ENVIRONMENTALY HIGH PERFORMANCE AND A GREEN RATED BUILDING STUDY FOR A MULTI-USE CONVENTION CENTER

THESIS REPORT

Submitted by

ARVIND KUMAR K
(19239008)

Under the guidance of
AR. SANGEETHA PRIYA

in partial fulfillment for the award of the degree of

M. ARCH (GENERAL) (EXE) (Master of Architecture)

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INSTITUTE OF TECHNOLOGY & SCIENCE
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BONAFIDE CERTIFICATE

Certified that the Planning Thesis Phase I titled "ENVIRONMENTALLY HIGHER PERFORMANCE AND A GREEN RATED BUILDING STUDY FOR A MULTI-USE CONVENTION CENTER" is the bonafide work of Mr. K.ARVIND KUMAR who carried out the work under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other PG student.

Ar.Sangeetha priya

Associate professor (SPADE)

Dr.SheebaChander

Dean (SPADE)

INTERNAL EXAMINER

Name:_____

Designation: _____

EXTERNAL EXAMINER

Name:_____

Designation:_____

Date of Viva voce:

ACKNOWLEDGEMENT

Foremost, I think almighty for giving me the courage and strength to accomplish this dissertation.

I express my very sincere thanks to **DR. SHEEBA CHANDER**, Dean, School of Planning Architecture and Design Excellence, Hindustan Institute of Technology & Science for her encouragement, comments and supervision which makes this dissertation a memorable learning experience.

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I also express my gratitude to my parents and relatives for their moral support and encouragement during the course of the dissertation.

K. ARVIND KUMAR

LIST OF FLOW CHARTS

LIST OF FIGURES

LIST OF MAPPING

ABSTRACT

International convention centers hold many advantages, as holding international large-scale conventions and exhibitions will attract international guests and will boost the economy locally, the value-added brought by the events can also influence tourism industry with the service quality, and the influence will take effect even after the event is over. In this context, aesthetic and design of these centers are not only important to attract foot fall, but with growing concern for sustainable development, and with need to nurture nature, it is important to design 'Sustainable Convention Centre'.

The concept of green building has made an gigantic significance in a creating nation like INDIA.The hypothesis implies of limiting the wastage and the taken a toll of construction.With increment in urbanization the normal assets were utilized in inappropriate ways which leads us towards the execution of green buildings and the concept makes a difference in making ideal utilize of normal resources.The green building is an eco-friendly component,since it is based on the basic run the show – “REDUCE, REUSE, RECYCLE”.Eventually, The green buildings manages a tall level of financial and engineering performance, which leads us to the betterment of future era.

CHENNAI INTERNATIONAL CONVENTION CENTER (CICC)
SYNOPSIS

INTRODUCTION

India, the seventh largest country by area and the second most populous country with a population of about 1.2 billion is on its way to becoming one of the leading democracies of the world. In such a scenario, it is inevitable that India should host a variety of international meetings and concerts of global importance which would ultimately have a profound effect on its overall growth**.**

AIM

- To design an international convention center
- It would be able to accommodate large gatherings with ease by proper spatial analysis and formal analysis which would help in improving the general outlook of its vicinity.

OBJECTIVES

- To design climate response building
- LEED certification - Platinum rated building.
- Material study

SITE LOCATION

The site is located in the state capital CHENNAI ,where the air traffic and connectivity for the businessman and delegates is high as we are expecting more and more foreign delegates and international entrepreneurs.

SCOPE

While taking a look at gathering space for conventions and conferences held in Chennai. Gathering space like trade center. Chennai is still unable to host an international convention and conference due to its poor quality of facilities. It is clear lack of integrated convention center. In order to rectify that and in consideration with Economic growth pattern of Chennai. An international convention has huge scope**.**

CASE STUDY

- Vancouver Convention Centre
- Oregon Convention Centre
- Hyderabad International Convention Centre
- Bangalore International Convention Centre

METHODOLOGY

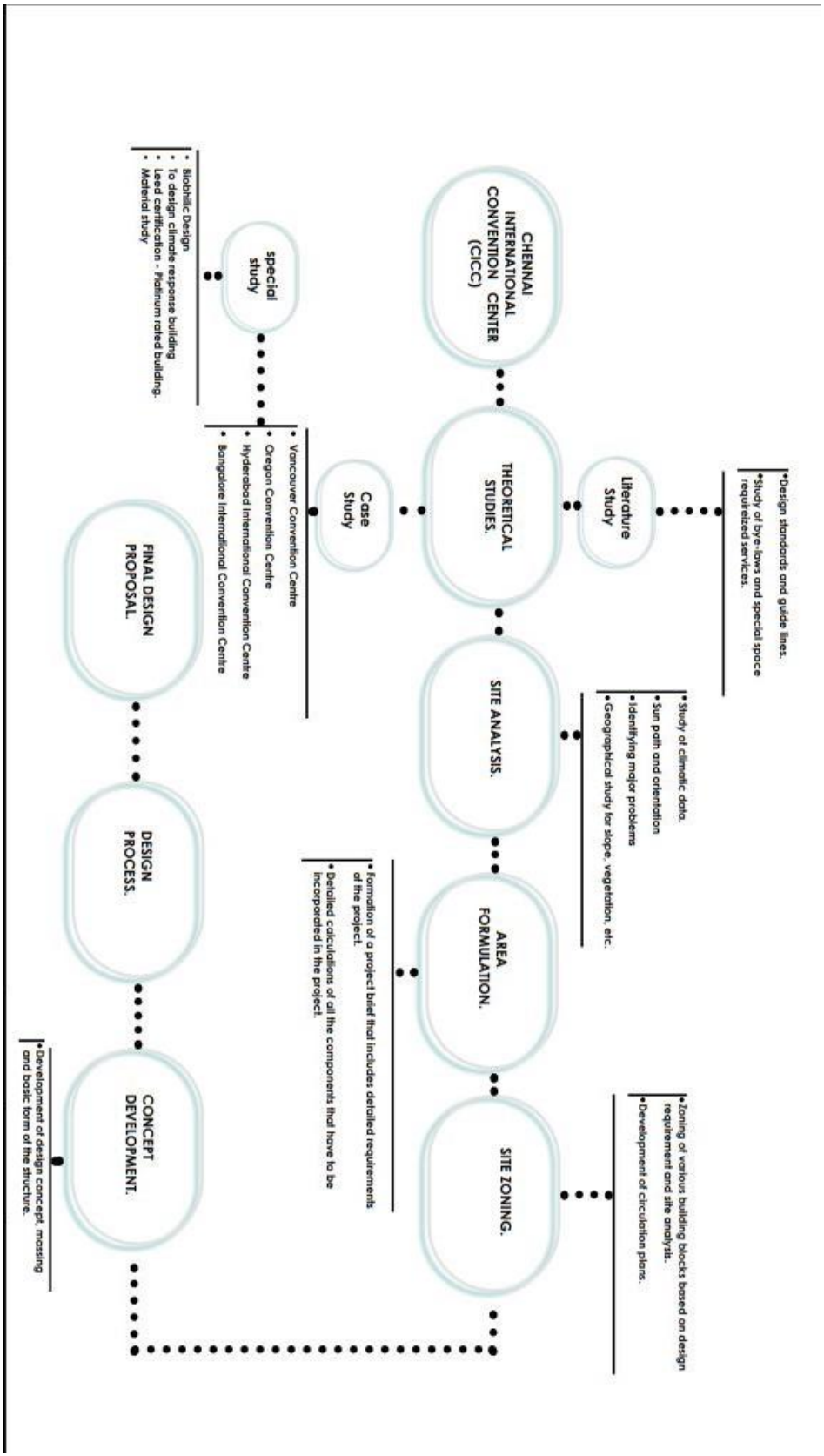


Fig 1.1 Methodology

3.LITERATURE STUDY

3.1 SUSTAINABLE CONSTRUCTION GREEN BUILDING CONCEPT – THE CII SOHRABJI BUSINESS CENTRE

PROJECT : The CII-Sohrabji Godrej Green Business Centre (CII-Godrej GBC)

AREA WIDTH : 1858m2

Figure 1 Photo Graph of CII-Sohrabji Godrej Green Business Centre (CII-Godrej GBC).
The building was the first LEED Platinum-rated building for New Construction (NC) outside of the US.
According to the Indian Green Building Council, the CII-Godrej GBC building "marked the beginning of the Green Building movement in India."

ENVIRONMENTAL BENEFITS:

- 31000 kWh of renewable energy generated per year.
- Over 120000 kWh energy savings per year as compared to ASHRAE 90.1 base case.
- A reduction in CO2 emissions of 100 tons per year since 2004.
- Potable water savings of 40% compared to a conventional building.
- Excellent indoor air quality.
- 100% day lighting (Artificial lights are switched on just before dusk).
- Higher productivity of occupants.

ENERGY EFFICIENCY:

- Installed a state-of-the-art Building Management System (BMS) for real-time monitoring of energy consumption.
- Use of aerated concrete blocks for facades reduces 15-20% load on air-conditioning.
- Double-glazed units with argon gas filling between the glass panes, have enhanced the thermal properties.
- Water-cooled scroll chiller.
- Installed two 25TR chillers.
- Secondary chilled water pumps installed with Variable Frequency Drives (VFDs).
- Energy efficient lighting design through Compact Fluorescent Lamps (CFLs).
- Roof garden covering 60% of area.

RENEWABLE ENERGY:

• 20% of the building energy requirements are catered by Solar Photovoltaics (PVs).
• The Solar PVs have an installed capacity of 23.5kW.

WATER EFFICIENCY:

• Zero water discharge building.
• The entire waste water, grey and black water generated in the building is treated biologically through a process called the 'Root Zone Treatment System'. The treated water is reused for landscaping.
• Waterless urinals used in men's restrooms.
• Rain water harvesting system to reuse storm water.
• Water-efficient fixtures include low-flow/flush fixtures.

INDOOR ENVIRONMENTAL QUALITY:

• Indoor Air Quality is continuously monitored and minimum fresh air is pumped into the conditioned spaces at all times.
• Fresh air is also drawn into the building through wind towers.
• Use of low Volatile Organic Compound (VOC) paints and coatings, adhesives, sealants and carpets.
• Maximum day-lighting.
• Operable windows and lighting controls for better day-lighting and views.
• Fenestration maximized on the north orientation.

MATERIALS AND RESOURCES:

• 80% of the materials used in the building were sourced within 500 miles from the project site. Most of the construction material contains post-consumer and industrial waste as a raw material during the manufacturing process.
• Fly-ash based bricks, glass, aluminum and ceramic tiles, which have post-consumer and industrial waste were used in constructing the building to encourage usage of recycled content.
• Office furniture is made of bagasse-based composite wood.
• More than 50% of the construction waste was recycled within the building or sent to other sites and diverted from landfill.

SUSTAINABLE SITE :

• The building design was conceived to have minimum disturbance to the surrounding ecological environment.
• The disturbance to the site was limited within 40 feet from the building footprint during the construction phase.
• The majority of the existing flora & fauna and natural microbiological organisms were retained around the building.

• Extensive erosion and sedimentation control measures to prevent top soil erosion were implemented at the site during construction.
• Large vegetative open spaces.

OTHER NOTABLE GREEN FEATURES:

● Swales for storm water collection.
● Electric vehicle for staff use.
● Car parking shaded with trees.

INFERENCE

● Potable water savings
● Excellent indoor air quality.
● Water-cooled scroll chiller.
● Roof garden
● 20% of the building energy requirements are catered by Solar Photovoltaics (PVs).
● Zero water discharge building.
● Rain water harvesting system to reuse storm water. Fresh air is also drawn into the building through wind towers.
● Operable windows and lighting controls for better day-lighting and views. Office furniture is made of bagasse-based composite wood.
● Electric vehicle for staff use.
● Car parking shaded with trees.

3.2 GREEN BUILDING - CENTRE FOR ENVIRONMENTAL SCIENCE AND ENGINEERING ,IIT KANPUR

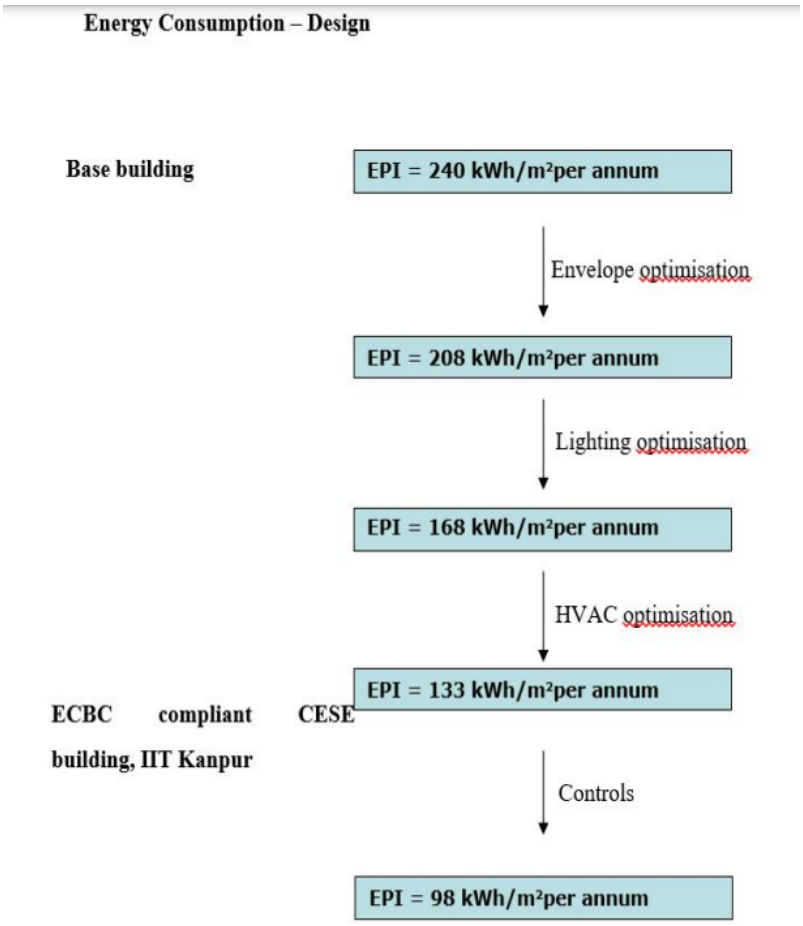
BUILDING: CESE IIT Kanpur
LOCATION: Kanpur, India FLOOR
AREA: 17,500 SQM
ARCHITECT: Kalvinde Rai and Chowdhury Architect and Planners

ENVIRONMENTAL PRACTICES
• The building is fully complaint with the ECBC (Energy Conservation Building Code).
• Sustainable site planning has been integrated to maintain favorable micro climate.
• The architectural design has been optimized as per climate and sun path analysis. • Energy efficient artificial lighting design and daylight integration.
• Energy efficient air conditioning design with controls integrated to reduce annual energy consumption.
• Passive strategies such as an earth air tunnel incorporated in the HVAC design to reduce the cooling load.

