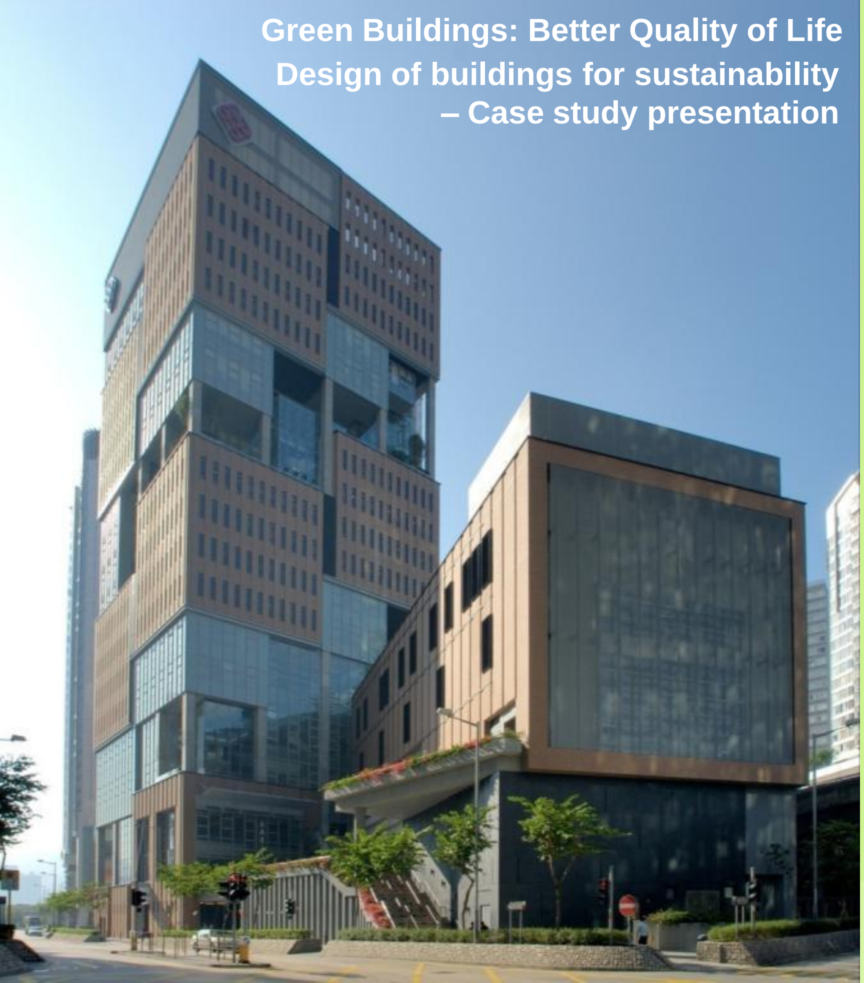


Green Buildings: Better Quality of Life

Design of buildings for sustainability – Case study presentation

Prof. Bernard V. Lim JP

Principal, AD+RG Architecture Design and Research Group Limited

Professor, School of Architecture, The Chinese University of Hong Kong

The Hong Kong Community College

The Hong Kong Polytechnic University

Client:
The Hong Kong Polytechnic University

Project Manager:
Campus Development Office,
The Hong Kong Polytechnic University

Project Architect:
AD+RG Architecture Design and Research Group Ltd.

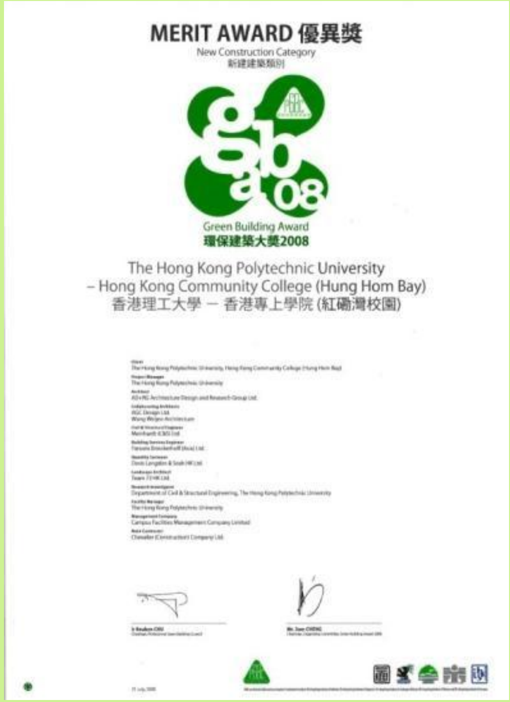
Architectural Collaborators:
AGC Design Ltd.
Wang Weijen Architecture

Acknowledgements Received

- Green Building Award 2008
  Merit Award in the New Construction Category.
  by Professional Green Building Council

- Highest BEAM (Building Environmental Assessment Method) rating of Platinum
  by HKBEAM Society.

  (The first educational building in Hong Kong to achieve such rating)



MERIT AWARD 優異獎

New Construction Category

新建建築類別

Green Building Award

環保建築大獎2008

The Hong Kong Polytechnic University – Hong Kong Community College (Hung Hom Bay)

香港理工大學 – 香港專上學院 (紅磡灣校園)

BEAM Society

香港環保建築協會

This is to certify that the

評 估 證 書

THE HONG KONG POLYTECHNIC UNIVERSITY

HONG KONG COMMUNITY COLLEGE

(HUNG HOM BAY CAMPUS)

8 Hung Lok Road, Hung Hom, Kowloon

香港理工大學 - 香港專上學院(紅磡灣校園)

九龍紅磡紅樂道8號

IN ACCORDANCE WITH THE BUILDING ENVIRONMENTAL ASSESSMENT METHOD (BEAM) FOR NEW BUILDINGS (4/04 VERSION), ACHIEVING THE RATING OF

PLATINUM STANDARD

白金級別

Mr Kevin Edmunds

Vice-chairman, BEAM Society

香港環保建築協會副主席

ISSUE DATE: 17th October 2009

簽發日期: 二零零九年十月十七日

BUSINESS ENVIRONMENT COUNCIL

商界環保協會

THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

HONG KONG COMMUNITY COLLEGE 香港專上學院

Acknowledgements Received

- Finalist in "World Architecture Festival 2008" in Barcelona on October 2008

- one of the 12 Finalists in the Learning Category and is the only Hong Kong architectural practice in this Category.

0.0 Project Brief

(I) Introduction

The Project is a high-rise 19-storey institutional building for the Hong Kong Community College.

It aims at providing a **dynamic and interactive space** for youth education while incorporating the ***sustainable design considerations* and construction techniques** into the building.

