ENERGY COMMISSION HEADQUARTERS BUILDING PUTRAJAYA

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Design Inspiration

The Headquarters of Energy Commission of Malaysia (EC), is designed to showcase technologies that will reduce the building energy consumption, and potable water usage, promote sustainable building material usage and provide an enhanced indoor environmental quality.

A holistic approach for the building envelope, atrium design, mechanical and electrical system, daylight system, landscaping, materials selection taken by the design team enabled the design of an environmentally responsible corporate headquarters targeted for the highest environmental label Platinum for Green Mark from Singapore.

The diamond form symbolises transparency, value and durability; characteristics which represent the EC's role and mission as a regulatory body.

In recognising these aims and visions, the design team has taken this opportunity to apply various energy efficient theories for building designs in hot-humid climate in order to achieve EC's requirements. Extensive computer simulation of the 'diamond' form which was conducted ensures that the daylight and energy performance is met for this building. Daylight simulation conducted ensures adequate and well distributed daylight is provided while preventing glare to maintain visual comfort. Detailed hourly energy simulation of the building which is also being conducted provides detailed information on the appropriate measures that the building can adopt to ensure reduced energy, while maintaining same comfort conditions for the building occupants. This building when completed will present itself as a unique model that employs energy efficient and sustainable building technology for hot-humid climates.

The main idea behind the design of EC Headquarters Building is to demonstrate prominent uniqueness. The building is in harmony with the hot-humid climate of Malaysia by integrating multi-disciplined input to the design concept. Emphasis is not solely on aesthetic qualities, but also on science, technology, economics and engineering. Each variable of the different disciplines expresses the logical contents of each subject through the physical architecture. Designed with the knowledge of science, and expression of the visual arts, this building ultimately results in an attractive architectural form.

Design Revolution

The design of EC Headquarters Building, displays architectural design that is influenced by novel ideas through the combination of new technology along with modern materials and equipment while keeping construction costs low, to showcase that green buildings need not cost much more than a typical building in Malaysia. The EC Headquarters Building is targeted to reduce energy usage by 60%, with an energy index of 61 kWh/m^2 per year at 2,000 hours usage, as compared to a normal office building in Malaysia, which has an energy index of between 150 to 200 kWh/m^2 per year. Although energy efficiency has a high priority in the EC Building, the occupants' thermal, visual and environmental comfort is placed as the highest priority in this building to ensure occupants of the building get an enhanced environment for better productivity in such an environment.

Total integration of the building's systems is also taken into account. Different systems are integrated and combined with information technology (IT) in order to control the building's performance. These include thermal factors, natural and artificial lighting, acoustical properties, and visual conditions within the building. Scientific and economic analyses are also taken into consideration. Thus, rudimentary architectural concepts are revolutionised to suit the design for a hot and humid climate.

Where high-efficiency lighting is concerned, energy efficient T5 fluorescent tubes are used throughout the building instead of the conventional T8 fluorescent tubes. In addition, special fittings are provided to ensure proper distribution of lighting that will reduce the lighting power consumption by approximately 50% as compared to conventional designs, while providing the same brightness to the space.