GLASS SOLUTION FOR DAY-LIGHTING AND ENERGY EFFICIENCY STRATEGY

High light transmission allowing natural daylighting with minimum artificial requirements during daytime. Saint Gobain's advanced thermal Insulation Low-e glass 6mm Planitherm Mint Green with 12mm air gap and 6mm Clear Planilux glass was 76 specified and glazed to give a very low solar factor and U-value to provide an energy efficient solution

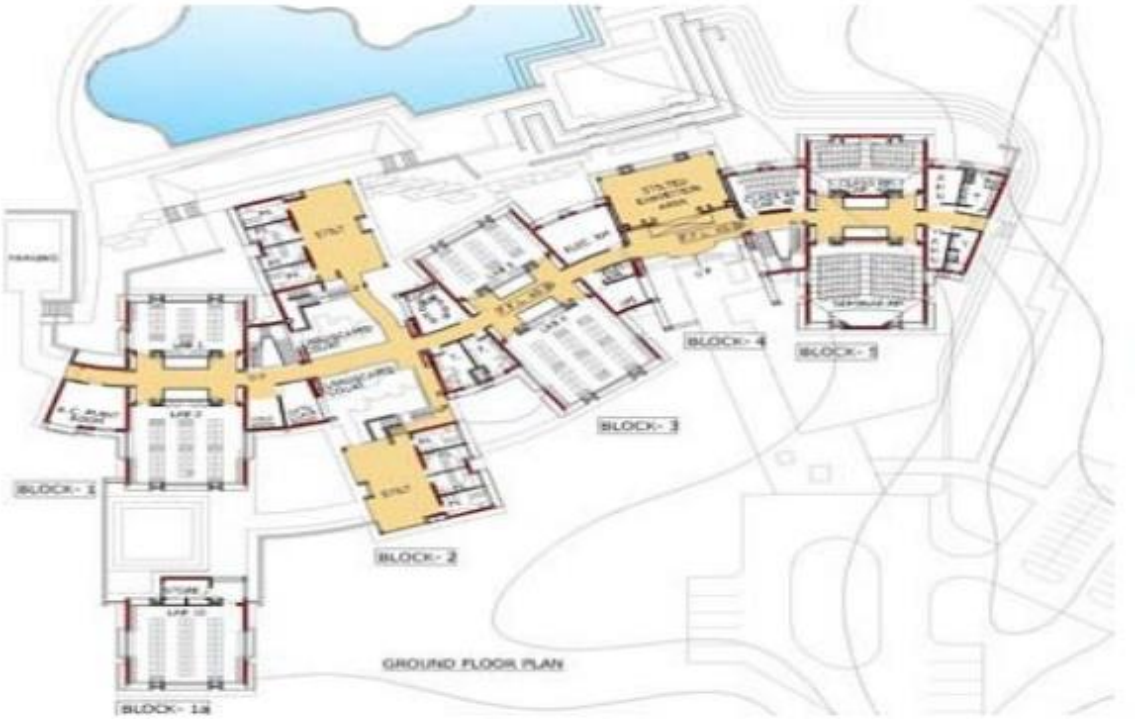
- Visual light transmission 62%
- Solar Factor SF 0.36
- U value 1.8W/SqmK



1.2 Energy consumption - Design

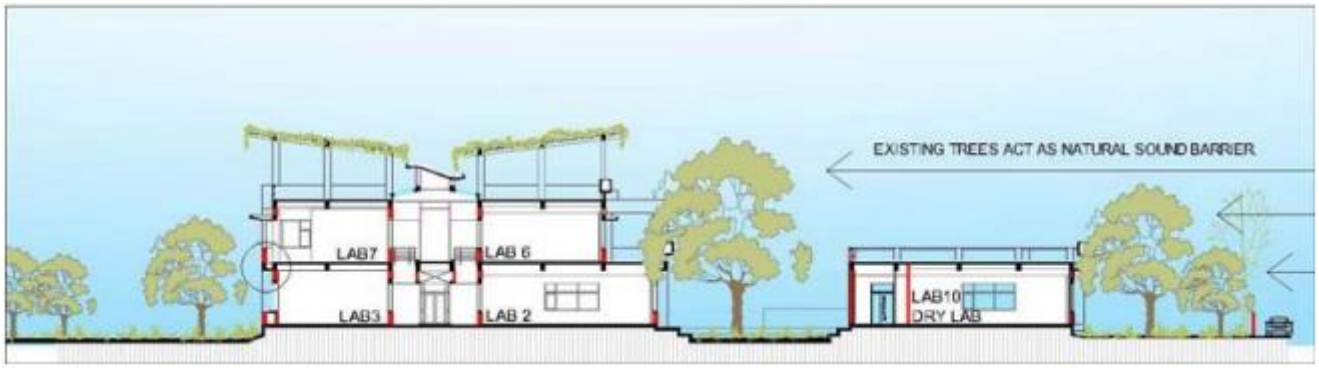
● Envelope Optimization 208 Kwh/Sqm (13.3%) The Architecture design optimized as per the climate of Kanpur. The Sunpath analysis of the building was conducted to strategically design the opening area and location. It also helped in designing the external shading depth for the opening designed which block any direct solar radiation yet allowing daylight into the interiors.

● The building envelope was chosen such that it meets the ECBC compliance. The project prime focus was to reduce the energy consumption with no compromise to occupants' thermal comfort.



2.1 Centre for environmental and science, IIT Kanpur.

● The major wall area is along the east west axis by which the wall area is exposed to north and south direction
● The building plan was designed with little disturbance to ecosystem.
● The surrounding trees were used as a sound barrier



2.2 The surrounding trees were used as a sound barrier.

Lighting Optimization 168 Kwh/Sqm (19.2%)
Efficient window design, with external shading device achieve glare free natural daylight inside the laboratory space of the building.

Use of energy efficient lighting system integrated daylight dimmers control the use and need of lighting requirements during daytime operation Integration of Natural lighting sensor with artificial lighting system

▪ HVAC Optimization 168 Kwh/Sqm (20.8%) Use of energy efficient building Materials such as Cavity wall with insulation

• Insulated and shaded roof

• Energy efficient Advanced Thermal control Low-e Planitherm Mint Green PLT TG Double glazing and shading for windows significantly reduces the heat gain entering the building and hence the cooling requirements for cooling the heat through envelope. Use of variable frequency drive for Air handling units significantly 10 reduced the running cost for cooling requirements

• Controls 98 Kwh/Sqm (26.3%)

• Use Daylight sensors which turns off the artificial light when the living space is illuminated by daylight Use of occupancy sensor.

INFERENCE

• Passivestrategies such as an earth air tunnel incorporated in the HVAC design to reduce the cooling load.

• Glass solution for day-lighting and energy efficiency strategy Integration of Natural lighting sensor with artificial lighting system

• Energy efficient Advanced Thermal control Low-e Planitherm Mint Green PLT TG Double glazing and shading for windows Use of variable frequency drive for Air handling units significantly reduced the running cost for cooling requirements •Reflective material and light colour will be used at the roof surface to reflect solar heat.

• The building structure will also incorporate light walls to channel natural daylight from the roof to the first floor.

•Electric airside vehicles will be used wherever possible to reduce atmospheric emissions.

• Energy Harvesting Speed Bumps at the car parks to generate the electricity.

3.3 GREEN BUILDING CONCEPT - NEW LCC TERMINAL & KLIA 2 SEPANG, SELANGOR,MALAYSIA. PROJECT : New LCC Terminal & KLIA 2 Sepang, Selangor, Malaysia

CONSTRUCTED BY: UEM Construction Sdn. Bhd., a group of UEM Builders and Binapuri Sdn. Bhd..

ENERGY STRATERGY

i) Reflective Material And Light Colour Will Be Used At The Roof Surface To Reflect Solar Heat.

ii) The Building Structure Will Also Incorporate Light Walls To Channel Natural Daylight From The Roof To The First Floor.

iii) A Cogeneration (Trigeneration) Plant Shall Be Built To Supply Electricity, Cooling And Hot Water Requirements.

iv) Energy-Efficient Displacement Ventilation System Will Be Used In The High Occupancy Areas.

v) Electric Airside Vehicles Will Be Used Wherever Possible To Reduce Atmospheric Emissions.

vi) High Ceiling Space Of The Terminal Will Have A Forced Air Volume HVAC System Employing Stratification Principles To Conserve Energy.

vii) High-Performance Glazing With Ceramic Frits Will Be Used To Reduce Interior Glare And Solar Heat Build-Up In The Concourses.

The Use Of Energy Efficient, Innovation In Building, Engineering And Designation Will Ensure A Low-Emissions Terminal. It Is Becomes Benefits From Opportunities Resulting From Biogas Energy, Kinetic And Photovoltaic Technology.

I) Building Envelope

● Walls

Walls That Are Connected To Air-Conditioned Spaces Shall Have A Maximum Effective U- Value Of 1.2 W/M2k. In Example Including Cold Bridges At Connections.

● Roof

The Roof Of KLIA 2 Shall Be Insulated. The Maximum Allowable U-Value Of The Roof Is:

A) Light Weight Roof Shall Have A Maximum U-Value Of 0.4 W/M2k.

B) Concrete Flat Roof Shall Have A Maximum U-Value Of 0.6 W/M2k.

Table 1 Simulation Result Based On the Variation Thickness of Roof Insulation

Thickness	Cooling	Auxiliary	Light	Equip.	Total
50mm	28912.816	24544.574	21699.129	18806.18	93962.699
100mm	28088.037	24204.352	21699.004	18805.949	92797.342
150mm	27797.43	24084.477	21699.004	18805.949	92386.86

2.3 Orientation of the Building on proposed site.

● Roof Light

Any Roof Lights Above 6 Meter Height From Floor Level Shall Be Single Glazing Or Laminated Glazing With High U-Values To Promote Conduction Heat Loss Out Of The Space. Double Glazing With Air-Gaps Should Be Used Where Necessary For Acoustic Considerations.

● Glazing

The Properties Of Glazing For The Airport Shall Have A Minimum Light To Solar Heat Gain Ratio (LSG) Of 1.65. The Visible Light Transmission Of The Glazing Shall Meet The Requirements As Set Forth By The Daylight Requirements.

Table 2 : Maximum U-Value

Window to Wall ratio	Max. Allowable U-Value
Below 40%	4.5 W/m2K
Between 40% and 60%	3.5 W/m2K
Higher than 60%	W/m2K

2.4 Building cross section showing the natural ventilation strategy for the building.

Day lighting and Views

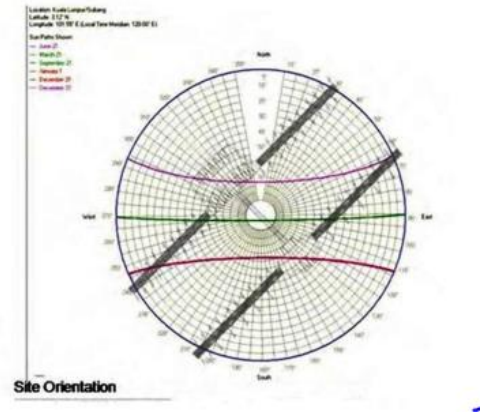
The physiological and psychological benefits of day lighting are tangible and include:

- Good colour rendering and visual recognition, because day lighting has a continuous spectral composition.
- Connection to day light facilitates time orientation, synchronizing occupants' metabolic rhythms.
- Windows provide psychological connection to the outside world
- View through windows create a visual rest and reduce visual fatigue.
- Reduce electric lighting can lead to energy savings so helping to conserve the world's resources.
- Day lighting depravation and flicker from fluorescent lamps have been linked to 'Sick Building Syndrome'.

Orientation of the Building

Orientation is the main key to reduce the heat gain especially in Malaysia's climate due to the East-West sun path throughout the year. The orientation of the current proposed KLIA 2 for Main Terminal Building and Satellite Building is slightly oriented to the North-South and East-West. These provide some benefits including exposure to the diffuse skies on southwest corners which will be alleviated with recommended extended louvers of these glazed facades.

Figure 1. Orientation of the building on proposed site



To quantify the effects of orientation of the building, LEED procedures need four aspects of simulation be carried out to general the base line of building performances.

Table 4: Result of Simulation Based on Differences of Orientation

Building Orientation	Cooling	Auxiliary	Light	Equip.	Total
0o	28088.037	24204.352	21699.004	18805.949	92797.342
90o	28080.326	24201.17	21699.004	18805.949	92786.449
180o	28087.311	24204.049	21699.004	18805.949	92796.313
270o	28079.842	24200.969	21699.004	18805.949	92785.764

Lighting Management

Lighting control system shall be in place for scheduled management. In addition, subcircuiting shall be planned for possibilities of switching off at least 90% lights whenever spaces are not used. A minimum number of lights are allowable to remain on for safety and security reasons.

