blackseal-1500 MY/-2000 MY is a self-adhesive polymer modified bituminous sheet membrane reinforced with a tough high density polyethylene film. The under side is protected by a release film.

| USE |

Sika Blackseal-1500 MY/-2000 MY can be used as a waterproofing membrane on:
- Flat or pictched roofs
- Foundations and basements
- Retaining walls
- Terraces and balconies

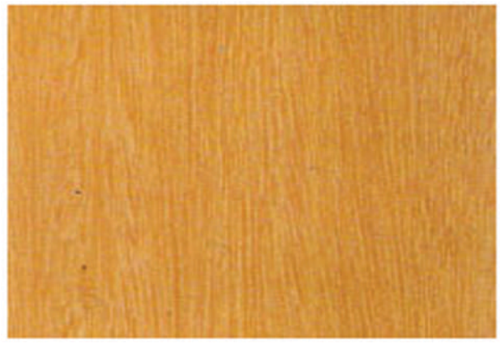
| CHARACTERISTICS AND ADVANTAGES |
- Cold applied
- Self-adhesive, easy to apply
- Excellent adhesion to vertical and horizontal surfaces
- Good chemical resistance
- Excellent stability when exposed to stresses such as movement and temperature extremes

| SPECIFICATIONS & SIZES |

1 x 15 m rolls

SUPPLIER

Sika Kimia Sdn. Bhd.
Sales Office - Central
No. 9, Jalan Timur
46000 Petaling Jaya, Selangor DE
Telephone: (03) 7957 0111
Fax: (03) 7956 7291



Chengal Timber Flooring

| Description |

It is among the most popular hardwoods found in Peninsular Malaysia. This species is the one of the most highly valued timber in the country.
Its finer uniqueness includes the well-defined sapwood, intertwined grain and fine texture with natural pin holes. When freshly sawn, its heartwood is light yellow-brown with a distinct greenish tinge. It darkens to dark purple-brown or rust red when exposed.

| CHARACTERISTICS AND ADVANTAGES |
- mature Chengal wood has a very long lifespan under outdoor conditions
- resistance against termites

| COLOUR |

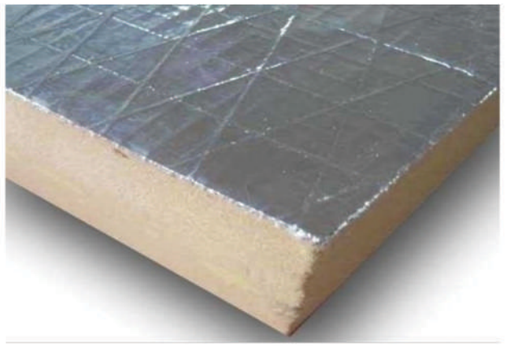
Heartwood is light yellow-brown with a distinct greenish tinge and darkens on exposure to dark Purple- brown or rust red.

| SPECIFICATIONS & SIZES |

On enquiry

| SUPPLIER |

Malaysia Wood Flooring
No B-03-21, Empire SOHO
Empire Subang, Jalan SS16/1
47500 Subang Jaya
Kuala Lumpur
Call : +6011 1188 1609
Email : malaysiawoodflooring@gmail.com



FOAMGLAS-T4/Super K (rigid slab)

| Description |

FOAMGLAS-T4/Super K insulation is a lightweight, rigid material composed of millions of completely sealed glass cells. Each cell is an insulating entity.

| CHARACTERISTICS AND ADVANTAGES |
- Low Thermal Conductivity (-0.038 W/mk @ 0°C) (-0.040 W/mk @ 10°C)
- Constant Insulating Efficiency
- Excellent Moisture & Corrosion Resistance
- Long-Term Dimensional Stability
- Vermin Resistance
- Non-Combustible
- Superior Accoustical Properties

| SPECIFICATIONS & SIZES |

thickness: 25-125mm
width: 450mm
length: 610mm

| SUPPLIER |

FOSTER THERMAL ENGINEERING (M) SDN. BHD.
FOSTER INSULATION SDN. BHD.
Lot 32, Jalan Delima 1/3, Subang Hi-Tech Industrial Park,
40000 Shah Alam, Selangor Darul Ehsan, Malaysia.
Telephone: 03-56353958 (Hunting Line) Gen
Fax: 03-56353952, Mkt Fax: 03-56314149

3.3.3 COMPARISON & ANALYSIS

| EXISTING SYSTEM : CONCRETE SYSTEM |

-Strong contrast with the surrounding context
-Harder surface to walk on
-Dull color
-Stale/ raw environment atmosphere

| MODIFIED SYSTEM : TIMBER DECKING CONCRETE FLOOR SYSTEM |

-Provide more sense of liveliness environment
-Provide soft walking floor
-User friendly
-Weather and pest resistant if given extra treatment
-Decrease hit impact compare to concrete
-Material response to site context
-Aesthetically pleasing

| SUITABILITY |

Both the existing and modified system utilize concrete as a major supporting material. The only difference is the addition of wooden decks layering on top of the concrete floor. With just this simple addition, the local timber material easily brightens the atmosphere of the building spaces, giving a vibrant and lively touch to people in terms of sensual experience.

The modified system also provides a softer walking area for the users, decreasing hit impact, hence promote safety. The colour and texture not only enhance the spatial qualities, but also binds and creates coherence with the surrounding forest context.

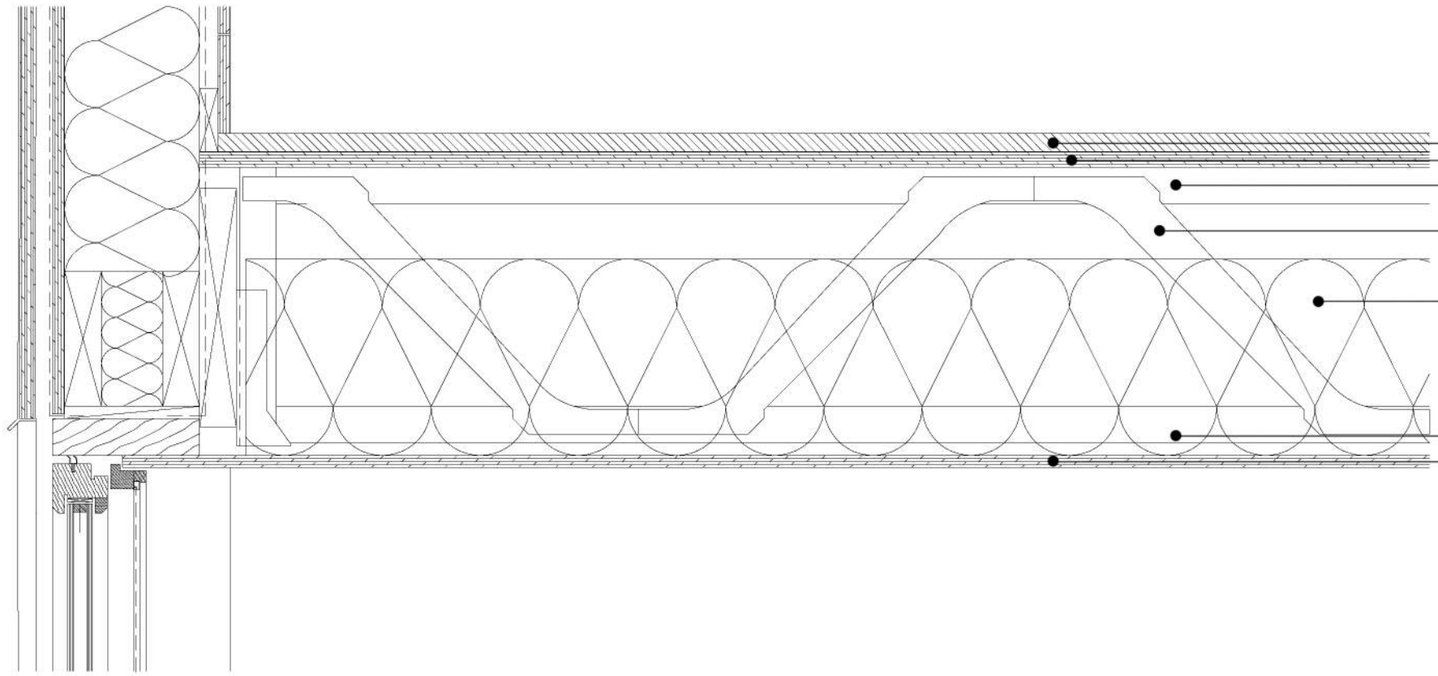
3.4.1 MAISON GOULET, QUEBEC, CANADA
SAIA BARBARESE TOPOUZANOV ARCHITECTS

| DESCRIPTION |

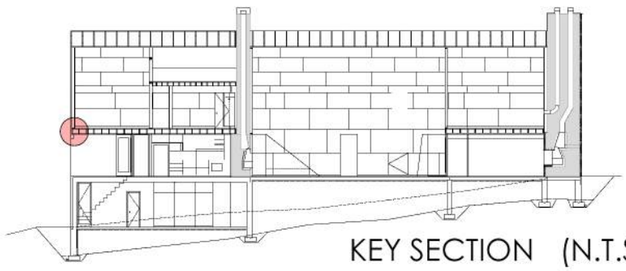
Located halfway down the slope on a relatively narrow natural rock shelf, the building is an archetypal house, four walls and a sloping roof, large chimneys, windows as cut-outs in the walls, the whole sitting on a flat plane. Tectonically, the house has a hard outer shell and a soft inner lining. The shell addresses the semi-wild landscape; the lining creates a warm interior generally associated with the traditional log cabin. In its interior, all walls, ceilings and window frames are clad in perfectly matched full-size sheets of semi-varnished Douglas fir plywood.

| METAL WEB SUSPENDED FLOOR SYSTEM |

The detail comprises of ceiling treatment of fir-faced plywood ceiling lining on furring channels. On top of a resilient composite deep batten system, 160mm acoustic insulation is placed between timber joists which fixed with metal webs. On these metal web joists a 19mm plywood flooring substrate is placed with a final deck of 18mm maple wood flooring board on top.



SUSPENDED FLOOR DETAIL 1 : 10



KEY SECTION (N.T.S)

3.5.1 POSI JOIST SYSTEM

| DESCRIPTION |

It combines the lightness of timber with the strength of the Posi-Strut™ steel web to form versatile open web system available to the modern building design.

| REASON TO MODIFY |

Timber floor gives an elegant aesthetic and high end look. It also offers warmth, natural look and beauty which fit into the site context of mangrove nature. Furthermore, the prefabrication of structure for quick site erection keeps the impact to natural surroundings to the minimum, serving the objective of a nature appreciation centre.

| ADVANTAGES |

SPAN TOLERANCE AND FLEXIBILITY

The ' Trimmable End' allows bearing location discrepancies to be remedied with simple on-site trimming which up to 600mm.No herring bone strutting is necessary on long spans. If the span exceeds 4m, a strong-back is installed at mid-span.

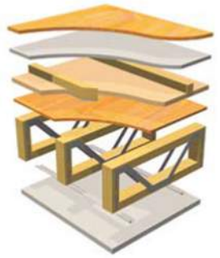
ECONOMY

The unique open web design provide an area which makes installation of service and utilities far simpler and quicker, reducing both labour costs and build-up time on site. The elimination of the need for load-bearing intermediate walls has also dramatically cut overall building costs.

RESISTANCE TO FIRE

It has 90 Minutes fire resistant with 2 layers of 15mm Lafarge Fire check plasterboard suspended on galvanised resilient bars fixed to the underside of the Posi-Joists™ 18mm Oriented Strand Board (OSB) sub deck.

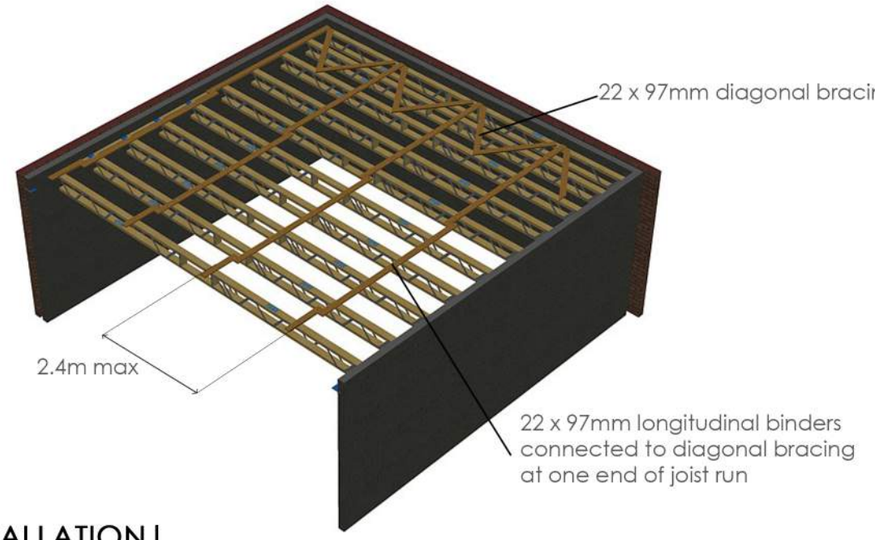
SOUND RESISTANCE IN SEPARATING FLOORS



The detail comprises of ceiling treatment CT2 made up of two layers of 15mm (nominal 12.5 kg/m²) fireline plasterboard fixed with 25mm and 42mm screws to resilient bars at 400mm centres. On top of an 18mm T&G Sub deck, a resilient composite deep batten system with a minimum depth of 70mm is placed with 25mm (10-33kg/m²) insulation placed between the battens. On these battens a 19mm Gypsum based board (nominal 13.5kg/m²) is placed with a final deck of 18mm (min) T&G flooring board on top.

FLOOR PERFORMANCE

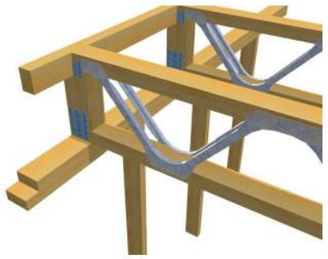
Exceptional floor performance from a minimum 72mm wide fixing surface makes flooring easy, controls shrinkage, and reduces return visits and remedial work during construction.



| SITE INSTALLATION |

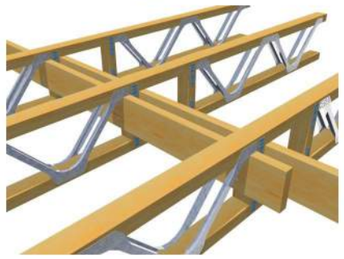
Diagram above indicates temporary erection bracing which comprises diagonal bracing, longitudinal binders and permanent strong-backs. The bracing may be progressively removed as decking is fixed.

Posi-Joists should be erected straight and vertical. The maximum deviation from horizontal should not exceed 10mm and the maximum deviation from vertical should not exceed 2mm.



BOTTOM CHORD FIXING TO TIMBER FRAME

It can be done with continuous top chord restraint or top chord restraint nogginsfixed over ribbon block.



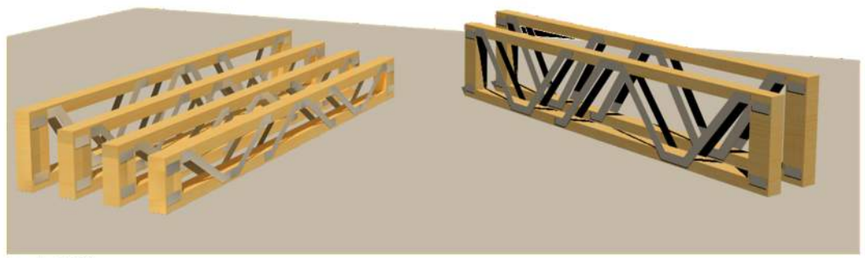
STRONGBACK BRACING DETAIL

Strongback has to be inserted before fixing joists. The deeper the strongback, the stiffer the floor.

