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ARC61804

GREEN STRATEGIES FOR BUILDING DESIGN

ASSIGNMENT 2A: REFLECTIVE WRITE-UP

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1.0 Heriot-Watt University Malaysia

Heriot-Watt University Malaysia stands out as a benchmark for sustainable architecture in a tropical climate. Its use of passive design strategies such as natural ventilation, daylighting, and a large living green roof responds effectively to Malaysia's hot and humid conditions. Reflecting on this, I am inspired to apply similar climate-responsive strategies in my Architectural Design IV final project, a Creative and Recreational Hub. This approach will help me design a space that supports community engagement and creativity while adapting responsibly to its tropical environment.

1.1 Site Planning

1.1.1 Building Orientation

At Heriot-Watt University Malaysia, buildings are oriented with their longer facades facing north and south to reduce solar heat gain from the east and west. This minimizes direct sunlight exposure, keeping interiors cooler. Extended overhangs provide additional shading, while north-south facades receive soft, diffuse daylight. I aim to apply a similar passive strategy in my project to improve thermal comfort and energy efficiency.

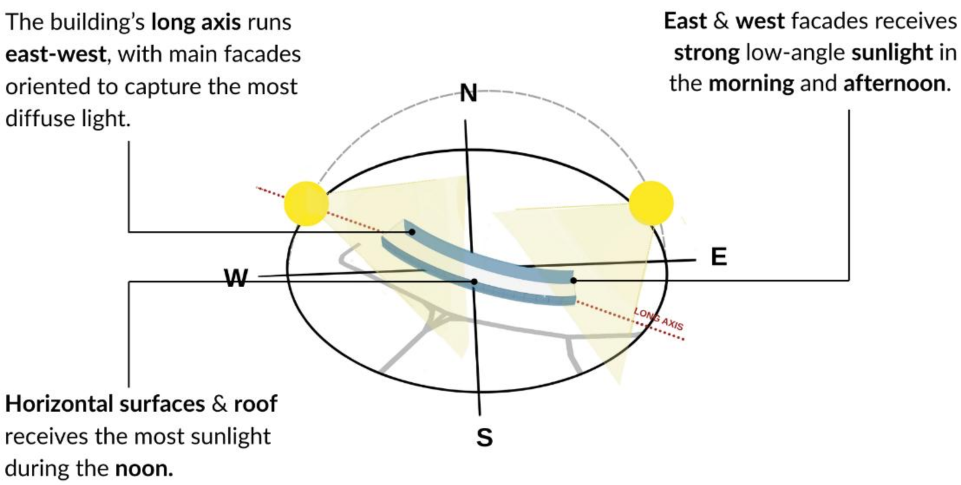

Figure 1 East-West Axis Alignment

1.1.2 Zoning and Setback from Street

A landscaped setback from the street reduces noise, filters air and cools the surroundings. Facing Putrajaya Lake, the building opens to walkways and greenery that enhance views and capture breezes. Inside, an open layout supports airflow, daylight, and spatial flexibility. These design moves show how landscape integration and open planning can elevate environmental quality and user experience.

Figure 2 Landscape Setback

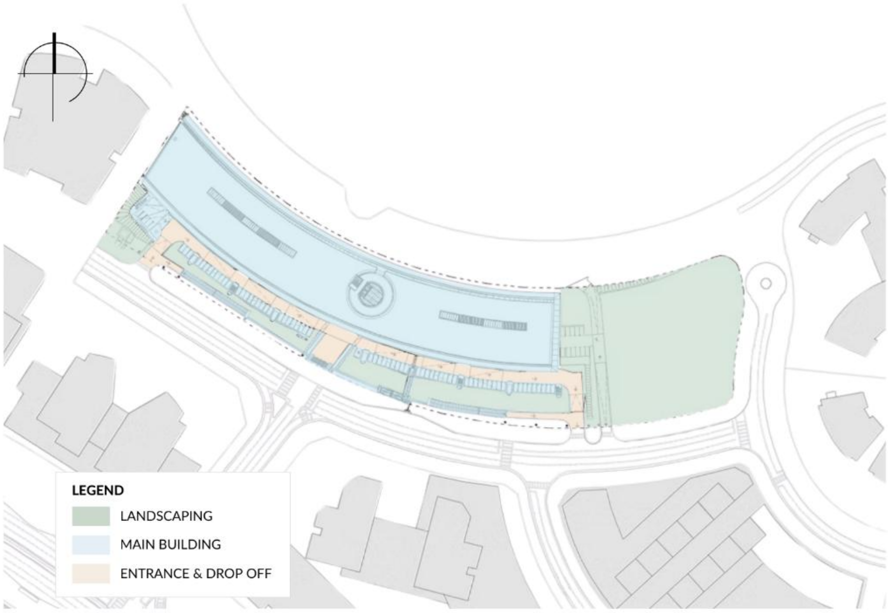

Figure 3 Heriot-Watt Contextual Map

1.1.3 Earth Berm and Green Roof Integration

A key green strategy at Heriot-Watt University Malaysia is the integration of an earth berm with a 300-meter green roof. The berm improves thermal regulation by embedding the building into the site, while the green roof enhances insulation, manages rainwater, and supports biodiversity. Inspired by this approach, I plan to incorporate an earth berm in my own design to strengthen thermal performance and integrate the building more harmoniously with the landscape.

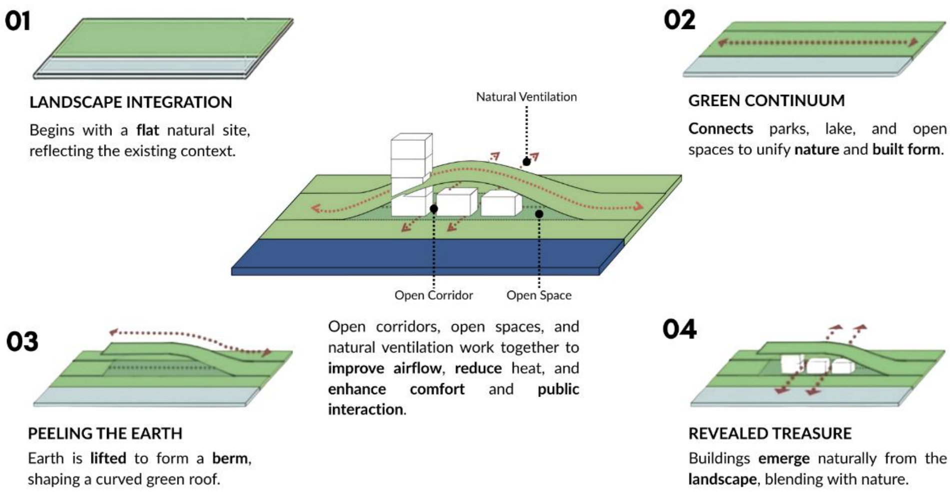

Figure 4 Contextual Form Integration

1.1.4 Pervious Surface

Permeable ground surfaces at Heriot-Watt University Malaysia help manage stormwater, reduce flooding, and cool outdoor areas. Grass and permeable materials support natural infiltration and ground moisture retention, benefiting vegetation. In a park setting like ours, this strategy offers an effective way to reduce urban heat and improve drainage while maintaining a natural landscape feel.