Day light sensor shall be used at all day lit spaces. Occupancy sensor shall be used for all toilets and other occasional use spaces. A minimum number of lights are allowed to remain on for safety and security reasons.

i) Air Handling Units (AHUs)

All air handling units shall be Variable Air Volume type. It shall be designed to have maximum of 500Pa total static pressure or lower wherever possible. The fan shall be of air foil type and shall have a minimum efficiency of 77%. In addition, the motor shall be type 1 efficiency as provided by the MS 1525. Carbon dioxide, CO2 controlled modulating fresh air intake shall be used on all AHUs.

ii) Chilled Water Pumps

Chilled water pumps shall be fitted with a variable speed drives to regulate chill water flow as demand. The piping system shall be designed for minimum pressure losses and where spaces permits, 90o elbows shall not be used compared to 45o elbows are preferred. Low pressure loss valves and cooling coil system shall be used. A maximum allowable pressure for the chill water pipe system is 2 Bar. The motor for the chill water pump shall of type 1 efficiency as per MS 1525.

Renewable Energy Sources

By adapting the application of renewable energy sources, it can supply 1 to 5 percent of the overall energy requirements in KLIA 2. Besides the renewable energy sources also provide technology that are cost effective, inventive, and attractive and create a visual sustainability statement to the airport's visitors.

There are few strategies that can be considered in encouraging the use of renewable energy sources in KLIA 2:
- Biogas generation at the septic tank to fire the co-generation plant.
- Energy Harvesting Speed Bumps at the car parks to generate the electricity
- The application of Photovoltaic (PV) panels at the car park canopies for generating the electricity.

INFERENCE

- Reduce electric lighting can lead to energy savings so helping to conserve the world's resources
- Day lighting depravation and flicker from fluorescent lamps have been linked to 'Sick Building Syndrome'.
- Energy Harvesting Speed Bumps at the car parks to generate the electricity

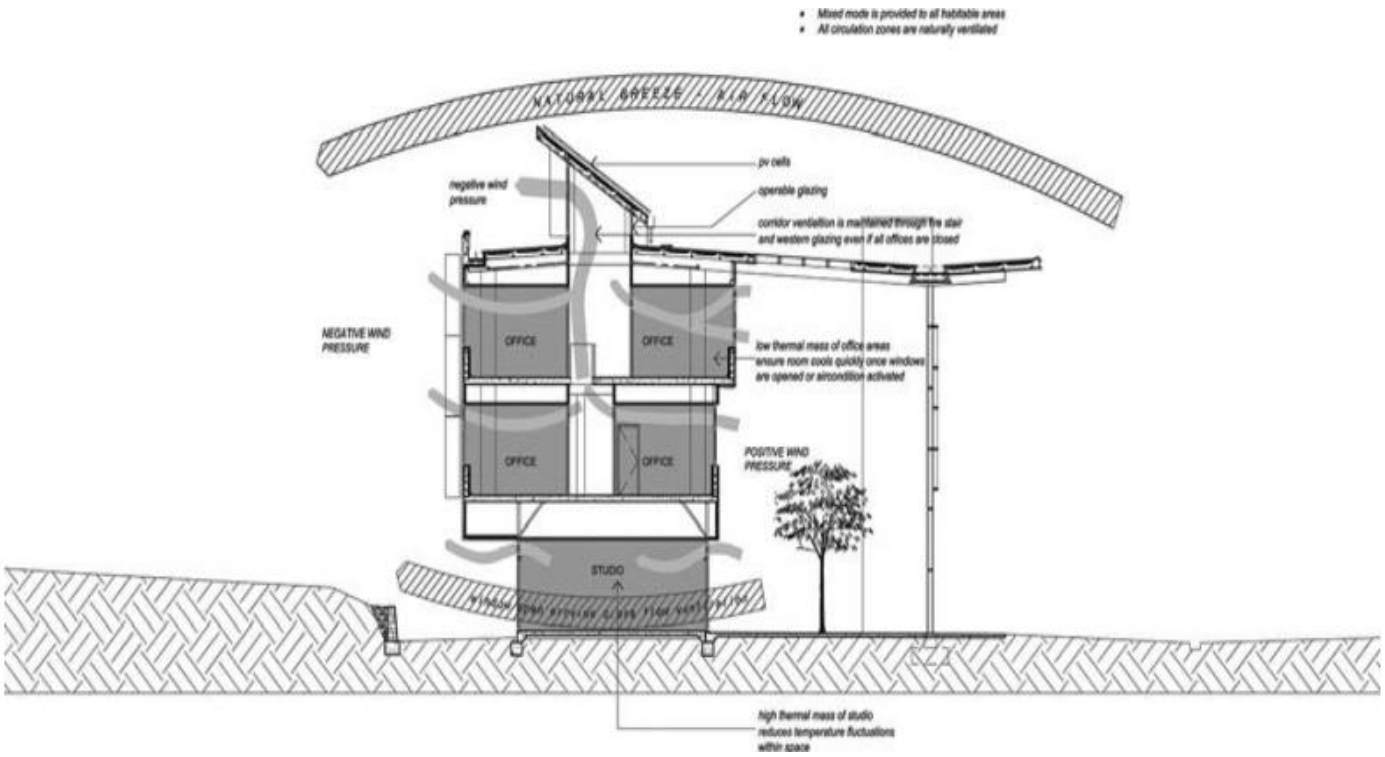
3.4 MIRAV SCHOOL OF SUSTAINABLE DEVELOPMENT, GOLD COAST, AUSTRALIA

PROJECT	: Bond University, MIRAV SCHOOL OF SUSTAINABLE DEVELOPMENT
LOCATION	: Gold Coast, Queensland.
TOTAL BUILT UP AREA	: Set on a 49.86 hectare campus at Robina on Queensland's Gold Coast.

ENVIRONMENTAL INITIATIVES

• Multi-split VRV air cooled air conditioning sys- tems to take advantage of the wide load diversity within the building (estimated by Bond Univer- sity as 80% of offices vacant 80% of the time).
• Mixed mode with ceiling fans to encourage natural ventilation and extend the comfort range without air conditioning.
• Naturally ventilated corridors and common areas.
• Occupancy and daylight controlled high efficiency lighting (T5) with task lighting in offices.

• Regenerative lift technology that generates electricity as the lift descends. This technology is fully metered to allow for student and industry analysis of the effectiveness of this technology.
• Solar hot water with gas boost. 19 • Inclusion of 18.375kW PV Cells and 1kW Wind Turbine.
• Grey water collected from the building is treated to Class A standard and stored in a 45,000 litre irrigation tank. This grey water is combined with rainwater from the roof of the adjacent maintenance shed to supply 100% of landscaping irrigation water needed for the MSSD.
• Rainwater is collected from the roof of the MSSD building and treated before being used to flush urinals and toilets. Excess rainwater from this system is directed to the 100,000 litres of rainwater storage and used for irrigation.
• Water efficient equipment, fixtures, and fittings are used throughout the building.
• All systems integrated onto the MSSD BMS, which is connected to the campus wide BMS.
• Provision of an advanced “Living Laboratory” facility where static and active touch panel dis- plays, along with cut-away wall sections will explain how the building works and what the cur- rent and historic performance of the building has been. This facility will be used internally by Bond University to compliment the curriculum and is expected to attract significant attention from others in the construction industry and broader com- munity with an interest in sustainable buildings.
• 90% of construction waste by weight was reused or recycled. Refrigerants with zero ozone depleting potential and minimal global warming impact.
• 30% of cement in concrete was substituted with fly-ash in all concrete to reduce embodied energy.
• Low volatile organic compound paints, car- pets, and furniture to improve the indoor environment.
• Office spaces have been designed to standard sizes to minimize waste and over 95% of loose furniture is recycled.
• Extensive cyclist facilities for staff and students.
• The quantity of flows to the Council sewer sys- tem have been reduced by 52% compared to a benchmark building.



2.4 Building cross section showing the natural ventilation strategy for the building.

Indoor Air Quality

• The building was designed for 60% of the UFA to have a 2.5% daylight factor.
• Glare was reduced across the UFA by using shading devices.
• High frequency ballasts were installed in fluorescent luminaries over a minimum of 95% of the UFA.
• The facility lighting design provides a maintenance luminance of no more than 25% above those recommended in AS1680.2.3 for 95% of the UFA.
• All of the UFA has a direct line of sight to the external environment.
• Thermal comfort levels for the as- built design of the UFA have been assessed and used to evaluate appropriate servicing options.
• A Predicted Mean Vote (PMV) level of between –1 and +1, calculated in accordance with ISO7730 (or equivalent using Draft ASHRAE Comfort Standard 55 and "Developing an Adaptive Model of Thermal Comfort and Preference–Final Report on ASHRAE RP884") has been achieved during Standard Hours of Occupancy and using standard clothing, metabolic rate, and air velocity values for 98% of the year.
• Every enclosed office is provided with individual control of its air supply rates and air temperature.
• Every enclosed office has openable windows.
• The building services noise level meets the recommended design sound levels provided in Table 1 of AS/NZS 2107:2000.
• 95% of all paint, adhesives, sealants, carpets, and other floor finishes, are low-VOC emitting.
• 95% of all tables, chairs, and desks are recycled.
• No composite wood products were used in the project. Energy

• The design reduces the energy consumption and greenhouse gas emissions of the base building compared to a conventional benchmark building as follows. Bond 22 University School of Sustainable Development was modelled to produce 19,800 kg CO2/yr,
•compared to a benchmark of 113,252 kg CO2/yr, which is an 82% reduction.
•Sub-meters are provided to monitor both lighting and general power consumption.
•The sub-meters are connected to the BMS and continually demonstrate actual performance against energy benchmarks.
•Energy demand reduction systems are installed to reduce peak demand on electricity infrastructure by 40%. •This has been achieved by on-site generation.
•Highly visible, internal stairs with good daylighting are provided as an alternative to using the lift.
•Services to each space automatically shut down when not in use.
•All spaces have individual light switches.
•Switching is clearly labelled and easily accessible by building occupants.
•An automated lighting control, including occupant detection and daylight adjustment, is provided. Materials
• A dedicated storage yard is provided for the separation, collection and recycling of office consumables.
• The concrete used in the building construction has 30% of cement replaced with an industrial waste product.
• The total PVC content cost for major services elements was reduced by more than 60% (by cost) by replacing PVC with alternative materials.
• All timber products used in the building and construction works were sourced from either post-consumer reused timber or Forest Stewardship Council (FSC) certified Timber.
• The flooring used in the project has a reduced environmental impact.
• 95% of the joinery (by area) used in the project is new and has been designed to be modular and easily disassembled for future reuse.
• Loose furniture used in the project has a reduced environmental impact by being recycled from other parts of the University.
• In excess of 50% (by area) of the structural framing, roofing, and façade cladding systems are designed for disassembly.

Water

• The potable water consumption in the building has been reduced by using water efficient fixtures/fittings, and by using rainwater and recycled water.
• Water meters have been installed for all major water uses. Meters are linked to the Building Management System to provide a leak detection system.
• All of the water requirement for landscape irrigation is sourced from rainwater and recycled water collected on site.
• No water-based heat rejection system is used.
• Temporary storage has been provided for fire protection system test water and maintenance drain-downs for reuse on-site.

Innovation

Innovation points awarded by the Green Building Council of Australia were:
•For exceeding the benchmark PVC minimisation, with 96% achieved compared to a best practice benchmark of 60%.
• For exceeding the benchmarking for learning resources, with the self-guided tour and living laboratory described below going above and beyond the Green Star requirements.
• For the installation of a regenerative drive lift in a university building, with a multi-function meter linked to the living laboratory display and educational screens.

Land Use and Ecology

• The development site is neither prime agricultural land nor land on or within 100m of a wetland.
• The ecological value of a development site was enhanced beyond its previously existing state primarily through the inclusion of an artificial wetland.
• Cut and fill were balanced on the campus and there was no exportation of topsoil from the immediate site.

Transport

• The number of car parking spaces provided on the site was significantly reduced.
• All parking spaces are designed and labelled for small cars.
• The parking space is dedicated solely for use by carpool participants, hybrid or other alternative fuel vehicles.
• Secure, undercover storage is provided for 10 student bicycles.
• Lockable, undercover storage is provided for 5 staff bicycles.
• Showers, changing facilities, and lockers are provided for cyclists.
• A dedicated, well lit, and signposted pedestrian route, linking the site to public transport nodes and other nearby amenities is provided.

Management

• Green Star Accredited Professionals provided sustainability advice throughout the design and delivery period.
• Comprehensive pre-commissioning, commissioning, and quality monitoring was performed by the appropriate contractors and subcontractors.
• The design team and the contractor provided information and documentation to the building owner regarding design intent, as-installed details, commissioning reporting and training of building management staff.
• The building will undergo a 12- month commissioning / building tuning period.
• An independent commissioning agent was appointed.
• A Building Users' Guide is provided.

• Site specific Environmental Management Plan (EMP) for the works in accordance with Section 4 of the NSW Environmental Management System guidelines (1998).
• 90% of construction waste by weight was reused or recycled.
• The building's environmental attributes are displayed in a manner that can be readily understood by building users.
• A facilities management representative was included on the design team.

INFERENCE

• Naturally ventilated corridors and common areas
• Occupancy and daylight controlled high efficiency lighting (T5) with task lighting in offices.
• Solar hot water with gas boost.
• Water efficient equipment, fixtures, and fittings are used throughout the building.
• Minimal global warming impact.
• 30% of cement in concrete was substituted with fly-ash in all concrete to reduce embodied energy.
• Extensive cyclist facilities for staff and students.

4.1 CASE STUDY

4.1.1 VANCOUVER CONVENTION CENTRE

FIG 2.6 Vancour Convention Center

LOCATION : 1055 Canada pl, Vancouver, bc v6c 0c3, Canada
ARCHITECTS : LMN, Musson Cattell
AREA : 833000 sq.ft
CAPACITY : 12,000

4. The Vancouver convention centre opened in April 2009. It is known as the east building of Vancouver. It is the world's first double LEED platinum certified convention centre. It is situated on Vancouver's water front.