4 main design and engineering concepts:

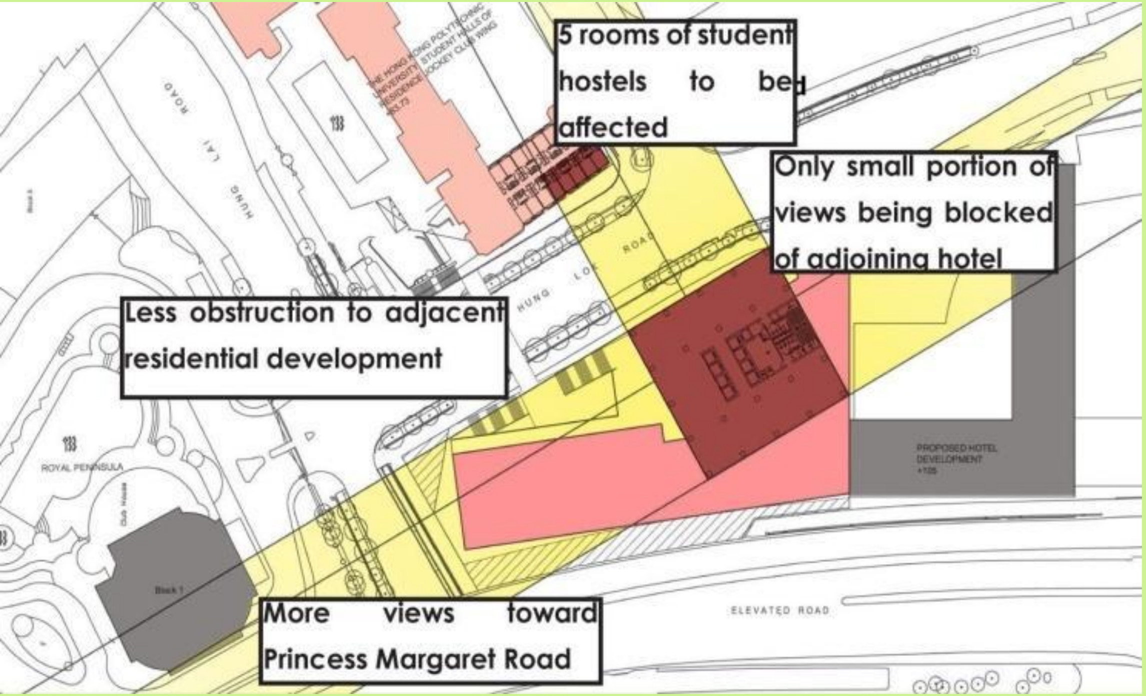
- **Sustainable** multi-storey building for the 21st century campus
- Design for **identity, adaptability and flexibility**
- Optimizing **public communal space** to inherit PolyU's campus quality
- **Effective circulation** design consideration for high-rise campus

(I) Introduction

The **Hong Kong Community College (HKCC)** serves as a new campus for the Hong Kong Polytechnic University to cater for the Associate Degree programmes at Hung Hom Bay.

0.0 Project Brief

(II) Master Plan Consideration



Site opportunities and constraints

Locating at nearby sites, HKCC and the existing PolyU Student Hostels should each have appropriate identity in terms of form, massing and spatial quality, but well integrated visually and linked physically

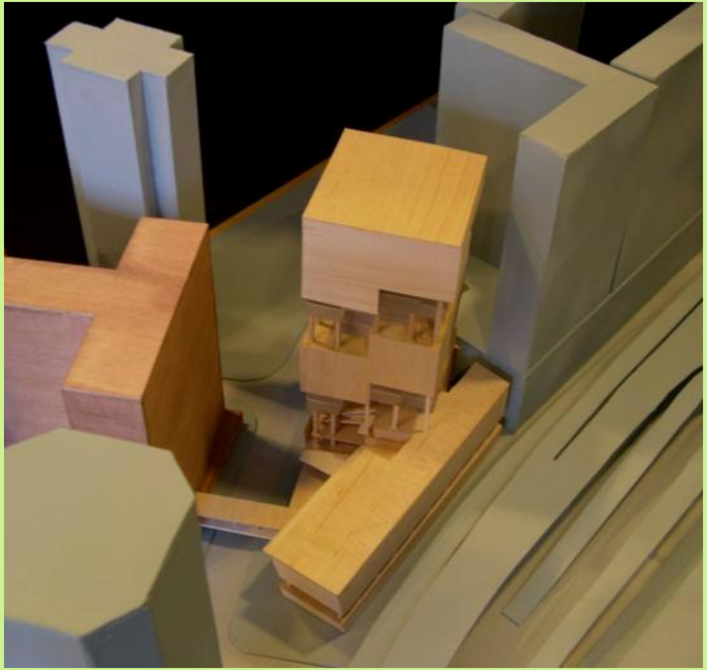
Design response

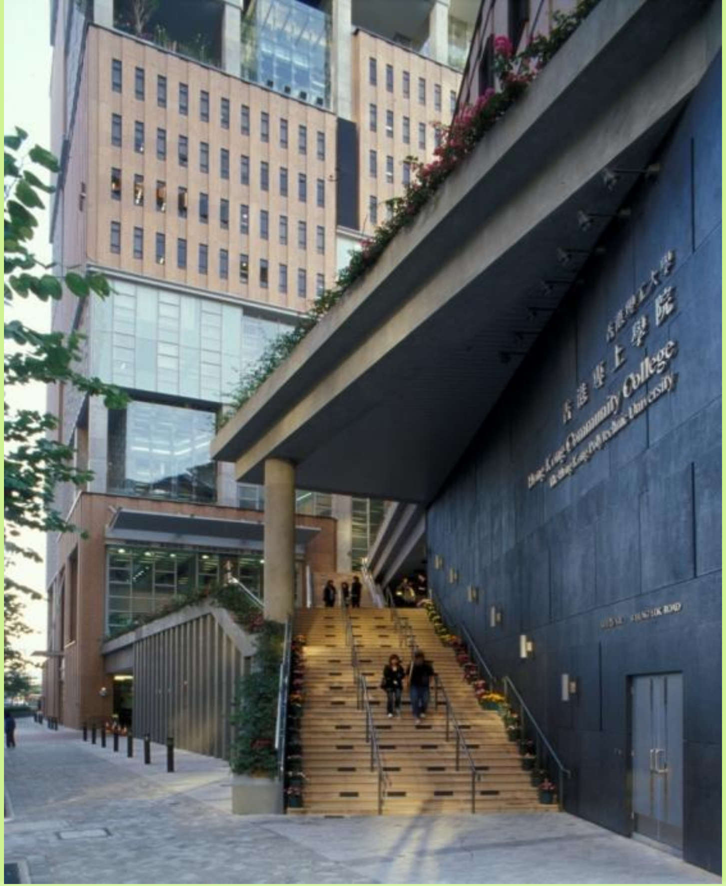
- Raised landscaped decks on top of the multi-purpose hall to provide greenery public space

-- Careful disposition of high-rise block for best view enjoyed by the users and optimum inter-block lighting/ventilation exposure

0.0 Project Brief

(II) Master Plan Consideration





0.0 Project Brief

(II) Programme

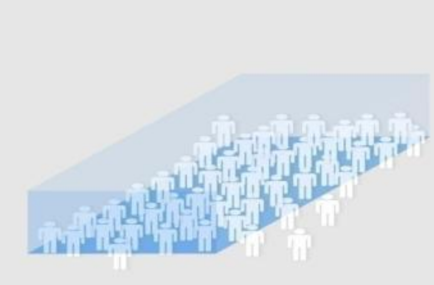
Vertical Campus

Challenges:

- effective vertical circulation system

- outdoor / communal spaces for learning

A Campus for **3000** students



Low Rise Condition

High Rise Condition

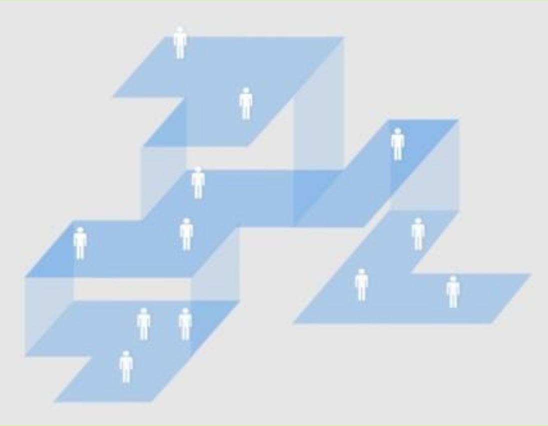
(II) Programme

Alternative learning spaces configurations

-Informal learning clusters

- Interactions

Traditional - Classroom



Alternative – Learning clusters

(II) Programme

Programmatic distribution:

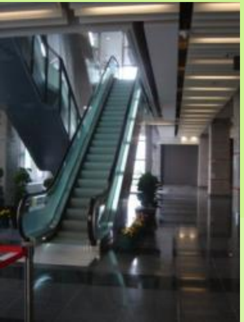
- Low block: mass teaching facilities in the low block

- Classrooms: up to 8/F

- Library / Computer Centre: 9/F to 11/F (Heart of Campus)

- Specialist Teaching Rooms: 12/F to 14/F

- Staff / Administration: 15/F to 17/F



0.0 Project Brief

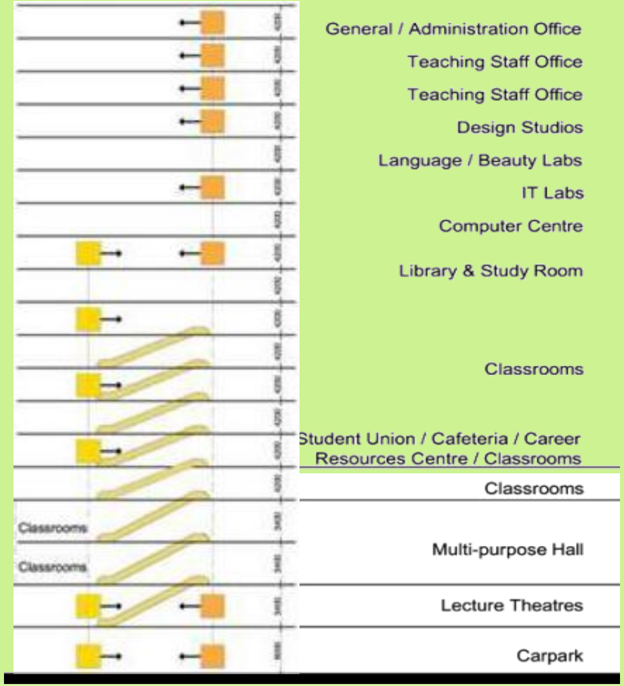
(II) Programme

Effective circulation design consideration for high-rise campus

- Escalators are used to serve the low levels where mass teaching spaces accommodated

- Lift landings at strategic communal spaces

- Lift traffic study was conducted to determine the **optimum lift number and zoning arrangement** for effective and efficient energy use strategy



0.0 Project Brief

(III) Modular Planning Design

Modular Planning Design

- The premises target to cater ever-changing teaching needs in future as well as developing technologies

- A flexible "modular system of spatial combination" capable of future transformation has been developed to facilitate the need of adaptability / flexibility

- Module - 8.4m x 8.4m spatial unit

- Pre-cast R.C. construction can be adopted for better environmental and construction management consideration

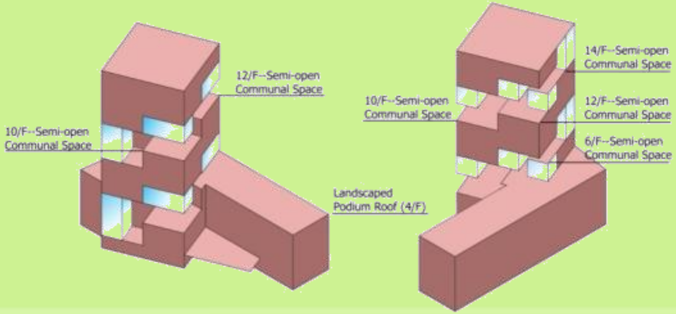
Upper floor layout plans

0.0 Project Brief

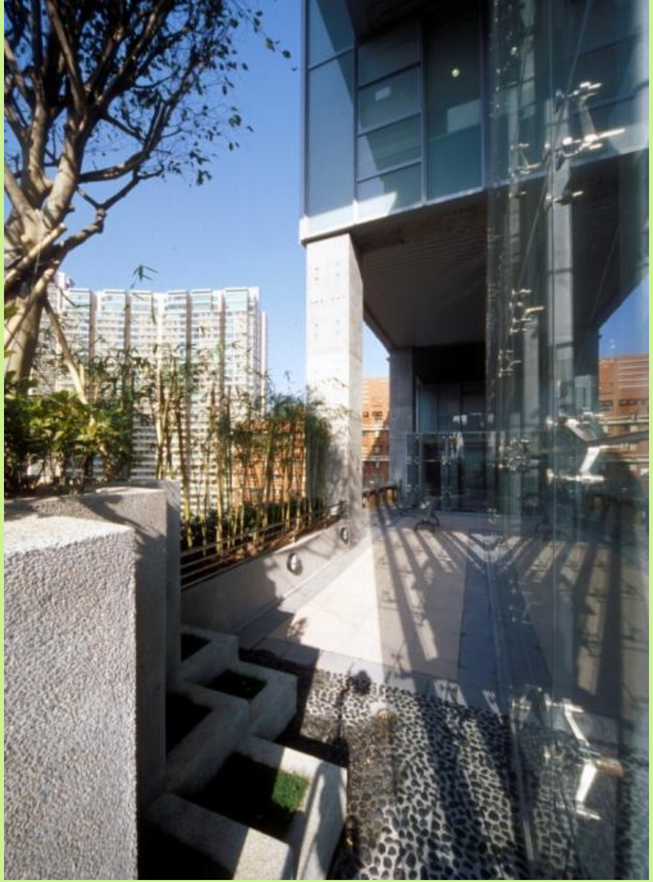
(III) Modular Planning Design

Sky gardens

- Access to external air in a high rise campus
- External communal spaces
- Spiral allocation