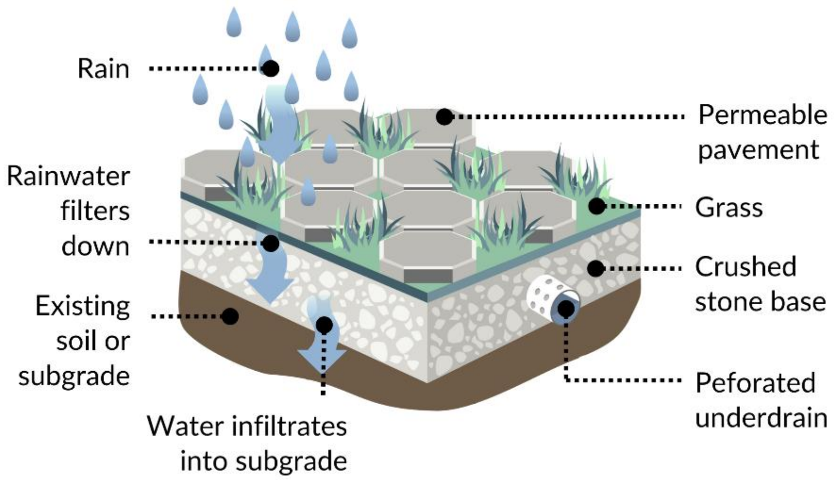

Figure 5 Typical buildup of a permeable paving system

1.2 Daylighting

1.2.1 Skylight and Lightwell

Skylights and light wells channel natural sunlight into interior spaces, reducing reliance on artificial lighting and lowering energy use. Reflective surfaces and glazing help distribute light effectively. I see how I can include this strategy to brighten enclosed areas in my design, enhance visual comfort, and support energy efficiency.

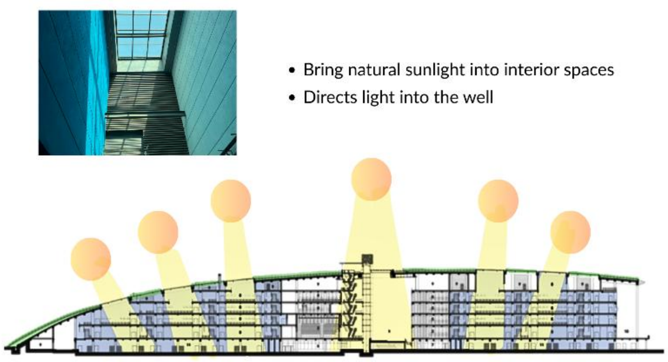

Figure 6 Light enters through skylight

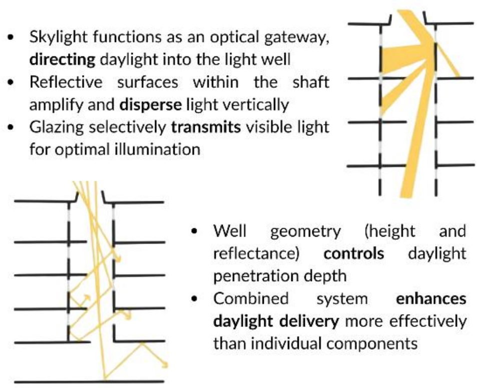

Figure 7 Light Well

1.2.2 Light-Colored Flat Walls

Light-colored surfaces with high reflectance (LRV above 70%) help reflect daylight deeper into interior spaces, reducing the need for artificial lighting and improving visual comfort. Understanding this strategy makes me more aware of how simple material choices can enhance energy efficiency and create brighter, more comfortable environments.

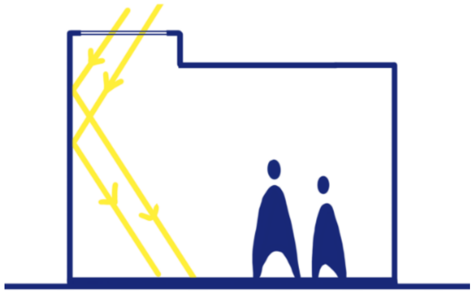

Figure 8 Light-Colored Flat Walls

1.3 Facade Design

1.3.1 Massing and Form

Deep overhangs and offset floors provide shade, reduce heat gain, and enhance thermal comfort and performance. This has inspired me to explore similar massing strategies, using form as both a passive climate response and a design feature.

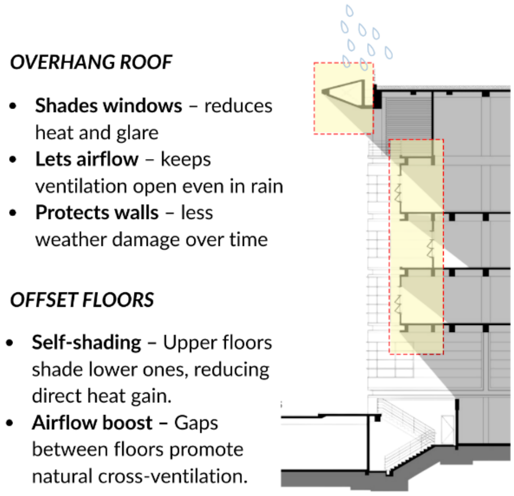

Figure 9 Section showing Overhangs & Offset Floors

1.3.2 Walls and Windows

At the campus, light-colored walls reflect sunlight to reduce heat absorption, while Low-E glass allows daylight in while limiting solar heat gain. With a window-to-wall ratio of around 70%, the design balances light access and shading. This has made me more aware of how material finishes and window proportions contribute to a comfortable, energy-efficient interior.

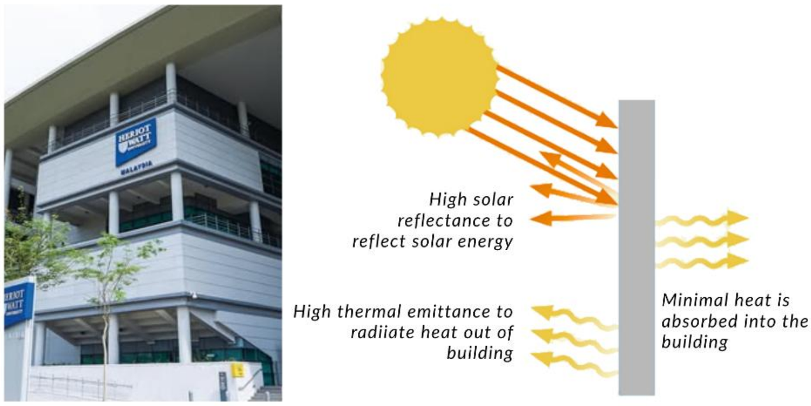

Figure 10 Light-Colored Finishes Wall Performance

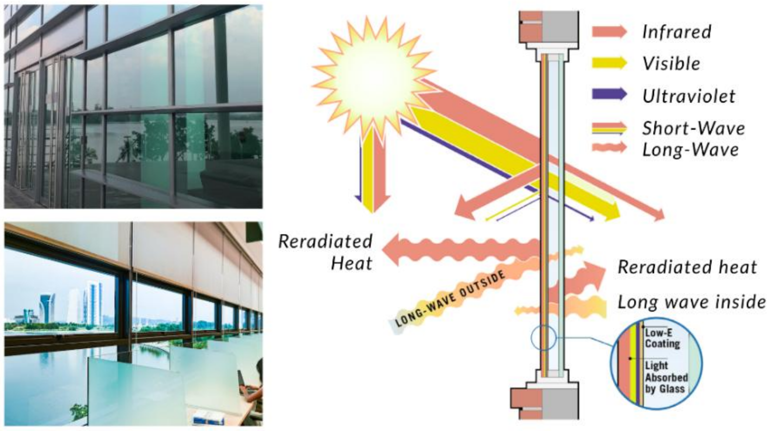

Figure 11 Low-E Glass Performance

1.3.3 Multi-Layered Facade System

At Heriot-Watt University Malaysia, aluminium louvres and perforated screens reduce heat gain by blocking direct sunlight while allowing airflow and filtered light. It deepened my understanding of how passive shading can enhance building performance and express architectural character.