5. The convention centre has exhibition area, pre-function spaces, Ball Rooms, Terrace meeting spaces, Outdoor plaza.

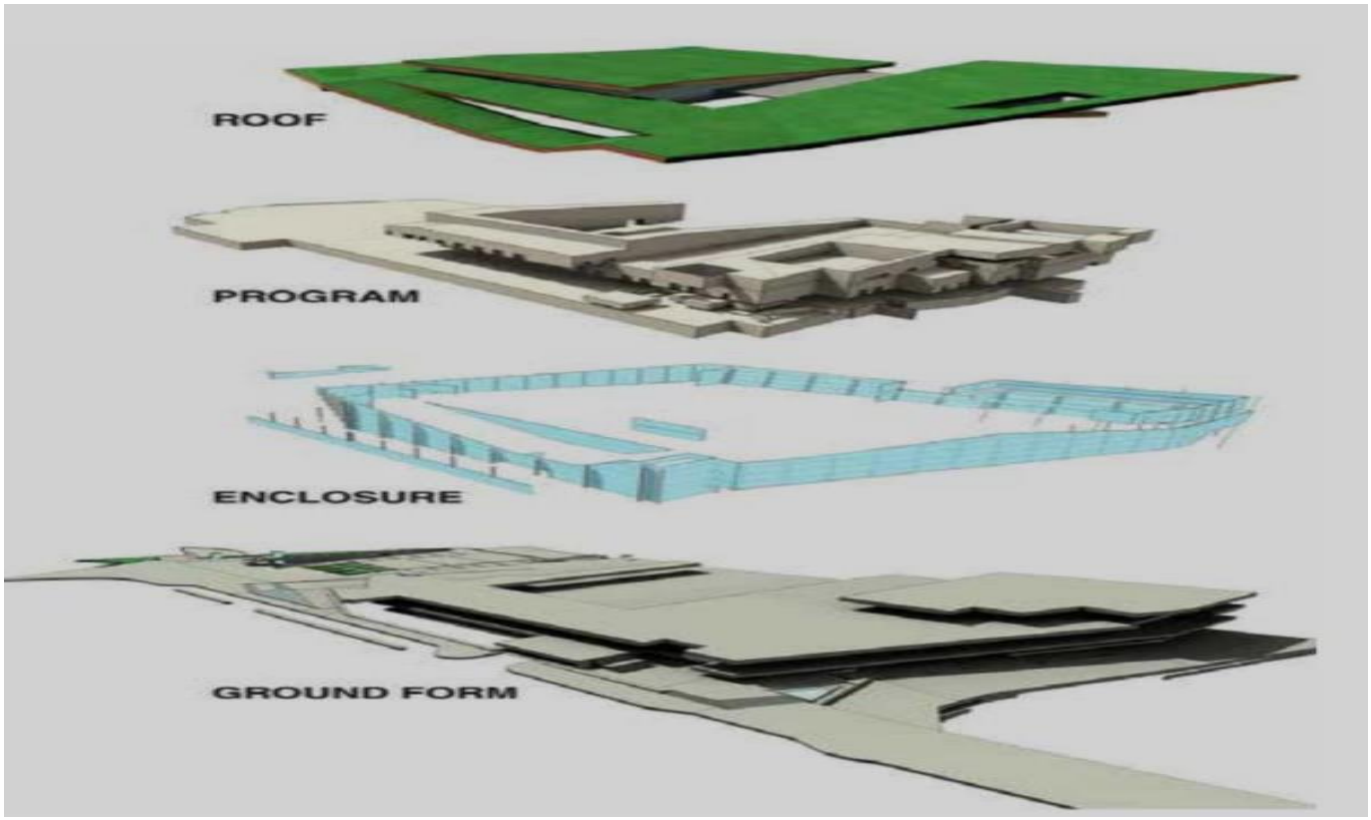


FIG 2.7 Green Roofing

ANALYSIS

- Green building is very important in recent years because of environmental changes, pollution and global warming. Strict requirements for setbacks and open space to protect sight lines & preserve green space.
- Materials Used - Interior wood, Wood panelled wall, Concrete deck, Glass, Steel, Lumber.

ENVIRONMENTAL BEST PRACTICES

- Waste minimization
- Organic recycling of all food waste, 3 part bins with the organics label.
- Food & Beverage Service
- Foods & Beverages are served in compostable cups & boxes instead of disposable single use bottles.
- Energy Efficiency & Resource Consumption
- Green building lighting is controlled by daylight and occupancy sensors; wall mounted control panels, sea water cooling heating is used. Low flow fixtures are used.

INFERENCE

ENERGY

The building reduces energy use by 60% as compared with peer facilities. The electricity demand in the new facility is about half of the existing East facility, due to the use of high-efficiency systems such as a high-performance

building envelope, efficient lighting design and daylight sensors, demand controlled ventilation and radiant heating and cooling.

ENVIRONMENTAL

The major identifying feature of the district is the expansive green roof that formally continues through the public realm to the water's edge.

LANDSCAPE EDGE

- Ecology-based living roof design referencing a British Columbia coastal grassland
- Largest non-industrial living roof in North America at 6 acres / 2.4 hectares
- 24 plant species native to coastal grasslands, with 400,000 plantings and 111 kg of seeds Economic
- The Vancouver Convention Centre is recognized as one of the world's leading convention centers currently generating $215 million in economic activity per year and growing**.**

SOCIAL

The large non-accessible portion contributes more meaningfully to the local ecology of the region as a habitat stepping stone linked to Stanley Park through a chain of waterfront parks**.**

URBAN EDGE

90% of the above-grade building is enclosed in an ultra-clear structural glass curtainwallEntrances and exits coincide with urban intersections Access to over 54 different transit routes. Lit interior creates "urban lantern" at night The convention district completes the Coal Harbour neighborhood, the city's "front porch"

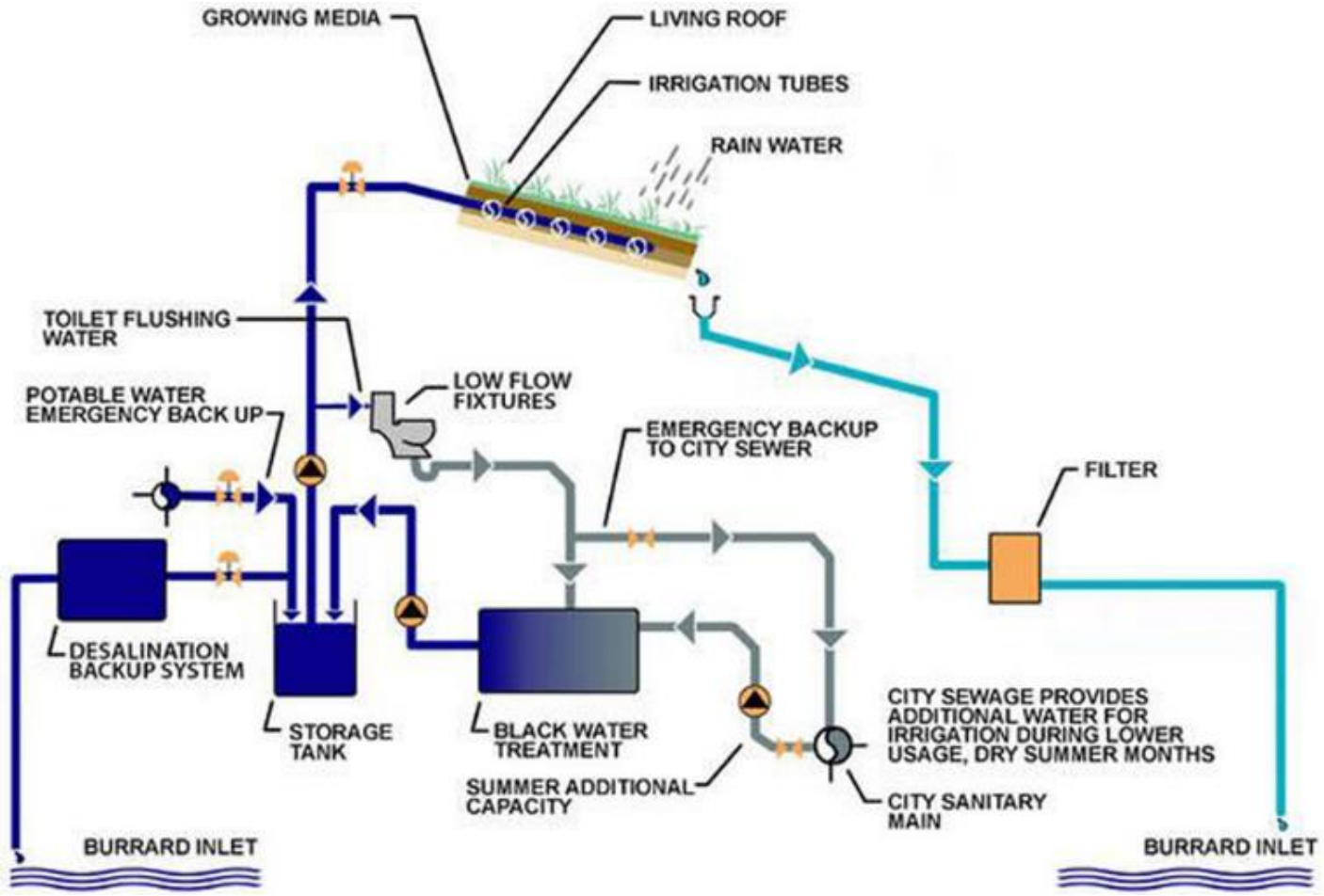
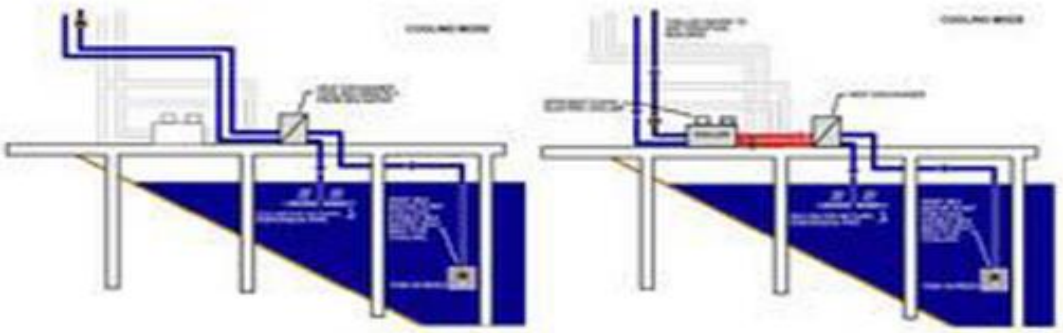


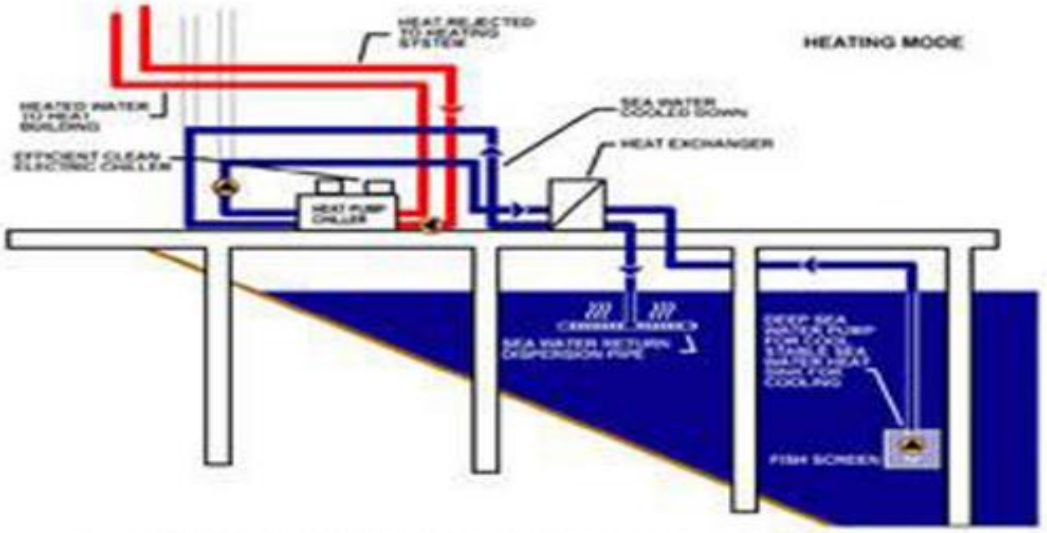
FIG 2.8 Waste water reuse

Cooling



- "Free Cooling" in the Spring and the Fall
- System produces 2,100 tons of Chilling
- System rejects heat to the Sea Water

Heating



- Extracts heat from the Sea Water
- Chillers also prodcue 50% of heating requirements
- System Produces 1,300 tons of heat = 21 mil BTU/Hr

4.1.2**OREGON CONVENTION CENTER**

LOCATION :777 NE Martin Luther King Jr Blvd, Portland, OR 97232, United States
AREA : 93,000 m2
ARCHITECT : Zimmer Gunsul Fransca

FIG 2.11 Oregon Convention Centre

The Oregon convention center was opened in 1990. It is located on east side of Willamette river. It is best known for twin spire towers.
This convention center practices green conventions & has the platinum LEED Certificate. It has exhibition area, ballroom (largest in the city of Portland)

ANALYSIS

- Solar panels on the roof of the Oregon convention center.
- The convention center practices energy efficient food preparation (i.e.) the leftover food is donated to local food banks, all oraganic waste is disposed.
- Air conditioning cost is minimised because of center open space which draw cool air into the building.
- Waste water treatment plant.

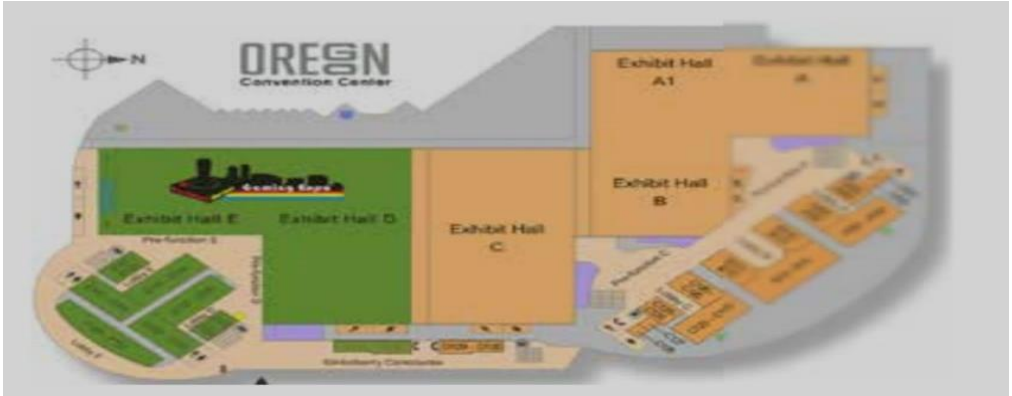


FIG 2.12 Public Interior Areas

INFERENCE

The food scraps are sent to pig farms. The leftover food from banquet is donated to food banks.