Nikon

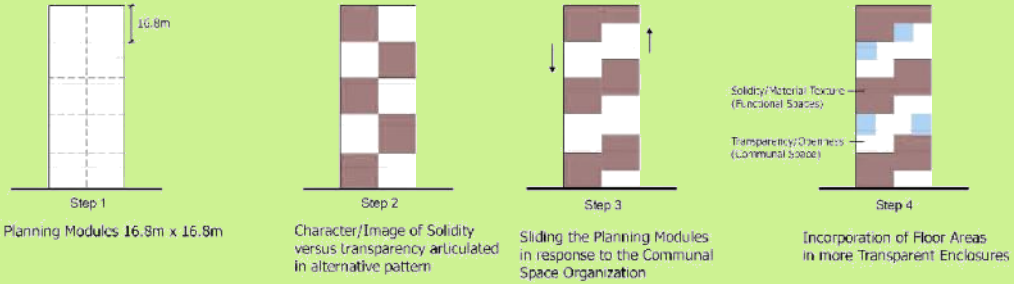


0.0 Project Brief

(III) Modular Planning Design

Modular design for elevation

- Response is made to the modular space organization



(III) Modular Planning Design

Modular design for elevation

- Modular design for elevation is articulated by square-shaped planning modules to match the spiral sky garden organization

- Enhance air flow across the building mass.

0.0 Project Brief

(III) Modular Planning Design

Computer 3D Model Façade Study

High rise learning space – Sky garden

1.0 Quality

1.1 Indoor Environmental Qualities

1.2 Bioclimatic & Landscape Qualities

1.3 Neighbourhood Amenities

Quality

From various building service implementations and structural system integration to the architectural layout planning and design, different simulations and prudent testings and commissioning aim at achieving a high quality building in terms of enhancing the indoor and outdoor air, visual enhancement, transportation and circulation, acoustic and noise attenuation etc.

1.0 Quality

1.1 Indoor Environmental Qualities

Natural lighting at indoor space

- **Internal courtyards with glass enclosure**

- **Air flow Control for Workshop**

- Exhaust system is provided to maintain the workshop at negative pressure to prevent smell from spreading to other areas.

- **Low Level Exhaust for Toilets**

- Low level exhaust is provided for each toilet cubicle. Ventilation fan is located above false ceiling of the toilets and discharged to open air.

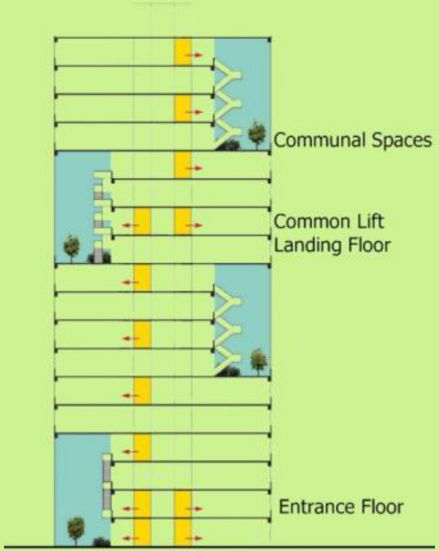
- **Fresh Air Intake**

- Fresh air intake is located away from the possible traffic contamination and other pollutant sources.

Internal Courtyards

1.0 Quality

1.2 Bioclimatic & Landscape Qualities

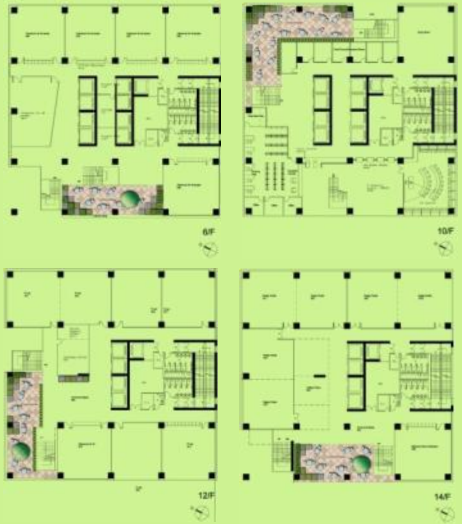


- **Sky gardens and green roof**
  - Enhance natural ventilation

- **Integration of Greenery into the Elevations**
  - Along periphery of building and parapet walls / outside classrooms - strip planting to enhance natural ventilation and to screen off unpleasant view

- **Internal courtyards with glass enclosure**

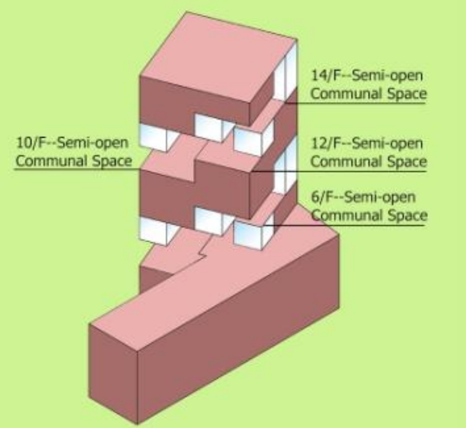
- **Foot Massage Pathways**
  - Foot massage pathways are installed at 4/F landscape deck

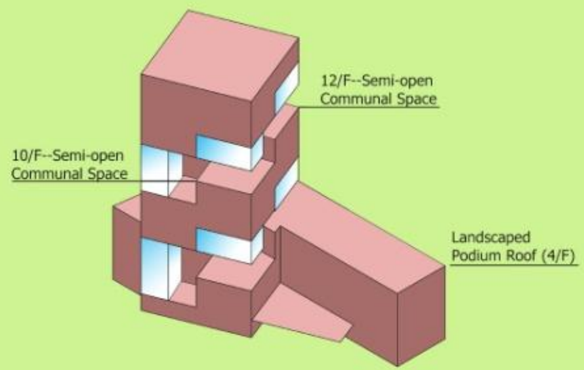


Sky gardens as communal spaces on upper floors

1.3 Neighbourhood Amenities

- **Integration of Greenery into the Elevations**
  - Feature trees/palms are located at semi-open communal spaces as a focus to create a unique ***landmark*** for orientation





2.0 Resources

2.1 Energy Flows & Energy Future

2.2 Material Use & Water Conservation

2.3 Waste Management & Pollution Control

Originality

The first fully pre-cast and modular unit system (including columns, beams, ribs, facades, staircases, etc) adopted in this high-rise institutional building with the objectives to promote off-site fabrication and reduce material wastage.

The maximized amount of sky gardens intends to bring in more fresh air and enhance the indoor air quality, meanwhile, provides visual comfort to visitors and users.

2.0 Resources

2.1 Energy Flows & Energy Future

- **Varied Ceramic Fritted Patterns on glass panels applied at different places of the building**
  -There are three different types of glass used in the building. They have different degrees of transparency. This is controlled by means for different percentage of ceramic fritted pattern on the glass. For the Glass on the outermost of the building, it has about 50% transparency: this helps reducing heat gain, and thus saving energy for cooling. For the inner glass, it is either clear glass or glass with 30% fritted pattern: this helps maintaining outside views.