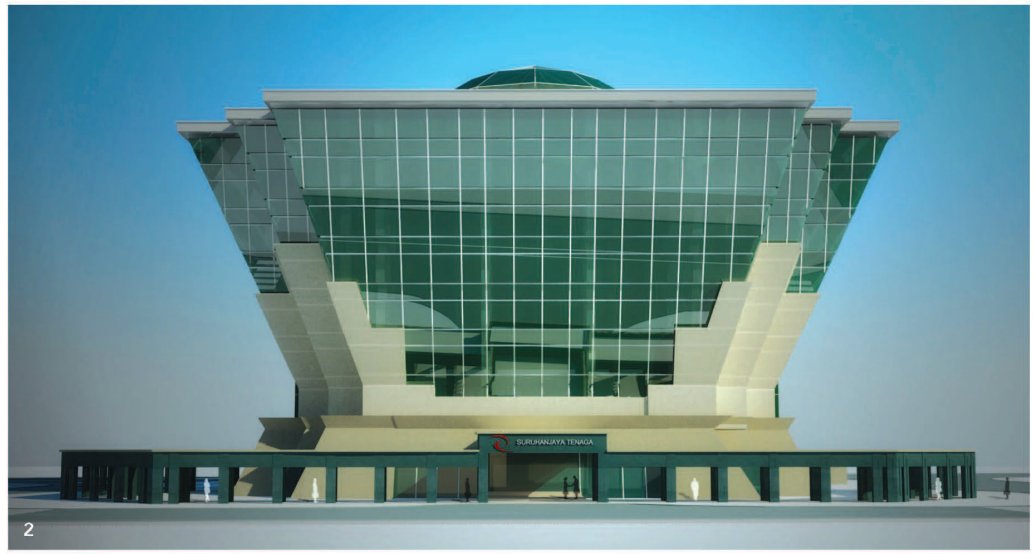
CO_2 sensors provide information on the fresh air intake to ensure that adequate fresh air (and oxygen) is delivered to all the occupants of the building. This type of control allows precise control of fresh air intake into the building to optimise the building performance for both the occupants and energy use.

Air-conditioning for the building is provided by two separate systems, the conventional cold air supply system and radiant cooling slab system.

The radiant cooling slabs have chilled water pipes embedded in the concrete slab itself. Cold water is run in these pipes at night time to cool the building slab down to 20°C. During daytime, these slabs will radiate cooling to the occupants of the building to provide comfort. The advantage of such system is that it will lower energy consumption, as water has a higher heat transfer rate than air, while the pump is typically more efficient than a fan, therefore reducing the energy used to transport cooling around the building. It also allows for lower air temperature in the building as the occupants are now cooled via radiation from the slab as well as the ventilation of cold air, in comparison to just cooling the occupants with only ventilation of cold air in a typical air-conditioning system, thereby increasing the energy efficiency of the system further.

The radiant cooling slab system needs to be complemented with a significantly downsized conventional cold air supply system to ensure that the environment is kept dry to prevent condensation on the chilled slab and also to provide adequate fresh air to the building occupants. As the air ventilation rate is reduced significantly with this air-conditioning system, the noise caused by the ducts is also reduced, improving the acoustic comfort.

The advantages of the above cooling system include improved energy efficiency, reduced noise level, reduced draft and a higher comfort level for the occupants of the building due to its lower radiant temperature.



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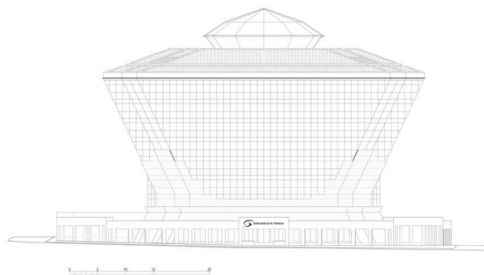
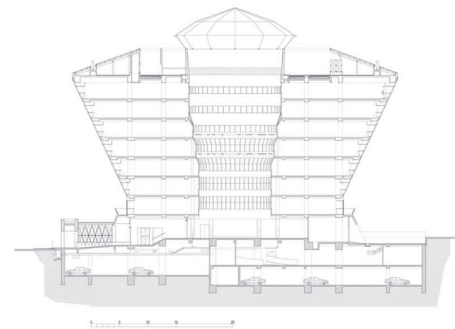