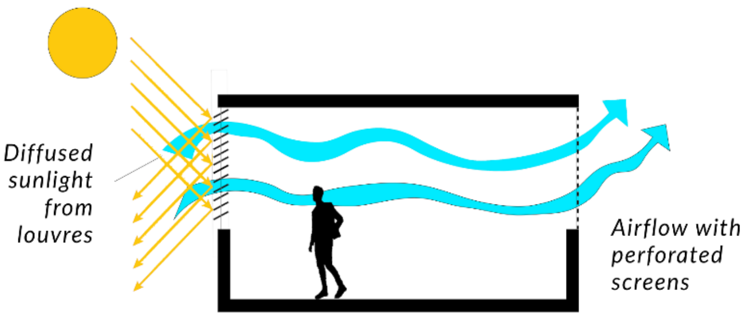

Figure 12 Airflow Performance through Screens

ALUMINIUM LOUVRES

- Allows **airflow** for HVAC/ducting systems.
- **Shields** M&E equipment from rain/debris.
- Permits maintenance while maintaining aesthetics.

PERFORATED SCREENS

- Diffuses light, reduces glare.
- Allow **ventilation** for thermal comfort
- Modern, decorative touch to facade

Figure 13 Louvres & Screens

1.4 Natural Ventilation

1.4.1 Cross and Stack Ventilation

The campus uses cross and stack ventilation through openings on opposite facades, high-level vents, and atriums to promote natural airflow, improve air quality, and reduce reliance on mechanical cooling. I learned that even large buildings can achieve effective ventilation with thoughtful layouts, such as aligning openings and using vertical voids to enhance air movement.

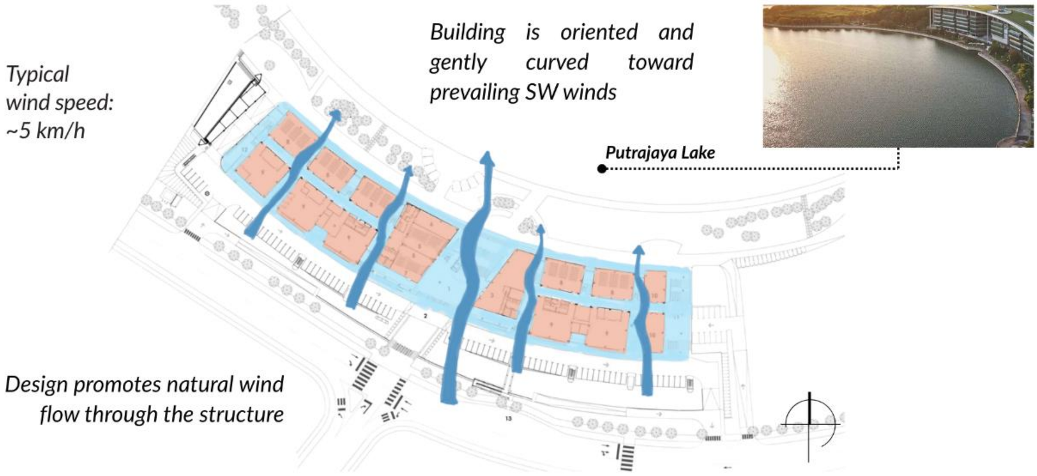

Figure 14 Plan showing cross ventilation through internal spaces

- Vertical voids **expel warm air**, **pulling** in **cool air** from shaded courtyards
- Open staircases, perforated landings, and angled baffles **improve** cross-ventilation
- Achieves **6–12** air changes per hour
- Lowers indoor temperature by **3–5°C**

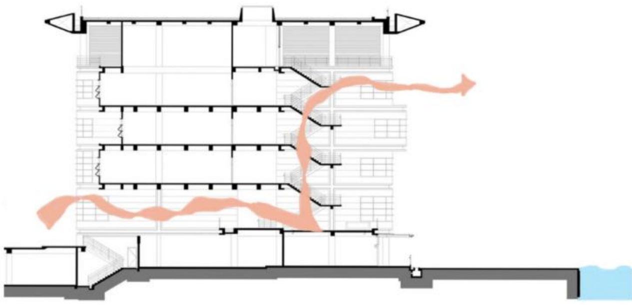

Figure 15 Section showing Stack Ventilation

1.4.2 Cooling from Lakefront Position

The campus uses lake-cooled air and stack ventilation to lower indoor temperatures by 3 to 5°C without mechanical cooling. This strategy shows how natural site features can be integrated to enhance passive cooling and comfort.

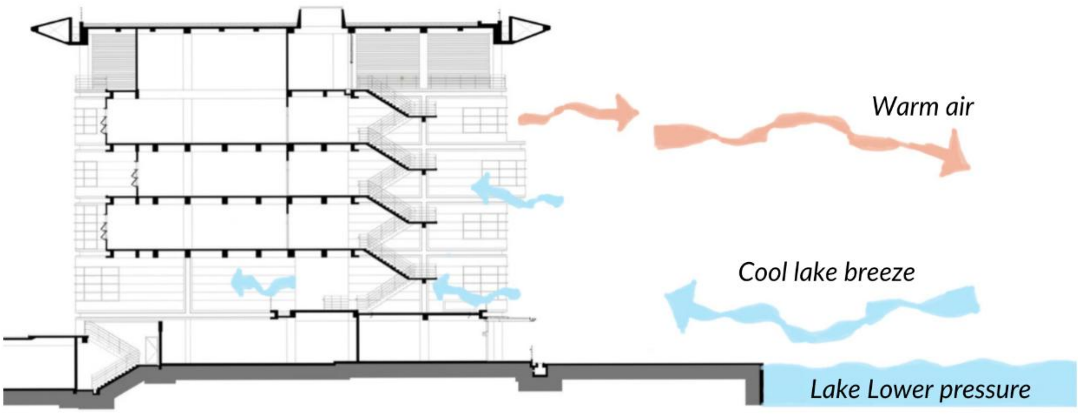

Figure 16 Section showing lake breeze airflow pattern

1.5 Strategic Landscaping

1.5.1 Green roof

The green roof reduces heat gain, manages stormwater, and supports local biodiversity. It also improves air quality and connects the building with nature, showing how vegetation can enhance both sustainability and user comfort.

Figure 17 Site plan showing exterior landscaping & green roof

1.5.2 Vegetation Types and Environmental Buffer

The campus uses native vegetation as environmental buffers to reduce heat, block noise, and support biodiversity. These plantings shade outdoor areas, cool surfaces, and improve air quality, highlighting the role of thoughtful landscaping in sustainable design.

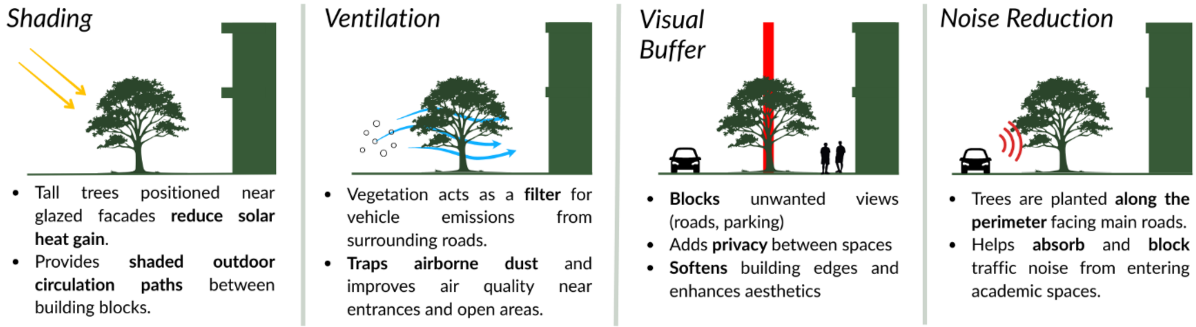

Figure 18 Environmental Buffers

1.6 Renewable Energy

1.6.1 Rainwater Harvesting

The campus uses rainwater harvesting for irrigation and flushing, reducing treated water use and managing runoff. This inspires me to incorporate a similar system in my project to conserve water and support sustainable design.