INTERNAL BEARING DETAIL

Bottom chord to be notched over steel bearer plate without interfering with connector plate.

3.5.2 MATERIAL SPECIFICATION



Posi-Joist™

| DESCRIPTION |

Posi-Joist™ is a tested product with a European Technical Approval ETA-07/0161. Fire tests of 30, 60 and 90 minutes have been success-fully passed. Acoustic tests for impact and airborne sound transfer have also been successfully passed.

| SIZES & SPECIFICATIONS |

Available in six standard depths

-202mm	-304mm
-225mm	-373mm
-253mm	-421mm

| SUPPLIER |

Prestar Resource Berhad (123066-A)
Lot 1298 Rawang Industrial Estate
16 ½ Miles, Jalan Ipoh,
48000 Rawang,
Selangor Darul Ehsan,Malaysia.

Telephone: 03-6092 5200
Fax: 03-6092 5203 / 5204
Email: info@prestar.com.my

3.5.3 COMPARISON & ANALYSIS

| EXISTING SYSTEM : CAST-IN-SITU REINFORCED CONCRETE SUSPEDED FLOOR SYSTEM |

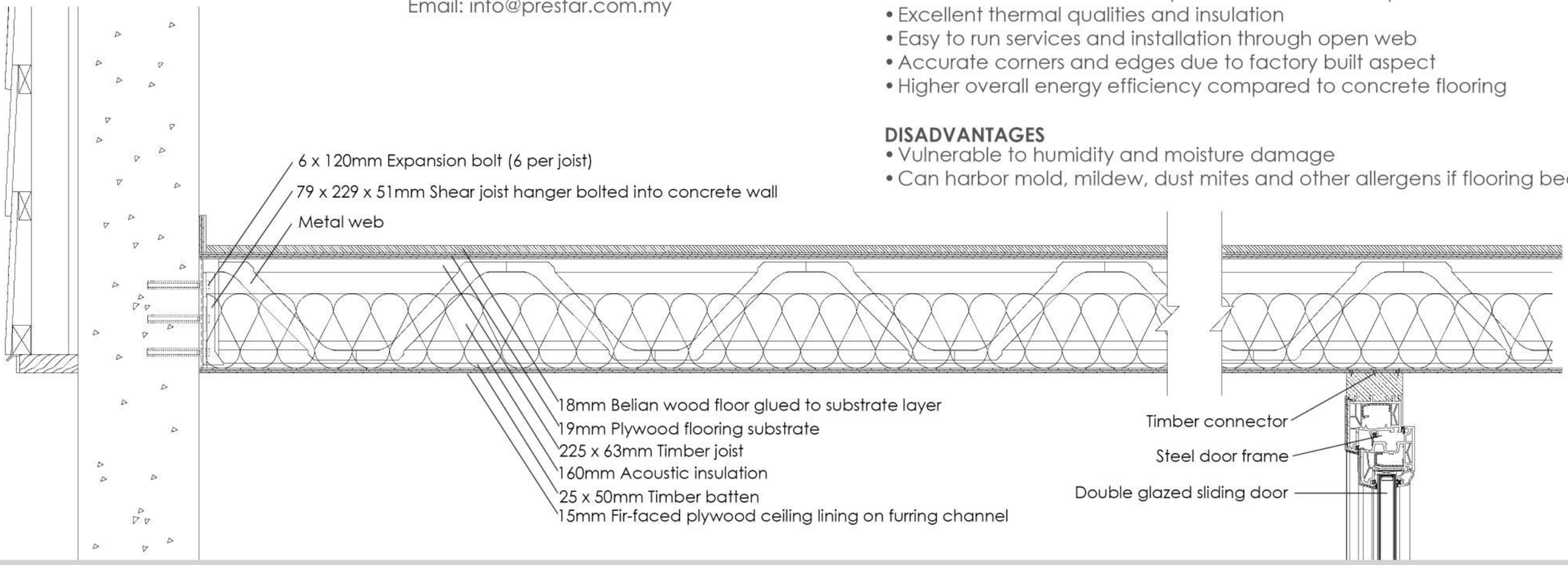
ADVANTAGES
- Available for a wide spectrum of design options
- Excellent longevity and performance
- Easy for maintenance
- Extremely tough and resilient and able to withstand the pressure from very heavy equipment
- Alterations can easily be made

DISADVANTAGES
- Difficult to achieve a good level of thermal insulation and could act as thermal mass to store solar energy
- Highly likely to encounter large settlement and shrinkage cracks
- Long build process due to dependency on weather conditions
- Slow to dry out during construction

| MODIFIED SYSTEM : METAL WEB TIMBER JOIST SUSPENDED FLOOR SYSTEM |

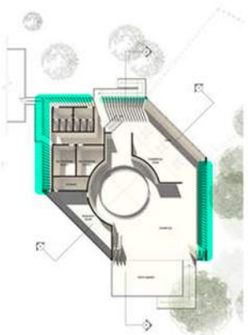
ADVANTAGES
- Prefabricated structure allows quick on site erection
- Less time lost in construction process due to non-dependance on weather
- Excellent thermal qualities and insulation
- Easy to run services and installation through open web
- Accurate corners and edges due to factory built aspect
- Higher overall energy efficiency compared to concrete flooring

DISADVANTAGES
- Vulnerable to humidity and moisture damage
- Can harbor mold, mildew, dust mites and other allergens if flooring becomes wet

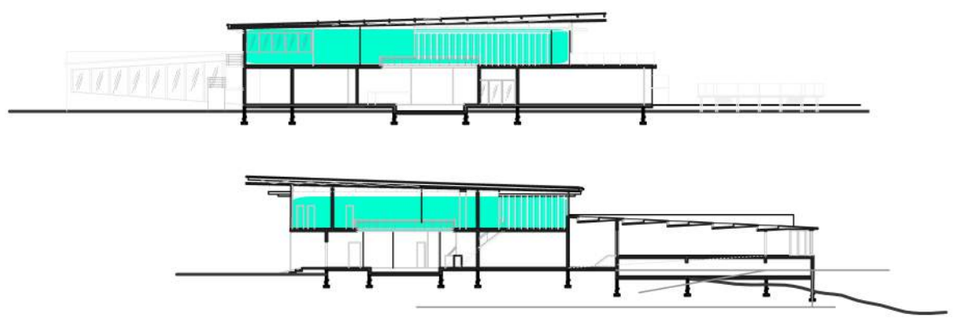


4.0 WALL SYSTEM
4.1 EXISTING WALL SYSTEM

KEY ELEVATION (N.T.S)

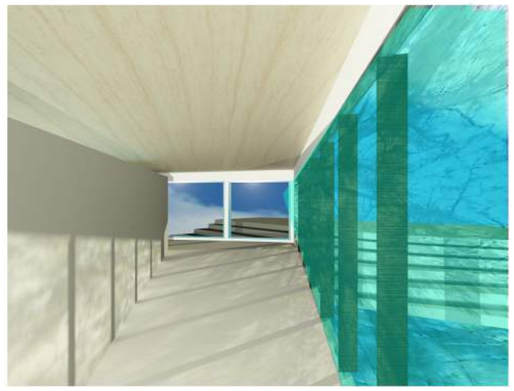


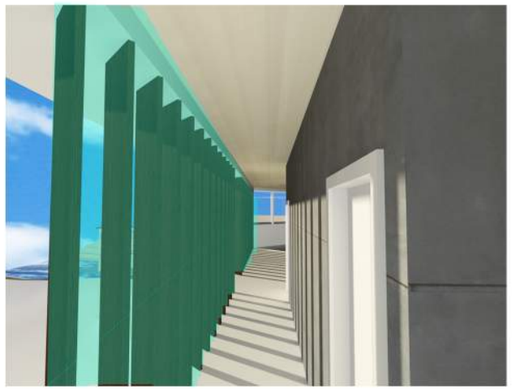
KEY PLAN [FIRST FLOOR PLAN] 1:1000



KEY SECTIONS 1:1000

PROPOSED CHANGING PARTS





INTERIOR RENDERINGS

4.1.1 TIMBER BATTENS SCREENING SYSTEM

| DESCRIPTION |

The timber battens screen facade is a non-load bearing structure comprised by vertical timber strips. It offers an alternative to conventional facade design providing a softened timber look to internal and external wall surfaces and soffits which can decorate the buildings wall to improve the look and protect buildings and their occupants from the harsh sun. Both ends of the structure are connected to concrete floor and concrete roof. It spans along the corridor, facing the exterior in a slightly slanted manner to filters the sunlight. Besides that, It promotes natural ventilation and increased the building's thermal comfort level. Moreover, it can provide certain level of privacy depend the spacing and sequences of the structure.

| ADVANTAGES |

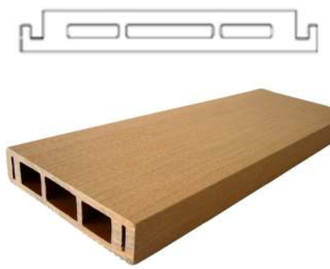
-Provide shading, enhance thermal comfort
-Large range of patterns and motifs, versatile
-Provide certain level of privacy
-Economy choice as it is cost effective
-Aesthetic, provide modern and classic look
-Allows ventilation

| DISADVANTAGES |

-Do not provide fully enclosure in certain private area
-Poor weather resistant

| MATERIAL INFORMATION |

Composite lumber is a material that is a mixture of wood fiber, plastic, and some type of binding agent. These ingredients are put together to form a material that is denser, stronger, and heavier than wood alone. (Wikipedia,2014) Although it is costly, it requires low maintenance and is durable, making it an economical choice for long run.



Dimension: 232mm x 25mm

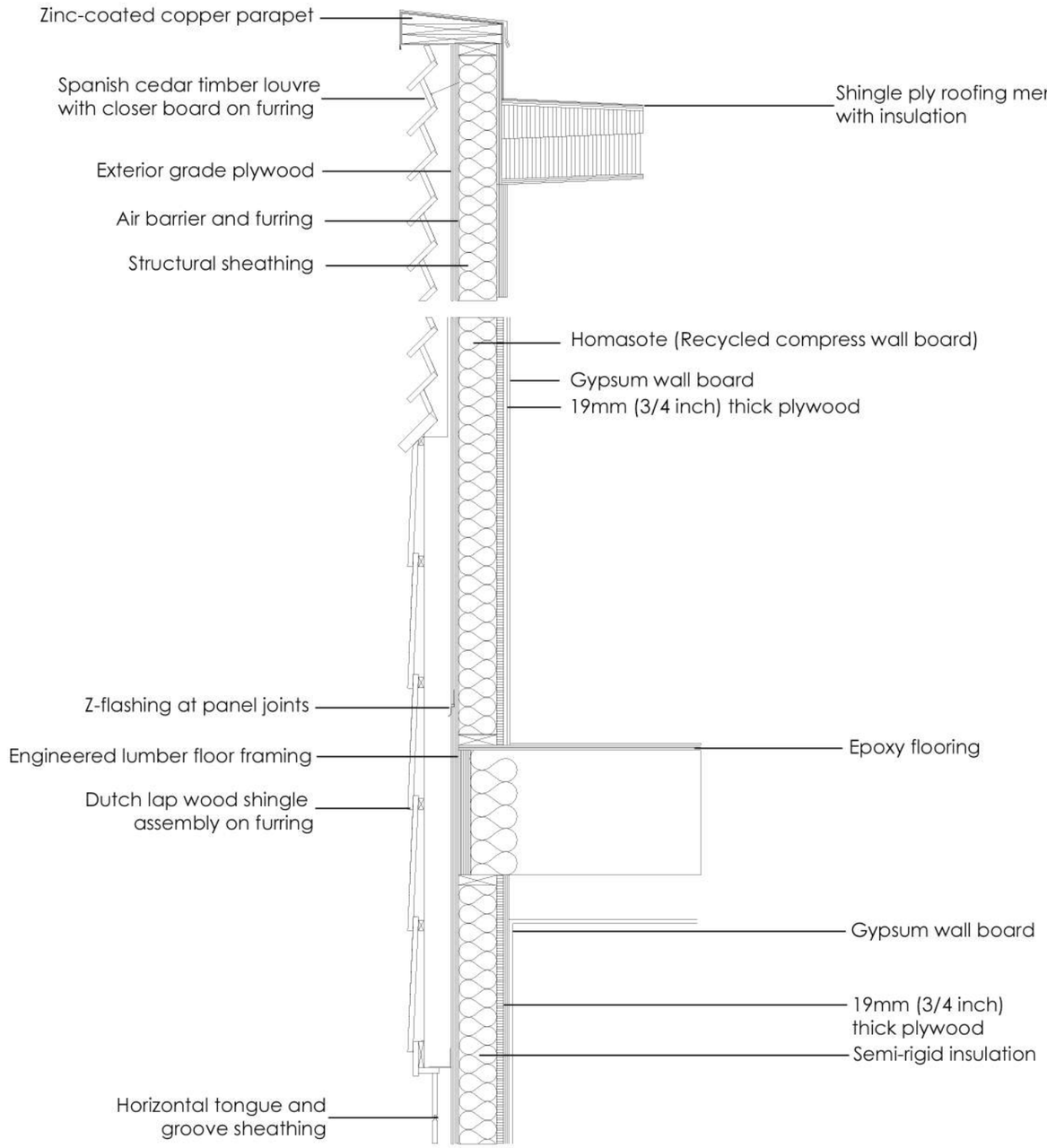
4.2.1 PROVINCETOWN ART ASSOCIATION AND MUSEUM
PROVINCE TOWN,MASSACHUSETTS,USA
MACHADO AND SILVETTI ASSOCIATES

| DESCRIPTION |

The building utilize a thermally efficient building skin with added insulation and high-performance windows.It is a timber-framed building over a concrete basement. The old portion of museum is clad with white cedar shingles, and the new portion with custom Spanish cedar shingles and louvres. (McLeod, V. ,2010).

| TIMBER SOLAR SHADING LOUVER & SHINGLE RAINSCREEN WALL SYSTEM |

19mm (3/4 inch) thick plywood wall system with Spanish cedar louvers and Dutch lap wood shingles assembly on furring. The louvres which serve as solar shading device filter the sunlight and reduced the heat gain of the building. It also promotes natural ventilation and consequently enhanced thermal comfort of the building. The shingle cladding forms a rainscreen facilitate the flowing of rainwater. It also showcase traditional characteristic and has its aesthetic value.