ELEVATION



SECTION

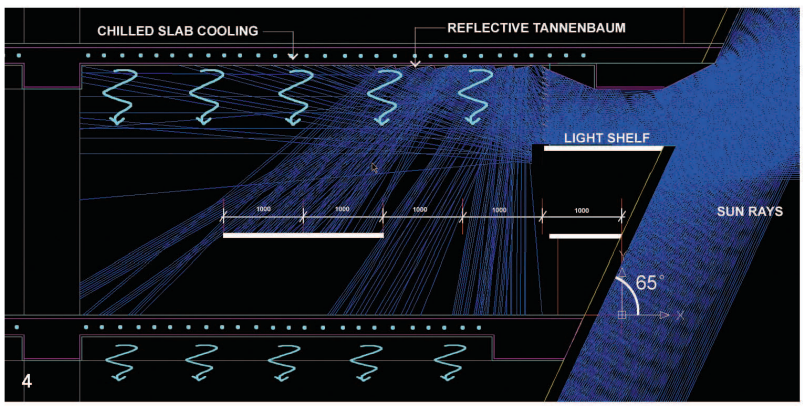
The objectives and surrounding factors affecting the revolutionary architectural concepts and ideas are as follows:

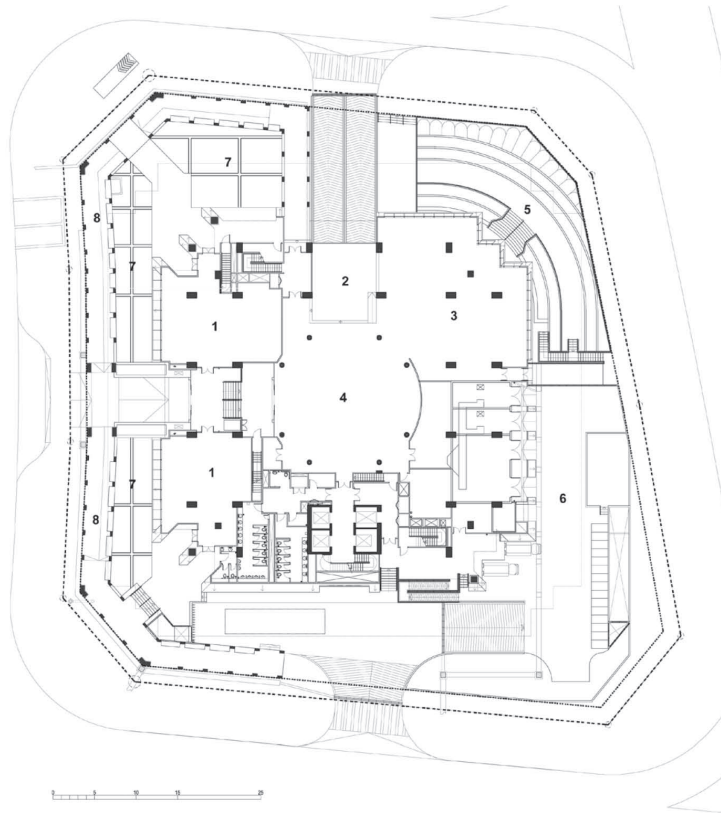
1. Modern technology which has brought about the invention of a large number of highly effective and state-of-the-art equipment.

2. The framework of basic requirements and needs for a better quality of life lies amid a deteriorating environment that is gradually becoming more severe. Thus, it is necessary to control the conditions or surroundings within the building to suit human expectations. Consequently, architects must seek out new forms to comply with the changes that have taken place.

3. The energy crisis currently occurring worldwide has brought about the necessity to use energy economically and efficiently.

1 External perspective of the building
2 External view of the building





GROUND FLOOR PLAN

Design Integration

Integrating the Natural Factors

In the past and still in many places today, outside air or wind has commonly been utilised as a medium for transferring heat in and out of a building. However, the EC Headquarters Building is designed to prevent breezes from passing through the building. An air-tight building will ensure that energy is not wasted due to uncontrolled leakages of outside air into the building. In terms of energy usage, introduction of outside air into the building will increase the demand for cooling load. This is due to the fact that outside air has a higher enthalpy level than the inside air-conditioned space. Blower door tests were conducted to ensure that the construction met the design criteria of 0.5 air-changes per hour for the building. Recent studies on a few selected buildings in Malaysia showed that Malaysian office buildings are generally very leaky, and this feature alone will enable the EC Headquarters Building to save at least 15% of the cooling load.