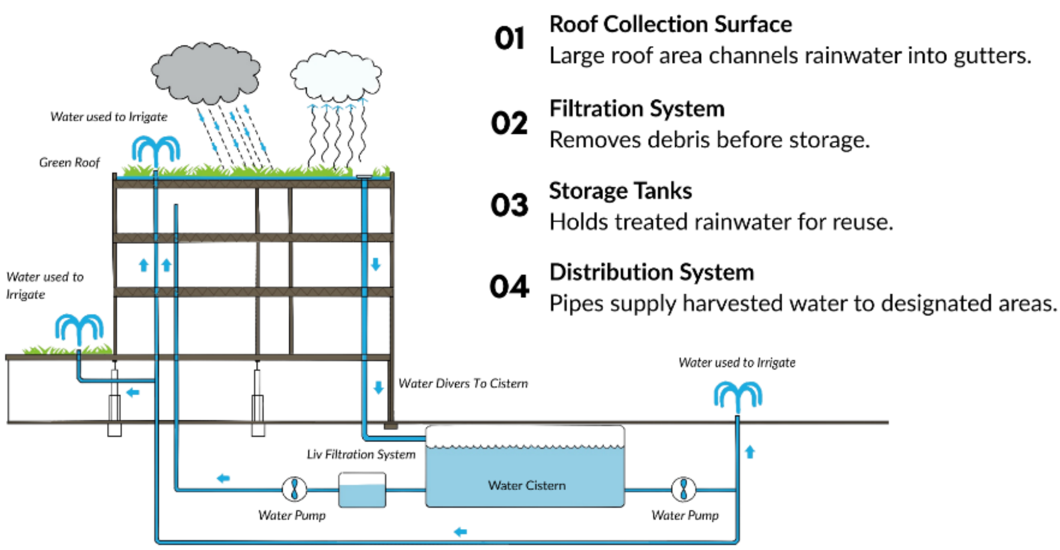

Figure 19 Key Components of a Rainwater Harvesting System

1.6.2 District Cooling System (DCS)

The campus uses a centralised District Cooling System that distributes chilled water across multiple buildings, reducing the need for individual air conditioning units. While this strategy isn't suitable for my project's scale, it made me more aware of the importance of reducing cooling demand through passive design principles.

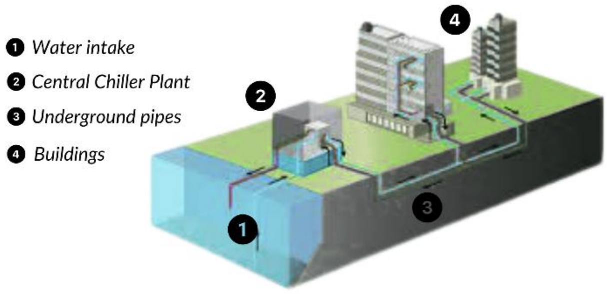

Figure 20 Overview of a District Cooling System (DCS)

1.7 Summary

Studying Heriot-Watt University Malaysia has deepened my understanding of how sustainable design strategies can be thoughtfully integrated in response to a tropical climate. The campus demonstrates how elements like building orientation, deep overhangs, landscaped setbacks, and earth berms work together to reduce heat gain and enhance user comfort. I found the combination of a 300-meter-long green roof with an embedded building form particularly inspiring, as it shows how architecture can blend into the landscape while improving environmental performance.

The use of skylights, light wells, and light-colored surfaces for daylighting, along with façade strategies such as Low-E glass, louvres, and perforated screens, also showed me how passive techniques can reduce energy demand without compromising spatial quality. I was especially drawn to the way natural ventilation was achieved through cross and stack systems, as well as lake-cooled air, proving that even large buildings can maintain thermal comfort through smart planning.

The integration of native vegetation and pervious surfaces throughout the site reminded me of the importance of landscape as an active environmental system, not just a decorative layer. Learning about rainwater harvesting and the district cooling system further reinforced the value of combining passive and active strategies for long-term sustainability.

Overall, these lessons have shaped how I approach my final project in Architectural Design IV. They encouraged me to explore passive solutions more deeply, design with site and climate in mind, and view sustainability not just as a performance goal but as an opportunity to enrich user experience and architectural expression.

2.0 Design Reflection: Application of Strategies from Heriot-Watt University Malaysia

2.1 Louvered Screen

Inspired by the louvres and perforated screens at Heriot-Watt University, I plan to use louvred screens on east and west facades to reduce heat gain, filter daylight, and improve airflow, while adding depth to the facade design.

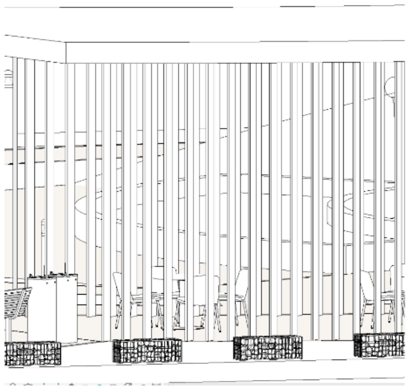

Figure 21 Vertical Wood Louvers

2.2 Open Layout

Observing the open layout of Heriot-Watt University Malaysia has inspired me to explore spatial arrangements that promote natural airflow, daylight, and flexibility. This approach supports thermal comfort, reduces mechanical reliance, and encourages interaction within a tropical park setting.

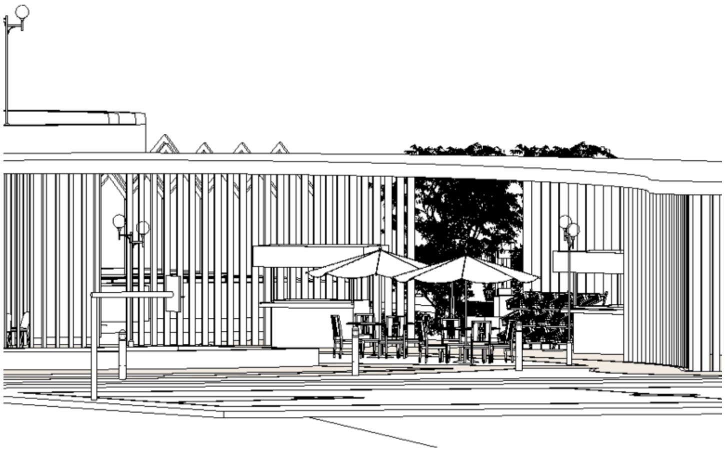

Figure 22 Open Layout

2.3 Building Orientation

Heriot-Watt University's building orientation showed me how aligning facades north-south can reduce heat gain and improve comfort. I plan to apply this in my project to maximise diffuse daylight and limit direct sun exposure.