DETAIL WALL SECTION SCALE 1:10

4.3.1 TIMBER SOLAR SHADING LOUVRE SYSTEM

| DESCRIPTION |

Timber solar shading and timber louver products are usually supplied from kiln dried wood without surface treatment in terms of staining or varnish finishes. Timber louvre blade profiles can be fixed between wooden, aluminium or stainless steel endplate rafters via stainless steel 'floating' pin connectors and screw fastenings. The solar shading blades and rafter profiles are supplied as single piece constructions up to 285mm x 45mm.(Timber Louvres Systems from Solinear ,2014)

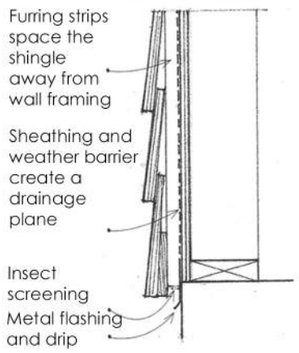
| REASON TO MODIFY |

-Maintain ventilation in an enclosed walkway
-Enhance interior thermal comfort by reduce building's heat gain

| ADVANTAGES |

-Energy efficient and sustainable design
-Provide higher level of privacy
-Aesthetic

4.3.2 RAINSCREEN WALL SYSTEM (TERRACOTTA CLADDING ON CONCRETE WALL)



| DESCRIPTION |

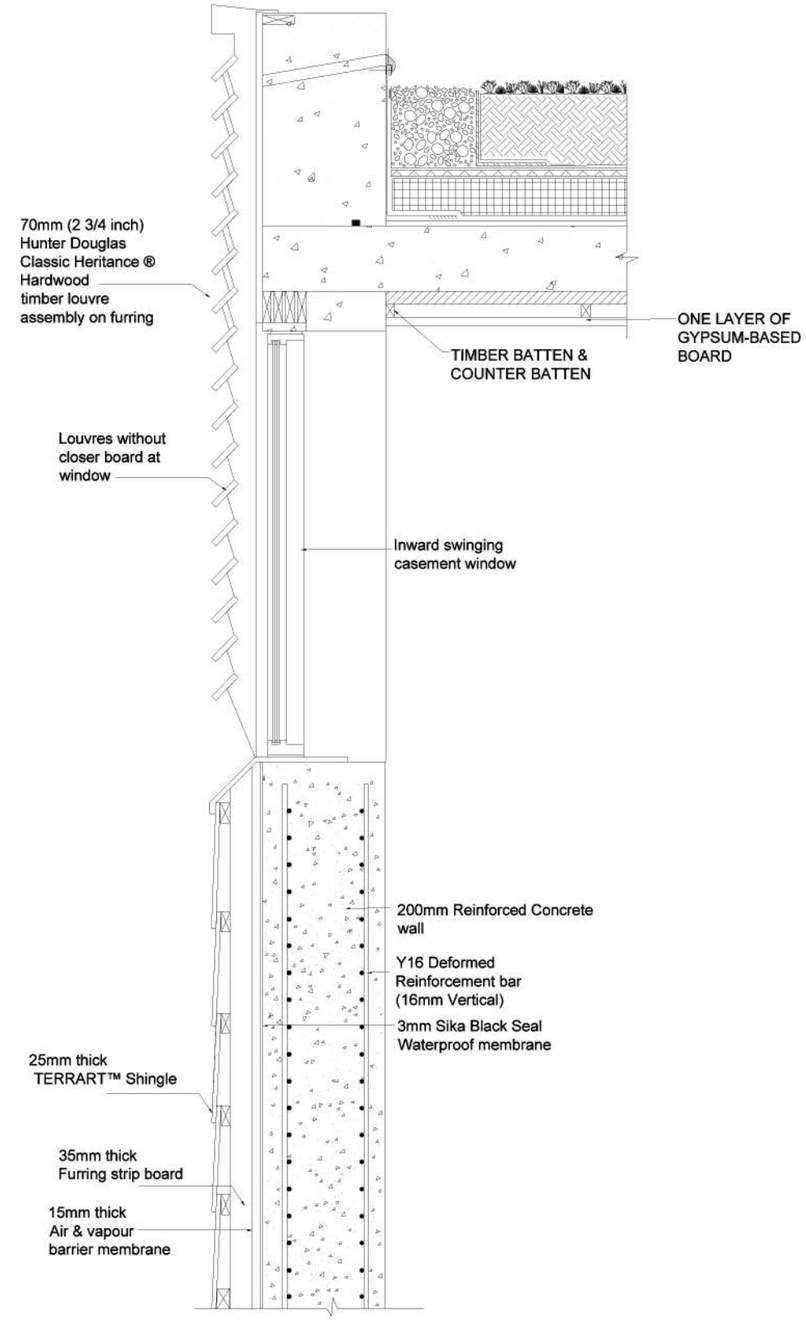
Rainscreen walls consists of an outer layer of cladding material, in this case terracotta shingle, and a drainage plane on a rigid, water-resistant, and air-tight support wall. The terracotta shingles deflect the kinetic force of rain and deters water penetration at the exterior face of wall. The concrete wall is airtight and rigid enough to withstand wind pressure. (Ching, F. , 2008)

| REASON TO MODIFY |

-To change into an enclosed walkway due to safety reason
-Shed rainwater effectively during rainy season
-To avoid slippery floor after rain
-Concrete floor is durable and have longer life span

| ADVANTAGES |

-Provide higher level of safety and privacy
-Reduce indoor humidity
-Aesthetic



WALL TO ROOF SECTION DETAIL SCALE 1:10

4.3.3 MATERIAL SPECIFICATION

Hunter Douglas Classic Heritance ® Hardwood Shutters

| DESCRIPTION |

Plantation-style shutters crafted from real wood and use dovetail construction for maximum strength and durability. Available in a large selection of stain and paint finishes.

| CHARACTERISTICS & ADVANTAGES |

-Horizontal orientation
-Soil & dust resistant
-Light & privacy control
-Solar heat contol
-Ultra violet protection
-Sound absorption
-Environmental friendly

| SIZES & SPECIFICATIONS |

-Widths:12"-312"
-Heights:12"-116"
-Louver size:2.5"-4.5"
-Various colours & specialty shapes available

| SUPPLIER |

Hunter Douglas (M) Sdn Bhd (6929-M)
Lot 493, Persiaran Kuala Selangor,
Section 26,40400 Shah Alam,
Selangor Darul Ehsan,
Malaysia
Telephone: (603) 5191 2020
Fax: (603) 5192 3900
Email: customercare@hunterdouglas.com.my

TERRART™ Shingle

| DESCRIPTION |

TERRART™-SHINGLE is a medium-format ceramic elements, which are arranged in such a way, that the horizontal joint is over-lapping. It is ideal for a scaled façade or a façade with a "clapboard" effect.

| CHARACTERISTICS & ADVANTAGES |

-Modern appearance
-Safety fittings
-Ease of installation
-Modular pieces
-Thermal insulation
-Impact resistant
-Effective in shedding rainwater

| SIZES & SPECIFICATIONS |

- Length: max. 6'-10" (1800 mm)
-Thickness: approx. 1"/1-½" (25/40mm)
-Finishes:Natural unglazed, Engobe finish, Sinterfire Engobe, Single-fired glazed and Double-fired

| SUPPLIER |

Hunter Douglas (M) Sdn Bhd (6929-M)
Lot 493, Persiaran Kuala Selangor,
Section 26,40400 Shah Alam,
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Telephone: (603) 5191 2020
Fax: (603) 5192 3900
Email: customercare@hunterdouglas.com.my

4.3.4 COMPARISON & ANALYSIS

| EXISTING SYSTEM : TIMBER BATTEN SCREENING SYSTEM |

-More open,more permeabilty
-Low privacy level
-Unprotected to weather : direct sunlight, heavy rainfall
-Limited insulation
-Increasing level of humidity in inteior spaces
-Require more cleaning/maintenance in interior spaces due to soil & dirt

| MODIFIED SYSTEM : TIMBER LOUVER SOLAR SHADING SYSTEM & TERRACOTTA CLADDING RAINSCREEN SYSTEM |

-Provide more sense of enclosure
-Provide privacy
-Provide insulation
-Weather resistant : direct sunlight, heavy rainfall
-More safe since it's enclosed walkway
-Soil & dirt resistant
-Enhanced thermal comfort
-Modern,aesthetic

| SUITABILITY |

Both the existing and modifies system utilize timber as major materials since it is versatile and blends into the context. Timber generally has a higher level of heat capacity relative to other construction materials and also uses less fossil fuel energy per unit during manufacture making it a greener product. Hence, it reduced the carbon footprint of the building.

The modified system has more sustainable green features which improve the building's thermal comfort. It also showcased a more intersting contemporary facade which created by locally available material

Besides that, the modified system is changing into enclosed space since it is located on 1st floor, a walkway with too many voids might make children fell off. Due to the existing system has many openings, the walkway's floor become slippery after rain and might cause injuries. Therefore, the modified system is to transform it into an enclosed space without minimize the ventilation effect.

5.1.1 CONCRETE FLAT ROOF SYSTEM

Waterponding on a flat roof is a prime cause of deterioration because variations in temperature between wet and dry areas of the roof can cause differential thermal movement. Together with the accumulation of acids left by evaporating rain, this would cause a breakdown on the roof surface. (Building and Construction Authority Singapore, n.d.)

| ADVANTAGES & DISADVANTAGES |

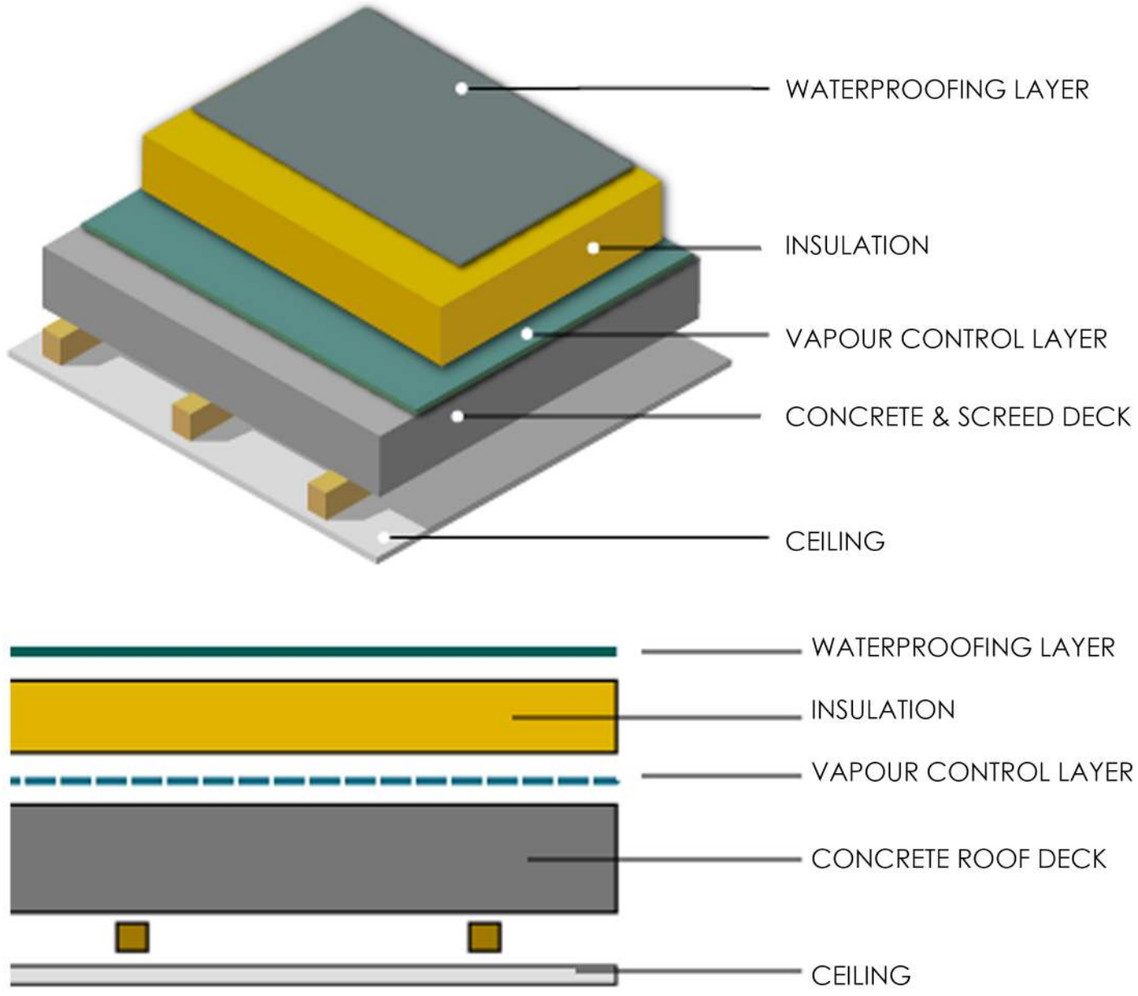
Advantages	Disadvantage
• Flat concrete roof stand up well when exposed to heavy winds. • Easy Cleaning: When cleaning a roof of stains, molds and algae, pressure washing is often the fastest and most effective method. • One of the most cost-effective methods of roofing alternative due to it allows the full height of the rooms below to be utilized well and it reduce the quantity of required material for roofing. • Provide a bigger area for collecting sunlight if solar panels are installed without considering the orientation of building.	• Collect debris and dirt: a roof that is flat, such as a flat concrete roof, is more likely to collect debris that will typically slide off a sloped roof. Required often cleaning process. • It stores a lot of heat under sun exposure, insulation is essential. • Conduct heat to the interior especially at night after long hours of absorbing the scorching sun during the day. • Rainwater accumulated during a rain storm can result in increasing live load to building structure, effective drainage system is needed to eliminate excess water.

| MATERIALS |

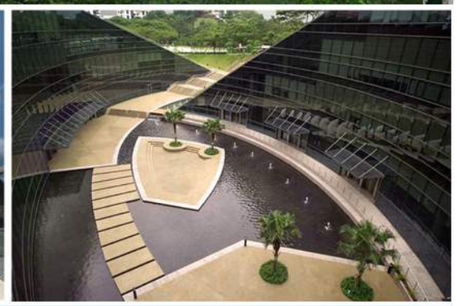
(A) Vapour control layer
-In warm roof construction, the VCL should always be located on the warm side of the insulation. The material specified should be a metal-foil laminated polyethylene or reinforced bitumen sheet. All penetrations of the VCL should be sealed, and the membrane turned up to all vertical surfaces by the thickness of the insulation.

(B) Insulation
-The correct choice of insulation is important when adhering the waterproofing, particularly where solvent-based adhesives are used.

(C) Roof membrane / covering
-EPDM or TPO membranes can be either loosely laid or fixed directly to the deck. These membranes can be quickly installed and are easy to repair – they can also be re-used, but only if they have not been mechanically fixed. (Greenspec, 2014)



3D ILLUSTRATIONS OF CONCRETE FLAT ROOF NTS



5.2.1 NTU SCHOOL OF ART, DESIGN & MEDIA SINGAPORE

| INTRODUCTION |

Formed by two sloping, tapering arcs that interlock with a third, smaller arc, the School of Art, Design, and Media is an elegant five-story, 215,000-square-foot structure housing more than two dozen studios and laboratories, two galleries, and as many lecture halls, alongside classrooms, a soundstage, a 450-seat auditorium, and motley other spaces spanning a library to prototyping rooms.

| MAIN FEATURES |

This fascinating building has many interesting twists; an unusual curved roof, a landscaped garden and a sleek curtain wall. These features imbue the building with exceptional appeal and transparency, adding richness and sensory depth to the architectural form (Alwitra GmbH & Co, 2013)