The main convention hall has been designed with almost perfect sightlines and viewing angle.
Since its located near river bank & the buildings orientation is in such a way it draws natural cool air inside.

- Waste water treatment plant is setup so that water can be reused.
- Natural air conditioning system.
- Solar panels to consume electricity.
- Environment or Earth friendly activities are followed in the convention center.
- Sustainability and energy efficient food management is mainly focused.

FIG 2.13 ORAGON VIEW

The LEED® Platinum certified Oregon Convention Center (OCC) is the largest convention center in the Pacific Northwest, making it an ideal venue for conventions, industry tradeshows, banquets and green meetings.
Located in beautiful and lively downtown Portland, Oregon, the OCC is the preferred destination for many groups because of its commitment to customer service and leadership in sustainable practices.

4.1.3 **HYDERABAD INTERNATIONAL CONVENTION CENTER (HICC)**

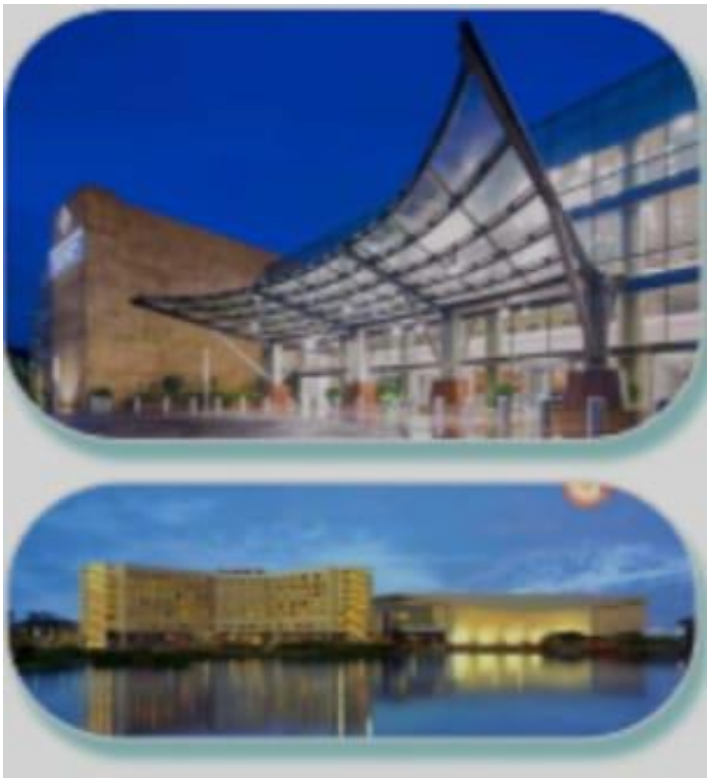


FIG 2.14 Hyderabad Convention Centre

LOCATION : P.O Bag 1101, near Hitec City, Izzathnagar, Kondapur, Telangana 500081
ARCHITECTS : Firm Terra Architect
AREA : 15 acre 60.630 sq m

The Hyderabad International Convention Center has a pillar less, purpose built facilities. It is a green convention building which organisers event planning, and is the only green globe certified convention center in India.
It has a lobby, Theatre, Banquet hall and meeting hall. It is a LEED certified building.

ANALYSIS

- Hyderabad and International Convention Centre and Novotel Hyderabad Convention Centre are Green Globe certified.
- Hyderabad International Convention Centre is committed to work towards key environmental indicators including energy and water consumption, total waste production and community commitment.
- HICC hosted India's first carbon light event - PATA Travel Mart 2008.

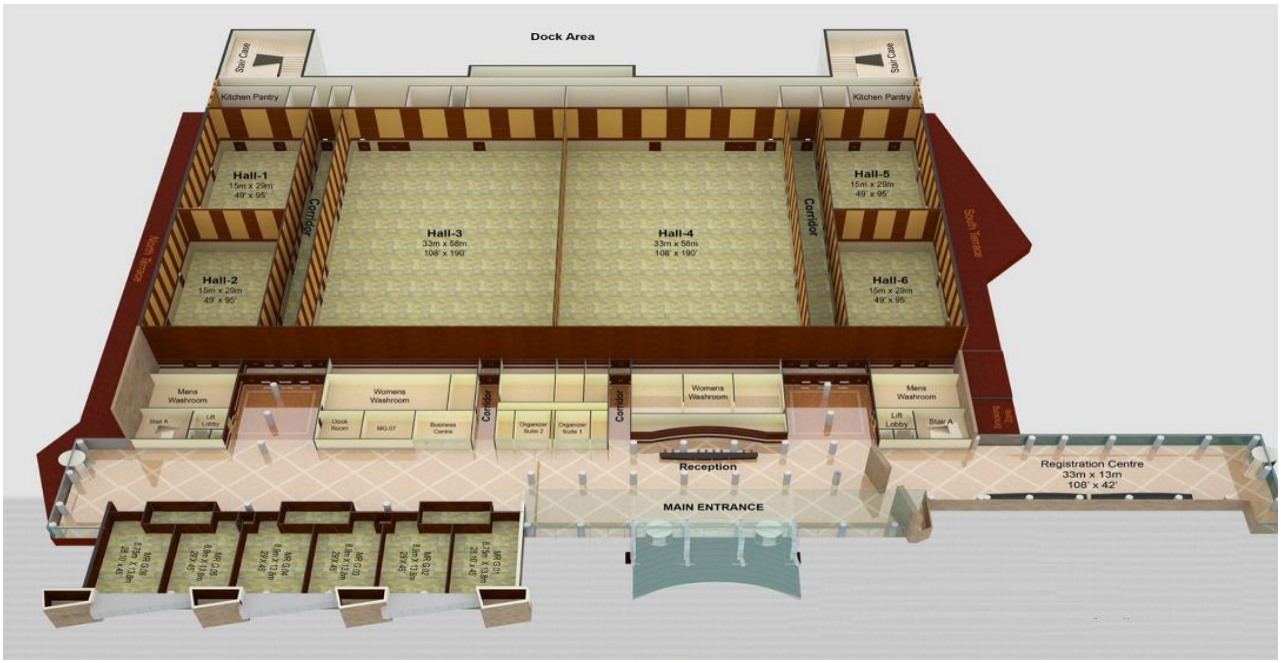


FIG 2.15 Hyderabad Convention Centre Plan

INFERENCE

- Lear Horizontal and Vertical zoning for functional and Efficient
- Planning. Space Utilization for both Conventions and Exhibition.
- Universal Design Approach to be followed.
- Inbuilt audio visual-sound reinforcement system is used in Hyderabad International Convention Center.
- Water Conservation measures are taken to consume water wastage.
- The convention center has been planned in a way that it visually centers the surrounding roads & buildings
- Glass Facade is provided so that there is a good view of the lake present at the exterior.

PURPOSE BUILT FACILITIES

A pillar-less main hall spanning over 6480 sq. m. which can be partitioned into six smaller halls with advanced design, technology, telecommunication and AV equipment along with a pre-function foyer area exceeding 6500 sq. m.

RIGGING BEAM- Each beam has a suspension capacity of one tonne.
SERVICE PITS & POWER SUPPLY- Service pits at every six metres with power, water, and internet supply. 100% power back-up.
ACCESS AND TRAVEL- 40 minutes from Rajiv Gandhi International Airport.
35 minutes from Secunderabad Railway Station. 10 minutes from Madhapur metro station.

4.1.4 **BANGALORE INTERNATIONAL CONVENTION CENTER**

2.16 Bangalore Convention Centre

LOCATION : 10th Mile, Tumkur Main Road , Madavara Post Dasanapura, Hobli, Bengaluru, Karnataka 562123
AREA : Hundred hands
ARCHITECT : 34 acres 1,37,428 sq m
4.The convention center has LEED certification for green rated buildings. It has exhibition complex, Conference center, food court, entrance plaza.

INFERENCE

SPECIAL ATTENTION HAS BEEN GIVEN TO

- Rain water harvesting
- Ozone-friendly air-conditioning system
- Adequate fresh air circulation
- Water based air-cooling in the exhibition halls
- Transplantation of trees together with extensive greening of the Area
- Recycling of waste water through a treatment process
- Usage of water material like fly-ash to the tune of 50% in concrete mix in select areas
- Maintenance of natural contour of land

ROOFS

While we were working on the design of the roofs, some interesting things happened. we were honestly frustrated because all the designs that we had come up with were costing much more than what we could afford.

AWARDS:

biec was certified as a green building by the usgbc (us green building council) for its energy efficient design in september 2008 and awarded as the best steel structure in india by insdag(institute for steel development and growth) for the year 2009.

4.2 LIVE CASE STUDY

4.2.1 MLR CONVENTION CENTRE, BANGALORE

2.17 MLR convention center

INTRODUCTION:

Brigade MLR convention center is a part of a 22 acre residential development in south Bangalore. The design we felt needed to respond to the emerging image of Bangalore and its urban environs. World class venues for Conventions, Shows, Celebrations and Weddings. Designed to international standards with state of the art acoustics, lighting, connectivity and ergonomic seating, MLR Centre contains halls that can be used for different purposes.

Build Area : 6503.2 SQM
Land Area : 1.60 ACRES
Location : Brigade Millenium, 7th Phase, J.P.Nagar, Bangalore.
Year : 2005
Architect :Architecture Paradigm Pvt Ltd

LOCATION:

The MLR Convention Centre is located at Brigade Millennium, 7th Phase J.P. Nagar, Bangalore. It is well-connected and easily accessible from the main areas of Bangalore.

BRIEF OF THE PROJECT:

- The MLR Convention Centre - J P Nagar is an established convention Centre that has hosted weddings, conferences and conventions with aplomb. Designed as a self-contained venue and based on an award winning design from an architectural competition, the MLR Convention Centre - J P Nagar has state of the art equipment, contemporary facilities and is a preferred venue for many an event 12.0kms 26mins distance from railway station 11.6kms 25mins distance from bus station.
- As per plot, architect designed longer side on north & south directions
- South side more vegetation to avoid heat
- Lawn on East side will all ways cool.
- On NW corner & North's, they used glass for elevation.

2.18 MLR map

ARCHITECT INFORMATION:

Project Description : Infrastructure Management
Architect : Architecture Paradigm Pvt Ltd
About the Architect : Architecture Paradigm was established in the year 1996 by Manoj Ladhad, Sandeep J and Vimal Jain and believes that it's most significant strength is the quality of its people and belief in values.

- All the members are young whose instinct for design is tempered by real world experience where they have been exposed to designing and supervision of a variety of projects. The team has an average experience of 16 + years in designing and project execution.
- Facilities at MLR Convention Centre

Auditorium

Auditorium :

Seating capacity of 480 people (Deep thrust Stage, modern green rooms, sophisticated data- projection equipment, state of the art acoustics and lighting facilities, professional sound system.)

Pre Function Area	: 300 People (Floating Crowd)
Banquet Hall	: Capacity 500 People (Floating Crowd)
Board Room	: 10 People
Conference Room	: 30 People
Open Air Spaces	: 700 People (Floating Crowd)
Accommodation	: 10 Deluxe guest rooms & 2 suites

AUDITORIUM:

-Deep Thrust stage

-2Modern Green Rooms

-Stage Dimensions 40Ft.x30Ft.x11.6Ft.

-Seating Capacity of 480 People at 2 Levels

PRE-FUNCTION AREA:

-Capacity of up to 300 People (Floating crowd)

SITE AREA STATEMENT AS PER CASE STUDY

PLOT PLAN	:	1.6ACRE (100%)
GREEN BELT	:	1.5M
SET BACK	:	10M
OPEN AREA	:	0.7ACRE (43.75%)
BUILT-UP AREA	:	0.9ACRE (56.25%)
PARKING	:	100 Cars / 100 Scooters

MERITS

1.Providing water-body in front of the building people will get fresh atmosphere
2.Having indoor and outdoor party areas to have events as per timing.

DE-MERITS:

1.Car has to take two circular drives to get into cellar.
2.Same entry for visitors and services.
3.All round drive way is not provided.

INFERENCE

MERITS

1.Overall the arrangement of spaces has been designed in different levels
2.Services has been arranged privacy to the public
3.For space utilizing chiller and other services provided on roof
DE-MERITS

1.Parking space is sufficient but arrange ment of cars not well.
2.Only one fire fighting stair case provided
3.Only one Internal stair case provided width is 1.0 m only.
4.Provided two 8 passenger lifts only.
5.Cafeteria is open. No protection with rain, wind and sun.
6.Kitchen is to small.
7.Entry exit of cellar floor of car parking is very narrow 3 mts only.
8.Lobby or entry foyer is no protection of rain.