The building form in the shape of a diamond is found to be the most aerodynamic and effective form to prevent air infiltration through the advantage of a tilted façade. The wind striking the tilted façade will flow below to help ventilate the parking at basement level instead of striking directly onto the façade and infiltrating the air-conditioned building. The self-shading slanted façade optimises a passive design approach to achieve energy efficiency. The perimeter outer walls are tilted at 65° from horizontal. As a result, the North and South façades receive virtually no direct sunlight and the sun penetration of the east and west façades is also greatly reduced.

Additional sustainable features include water management systems through the use of water efficient fixtures in the building and harvesting rainwater from the roof. This building is designed to reduce the use of potable water consumption for toilet flushing and irrigation by more than 90%. To further optimise the water efficiency of the building, grey water collected from the taps is also recycled for irrigation purposes.

As the growth rate of the usage of fossil fuels is spiralling to date, renewable energy in the form of photovoltaic panels is also integrated as part of the building design. The total installed PV capacity is 60kWp fed directly to the national grid. It is estimated that the solar panels will help to reduce the design energy target by an additional 6%.

Materials used in designing the EC Headquarters Building bring about a new dimension in material selection for design and construction as the basis for designing the EC Headquarters Building originated from an energy conservation concept. The selection of glazing is a very important factor for the EC Headquarters Building as it is a balance between the aesthetics of the building, a view to the outside, solar heat gain from the sun, and daylight harvesting needs. Use of low-e glazing that is reflective on

3 View of atrium
4 Study diagram of light shelf
5 Board room

the outside allows daylight into the building and minimises heat gain from the sun. Thus 50% of the office space in the EC Headquarters Building is designed to be day-lit. Integration of daylight sensors will enable the artificial lighting to be switched off when adequate light is provided by daylight, saving energy and reducing heat gain.

A day-lighting system is designed to bring in as much natural light as possible. A split window design for all exterior façades together with an internal light shelf helps to redirect natural light into the depths of the working space. A fixed glare protection blind for the upper daylight window and a slightly tinted vision window helps to ensure visual comfort for the occupants. The atrium is also optimised for daylight utilisation with reflective panels and an automatic roller-blind system responsive to the intensity as well as the angle of the incident sunlight. As a result, a 2 meter wide glare free daylight zone is achieved around the atrium for all floors. Roof lights are also incorporated to bring in daylight for circulation areas on the top floor.

Enhanced Environmental Quality

The design also aimed to provide the occupants with a healthy and productive working environment. Indoor materials with low VOC content such as paint and carpets are selected to minimise health risks to the occupants. The workstations are also designed and arranged to enable most occupants to have a view to the outside.

Occupants of this building will feel better thermal comfort in the building because the type of high performance glazing and walls that are used will transmit very little heat into the building and therefore result in a low mean radiant temperature.

In addition to providing a high quality indoor environment to the occupants, a good outdoor environment is also provided. Extensive landscaping and a sunken outdoor garden ensure not only a connection to greenery, but also provides a cool and shaded ambient environment for the occupants. This coupled with a green roof also helps to further reduce the urban heat island effect whereby the hardscape areas are reduced and replaced with soft green landscape.

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PROJECT NAME
Energy Commission Headquarters Building
LOCATION
Precinct 2, Putrajaya, Malaysia
SITE AREA
4,928.11 sqm
GROSS FLOOR AREA
14,229 sqm (excluding carpark)
BUILDING HEIGHT
43m
CLIENT
Energy Commission of Malaysia
DEVELOPER
Senandung Budiman Sdn. Bhd.
(Wholly Owned Subsidiary of Putra Perdana Berhad)
ARCHITECT
NR Architect
PRINCIPAL ARCHITECT
Ar. Nafisah Radin
PROJECT ARCHITECTS & INTERIOR DESIGNERS
Ar. Hanani Md. Zain
Shaiful Lizan Samsuri
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KRB Enviro Design Sdn. Bhd.
CONTRACTOR
Putra Perdana Construction Sdn. Bhd.
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