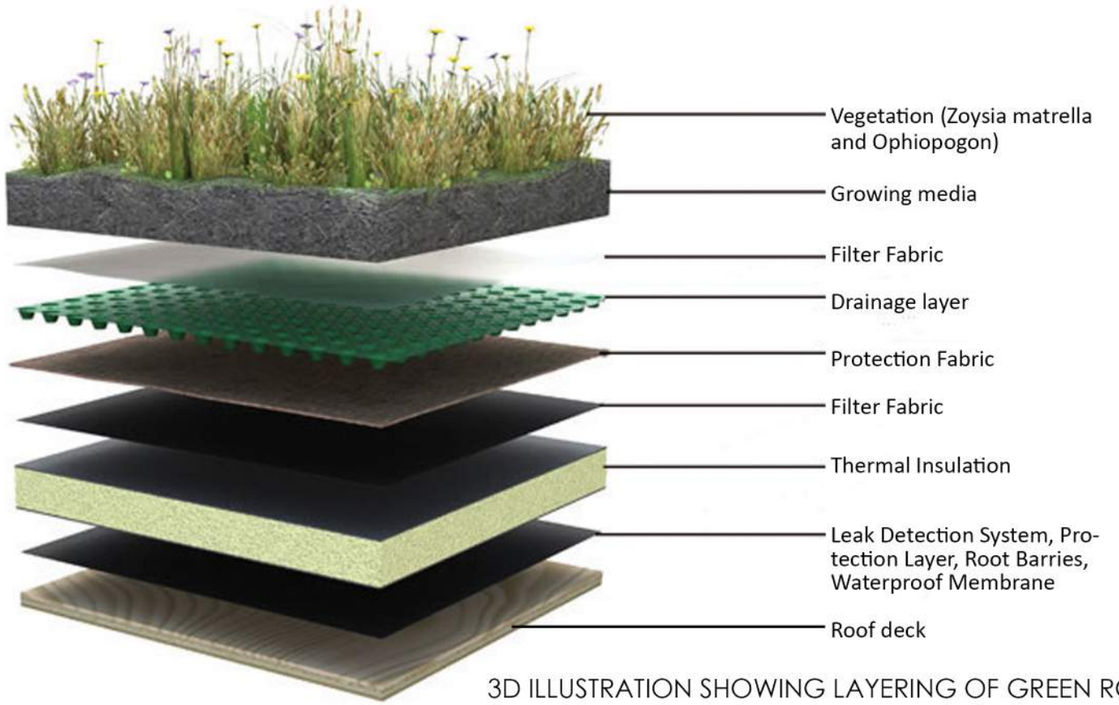
Following the roofs' arcing silhouettes, expansive curtain wall facades of high-performance, double-glazed glass not only maximize interior daylight while minimizing heat penetration. Longitudinally oriented east-west, the building has mostly north and south exposures, but they also contribute to a sense of openness, augmented by views to the surrounding natural landscape. The sunken, almond-shaped courtyard formed by the space in between the building's two main arms further expands access to daylight. Enlivened by fountains, cascading water, and a "floating" performance platform, its reflecting pond creates a pleasant communal area while helping to cool it as well. (Chen, 2009)

| GREEN ROOF SYSTEM |

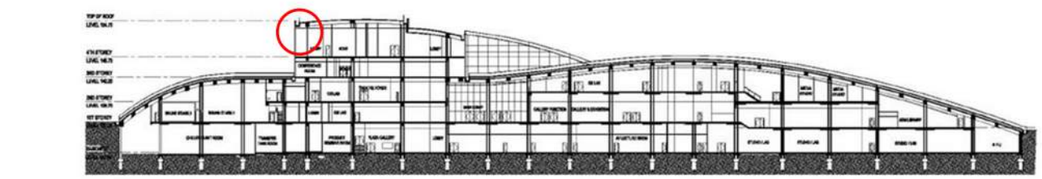
The most challenging aspect of the project was the construction of the roof, which is approximately 10,000 sqm. Conventionally, a green roof requires soil as a growing medium and the extent of its coverage would impose heavy loads on the building structure and foundations. On the onset, the architects have devised an unique greening system which allows the grass to grow and thrive on a thin layer of lightweight volcanic rocks, pumice and washed sand (for the grass to root). The entire composite section is barely 150 mm thick and incorporates a water absorption mat that constantly provides moisture to the roots. The turfgrass remains green and healthy year round via an automatic sprinkler system using harvested rainwater, thus reducing the need to frequently water the grass.

| WATERPROOFING MEMBRANE-alwitra's EVALON® |

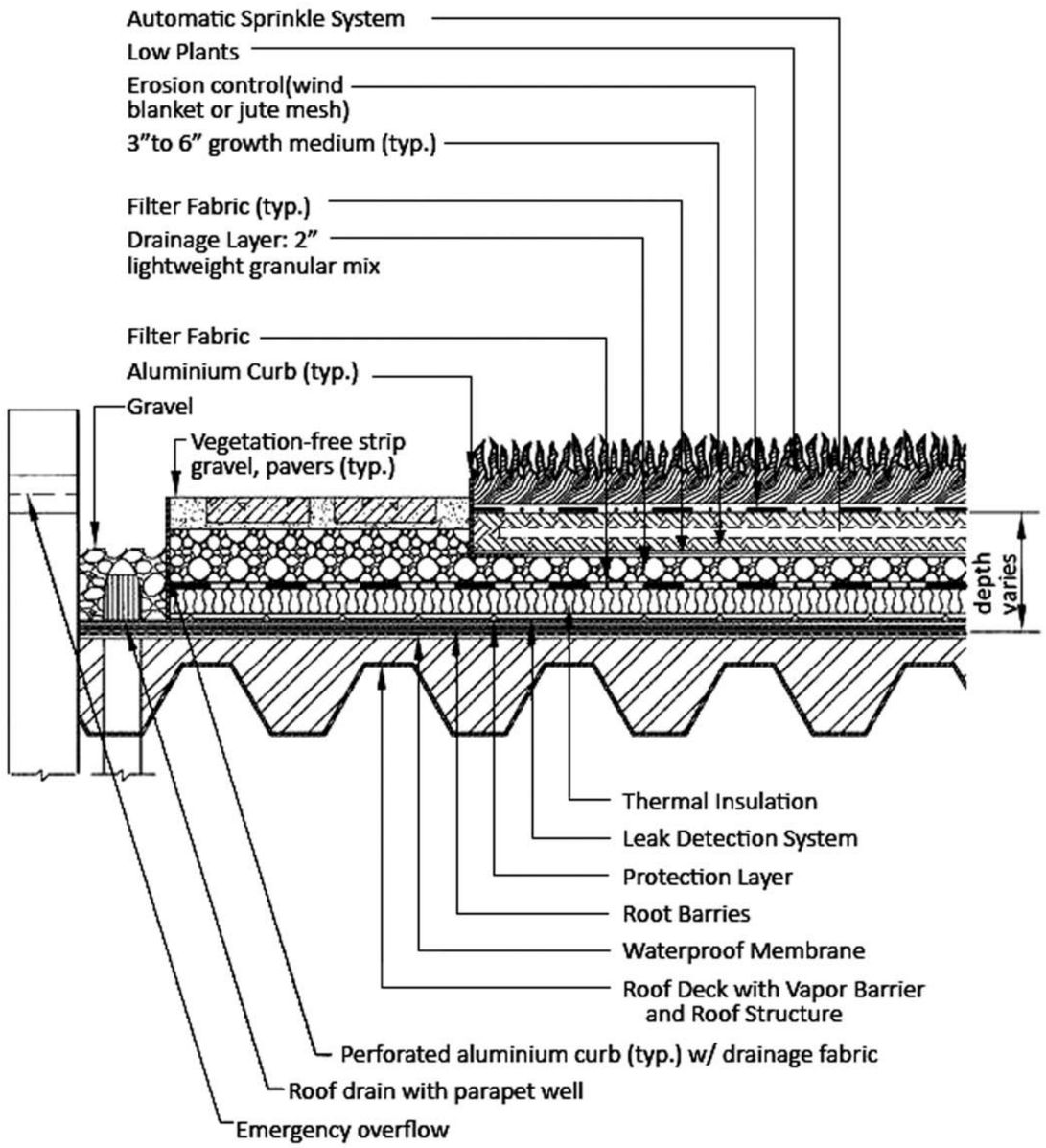
All these sit on top of a preformed single-ply waterproofing membrane to ensure watertightness to the roof. alwitra's EVALON® was chosen for its proven track record in tropical climate like Singapore's and in addition for its plant root resistance as tested to FLL standard.



3D ILLUSTRATION SHOWING LAYERING OF GREEN ROOF



SECTION A-A NTS



GREEN ROOF DETAIL SCALE 1:15

SITE PLAN NTS

5.3.1 SIKA EXTENSIVE GREEN ROOF WITH SINGLE PLY MEMBRANES

In so called 'Green Roofs' soil, or a suitable plant growing medium, is built up and planted with selected vegetation over the waterproofing membrane. Green roofs can therefore make a significant contribution and present practical solutions in the quest for sustainability, increased biodiversity and quality of life.

| ADVANTAGES & DISADVANTAGES |

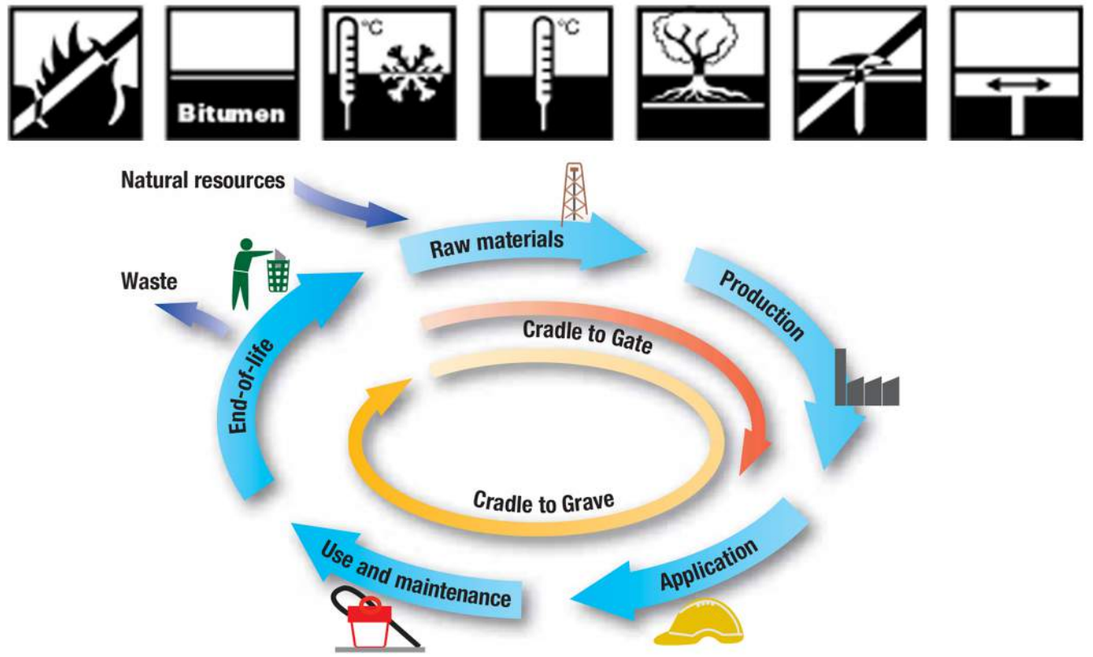
Advantages	Disadvantage
• Energy efficient: less energy for cooling or heating can lead to significant cost savings. • Serve as habitat: Low maintenance green roofs can be designed to serve as refuge for species such as ground-nesting birds. • Reduce material waste and durable. • Can be developed into social and recreational spaces. • It absorbs pollution and particles from air decreasing "heat island" effect. • Protects roof insulation material from UV radiation and reduces daily temperature fluctuations.	• Initial investment is usually higher than conventional roof systems. • Weight of the green roof increases the load on the building and should be carefully considered. • Green roofs should be regularly maintained, depending on type of green roof. • Care must be taken of any diseases that can easily spread and infect other plants. • Fire may be able to spread rapidly across areas of dry grasses and plants when they are dried.

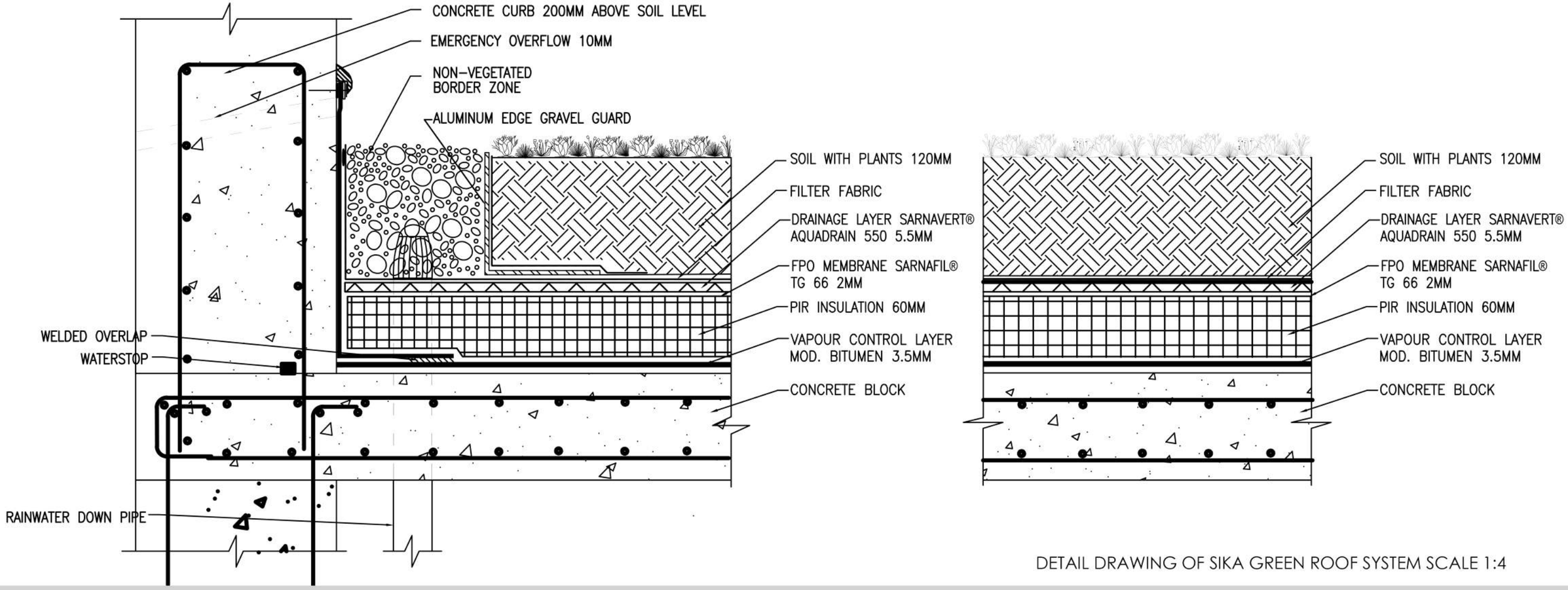
| SIKA SYSTEM |

However, Sika Extensive Green Roof with Single Ply Membrane Systemis able to combat the disadvantages brought by typical green roof system.

Advantages of Sika extensive green roof with single ply membrane system:
☒ Resistant against biological and microorganisms
☒ Fully resistant to root penetration
☒ Loose laying of the membranes provides fast waterproofing layer installation
☒ Soil with a minimum weight of 80 kg/m2 provides the necessary wind uplift resistance, eliminating the need for any additional mechanical fastening

The system provide many environmental and economic benefits including:
☒ Reducing heat-island effect in cities
☒ Protecting and prolonging the life of the waterproofing membrane
☒ Enhancing the aesthetics of the building
☒ Improved thermal performance of the building
☒ A natural environment on the roof with natural CO2 absorption





DETAIL DRAWING OF SIKA GREEN ROOF SYSTEM SCALE 1:4

5.3.2 MATERIAL SPECIFICATION

- Soil with plants
- Drainage layer Sarnavert® Aquadrian 550
- FPO membrane Sarnafil® TG 66
- PIR insulation 135mm
- Vapour control layer mod. bitumen 3.5mm
- Concrete deck

SUPPLIER:
Sika Services AG
Business Unit Contractors Industriestrasse 26
6060 Sarnen / Switzerland .
Phone +41 58 436 79 66
Fax +41 58 436 76 60
www.sika.com

Drainage Layers
Drainage is used in green roof build-ups for drainage and water retaining functions.
-Drainage layers *Sarnavert® Aquadrian 550*

PIR
Thermal insulation boards produced from rigid PU foam with an isocianurate catalyst. This is a very universal and efficient solution of all kinds of exposed roofs.
- *SarnaTherm® PIR*
- Very good fire resistance (more than 250degC)
- Extremely low thermal conductivity value of 0.023-0.028W/mK
- Lightweight of 30-40kg/m3

PE Vapor Control Layers
A wide range of PE foils with different densities and design to cater for all common applications
- *Sarvnavap® 3000M*
- High water vapour permeability resistance (sd value 250m)
- Compatible with PVC and FPO membrane systems
- Ideal for use on concrete substrates

5.3.3 COMPARISON & ANALYSIS

| EXISTING SYSTEM : CONCRETE FLAT ROOF SYSTEM |

- Easy construction
- Can efficiently cover a building of any horizontal dimension
- Required a lot of timber framework during construction
- Higher emmision of Carbon Dioxide compared to green roof
- Easily collect dirt and debris
- It stores a lot of heat under sun exposure, insulation is essential

| MODIFIED SYSTEM : SIKA GREEN ROOF SYSTEM |

Energy efficiency solutions
- low Cumulative Energy Demand (CED) of all of the roofing systems compared.