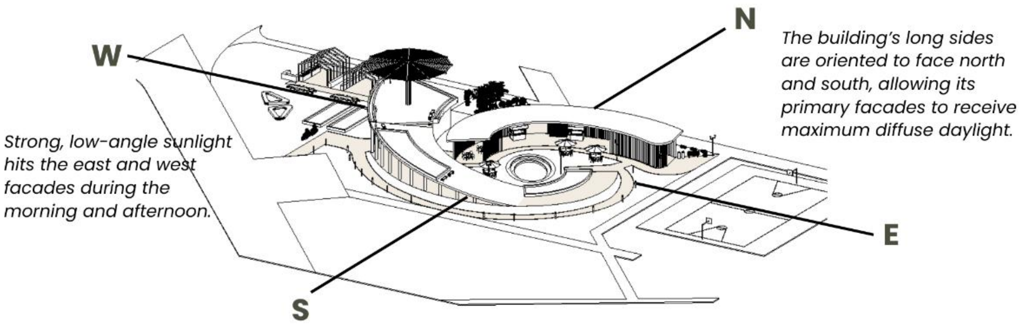

Figure 23 Building orientation with north-south aligned facades

2.4 Overhang Roof

Inspired by Heriot-Watt University's deep overhangs, I plan to use a wide overhanging roof in my project to reduce heat gain, improve comfort, and shield walkways and openings from sun and rain.

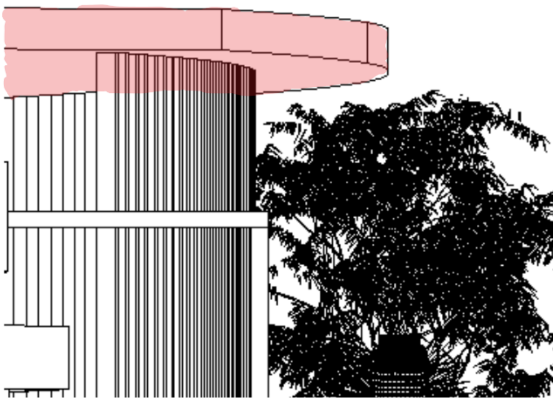

Figure 24 Use of Overhang Roof

2.5 Light-Colored Flat Walls

Learning from Heriot-Watt University's use of light-colored surfaces, I plan to use high-reflectance materials in my project to reflect more daylight, reduce artificial lighting needs, and enhance visual comfort.

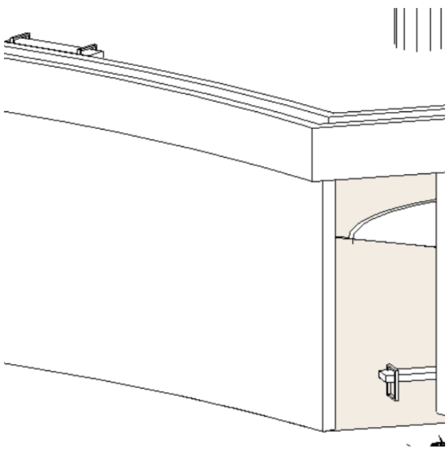

Figure 25 Use of light-colored wall

2.6 Cross Ventilation

Heriot-Watt University's cross ventilation strategy showed me how aligned openings can promote airflow. I plan to position openings in line with prevailing winds to improve air quality, reduce heat, and minimise reliance on mechanical cooling.

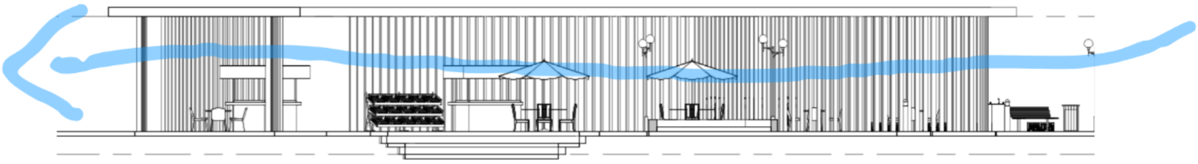

Figure 26 Cross ventilation strategy for natural airflow

3.0 Diamond Building

The Diamond Building in Precinct 2, Putrajaya, is a leading example of sustainable architecture designed for Malaysia's tropical climate. Built for the Energy Commission, it combines passive and active strategies to reduce energy use while ensuring user comfort. Completed in 2010, the building reflects Malaysia's commitment to green development and has earned both GBI Platinum and LEED Platinum certifications, making it one of the country's greenest buildings. It serves as a valuable reference for projects seeking to balance environmental responsibility with practical performance.

3.1 Site Planning

3.1.1 Building Orientation

Like Heriot-Watt University Malaysia, the building is oriented to limit east and west sun exposure while maximizing north-south facades for diffuse daylight. This climate-responsive approach reduces heat gain and cooling demand in Malaysia's tropical climate. It made me realise how early orientation choices can passively improve comfort and energy efficiency.

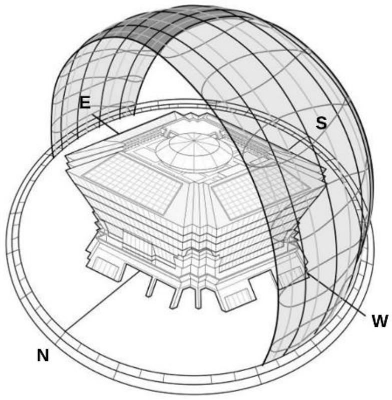

Figure 27 Solar path over Diamond Building

3.1.2 Setback from Roads

The site includes generous landscaped setbacks that create a green buffer between the building and nearby roads. These reduce traffic noise, cool the surroundings, and follow the natural slope to minimise earthworks. This showed me how setbacks can function as passive landscape strategies that enhance comfort and strengthen the connection between building and site.

Figure 28 Landscape Setback

3.1.3 Permeable Surfaces

Permeable paving allows rainwater to soak into the ground, reducing runoff and supporting natural drainage. This made me more aware of how surface treatments can help manage water sustainably and reduce flood risk.

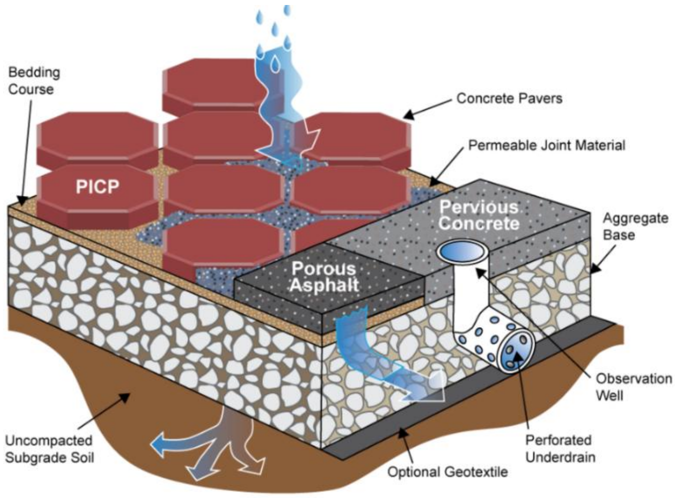

Figure 29 Cross-section of a Permeable Pavement Systems

3.2 Daylighting

3.2.1 Skylight Integration

The Diamond Building's central atrium with skylights brings daylight into the building's core, reducing the need for artificial lighting. High-performance glazing controls glare and heat gain. This showed me how daylight from above can lower energy use while brightening interior spaces.

Figure 30 View of the dome at the atrium

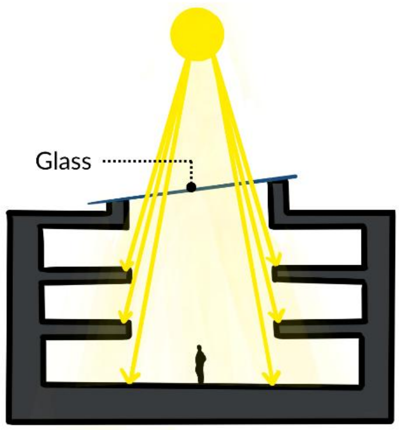

Figure 31 Central Atrium Performance

3.2.2 Light Shelf and Shading Devices

The north and south facades use split windows, light shelves, and shading fins to reflect daylight indoors while blocking direct sun. This showed me how facade elements can both shade and enhance indoor light quality.