Glasses with fritted patterns of various densities

2.0 Resources

2.1 Energy Flows & Energy Future

Lightings of various luminance at different locations

- **Energy saving standard of luminance is adopted for particular locations in the building**
  - Luminance of 300 lux is adopted for classrooms
  - Luminance of 100 lux is adopted for corridors

- **Maximizing the openable window provisions to the internal corridors in order to reduce electricity consumption**
  - Windows are introduced at the ends of the internal corridors on typical floors of the Tower Block

- **Night Mode chiller**
  - 4 big water-cooled chillers and one 1 small water-cooled chiller are adopted. The small chiller is used as nighttime or light load chiller to optimize the efficiency of the equipment.

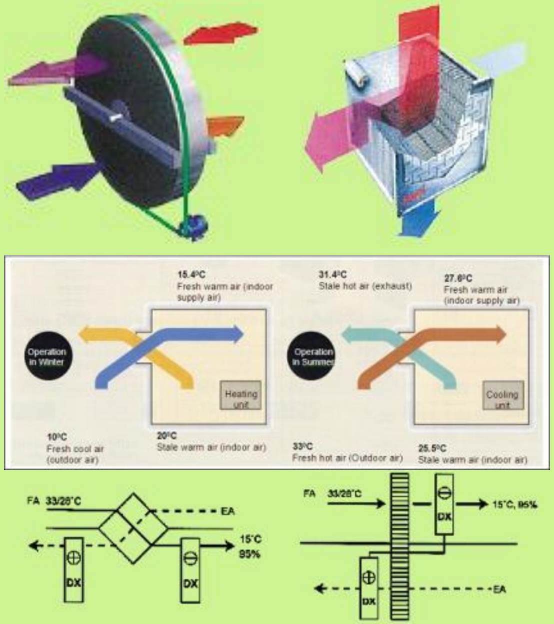
2.0 Resources

2.1 Energy Flows & Energy Future

- **CO_2 Sensors**
  - CO_2 sensors are adopted to control the outdoor air quantity supplied to the interior spaces. The total outdoor air quantity from the primary air handling unit is also regulated by adjusting the fan speed using frequency inverter. This can minimize the fresh air loading on air-conditioning system.

- **Intelligent Building Management and Control for public lighting and MVAC system at public area**
  - Group on/off control of the fan coil units and individual control for each Lecture Theatre, using time schedule. The time schedule can be adjusted at the BMS.

2.1 Energy Flows & Energy Future



Total-Heat-Recovery Concept for Fresh Air supply

- **Total Energy Recovery between Exhaust Air and Fresh Air in PAU (Primary Air Unit) Design**
  - Rotary heat wheel is provided to each primary air unit at 9/F to 14/F for total energy recovery between exhaust air and fresh air.

- **Low Level A/C supply at Multi-purpose Hall**
  - Cooling load was greatly reduced by strategically locating nozzles of A/C supply

Multi-purpose hall cross section

Multi-purpose hall

2.0 Resources

2.1 Energy Flows & Energy Future

Escalator with motion sensors

- **Motion Sensors for Escalators**
  - When the escalator is idled for a pre-determined period, the escalator will be slowed down. If the motion sensor at the entry landing detects a passenger going toward the escalators, the escalator will be switched automatically to the designed speed again.

- **LED Exit Signs**
  - The power consumption of LED exit sign with integral battery / charger is about 3W. It is adopted with long expected life, minimum maintenance and low power consumption.

2.0 Resources

2.1 Energy Flows & Energy Future

Motion sensor

On/off control of fan coil units in each classroom is interlocked with lighting

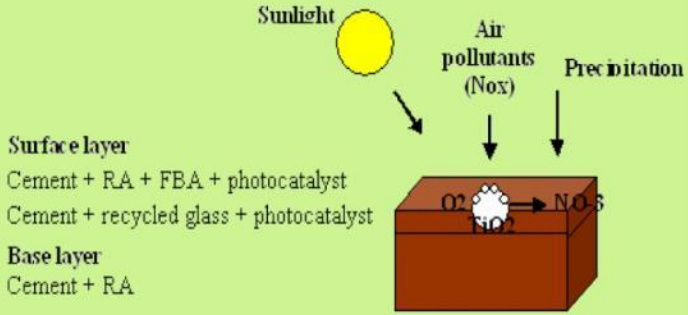
T5 tubes

- **Occupancy motion sensors for lighting and FCU control in classroom and individual staff offices**
  - Motion detectors (infrared type) are provided at each Lecture Theatres to turn off all lighting and reset the temperature set point to 28°C (adjustable) during unoccupied mode to save energy.

- **T5 Tubes and Electronic Ballasts**
  - Energy saving fluorescent luminaries are provided at classrooms, lecture theatres and staff offices.
  - Optimum energy efficiency and a lumen maintenance level of about 92% with 10,000 burning hours.
  - More environmental friendly for having relatively smaller amount of mercury used, less glass is used in the slimmer tube, less package material.

2.2 Material Use & Water Conservation

Eco-paving block used at LG/F



Design diagram of eco-paving block

- ***Use of Recycled Aggregates and Fine Aggregates for production of paving block – *"Eco-paving Block"*****

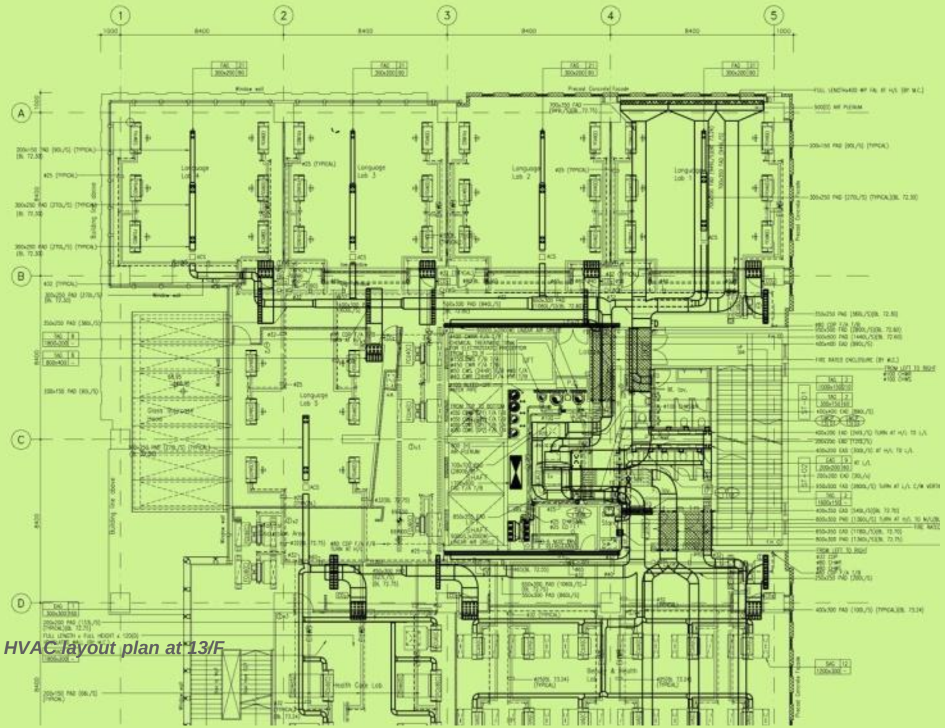
- **Reuse of Bleed Off Water**
  - A bleed off tank located at 4/F is provided to collect bleed off water from cooling towers. The bleed off water is transferred to flushing water tank for flushing purpose.