DIMENTION & FLOOR PLAN OF MLR CONVENTION CENTRE-JPN.
(A VENTURE OF BRIGADE HOSPITALITY SERVICES LTD)

Sr.No	NAME OF THE VENUE	WIDTH & LENGTH	TOTAL Sq.ft	CAPACITY
1	Auditorium Stage	41.5 X 28	1162	
2	Auditorium seating	59 X 54	3186	481 Persons
3	Cafeteria	40 X 50	2000	200 Persons
4	Conference Hall	26 X 16.6	432	030 Persons
5	Board Room	16 X 10.9	175	010 Persons
6	Banquet Hall Stage	26.9 X 36.9	993	030 Persons
7	Banquet Hall	81.9 X 52.6	4300	500 Persons
8	Banquet Lawn Area	30 X 20	600	100 Persons
9	Dining Hall	40.3 X 36.6	2640	150 Persons
10	Banquet Hall Dining Hall Cafeteria/Lawn Area	Spacious	9300	1500 Approx Floating crowd

COMMENTS:
1.Structural system has been taken on function of activity.
2.Levels arrangement has been taken different types of activity
3.Common columns connectivity to all the structures but different arrangement

AUDITORIUM STAGE LIGHTING DETAILS

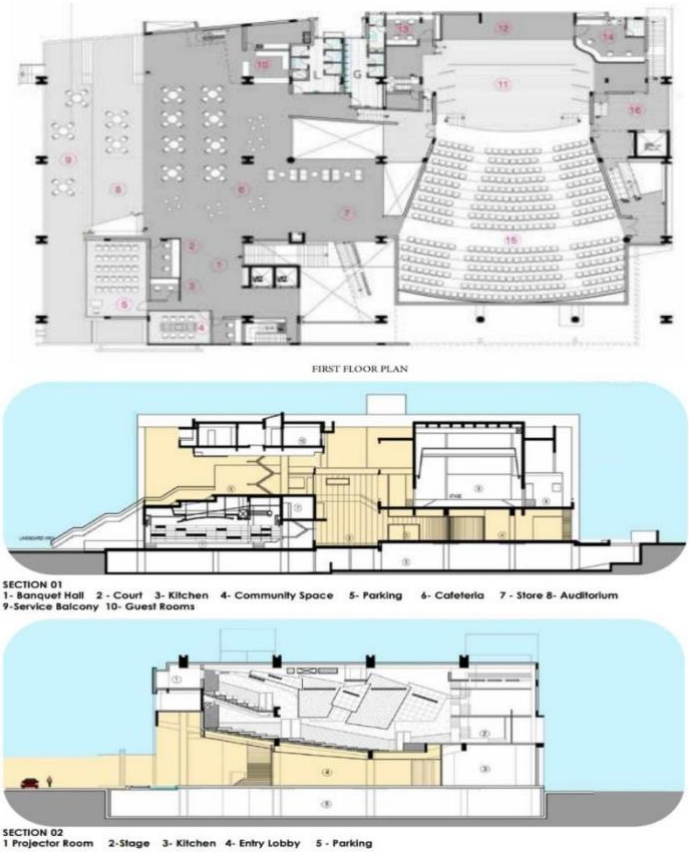
1	Parcan Lights	30 nos
2	Focus Lights	06 nos
3	Mini-Halogen Lights	08 nos
4	Flash Lights	06 nos

AUDITORIUM SEATING CAPACITY

1	Below Balcony	346 Seats
2	Balcony	135 Seats

COMMENTS:

- Cellar utilized for covered parking
- Kitchen and other services has been taken care for the service system to easy maintained
- Over head tank and other services provided at roof level to do not exposed to people
- People can view the elevation at large space opening entering into convention centre 5.Utilizing the set back with landscaping



2.19 MLR section

Sheet15

Solar Shading

1. Introduction

Moving towards passive house-level envelopes [1], zero-energy buildings or zero-emission buildings, as defined by the Research Centre on Zero Emission Buildings (ZEB) [2-4], where the carbon footprints of the buildings have been reduced vastly, the performance of the transparent parts of the envelope is vital in order to ensure a low energy demand and a desirable indoor environment [5,6]. Previous studies explored and confirmed that the energy performance of buildings is highly dependent on the design, functionality, and area of the transparent façades in office buildings [7-9].

Solar shading – types and functionality

The main reason for using internal solar shading should be to control glare, provide privacy, and regulate the visible light transmission through the glazed area. Depending on the properties of the shading system, superfluous heat may be radiated back through the glazing, thus giving a potential for a reduced cooling demand [31]. However, in this regard, this solution is less effective than that given by placing exterior shading devices.

Assessing shading system performance

In the existing literature one can find long lists of different parameters used to assess the performance of shading systems which could or should be considered [31,40]. Carrying out a holistic characterisation of systems based on all of these factors is time-consuming, and choices are often dependent on which parameters are selected and used for the respective analyses.

Objective

- Are users in modern office buildings satisfied with the visual comfort in the buildings
- In what way and how much does solar shading system performance influence the perceived comfort?
- Does assessment of daylight quality using standardized, and much used, daylight assessment metrics correspond to actual user satisfaction in case office buildings?

Method

- Fixed exterior shading towards south and west
- External venetian blinds towards south and west with automatic control
- Internal, semi-transparent roller-blinds made in a metallic-like fabric

Thermal comfort

The interviewees assess the external fixed shading to be sufficient to block out solar thermal radiation. One of the workers sitting close to the glazed parts of the south-facing facade points out that it can actually be too cold, even on sunny days. They all stress the fact that people have different preferences regarding which temperature levels they perceive comfortable. It must be noted that the actual energy demand for cooling of the offices are not available for comparison with the designed demand.
DF and UDI for the simulated office cubicle with the NiNa-office shading solution. (a) Unshaded, (b) with exterior shading deployed, and (c) interior roller shade covering 50% of area

AAC Blocks

- AAC blocks are a precast, foam concrete, sustainable construction material made from aggregates of quartz sand, calcined gypsum, lime, portland cement, water and aluminium powder. After mixing and moulding, the concrete is autoclaved under heat and pressure and it thus gains its distinctive properties.
- AAC bricks are in high demand, owing to their high strength, load-bearing and thermal insulation properties.
- AAC block is used as a construction material for interior and exterior structures. The blocks may be coated with a stucco finish or with siding materials like veneer brick or vinyl siding.

- Colour Greyish-white
- Lightweight 50% lighter than red bricks
- Fire resistance Between two and six hours, based on the thickness
- Energy efficiency 25% reduction in air-conditioning costs
- Thermal efficiency Three times higher than clay bricks
- Water absorption About 10% of its weight
- Sound insulation 42 dB (approximately)
- Affordable cost Nearly one-third of the cost of regular bricks AAC block price: AAC blocks sizes and prices

- Manufacturers of autoclaved aerated concrete produce AAC blocks ranging in varied sizes and strengths.
- The AAC block price for rectangular AAC bricks having size (length X height X weight) of 600mm x 200mm x 250mm can range between Rs 2,000 and Rs 3,500 per cubic meter.
- The AAC blocks sizes and prices differ, depending on the manufacturer.

AAC blocks advantages

- Thermal insulation and energy-efficiency
- The material contains small air pockets and hydrogen is used to foam the concrete, thus, giving it an excellent heat insulation property that allows temperatures to be warm in winters and cool in summers. Therefore, it can significantly lower your air-conditioning costs by about 25%. AAC blocks are energy-efficient across their lifecycle, as their production involves less energy consumption.

Fire-resistant

The AAC block material is non-combustible and provides fire resistance of up to six hours, depending on the block thickness and up to 1,200 degrees Celsius, compared to other building materials. Thus, it also has importance from a fire safety point of view.

Sustainable and affordable

- AAC blocks are made from natural and non-toxic raw materials and their manufacturing process

Generates minimum waste. Some of the waste or offcuts generated can be recycled or used in aggregates.

- As it is made from non-biodegradable materials, it makes the building durable and stable, preventing rot or mold. Furthermore, being lightweight, energy-efficient and easy to install, AAC blocks also minimise labour costs.

Moisture-proof

Moisture can severely damage a structure. The macro-pores inside AAC blocks ensure low absorption of water. Thus, they provide better moisture protection.

AAC blocks disadvantages:

- Although AAC blocks are widely used in masonry units of high-rise RCC (reinforced cement concrete) framed buildings, they can be expensive when used for small load-bearing structures.
- When using AAC blocks, it could be one of the disadvantages
- Considering the high AAC block prices, buying a small number of blocks for such structures can cost more, as compared to ordering in bulk quantities for large projects.

Double-Paned Window?

- A double-paned window has two panes of glass set into a frame to create a sandwich of glass with an air pocket to better insulate a room. It is sometimes referred to as a double-glazed window or an insulating glass unit (IGU).

- A single-paned window with one sheet of glass is an older style that has since been replaced by the more popular and energy-efficient double-paned window. Though double-paned windows were introduced commercially in the 1950s, they became common in homes around the 1970s.
- Double-paned windows are now standard for both new construction and replacement windows. Triple-paned windows **are sometimes recommended in environments with harsh weather for maximum insulation.**

Advantages of Double-Paned Windows

- Though glass itself isn't much of a thermal insulator, it can seal and maintain a buffer from the outside.
- Double-paned windows offer a significant advantage when it comes to the energy efficiency of a home, providing a better barrier against outside temperatures than single-paned windows.
- The gap between glass in a double-paned window is commonly filled with an inert (safe and non-reactive) gas, such as argon, krypton, or xenon, all of which increase the window's resistance to energy transfer.
- Though gas-filled windows have a higher price tag than air-filled windows, the gas is denser than air, which makes your home significantly more comfortable. There are differences between the three types of gas that window manufacturers prefer:
- Argon is a common and most affordable type of gas.
- Krypton is typically used in triple-paned windows because it performs best within extremely thingaps.
- Xenon is a cutting-edge insulating gas that costs the most and is not as commonly used for residential applications.

Wall vs. Window R-Values

- By comparison, a standard two-by-four stud wall with batt insulation and wallboard and wood siding has an R-value of R-12 to R-15, which is considered to be on the lower end compared to other types of materials and sidings.
- Window manufacturers continue to develop technologies that will allow windows to approach the higher R-value of the walls themselves.

Pane	Air/Gas	Coating	R-Value
Single	None	None	0.9
Double	Filled with 1/2" of air	None	2.084
Triple	Filled with 1/2" of air	None	3.226
Double	Filled with argon	Low-E (1 coating)	3.846
Triple	Filled with argon	BLow-E (1 coating)	5.433

5. ANALYSIS

5.1 SITE ANALYSIS

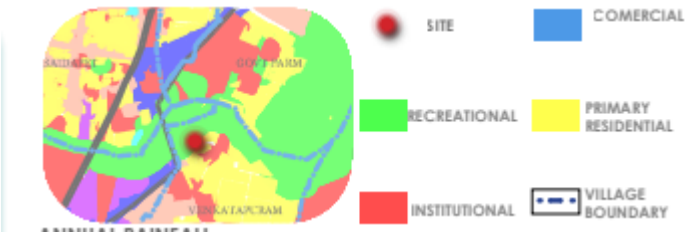
Fig 3.1SITE

5.2 SITE AREA : 15 Acres 60,692.65 m² sq m
LOCATION : Mount Poonamallee Rd, Kamala Nagar, Porur, Chennai, Tamil Nadu 600125

- Bus stop near by metro station located in 7.3 km away from the south east side of the site.
- Airport located in 9.2 km away from the south side of the site.
- Central railway station located in 15.7 km away from the north east side of the site.
- CMBT, koyambedu is located in 7.7 km away from the south west side of the site.

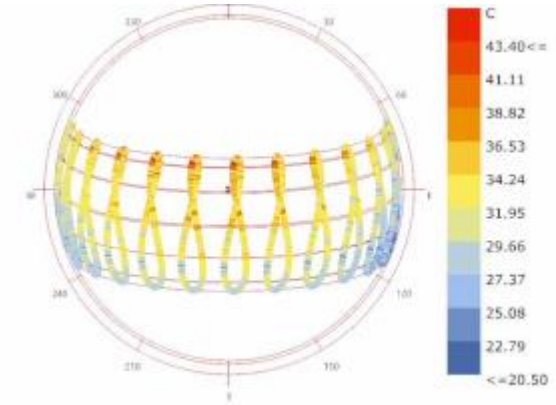
SOIL TYPE

The charnockite suite or series is a particularly widespread form of granofels. Granofels are one of the few non-foliated rocks to form under relatively high temperatures and pressures



ANNUAL RAINFALL

The average annual rainfall is about 1,400 mm (55 in). The city gets most of its seasonal rainfall from the north-east monsoon winds, from mid-september to mid-december. Cyclones in the bay of bengal sometimes hit the city. Highest annual rainfall recorded is 2,570 mm in 2005.



SEISMIC CONDITION

(i) Earth quake-prone Areas: Chennai Metropolitan Area falls under Seismic Zone – III. The whole of Chennai Metropolitan Area falls in this zone.

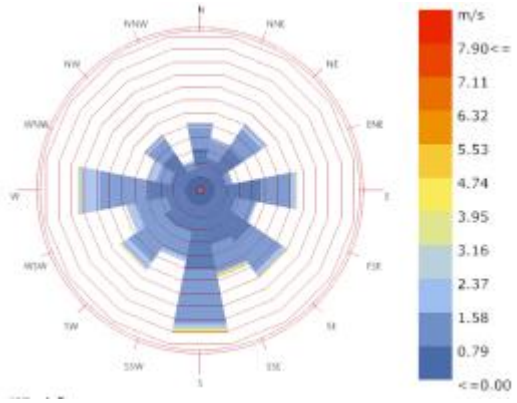
(ii) Cyclone-prone Areas: In this Chennai Metropolitan Area, it extends to a distance of 20 km. from the coast in all the coastal districts.

POPULATION AND TRANSPORTATION

Chennai Population in 2022 is 11.5 Million (1.15 Crores). Chennai is fifth largest urban agglomeration city in India and 30th largest city in the World. Geographically Chennai is well connected with all modes of transport by road, rail, air, and sea. It has an international airport and seaport. This city is renowned for Bharatnatyam, a popular south Indian dance and is one of the oldest classical dance forms in India

CLIMATE TYPE

Warm and humid climate a climate with an excess of moisture, in which the solar heat received is sufficient to evaporate all moisture occurring in the form of precipitation.



S W O T

STRENGTH

- The site is located in Porur, Chennai. Because of these metropolitan city facilities, which are needed for the site, it is easily accessible distance.
- The site has direct access from Mount Poondamalli Road, which is one of the main arterial roads of Porur.
- So, because of these access facilities, people will not have any difficulty accessing the site.

WEAKNESS

Because this main arterial road site should be affected by the Dust, Traffic, Air Pollution, And Noise Pollution.