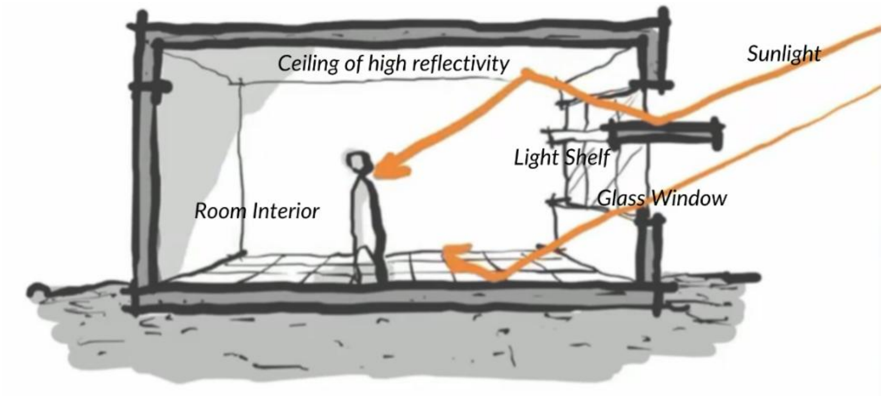

Figure 32 Light Shelf Performance

Figure 33 Shading Fins

3.2.3 Automated Atrium Blinds

The Diamond Building's central atrium features automated blinds that adjust every 15 minutes based on the sun's position to manage daylight and glare. With 30% light transmittance, they allow soft, diffuse light while reducing heat gain. I see this as an effective strategy to enhance daylight quality and indoor comfort through responsive shading.

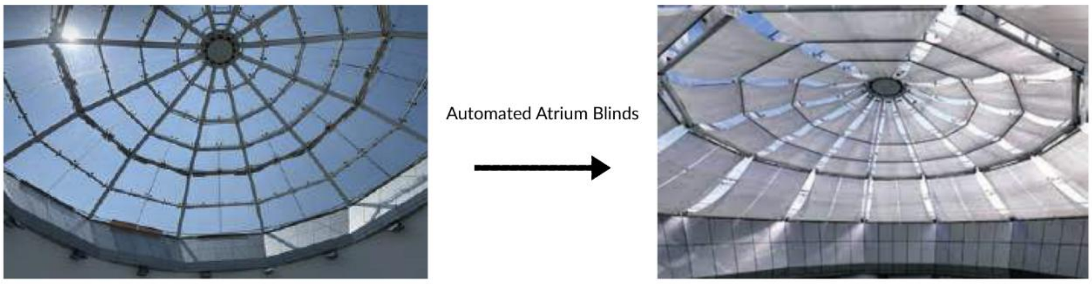

Figure 34 Automated Atrium Blinds Performance

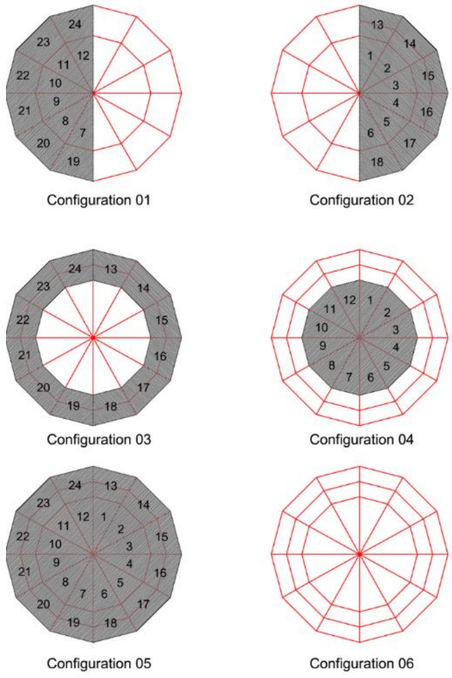

Figure 35 Blind Configuration

3.3 Facade Design

3.3.1 Diamond-Shaped Sloped Facade

The Diamond Building's sloped facade angles inward at about 25 degrees, creating a self-shading effect that reduces heat gain on upper floors. I see how building form can act as a passive strategy, using geometry for both function and visual identity.

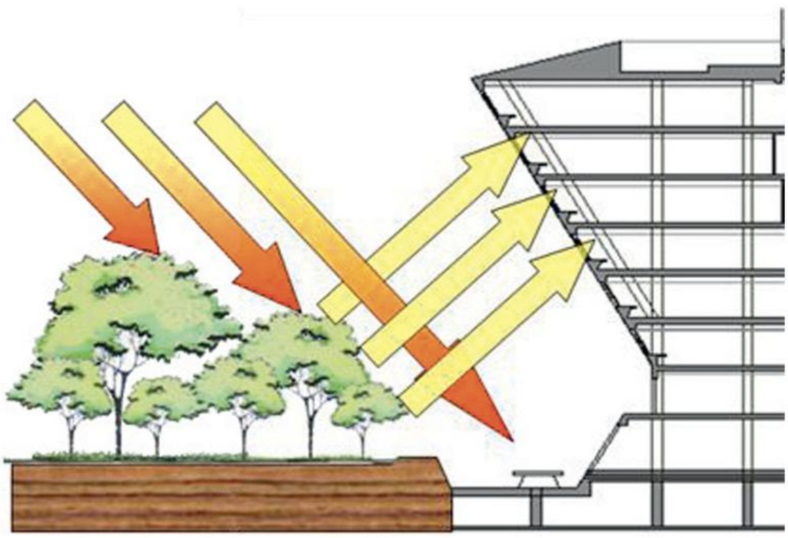

Figure 36 Slanting Facade

3.3.2 Double-Glazed Low-E Glass

The facade uses Low-E double glazing to let in daylight while reflecting heat, helping keep interiors cool. This showed me how glass selection can improve energy performance while maintaining transparency and comfort.

Figure 37 Application of Low-E Glass

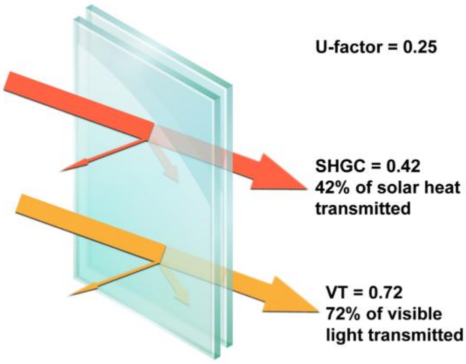

Figure 38 Low-E Glass Performance

3.3.3 External Vertical Louvres

Vertical aluminium louvres on the east and west facades block low-angle sun while allowing airflow. They also cast dynamic shadows, showing me how simple elements can enhance both environmental performance and visual depth.

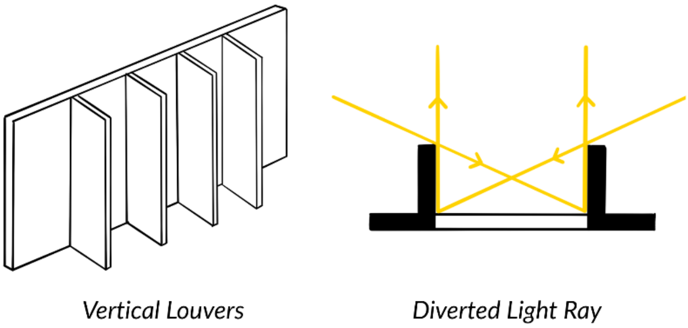

Figure 39 Vertical Louvers Performance

3.4 Natural Ventilation

3.4.1 Stack Ventilation

The Diamond Building features a tall central atrium that facilitates stack ventilation where hot air rises and escapes through high-level openings, drawing cooler air in from below. This reduces reliance on mechanical cooling while maintaining indoor comfort. This showed me how vertical voids can be cleverly integrated to enhance passive airflow, especially in multi-storey spaces.