- **Reuse of Condensation Water**
  - A treatment plant for recycling condensation water from fan coil units and air handling units is provided. The treated condensation water will be re-used for flushing purpose.

**** Academic collaborator:***
Professor C.S. Poon,
Department of Civil and Structural Engineering,
The Hong Kong Polytechnic University

2.0 Resources

2.2 Material Use & Water Conservation



HVAC layout plan at 13/F

- **Use of Transfer Air**

  - Transfer air duct with silencer is provided for air-conditioned areas for transferring air from classrooms to the corridors, from which the “used” air is then transferred to the toilets where exhaust system is installed.

  - Exhaust air from Lecture Theatres is transferred to Chiller Plant Room/Carpark at LG/F and communal space. This can fully utilize the treated air before exhaust.

energy conservation

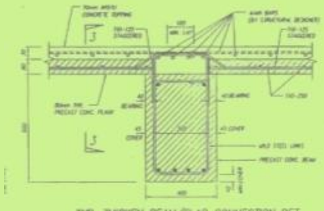
2.0 Resources

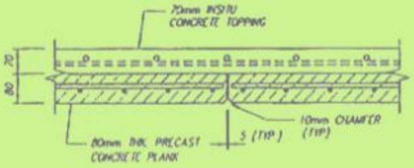
2.3 Waste Management & Pollution Control

Pre-cast R.C. column installation

- **Pre-cast Reinforced Concrete construction**

  - Pre-cast R.C. construction is **FULLY** applied to pre-cast facade, structural columns, slabs, beams and staircases (The first fully pre-cast construction for institutional building in HK)
  - Prevent extensive wet trade on the works site and reduce C&D waste/debris generated on site
  - Minimized use of timber formwork / falsework
  - Noise is reduced by less use of vibrator for in-situ concreting works



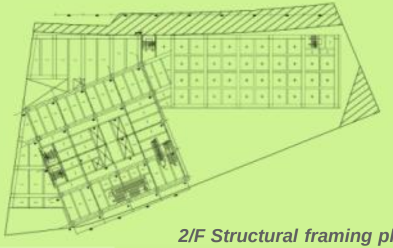


Pre-cast R.C. slabs

2.0 Resources

2.3 Waste Management & Pollution Control

Pre-cast manufacturing & installation



2/F Structural framing plan

- **Pre-cast Reinforced Concrete construction**

  - ***Fast track works programming :*** Without the need to formwork erection and striking for the secondary beams and slabs, and with early programming for production of pre-cast members from the set-up plants, the construction time is shortened. It implies shorter site works time and so as the pollution and nuisance caused to the surrounding environment

Aerial site progress photos

2.0 Resources

2.3 Waste Management & Pollution Control

2.0 Resources

2.3 Waste Management & Pollution Control

Fair-face R.C. at outdoor / indoor areas

- **Fair-face R.C. applied on façade**
  - It reduces the necessity of plastering use, and in turn less material waste results during construction.
- **Non-timbering hoarding, metal falsework applied**
- **On-site sorting of construction and demolition (C&D) waste**
- **Trip ticket system is adopted and the construction waste is disposed at the Government designated disposal area**

2.3 Waste Management & Pollution Control

- **Non-HCFC/ Halon Portable Fire Extinguishers**
  - Non-HCFC/ halon portable fire extinguishers are provided inside electrical and mechanical plant areas, laboratories and other specified areas.

- **CFC-Free Refrigerant**
  - The chillers are operated on R134a or CFC-free refrigerant to minimize ozone depletion and global warming effect.

3.0 Sustainability

3.1 Life Cycle Perspective

3.2 Building Amenities

3.3 Sustainability Policy & Feedback Loops

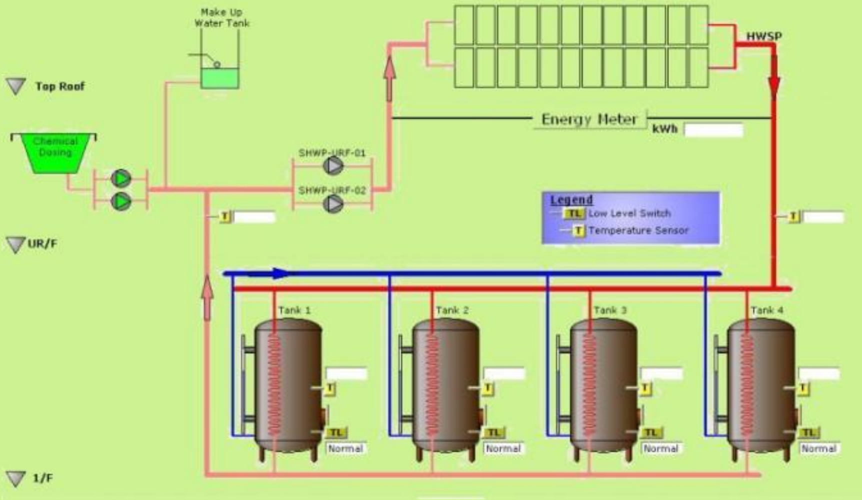
Practicality

All treatments and planning of the building involve in-depth research on the practical use viewpoints, medium and materials selection, plant species for greening and its supporting devices, actual maintenance and operation issues.

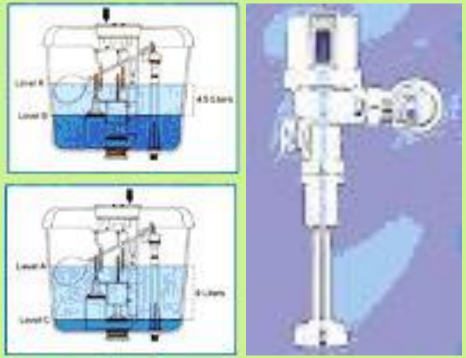
The output is achieved through successful collaborations with PolyU's environmental and engineering professors and practitioners.

3.1 Life Cycle Perspective

- **Solar Water Heating System**
  - The system aims at providing sufficient hot water for 16 numbers of shower to serve a maximum of 30 numbers of person per hour.
  - 60 numbers of solar collectors are installed on upper roof floor and as pre-heat system for such showers.
  - The solar water heating system is a closed circuit solar water heating system. The proposed solar collector system can rise the circulating water temperature above 80 degrees Celsius while the heat is transferred to the potable water through the calorifier tanks.