Resource efficiency solutions
- Use fewer resources than competitive technologies.

Climate protection solutions
- Low Global Warming Potential (GWP) of and low Carbon Footprint
- Excellent durability means replacing fewer times and as a result saving costs, energy and CO2

Air quality solutions
- provides roofing systems with a low POCP – notably Sika thermoplastic PVC and FPO mechanically fastened roofing systems as well as Sika thermoplastic PVC and FPO green roofing solutions.(Sika Services AG, 2012)

| SUITABILITY |

Being located in mangrove swamp context, concrete flat roof required more timber framework during construction which is not sustainability. Instead, the construction of green roof is sustainable from the sense of low energy and resource demand from the raw material and production phase. The Sika Green Roof System has a very low Global Warming Potential and low carbon footprint that respond to the global issue.

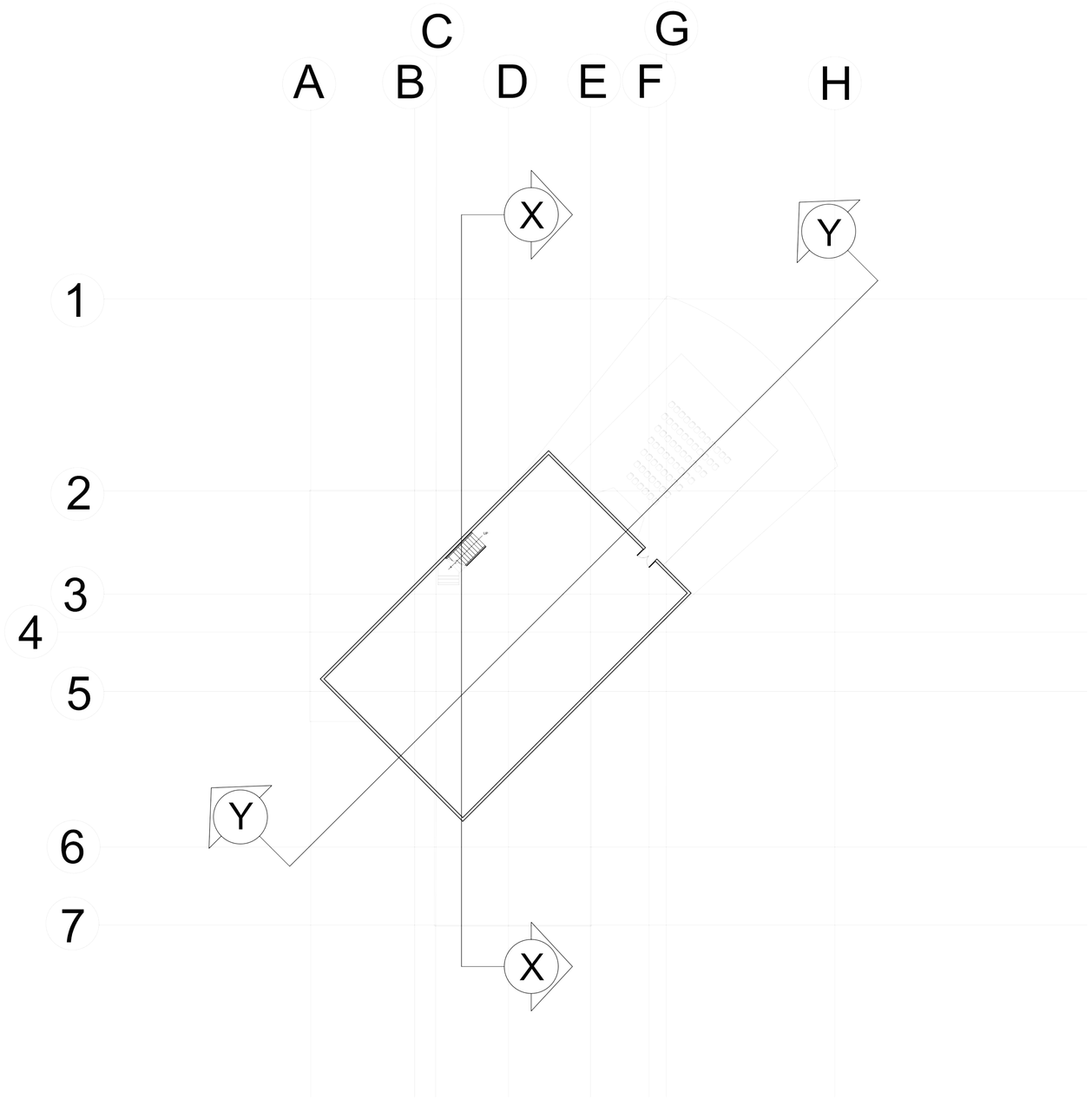
Green roof provides a habitat for creatures in the jungle of mangrove which helps to balance the biological system and opportunities for human being to get close to those animals in mangrove swamps that responds to the concept of the centre.

The growing of mold would be the latent problem in a few years after construction due to its humid context that would influence its aesthetic which is not the intention of the designer. However, green roof can combat this problem and aesthetically merged into the site context.

6.1 COMPARISON TABLE & CONCLUSION

	EXISTING SYSTEM	MODIFIED SYSTEM
GROUND FLOOR SYSTEM	CAST IN SITU REINFORCED CONCRETE SUSPENDED FLOOR SYSTEM -Tough and resilient, able to withstand heavy load -Require low maintenance -Durable and long life span -Versatile -Likely to encounter large settlement and shrinkage cracks -Difficulty in achieve good thermal insulation due to concrete floor act as thermal mass to store heat -Lengthened build process due to dependancy on weather conditions *Cast in situ reinforced concrete suspended floor system is durable. However, it took comparative long time to finish built. Moreover, deflections such as shrinkage and cracks might occur.*	METAL WEB TIMBER JOIST SUSPENDED FLOOR SYSTEM -Prefabricated structure allows quick erection progress -Easy to run services and installation through open web -Higher overall energy efficiency compared to concrete flooring -Likely to encounter moisture damage *Metal web timber joist system is comparative easier to build. Site context wise, timber structure is more suitable as it cause less damage to the land. As to complement the building's programme, timber texture blends in the context well. It is also a very sustainable material.*
FIRST FLOOR SYSTEM		WOOD DECKING ON CONCRETE FLOOR -Eco-friendly and renewable -Promote usage of recycle materials -Locally available materials, reduce transportation energy -Warm colour tone blends into surrounding context *Wood decking is a good choice of covering materials as it provide a better sensation for users' experiences. It also compatible with the building's concept which encourage sustainability and environment friendly.*
WALL SYSTEM	TIMBER BATTENS SCREENING SYSTEM -Economic choice -Allows comfort ventilation -Do not provide full enclosure -Poor weather resistant *Timber battens screen enhanced ventilation however it does not provide privacy. Moreover,it is unprotected to weather and caused rain water flows in, slippery floor might become an issue for users' safety.*	TIMBER LOUVRES SOLAR SHADING SYSTEM TERRACOTTA CLADDING RAINSCREEN SYSTEM -Provide more sense of enclosure and privacy -More insulated, enhanced thermal comfort -Weather resistant, effective in shedding rainwater and served as shading device *The systems provide an alternative solution for sun shading at the same time provide enclosure and also resist to tropical weather. The facade design is now showing more abundant varities, achieveing aesthetic and contemporary design by using traditional materials.*
ROOF SYSTEM	CONCRETE FLAT ROOF SYSTEM -Efficiently cover a building in horizontal dimension -Easier construction -Stores heat under long term sun exposure, require insulation -Easily collect dirt & debris *Concrete flat roof require more timber framework to construct hence it caused wastage of materials and not sustainable*	GREEN ROOF SYSTEM -Low cumulative energy demand compared to other systems -Provide climate protections -Environment friendly *Green roof system is energy efficient and sustainable. It suits the nature context well. Besides that, it provided habitat for mangrove creatures and promoted biodiversity in the area, encourage users interact with the nature. It also combats the problem of mold growing which affects building's aesthetic.*

An extensive study of various types of construction system was conducted by investigating the advanced technology and practice of the industry before proposing the more adaptable construction system to the Nature Appreciation Centre. To merge the building better into the forest setting, green roof and timber louvered are used instead of concrete roof and concrete wall. In this project, we were exposed to the types of construction through case studies of existing building. By completion of this project, we are able to analyse and document construction method and materials by evaluating the detailing of the project. We understand how the structural system effects the overall performance and sustainability of the building design. As a conclusion, solutions in terms of sustainability and reducing emission of VOC and CO2 shall be carefully considered during the design process to provide a better environment.



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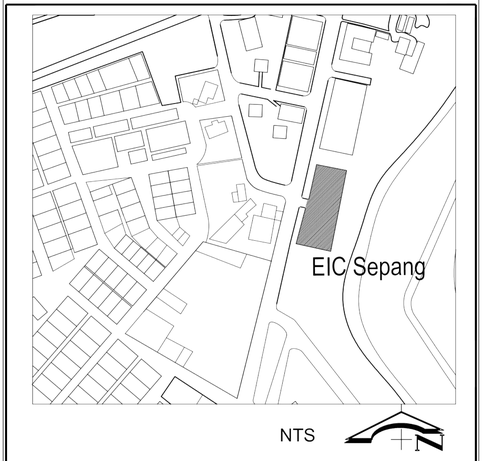

PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
BASEMENT PLAN

SCALE
1:200

SIZE
A1

DATE CREATED
3 OCT 2014

DRAWN BY

HOO ZHI XIN
LEE MIN
LIM YEE ZHING
LING GEE YOU
PUNG JIA CHYI
TANG HUI YING

TUTOR
MS CHERYL NGIAM

REMARKS

DRAWING NUMBER
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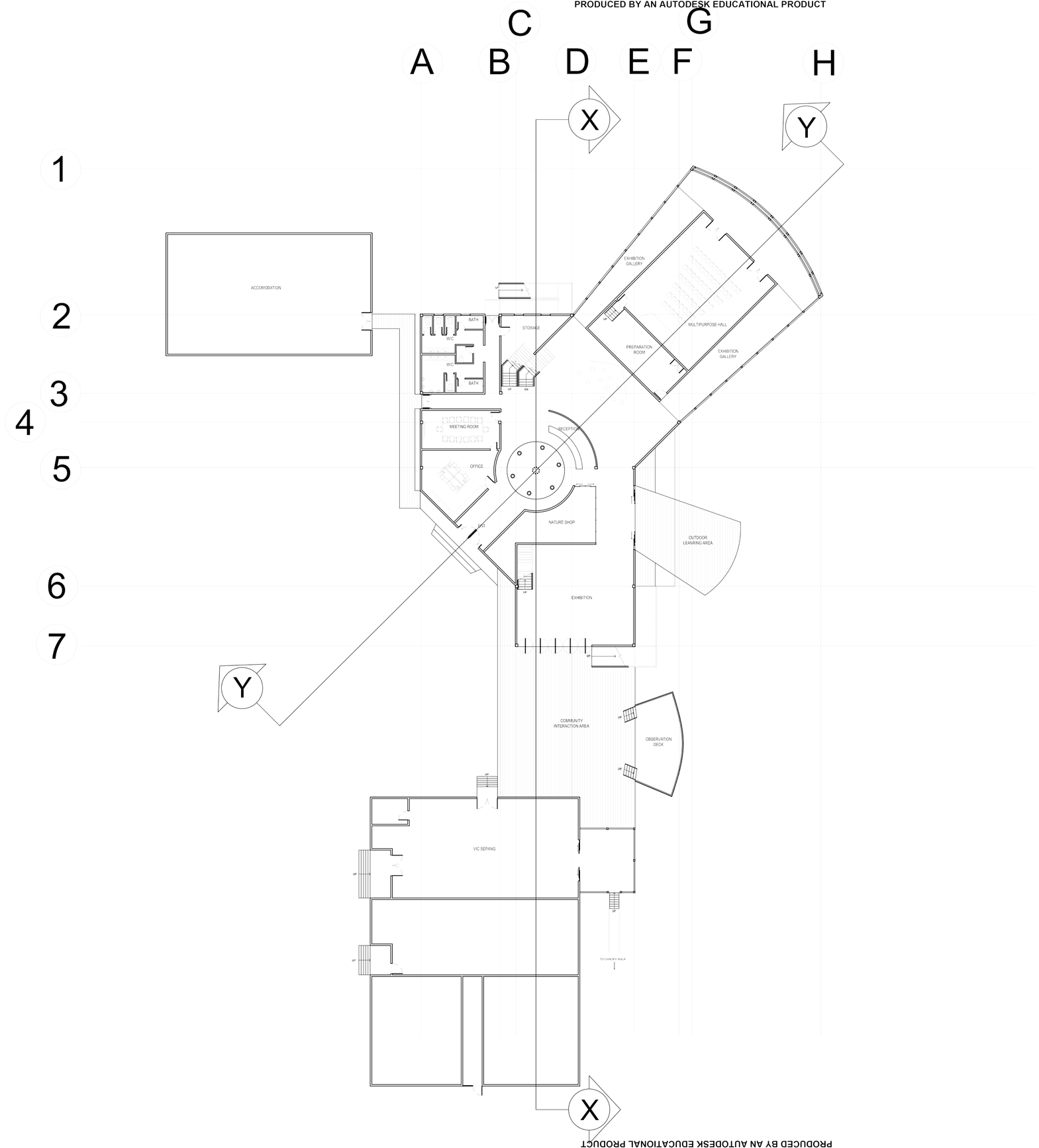

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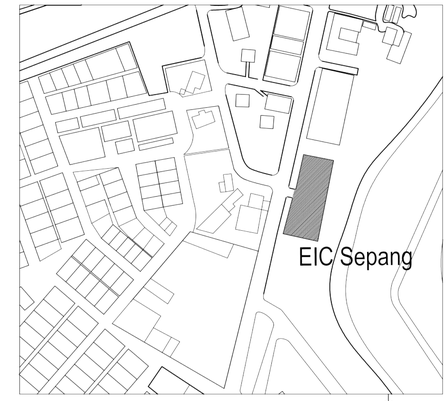

PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
GROUND FLOOR PLAN

SCALE
1:200

SIZE
A1

DATE CREATED
3 OCT 2014

DRAWN BY

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REMARKS

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2/16

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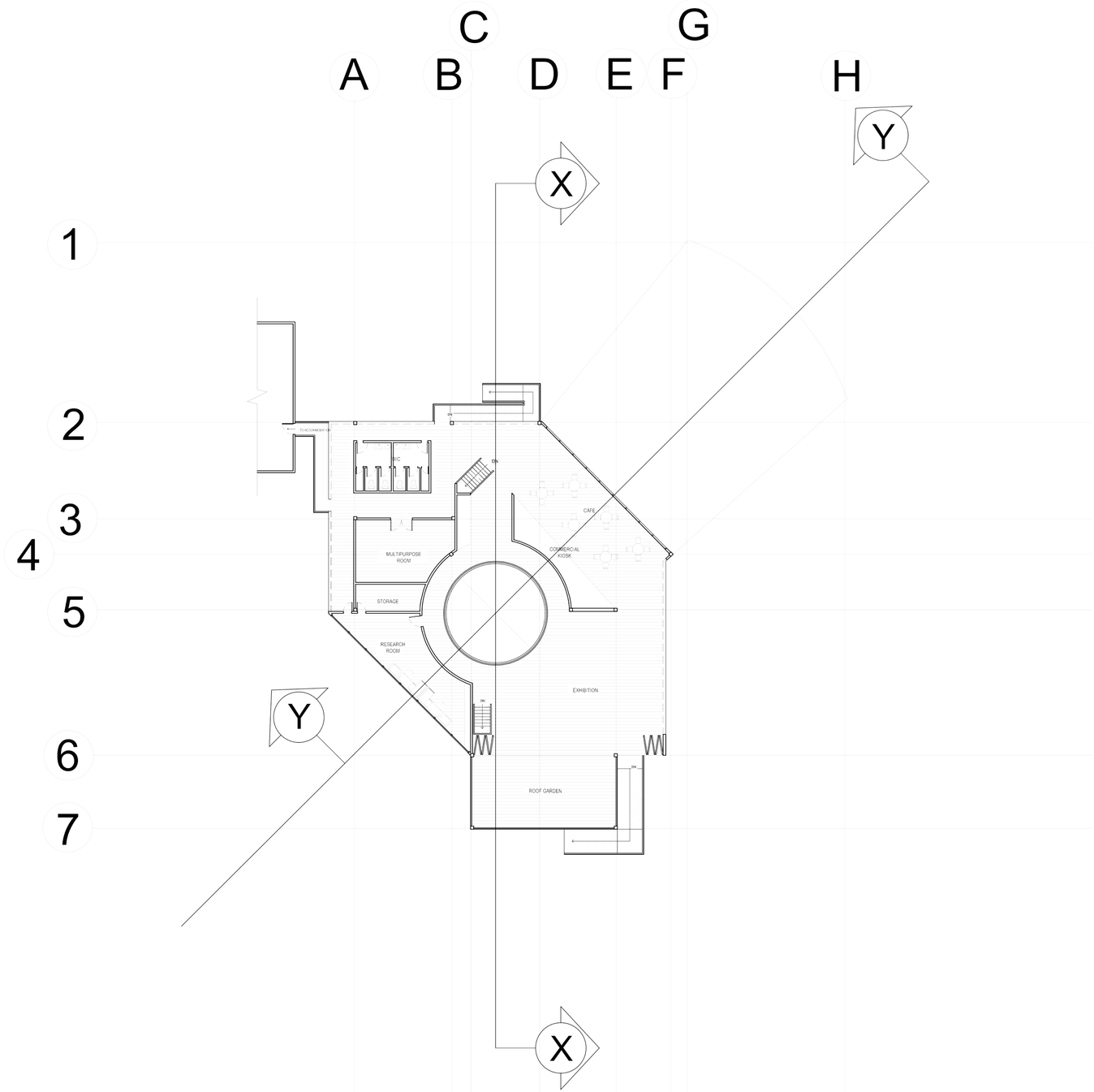

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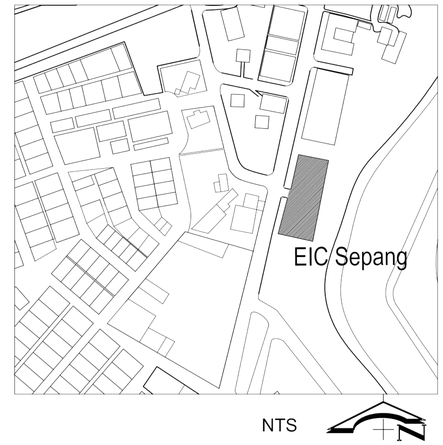

PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
FIRST FLOOR PLAN

SCALE
1:200

SIZE
A1

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3 OCT 2014

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REMARKS

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3/16

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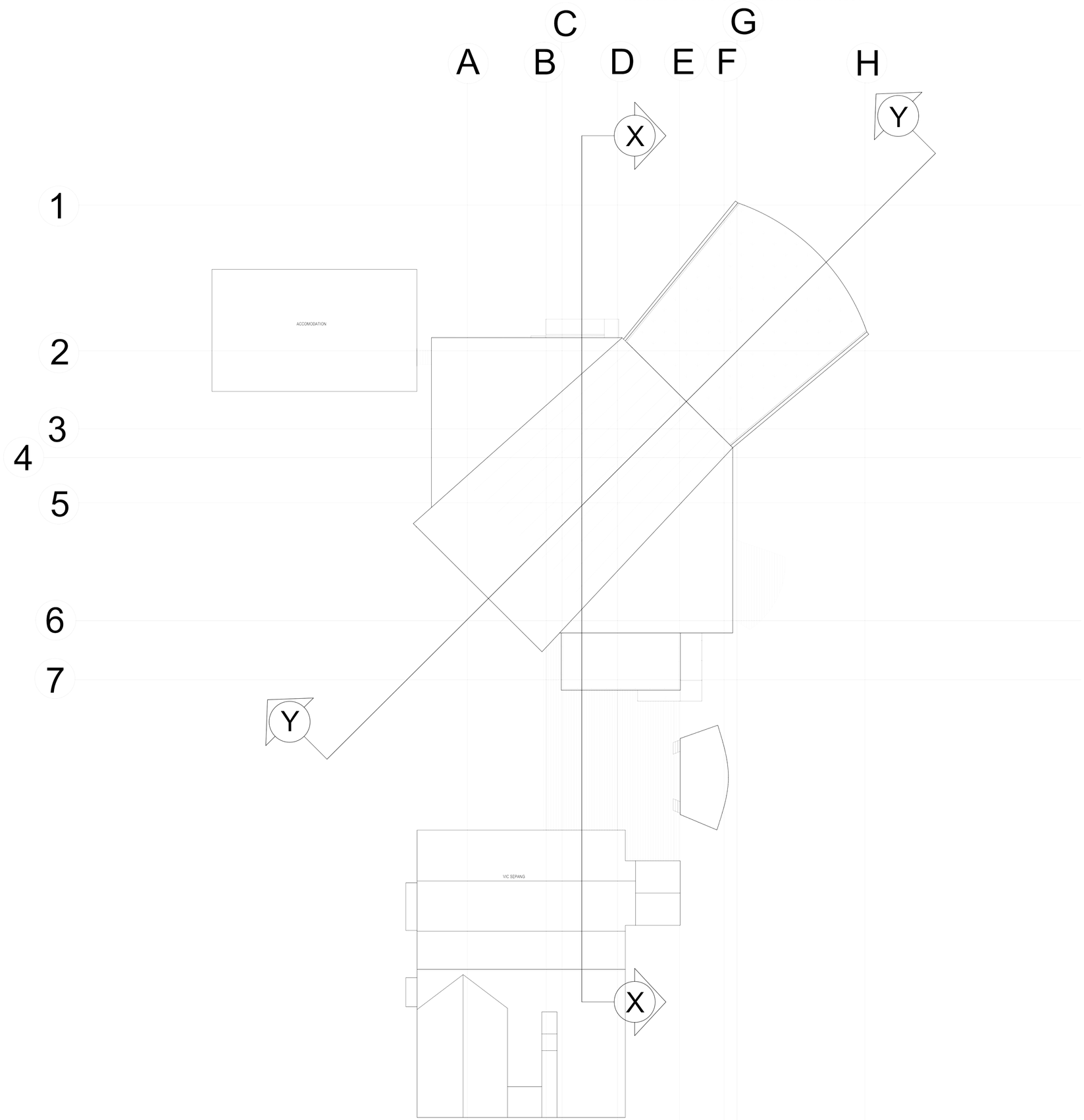

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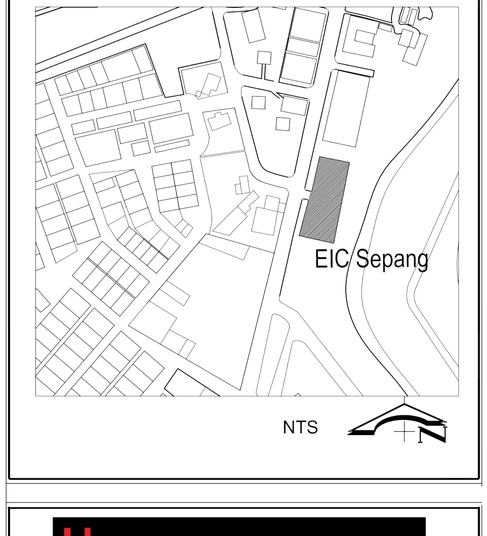

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PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
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ROOF PLAN

SCALE
1:200

SIZE
A1

DATE CREATED
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REMARKS

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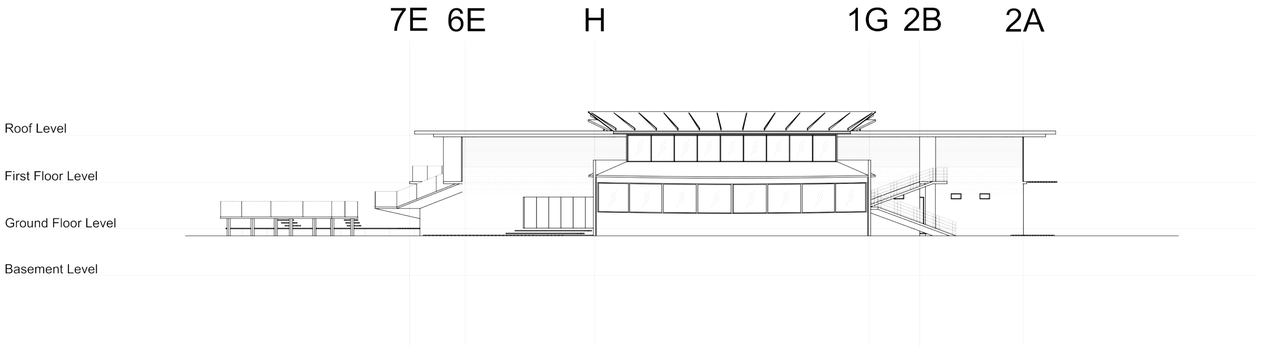

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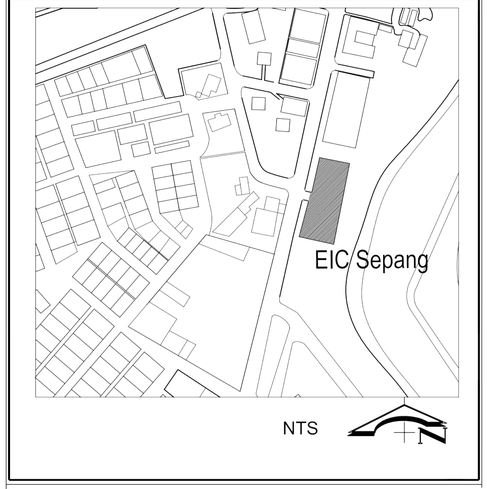

PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
NORTH EAST ELEVATION

SCALE
1:200

SIZE
A1

DATE CREATED
3 OCT 2014

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REMARKS

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5/16

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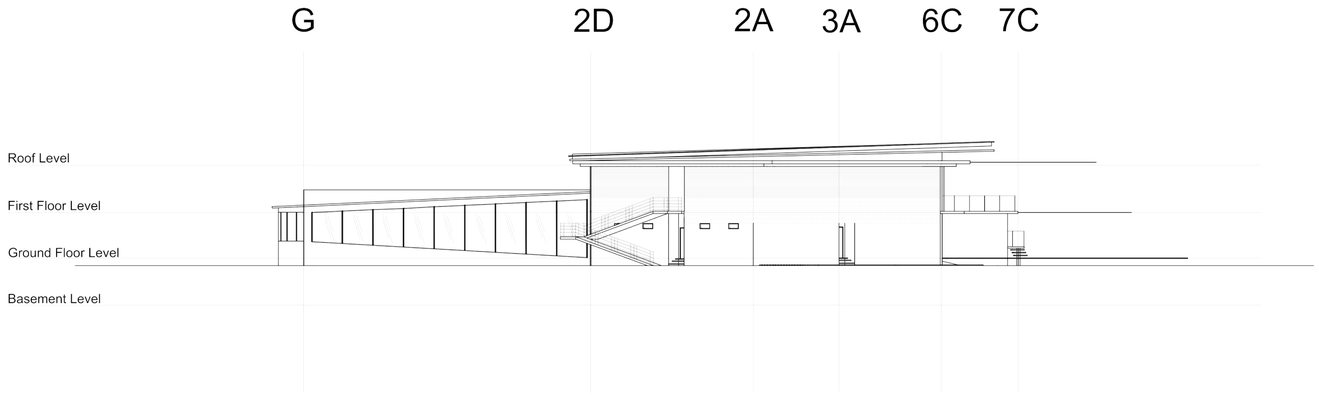

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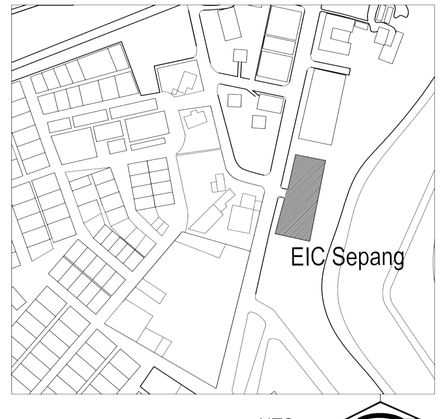

PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
NORTH WEST ELEVATION

SCALE
1:200

SIZE
A1

DATE CREATED
3 OCT 2014

DRAWN BY

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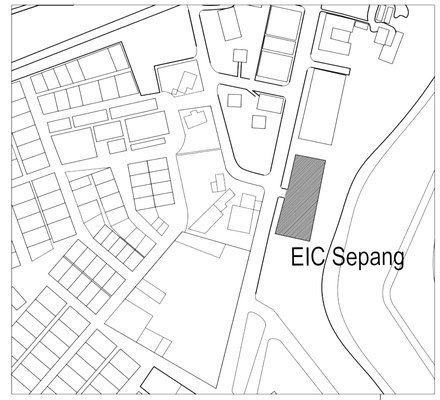
REMARKS

DRAWING NUMBER
A006

SHEET NUMBER
6/16

LOCATION PLAN



PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
SOUTH EAST ELEVATION

SCALE
1:200

SIZE
A1

DATE CREATED
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REMARKS

DRAWING NUMBER
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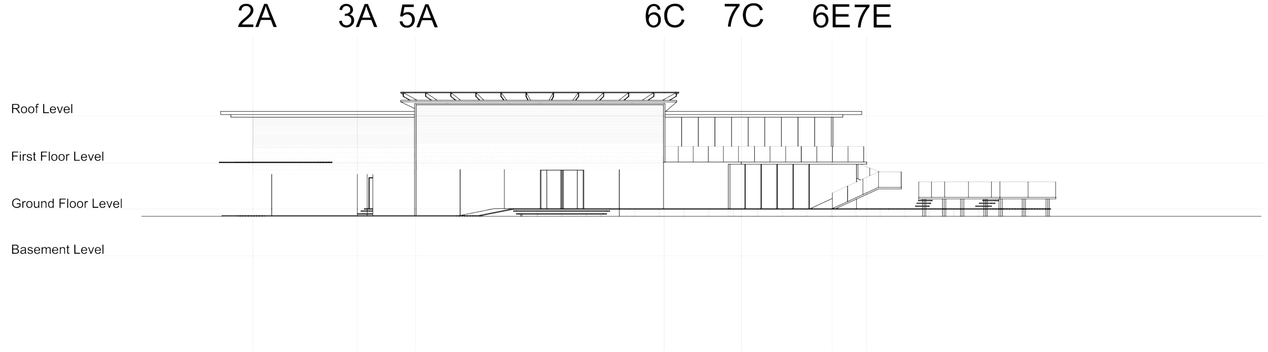
SHEET NUMBER
7/16