OPPORTUNITY

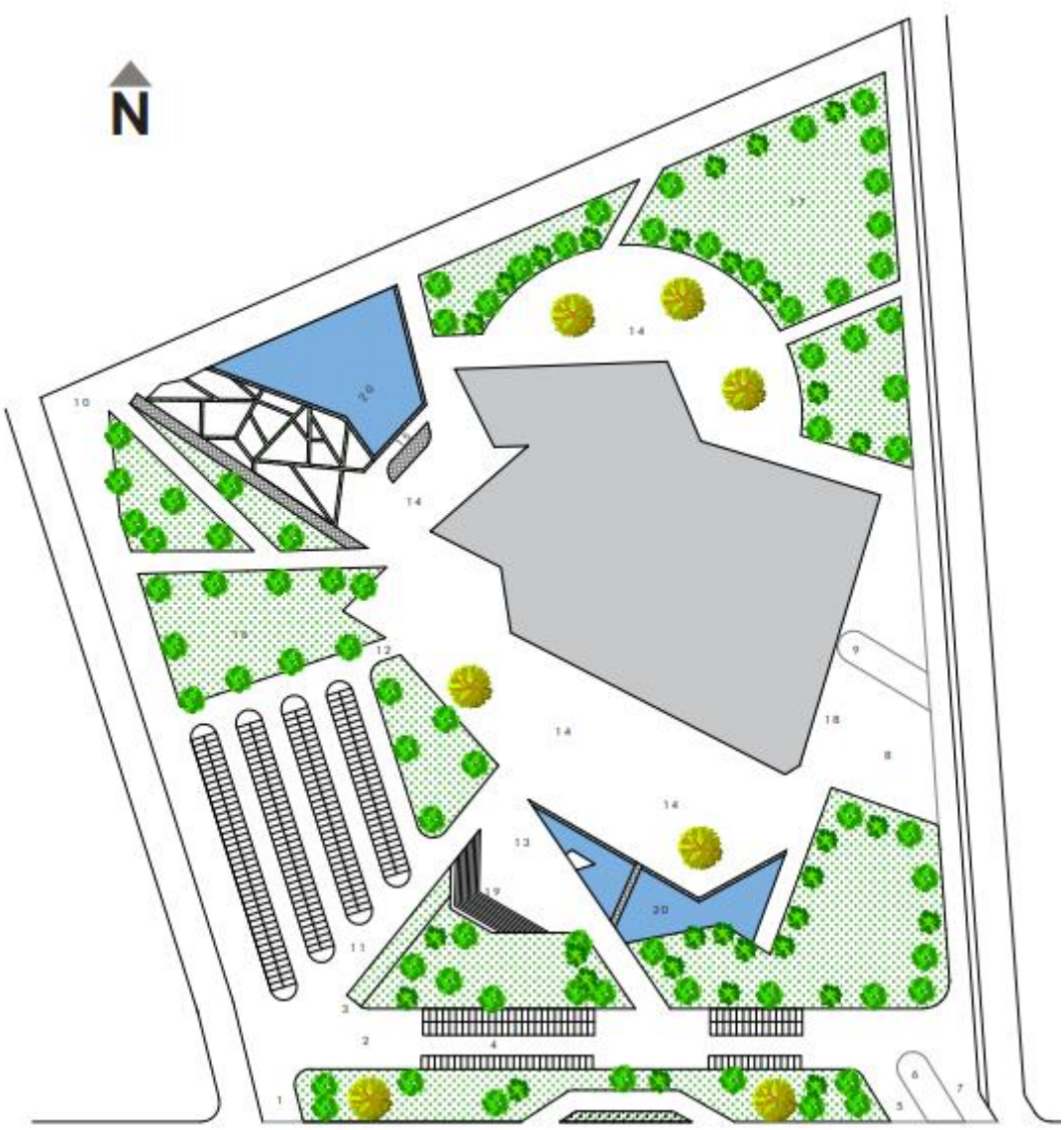
- Bus stop is located in nearby distance of 56 m.
- Near By Metro Station Located In 7.3 Km Away From the South East Side Of The Site.
- The Airport is 9.2 kilometer to the south of the site.
- The Central Railway Station is located 15.7 km away from the North Eastern Side of the Site.
- CMBT Koyambedu is located 7.7 km away from the south-western side of the site.

THREAT

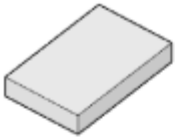
- The site is surrounded by a lot of commercial buildings, so the site has a chance to be affected by the commercial wastes.

6. DESIGN DEVELOPMENT & PROPOSAL

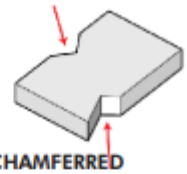
6.1 Master Plan



6.2 Concept Development

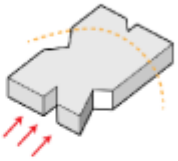


BUILD MASS
According to FAR

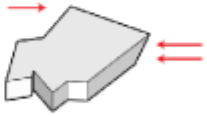


CHAMFERRED
Entries to building from both sides

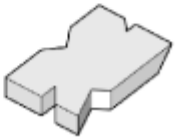
1.PEDESTRIAN ENTRY CONVENTION ZONE
2.VEHICULAR ENTRY CONVENTION ZONE
3.TO BASEMENT PARKING
4.SURFACE PARKING
5.ADMIN & VIP ENTRY
6.FROM BASEMENT
7.ALL VEHICULAR EXIT
8.ADMIN PARKING
9.ADMIN & VIP ENTRY
10.SERVICE ENTRY
11.PARKING FOR URBAN PLAZA
12.WAY TO URBAN PLAZA
13.WELCOME PLAZA
14.PLAZA WITH SEATING
15.YOGA DECK
16.PLAZA FOR FOOD COURTS
17.OPEN EXHIBITION /CONVENTION AREA
18.AMPHITHEATRE BELOW
19.OPEN AIR THEARE
20.WARTER BODY



MOULDED
according to the sun path for natural light throught the builtmass, also to break the monotony of the builtmass chamferred



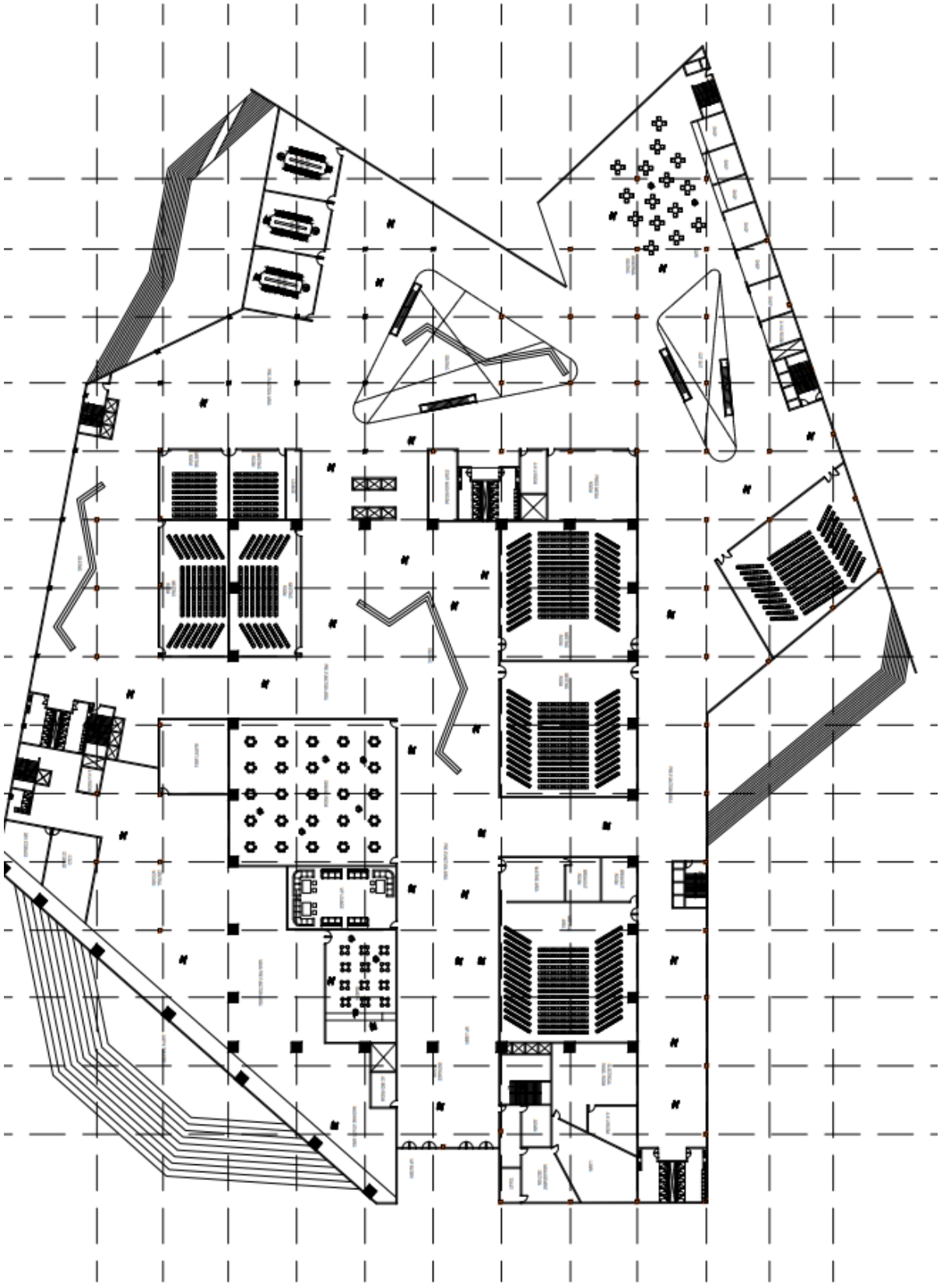
INTRODUCED
amphitheatre and stramped plaza to the other side of the buildmass to make it interactive and Active Public space



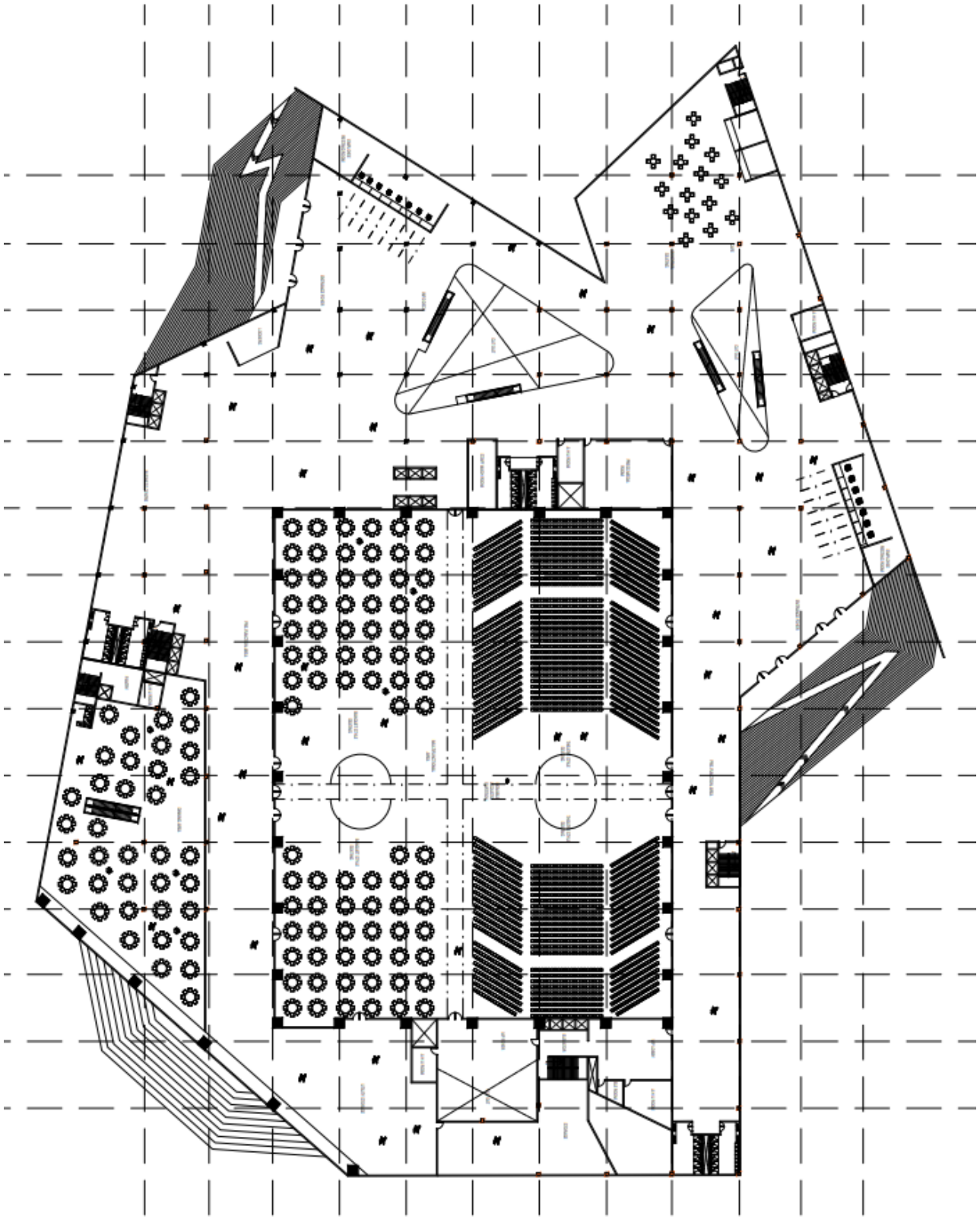
ITERATED
accordingly to maximize the natural light to atrium and other areas