3.2 Building Amenities



Application of 7.5 Litres flushing cisterns with low and high flow selection

- **Use of dual-flush water tank for water closet**
  - Users could choose different flushing volume of 7.5 litre and 3 litre for water conservation
- **Infra Red Sensor for Water Taps**
- **Free Cooling for Lecture Theatres and Multi-purposes Hall**
  - When the outdoor enthalpy and temperature is lower than the design room air condition of Lecture Theatres and Multi-purposes Hall, free cooling is adopted. The fresh air volume is controlled to achieve the higher energy benefit
- **LED Exit Signs**
  - LED exit sign is adopted with long expected life, minimum maintenance and low power consumption

3.3 Sustainability Policy & Feedback Loops




Close Relationship among different parties

Partnering workshops among end-users, project manager, consultants and contractors are organized to foster a partnering approach in the project development.

Facilities Programming Workshops

Three facilities programming workshops are conducted to develop the project brief and design layouts through the discussion with the Community College's representatives, Campus Development Office, Facilities Management Office and the Project Team.

3.0 Sustainability

3.3 Sustainability Policy & Feedback Loops

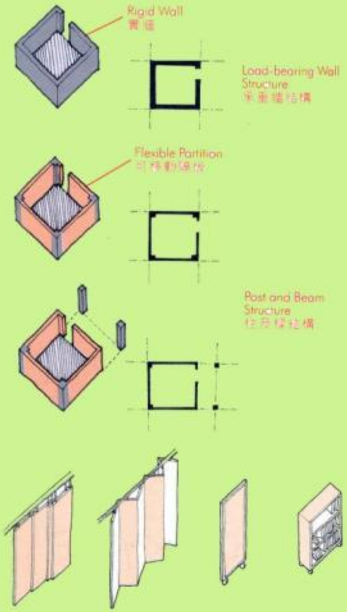
User's response and feedback system

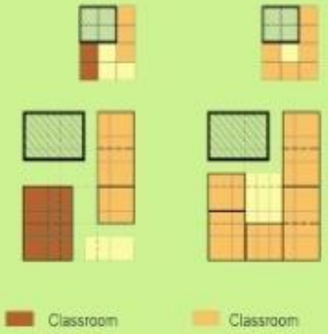
- Different events and workshops are arranged at different stages of the project with all stakeholders for better interaction, sense of involvement and feedback engagement.
- A standard form of report is designed for users' feedback. All defects would be analyzed and reviewed by the project team. Joint inspections are carried out to ensure all problems would be handled carefully.

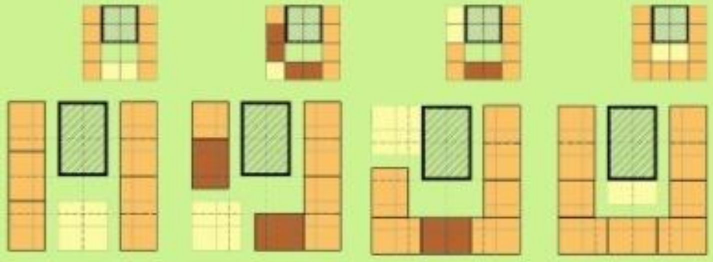
Ease of operation and maintenance, cost effectiveness

-For maintenance considerations, alternatives of materials and fittings were adopted for the project and with long term maintenance costs considered and studied.
- Value Engineering was extensively employed at all stages to provide a true comparison of alternatives and options, taking into account the life cycle costs, tangible and sometimes intangible values of different choices.

3.3 Sustainability Policy & Feedback Loops







Flexibility for changing needs

- Future expansion has been reserved at the building design stage. Teaching clusters formed by modules of 8.4m x 8.4m, separated by folding partitions, allow flexibility for spatial arrangement and possibility of reorganization. The clusters are arranged in a dynamic and vibrant vertical composition to create spaces of different scales and characters for social interaction and teaching purposes.
- The design can minimize disturbance in case of future alteration and additions, in view of inevitable changes of teaching and curriculum requirements over the life span of the Community College.

4.1 Computer Modeling

4.2 Integration of building service with structure

4.3 ”Immunized Building”

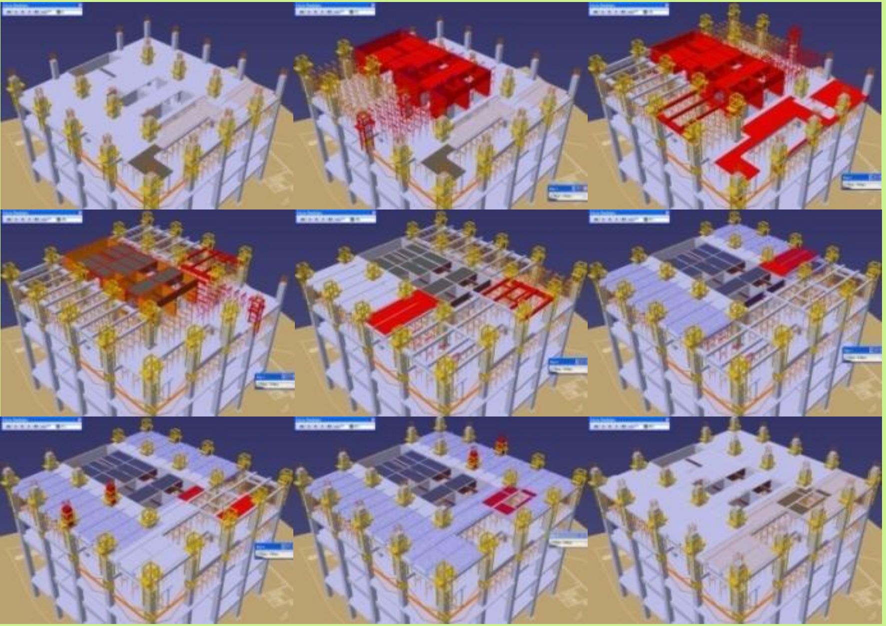
Innovation

The project systematically and practically achieves a great success of combining innovative ideas and environmental objectives with architectural design. It not only gives a new atmosphere to its surrounding but also to a larger extent defines new paradigm of how a high-rise institution building could integrate with the natural environment and the surrounding in an urban climate at an urban scale.

Valuable inputs were made from PolyU’s research collaborators, facilities management and campus development colleagues and the design team.

4.0 Innovation

4.1 Computer Modeling

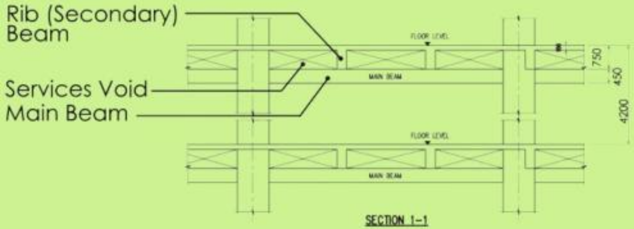


Computer simulation of
pre-cast R.C. construction process

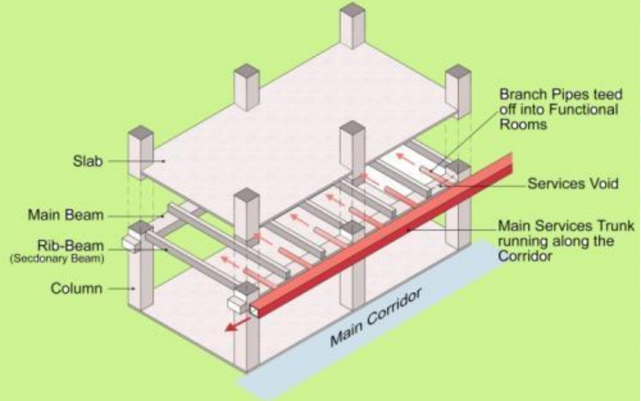
Computer-aided renderings, physical and computer models of different scale, elevation studies, computer fluid dynamic model, and other cutting edge simulations are utilized and reviewed at client-consultant meetings to discuss and illustrate the continuous development of the project.