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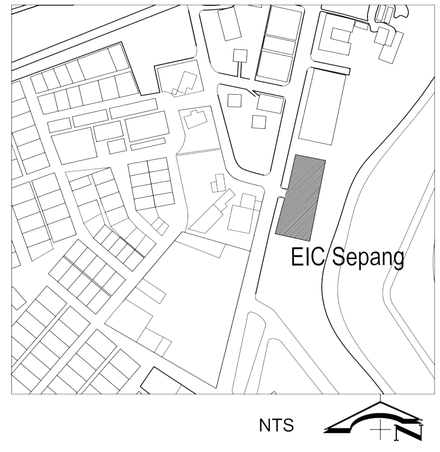

PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
SOUTH WEST ELEVATION

SCALE
1:200

SIZE
A1

DATE CREATED
3 OCT 2014

DRAWN BY

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TANG HUI YING

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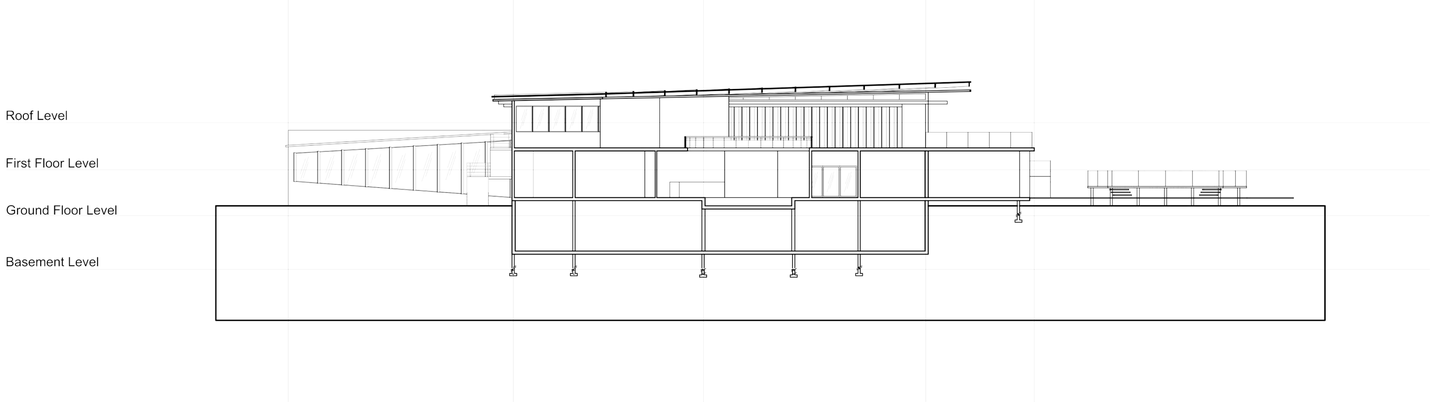
REMARKS

DRAWING NUMBER
A008

SHEET NUMBER
8/16



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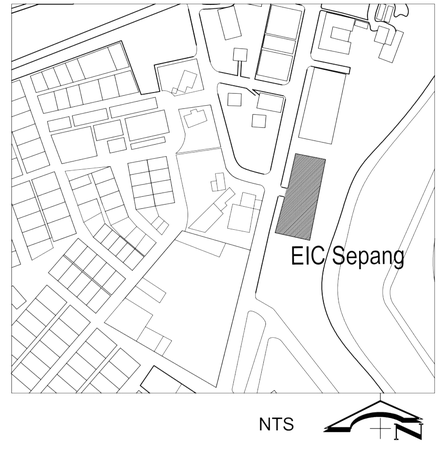

PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
SECTION X-X

SCALE
1:200

SIZE
A1

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3 OCT 2014

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REMARKS

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SHEET NUMBER
9/16

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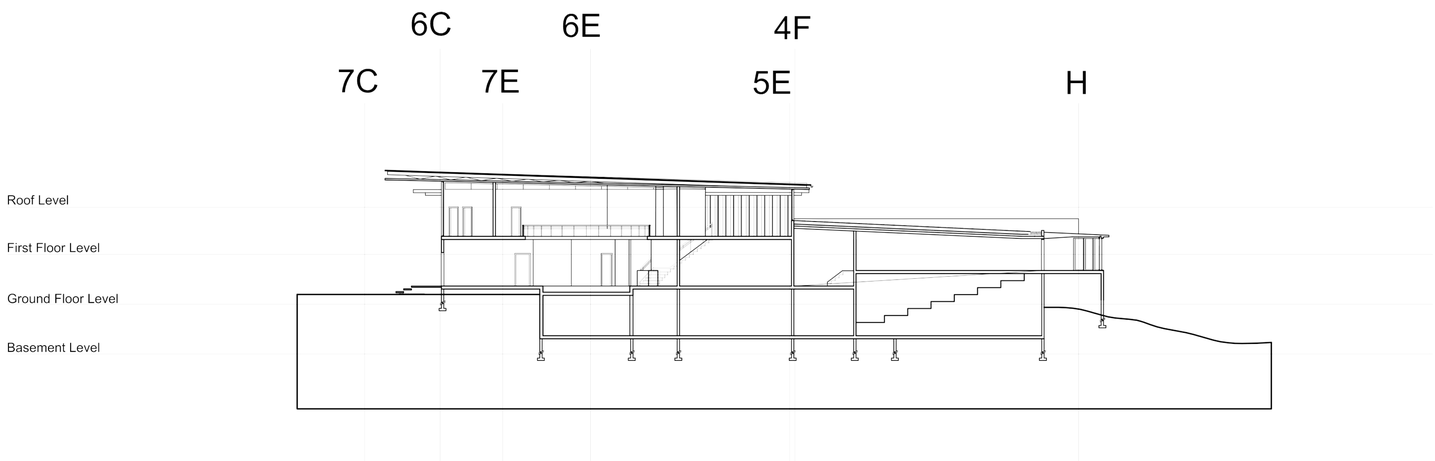

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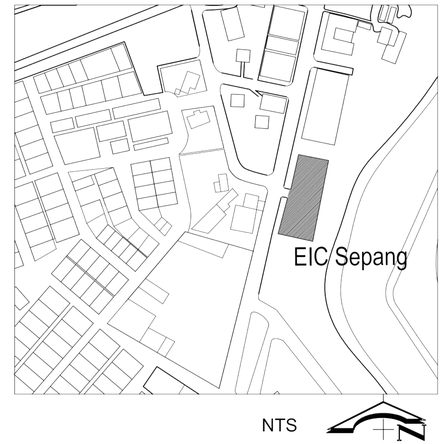

PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
ORTHOGRAPHIC DRAWING:
SECTION Y-Y

SCALE
1:200

SIZE
A1

DATE CREATED
3 OCT 2014

DRAWN BY

HOO ZHI XIN
LEE MIN
LIM YEE ZHING
LING GEE YOU
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TANG HUI YING

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MS CHERYL NGIAM

REMARKS

DRAWING NUMBER
A010

SHEET NUMBER
10/16

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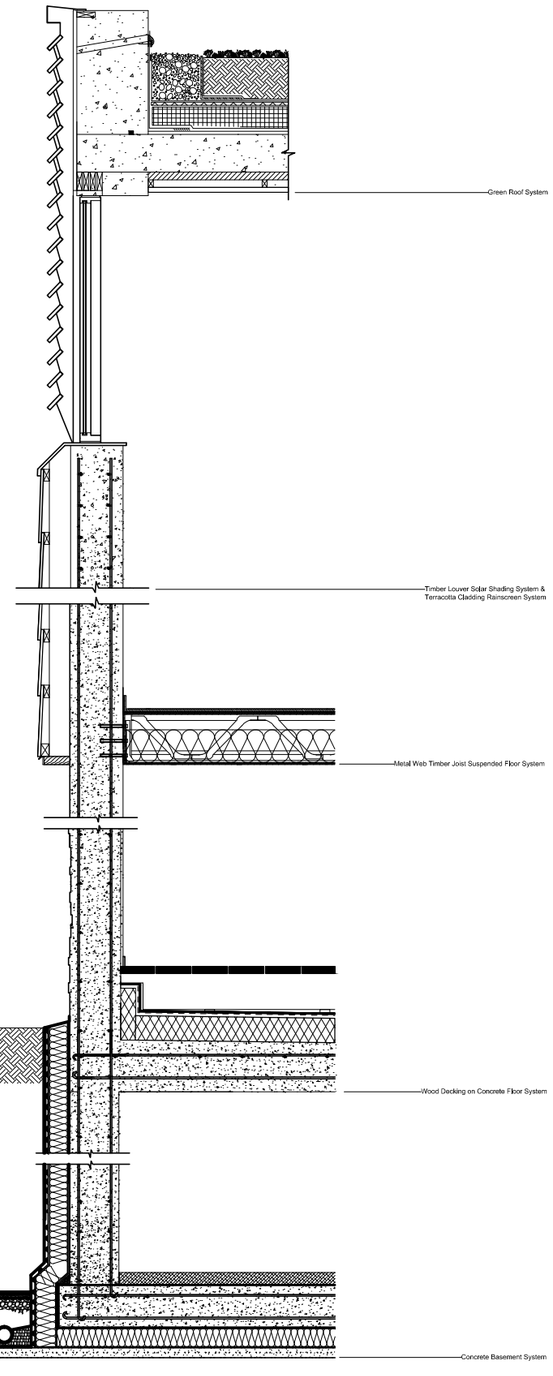

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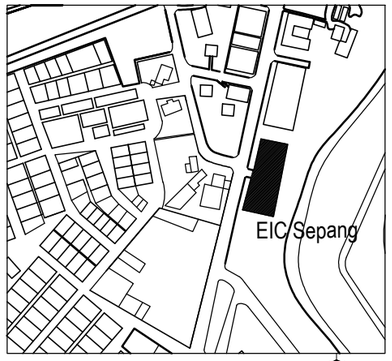

NTS

PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
DETAIL DRAWING:
SECTION DRAWING DETAILS

SCALE	SIZE
1:25	A3

DATE CREATED
3 OCT 2014

DRAWN BY

HOO ZHI XIN
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LIM YEE ZHING
LING GEE YOU
PUNG JIA CHYI
TANG HUI YING

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MS CHERYL NGIAM

REMARKS

DRAWING NUMBER	SHEET NUMBER
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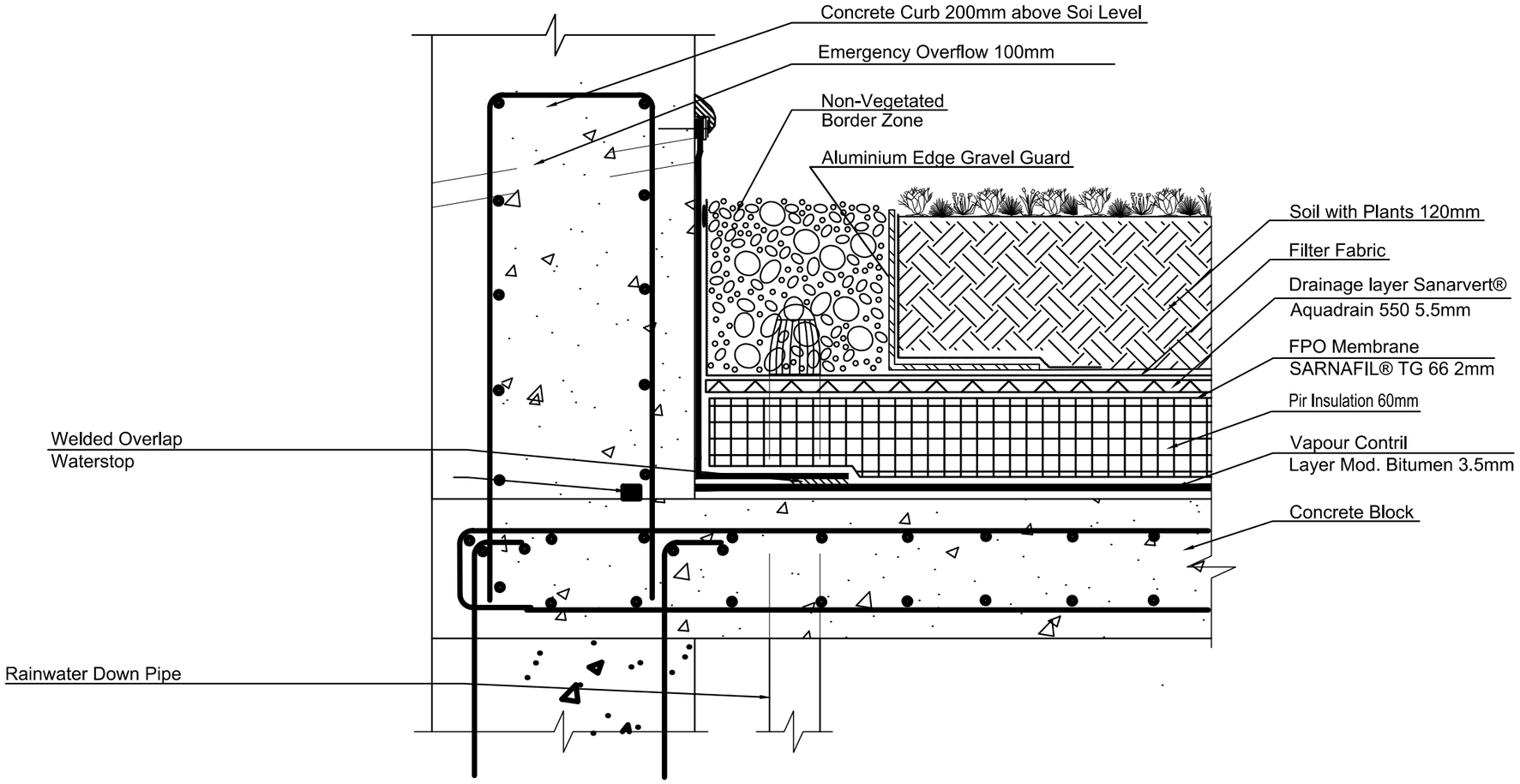

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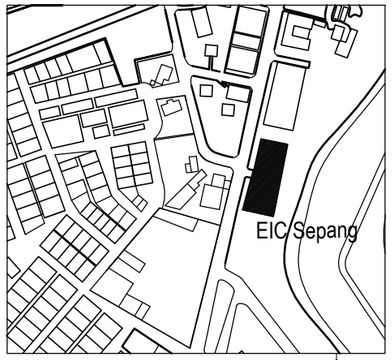

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PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
DETAIL DRAWING:
GREEN ROOF SYSTEM

SCALE
1:4

SIZE
A3

DATE CREATED
3 OCT 2014

DRAWN BY

HOO ZHI XIN
LEE MIN
LIM YEE ZHING
LING GEE YOU
PUNG JIA CHYI
TANG HUI YING

TUTOR
MS CHERYL NGIAM

REMARKS

DRAWING NUMBER
B002

SHEET NUMBER
12/16

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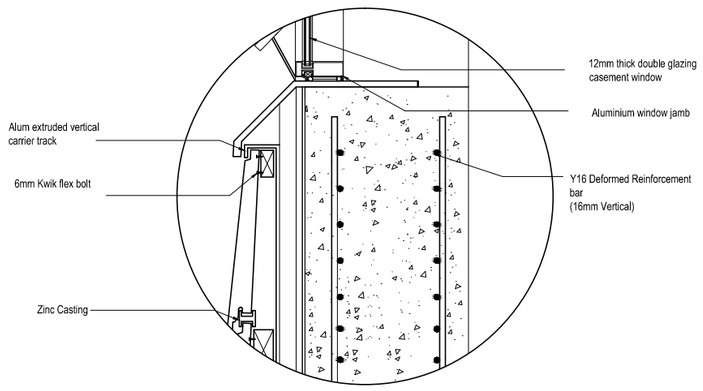