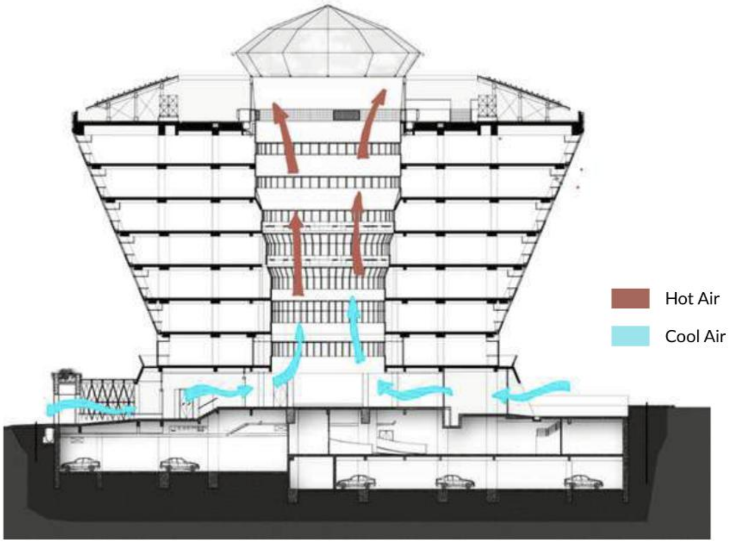

Figure 40 Stack Ventilation Section

3.5 Strategic Landscaping

3.5.1 Native and Adaptive Planting

The landscaping uses low-maintenance native and adaptive plants that need less water and support local biodiversity. This reinforced my understanding that thoughtful plant selection can reduce upkeep and strengthen ecological resilience, especially on large urban sites like mine.

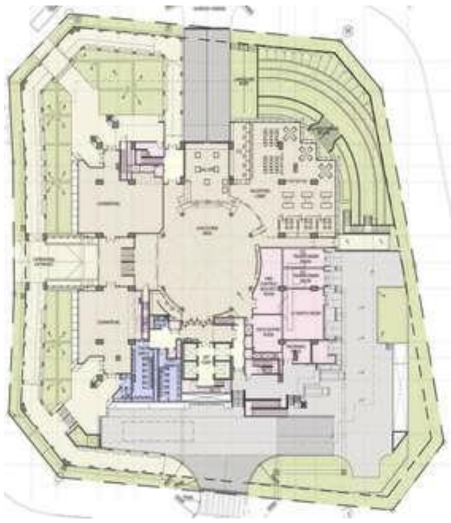

Figure 41 Ground floor plan showing landscaping of the building

3.5.2 Sunken Outdoor Garden

The sunken courtyard brings layered greenery into the basement level, improving ventilation, thermal comfort, and daylight. It shows how landscape can enhance the microclimate and quality of subgrade spaces.

Figure 42 Sunken Garden Area

3.6 Active Strategy

3.6.1 Building Integrated Photovoltaics

The Diamond Building uses a 71.4 kWp thin-film PV system integrated into its sloped roof, meeting about 10% of its energy needs. Lightweight CIGS panels are also installed on all facades to study performance by orientation. This deepened my understanding of how PV technology can be seamlessly integrated into building form to support energy goals without compromising design.

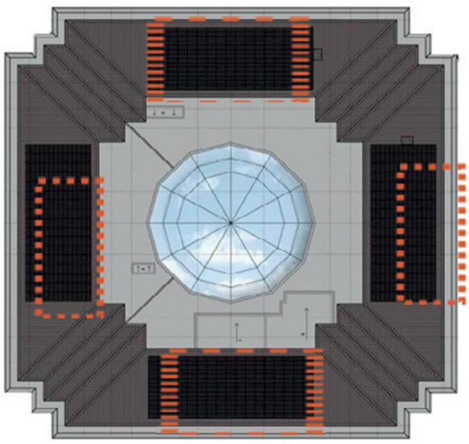

Figure 43 Locations of the Photovoltaic Panels

Figure 44 Photovoltaic Panels on the roof

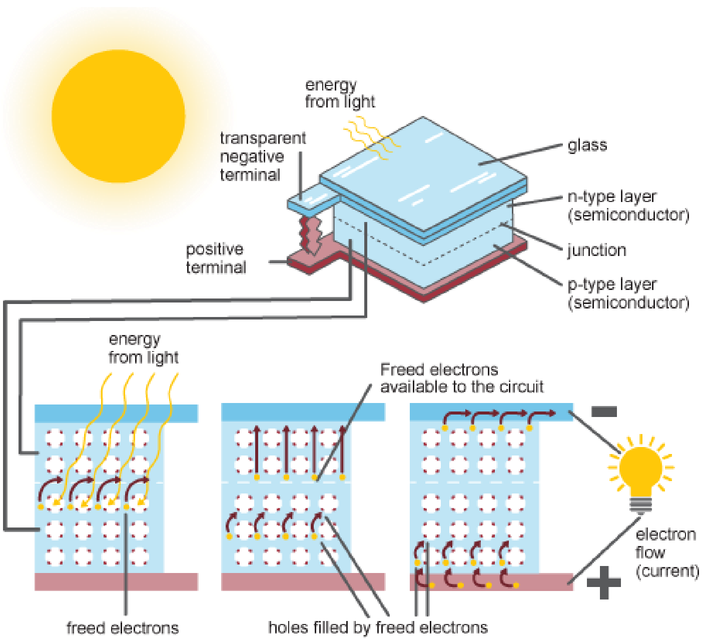

Figure 45 How Does Photovoltaic Cells Work

3.6.2 Radiant Cooling System

The Diamond Building uses an active radiant cooling system with 22 mm PERT chilled water pipes embedded in concrete slabs. At night, cold water cools the slabs to around 20°C, which then absorb and radiate heat during the day, reducing air-conditioning demand. This system also allows the air-handling unit (AHU) room to be 30% smaller. I found this strategy innovative for using thermal mass to deliver cooling, showing how building elements can serve multiple roles.