Basement Plan

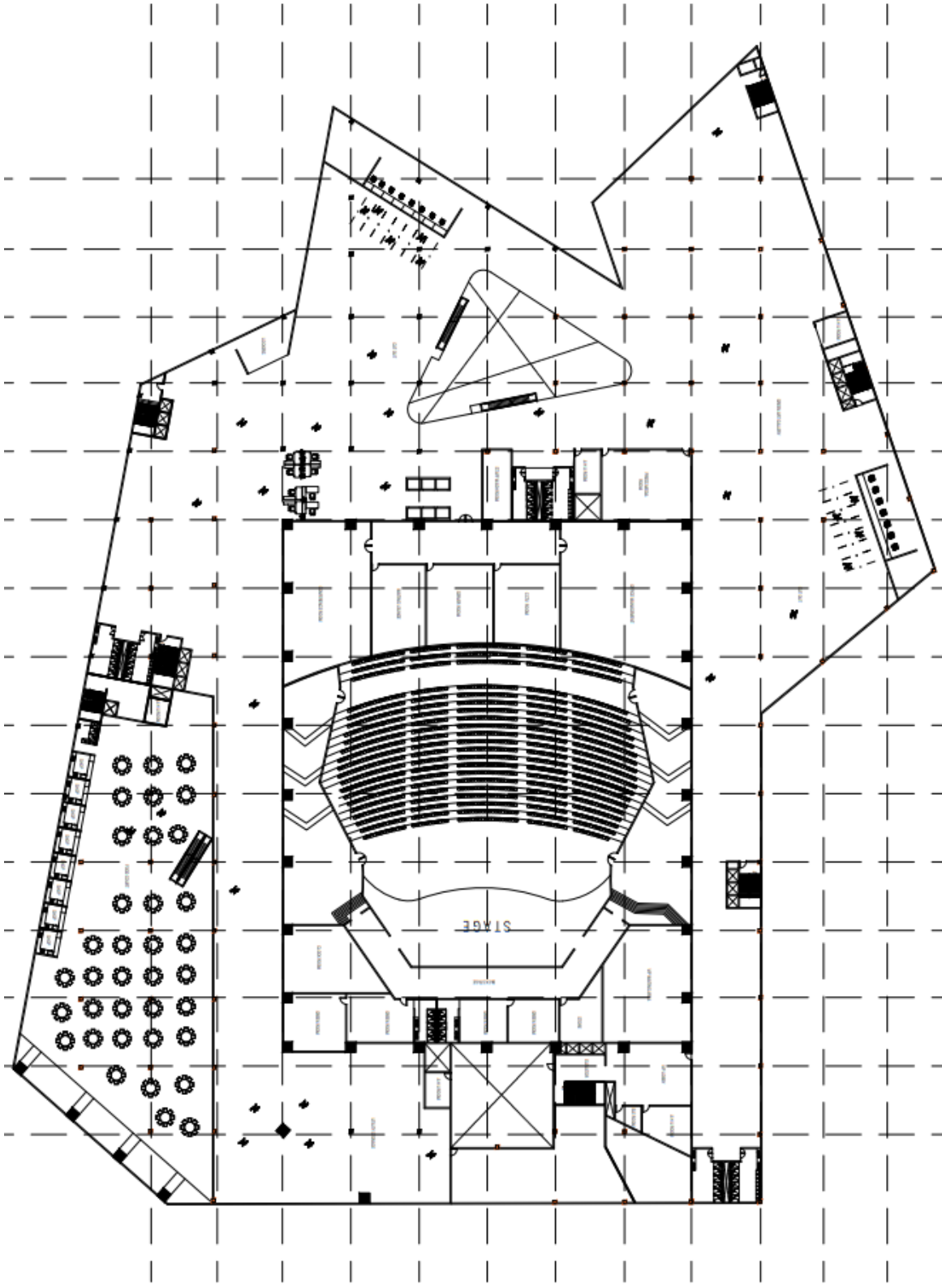
Floor plan



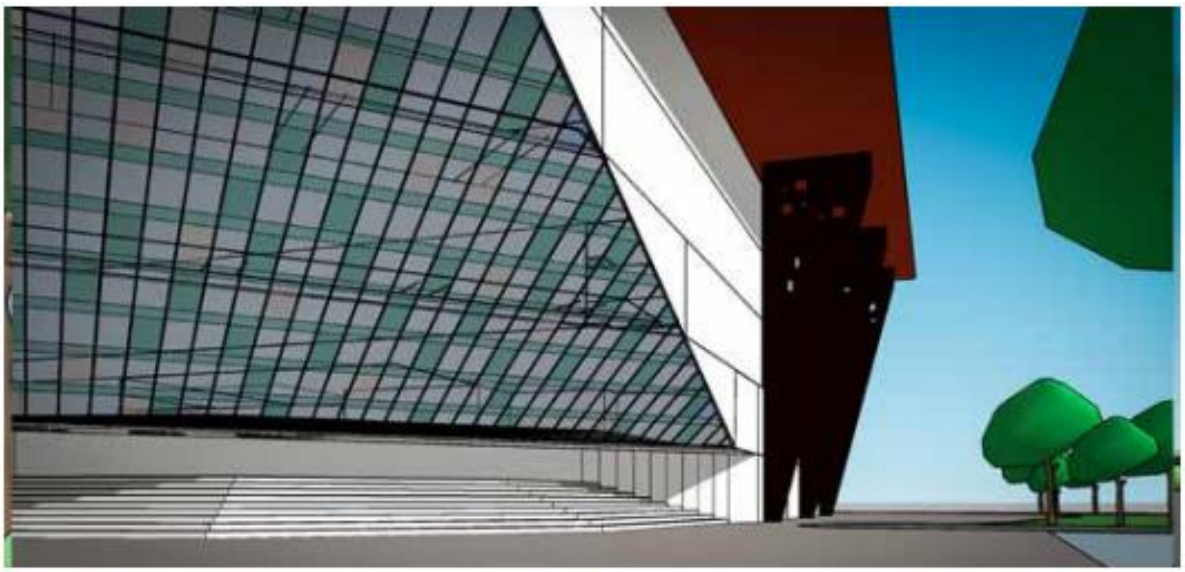
Floor plan

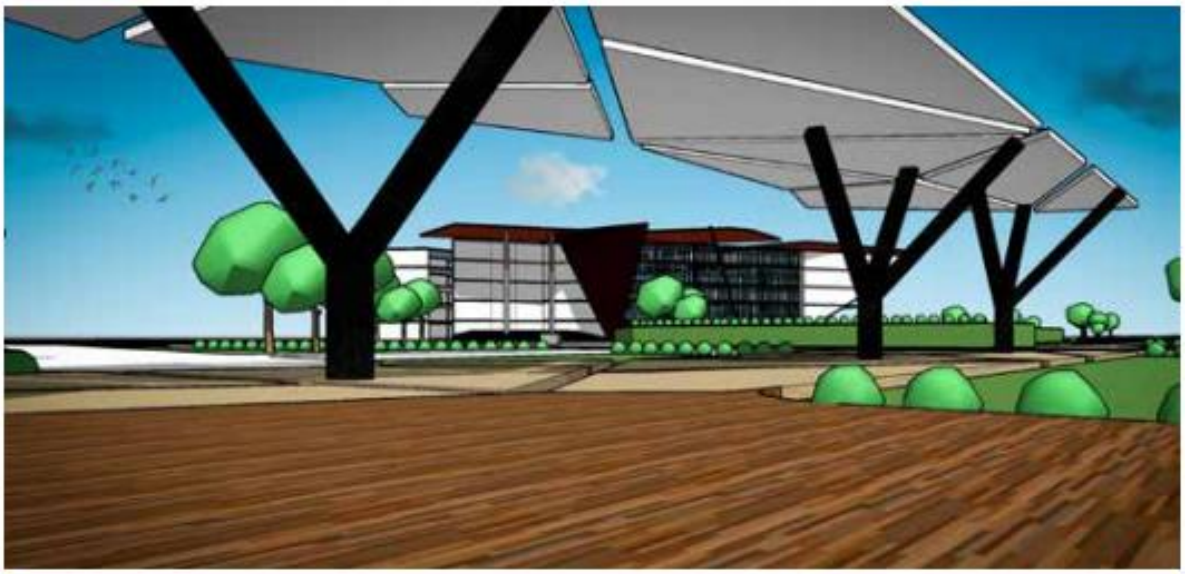


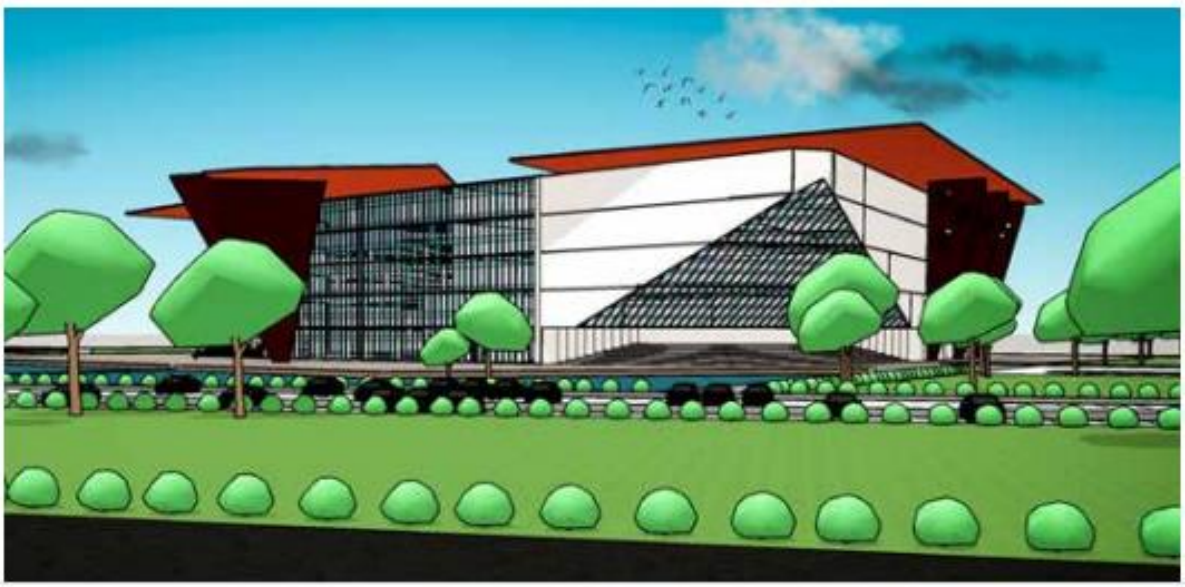
Floor plan

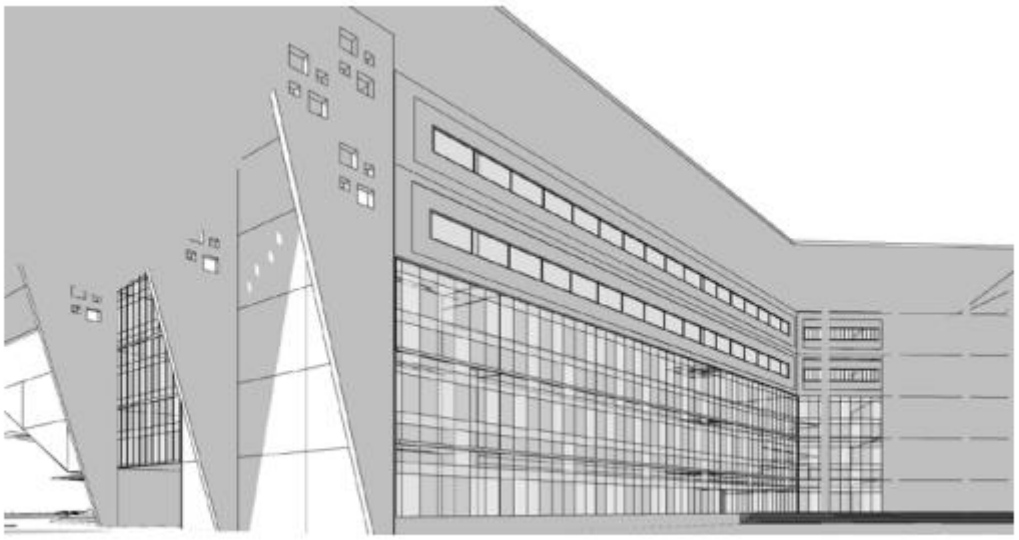

STAGE

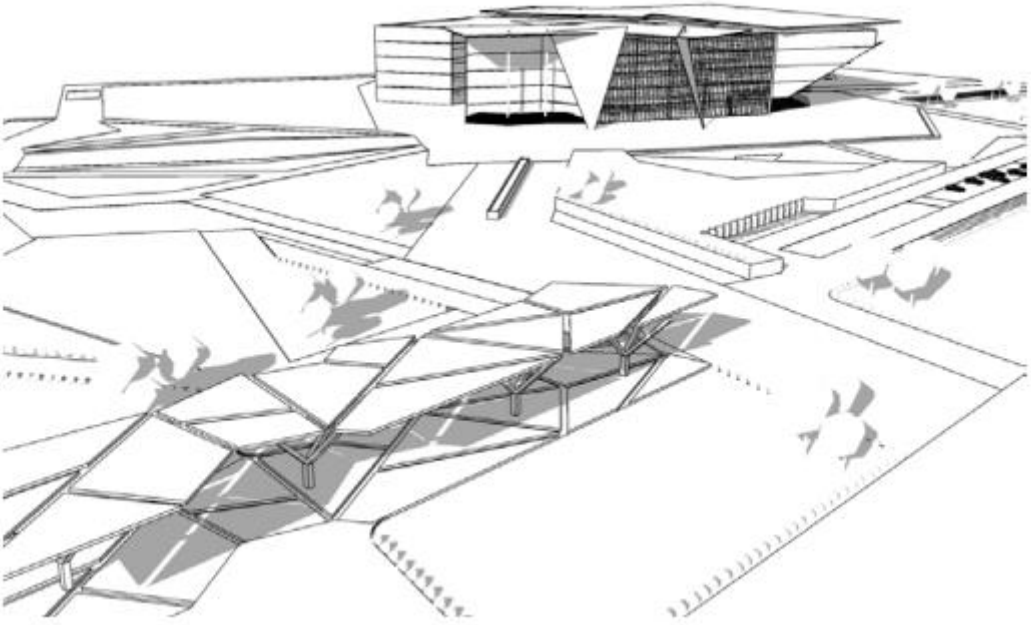
6.3 VIEW











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