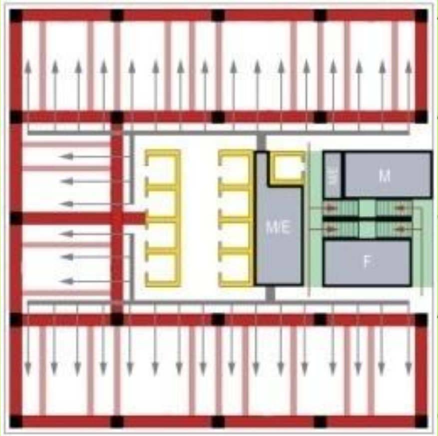
Computer simulation on the construction of Pre-cast Reinforced Concrete is adopted to enhance the structural design as well as assembly process and planning of the pre-cast elements. Different parties of the project teams have also been facilitated substantially to visualize the structural system and construction process of the main structure frame.

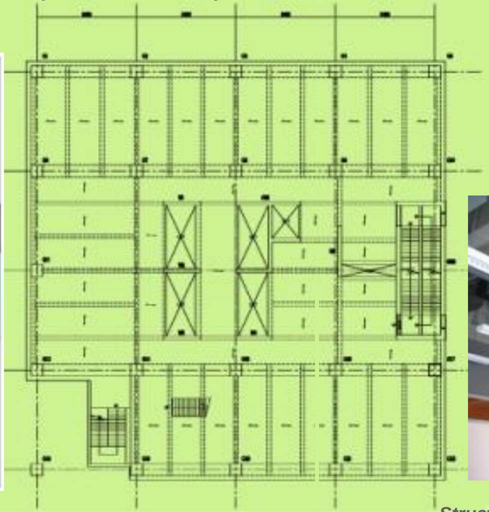
4.2 Integration of building service with structure



Building service is well integrated with the **structural system** to cater for future alterations. The main service trunks run along the corridor, with branch pipes branch off into function room. Hence it becomes flexible for future service and architectural layout modification if the space are re-partitioned.







Structural system allows flexible M&E design

4.0 Innovation

4.3 * ”Immunized Building”

Sustainable Immunized Building (SIB)

- The project adopts the “Immunized Building” concept as a new dimension of building quality

-New principles are introduced for strategic building modeling and its system on the delivery of a safe, healthy and comfortable environment having the effective use of energy

- The principles formulate various holistic, pathological and system indices for total approach of health management in a building for people, space and system

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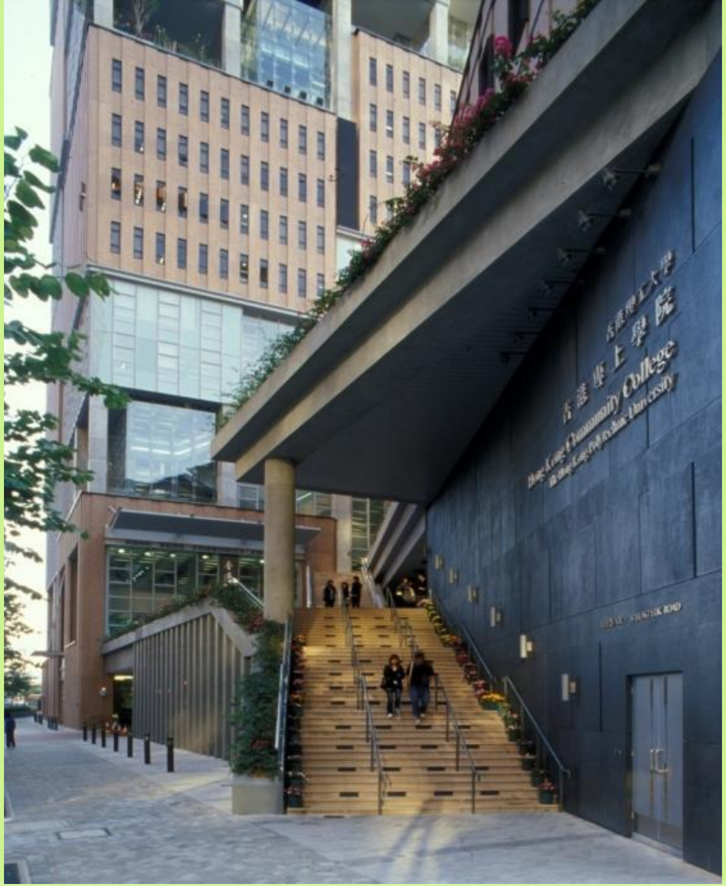

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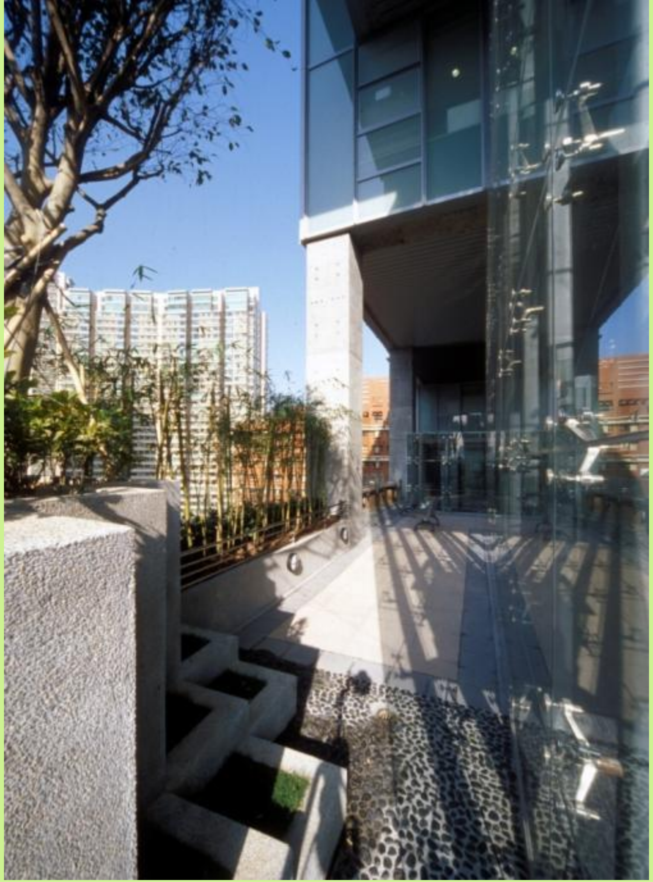

Thank you

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