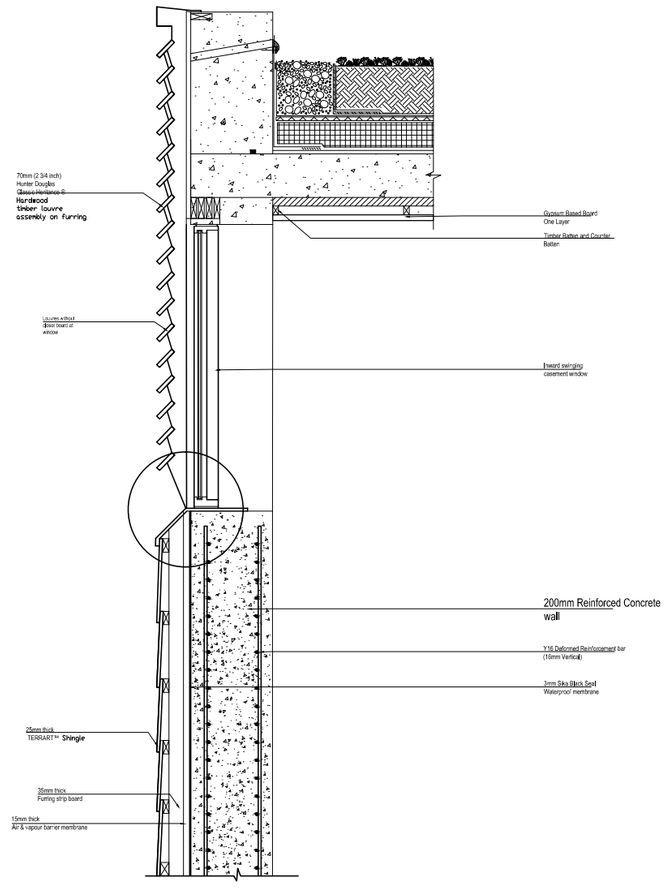

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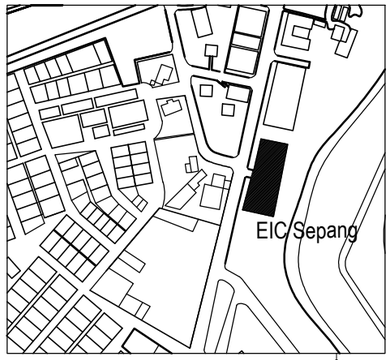

PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
DETAIL DRAWING:
WALL SYSTEM

SCALE
1:15

SIZE
A3

DATE CREATED
3 OCT 2014

DRAWN BY

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LEE MIN
LIM YEE ZHING
LING GEE YOU
PUNG JIA CHYI
TANG HUI YING

TUTOR
MS CHERYL NGIAM

REMARKS

Timber Louver Solar Shading System &

Terracotta Cladding Rainscreen System

DRAWING NUMBER
B003

SHEET NUMBER
13/16

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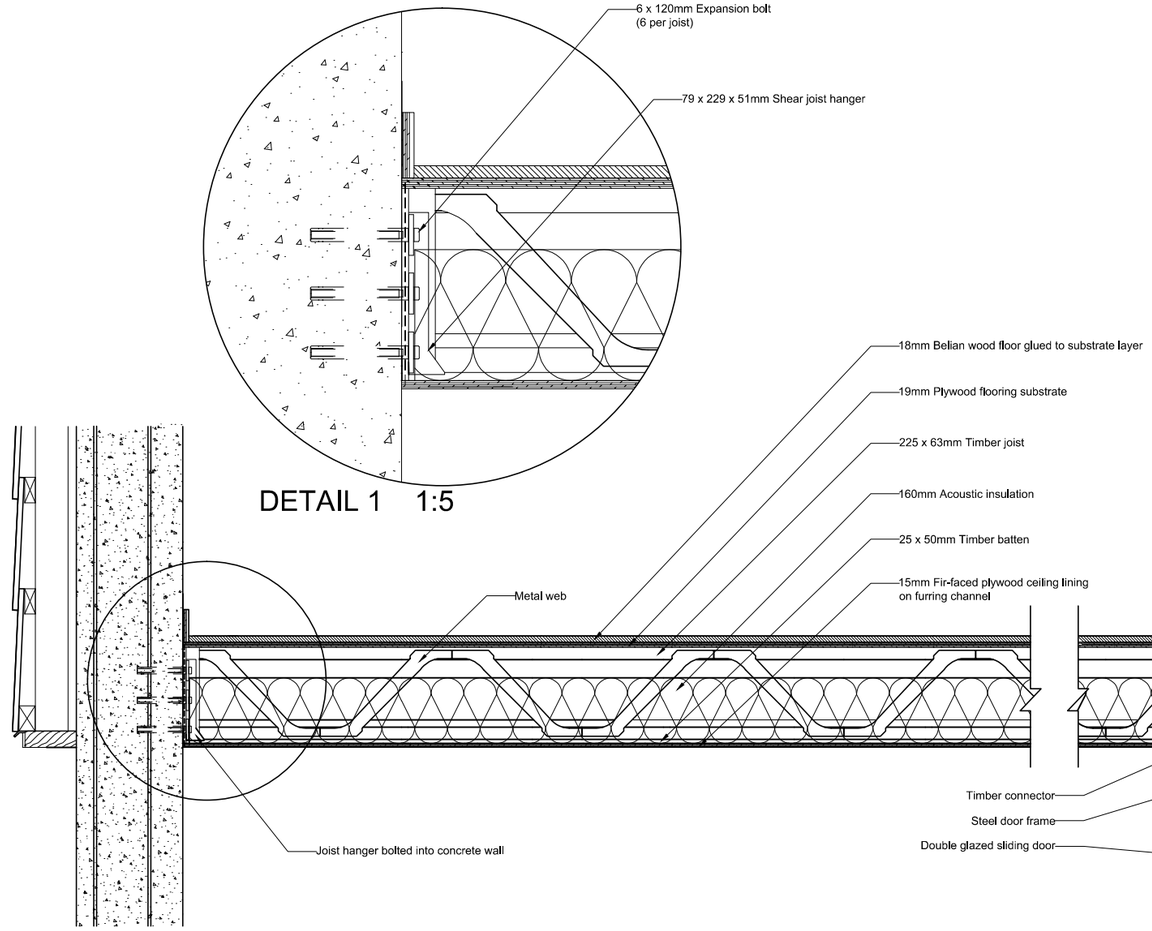

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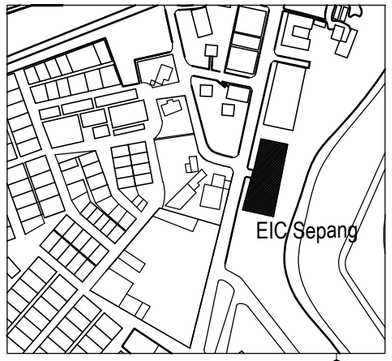
LOCATION PLAN



PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
DETAIL DRAWING:
FIRST FLOOR SYSTEM

SCALE
1:15

SIZE
A3

DATE CREATED
3 OCT 2014

DRAWN BY

HOO ZHI XIN
LEE MIN
LIM YEE ZHING
LING GEE YOU
PUNG JIA CHYI
TANG HUI YING

TUTOR
MS CHERYL NGIAM

REMARKS

Metal Web Timber Joist Suspended Floor System

DRAWING NUMBER
B004

SHEET NUMBER
14/16

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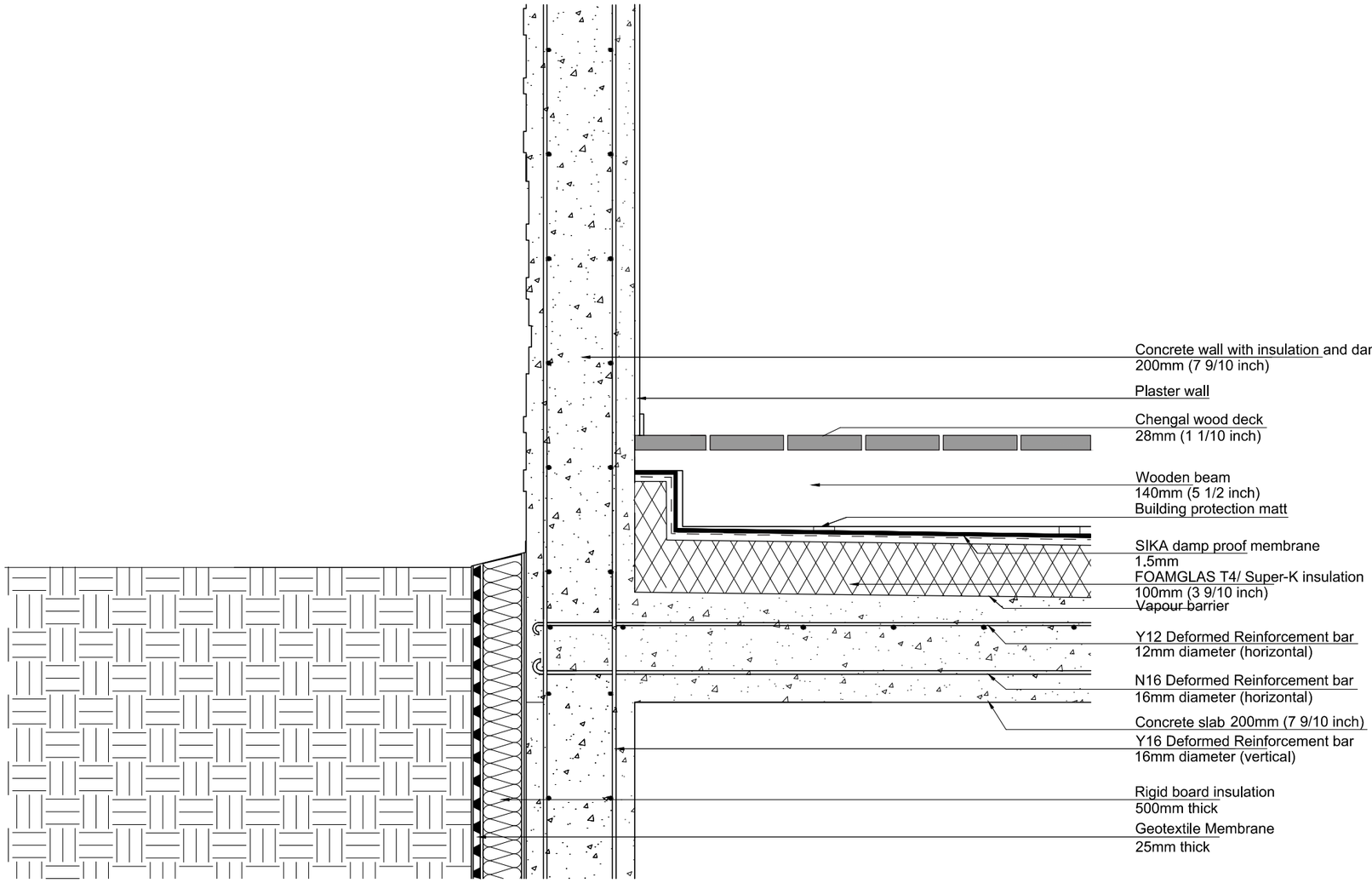

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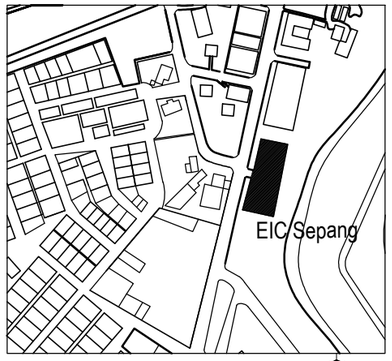

PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
DETAIL DRAWING:
GROUND FLOOR SYSTEM

SCALE
1:10

SIZE
A3

DATE CREATED
3 OCT 2014

DRAWN BY

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REMARKS

Wood Decking on Concrete Floor System

DRAWING NUMBER
B005

SHEET NUMBER
15/16

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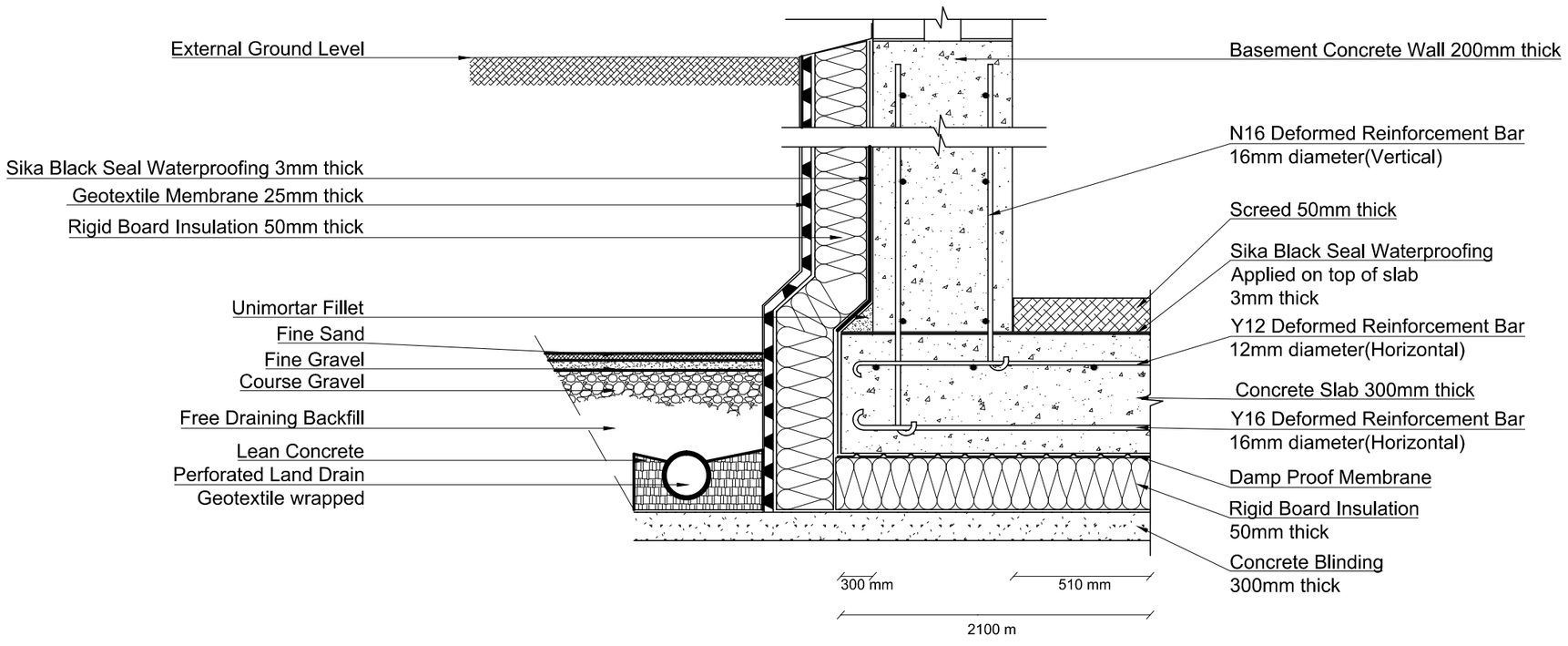
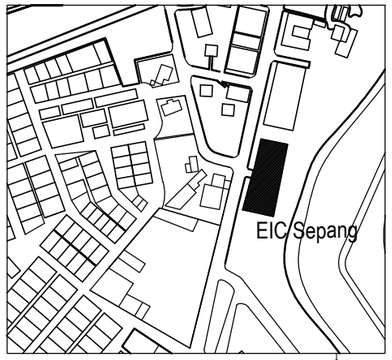


LOCATION PLAN



PROJECT TITLE
BUILDING TECHNOLOGY 1-
ALTERNATIVE CONSTRUCTION SOLUTION

DRAWING TITLE
DETAIL DRAWING:
BASEMENT SYSTEM

SCALE
1:8

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A3

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REMARKS
Concrete Basement System

DRAWING NUMBER
B006

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