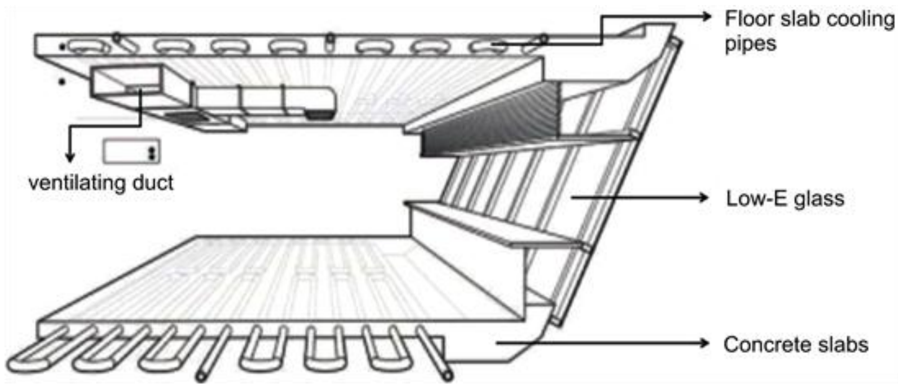

Figure 46 The building's internal cooling system

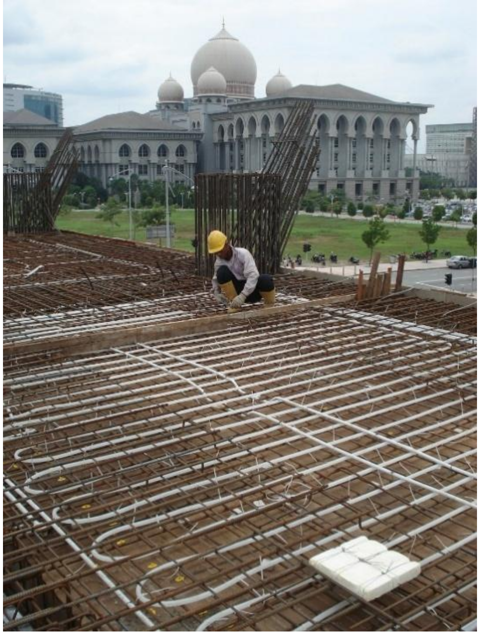

Figure 47 Radiant cooling pipes are set in the floor before concrete is poured

3.6.3 Rainwater Harvesting

The building uses a rainwater harvesting system for irrigation and toilet flushing, supported by water-efficient fixtures like dual flush toilets and aerated taps. This reduces potable water use by over 65%. I see this as a practical strategy for tropical climates and one I would strongly consider for my own projects.

Figure 48 Rainwater Harvesting Systems at the roof

3.7 Summary

Exploring the Diamond Building helped me understand how thoughtful site planning like orienting the building along the east–west axis, using green buffers, and working with the natural slope can passively manage heat, reduce runoff, and enhance user comfort without heavy intervention.

Its daylighting strategies, including split windows, light shelves, and automated atrium blinds, showed me how layered systems can maximise natural light while minimising glare and heat, making interior spaces more energy-efficient and pleasant.

The angled, diamond-shaped facade showed how building form can double as a passive shading device, reducing solar heat gain while reinforcing visual identity, an approach that blends climate responsiveness with aesthetics.

Landscaping elements such as the green roof, native planting, and a sunken garden demonstrated how greenery can cool spaces, manage stormwater, and improve microclimates at multiple levels, reinforcing the idea that landscape is integral to sustainable design.

Finally, the radiant cooling slabs and rooftop PV system revealed how active systems can work with passive design to optimise energy performance. This taught me to think holistically about how different strategies can complement each other to meet environmental goals.

4.0 Design Reflection: Application of Strategies from Diamond Building

4.1 Sunken Area

The Diamond Building's sunken garden inspires me to introduce a sunken courtyard at the core of my structure. I see it as a way to improve thermal comfort, draw in cooler air, and bring daylight and greenery into the heart of the building.

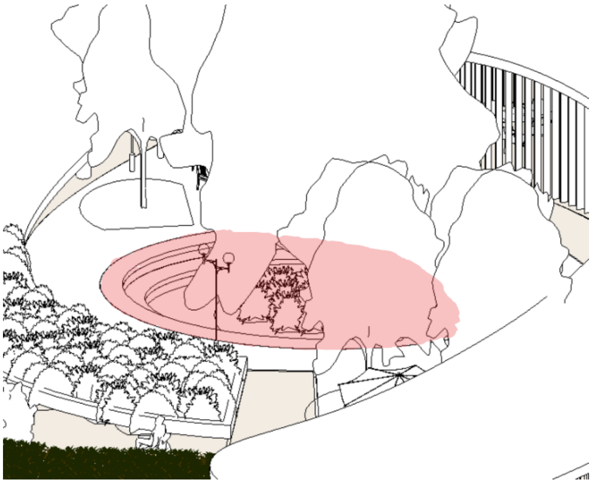

Figure 49 Central Sunken Courtyard

4.2 Setback from Street

Inspired by the Diamond Building's landscaped setback, I plan to create a green buffer along the west edge of my site facing a busy road. Using native plants, this zone will reduce noise, cool the area, and create a more comfortable transition into the site.

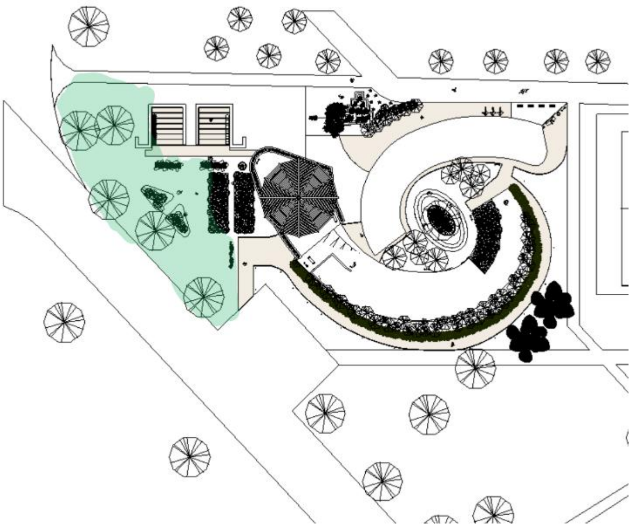

Figure 50 Setback from street with native vegetation

4.3 Permeable Surfaces

Inspired by the Diamond Building, I plan to use permeable surfaces instead of other flooring to reduce runoff and cool outdoor areas. This supports natural drainage, vegetation, and overall site comfort.

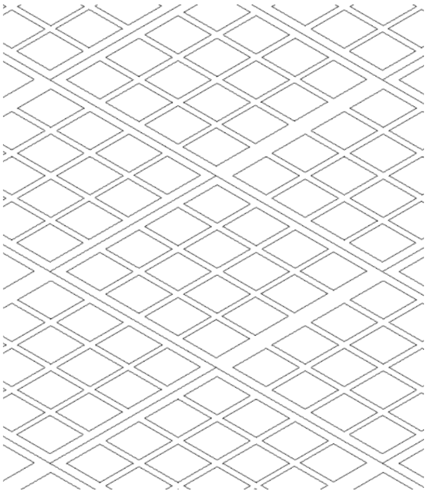

Figure 51 Use of Permeable Surface

4.4 Building Integrated Photovoltaics

The Diamond Building's integration of thin-film PV panels into its sloped roof and facades inspired me to see solar technology as part of the architecture, not just an add-on. For my project, I'm exploring how PV panels can support energy goals while contributing to the building's identity, especially on sun-exposed roof surfaces.

4.5 Rainwater Harvesting

The Diamond Building's rainwater harvesting system, combined with water-saving fixtures, shows how rainwater can be reused efficiently. In Malaysia's tropical climate, this is both practical and impactful. I plan to adopt a similar approach to reduce treated water use in my project.

5.0 Conclusion

Through the in-depth case studies of Heriot-Watt University Malaysia and the Diamond Building, I have gained a deeper appreciation for how passive and active strategies can work together to create environmentally responsive architecture. Both buildings demonstrated how climate-adaptive decisions, from orientation and ventilation to shading, energy generation, and water reuse, can not only reduce environmental impact but also enhance comfort, usability, and design expression.

Heriot-Watt's integration of green roofs, lake-cooled breezes, and natural ventilation opened my eyes to how site features and landscape can be harmoniously combined with architectural form. Meanwhile, the Diamond Building taught me the power of precision in design, how small moves like light shelves, radiant cooling slabs, or atrium blinds can deliver big performance results. These examples made me more mindful of the relationship between design intent, user experience, and sustainability.

Moving forward into my final design project, I intend to implement strategies inspired by both precedents, such as north–south orientation, open layout, louvered shading, large overhang roof, light-colored surfaces, permeable landscaping, PV integration, and rainwater harvesting. Each decision will respond not just to environmental performance, but also to spatial quality and community needs. Ultimately, these precedents have taught me that sustainability is not about isolated technologies, it is about designing holistically with purpose, climate, and people in mind.

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