ARCH 366: ENVIRONMENTAL DESIGN
CASE STUDY

MENARA MESINIAGA

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1_INTRODUCTION:

In 1998 the U.S. Green Building Council created the quantification system that would rate buildings and their 'greenness,' which would eventually accelerate the implementation, development, and popularity of green buildings[x] in the most wasteful continent of North America; this is LEED. Last year in 2003, the U.S. saw its first environmentally conscious high-rise building that received Platinum LEED rating. But more than a decade ago, before any 'certified' buildings, before any certification system, there was a commercial skyscraper in Malaysia that took the initiative to reinvent a wasteful and often pompous building type. Instead of a hermetically sealed glass-box regulated by mechanical air-conditioning systems, it was atypically climate-conscious and incorporated architectural features that help to regulate the indoor environment without excess energy. The only leisure space in a typical office tower may be the cafeteria in the basement or the office pantry; this skyscraper has shaded outdoor terraces that go all the way up to its rooftop pool and gym.

Shaded outdoor terraces

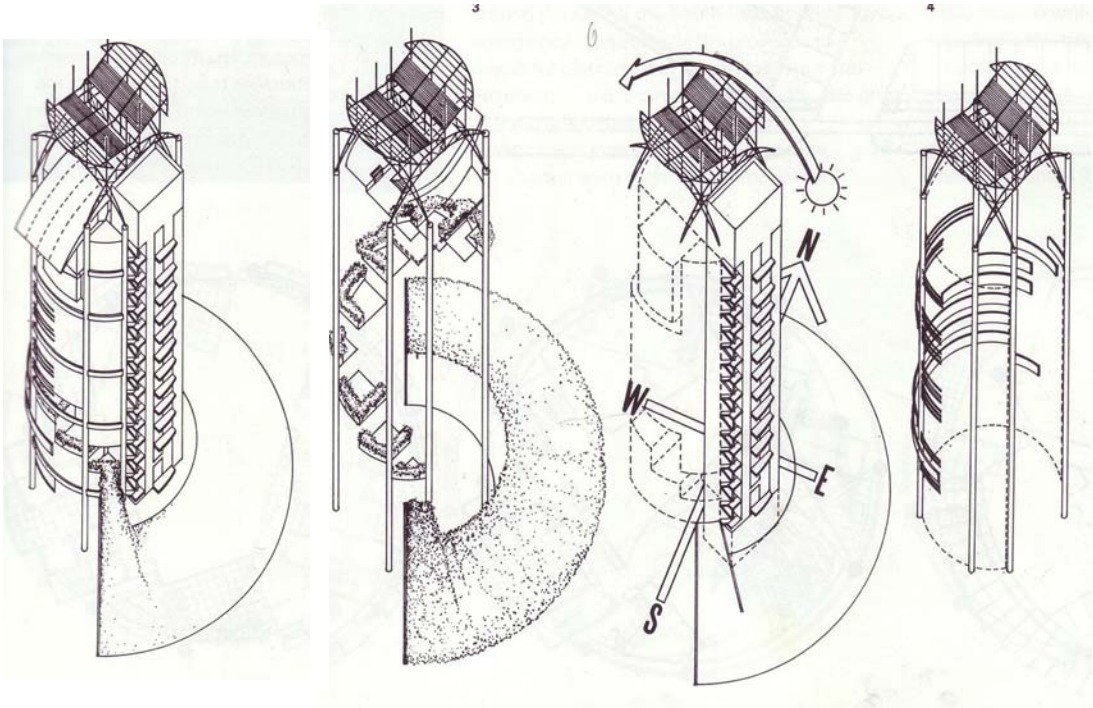
Outdoor employee swimming pool

When the IBM headquarter Menara Mesiniaga, situated in Subang Jaya near Kuala Lumpur, was erected in the summer of 1992[iv], its architect Ken Yeang had the terms energy-saving, climate-consciousness and occupancy comfort realized in built form. IBM approached Ken Yeang's firm, T.R. Hamzah and Yeang, and asked them to design a building which was a showcase for the firm's high-tech corporate image[i]. Yeang designed the building but added his ideas and principles of a "bioclimatic skyscraper" which gave IBM a progressive and environmentally responsible image that proved so valuable that it actually increased surrounding land value[ii].

2_ENVIRONMENTAL DESIGN STRATEGIES:

"The bioclimatic high-rise is a tall building with passive low energy benefits, achieved through design responses to the climate of the place and through optimizing the use of the locality's ambient energies, to enhance the quality of life and comfort for its occupants." [ii]

The noticeable building features of the IBM tower not only visually define the high-tech style of the company and its conceptual organic disposition, but also define it as a bioclimatic high-rise. First, the building's general form, structural strategy, component cores, glazed surfaces, is oriented for maximum environmental efficiency shading against direct overheating but allowing for natural daylight. Second, where the main components of the building and its orientation cannot shade the building, ingeniously calculated shading devices are installed on the building face for passive cooling. Finally, the extension of the land that begins at the sloped berm spirals up the height of the building with planted terraces that culminates at the inhabited rooftop. These terraces not only provide for vertical gardens and transitional spaces, but also shades and ventilates the building. These major innovations in form, envelope and regional adaptations to the typical skyscraper indicated that Yeang's work was at the leading edge of the then contemporary architecture at the time ecological design was at its organizational infancy.



Axonometrics: (Left to Right) Built form; Planting & sky gardens; Solar orientation; Shading devices

The Menara Mesiniaga is a sixteen-storey office tower built on a highly visible site on the way from the domestic airport to the city. Local taxi drivers call it the 'rocket'; possibly due to its cylindrical form and a distinct tripartite structure that visually connects the landscape to the building[iii]. At the bottom is a sloped landscaped base that houses the main lobby, theatre, classrooms and other exhibition spaces. It creates a gradation from surrounding grass fields to the main structure. The body is a series of spiraling floorplates with landscaped terraces and external louvers that shade the office space within. They rotate about the central axis that is the core of the building. At the top, the tower is capped with a cantilevering pool terrace and an overhanging gym and is finally capped by a steel trellis.

The simple expansion of the tower's base generates several positive environmental effects. The sloped berm circles around half the circumference of the building, the other half opens the mezzanine floors to the surrounding land. This allows for a functional connection with the site, avoiding how typical enclosed lobbies segregate the building from its landscape. As well, it encourages air movement underneath the building, creating a lobby entrance that is shaded as well as ventilated without mechanical effort[iv]. The program that is in the mezzanine requires little daylight; therefore, by building the hollow berm up to these levels it increases the surface area for planting and provides opportunity for the building to involve the surrounding vegetation. And like the effectiveness of sloped roofs in snowy regions of the world, the gradated green base channels as well as absorbs the abundance of rainfall before it returns back to the earth.

The lobby is naturally ventilated

The exposed steel and reinforced concrete structure can be conceived of as an exoskeleton that is suspending the differently shaped office floors with each floor's main girders connecting to the concrete core for shear resistance. Where the general rule of thumb for buildings in colder regions is 'skin outside, structure inside', the tropical climate may have an exposed structure without adverse temperature effects. In fact, the structure that wraps around the curtain wall shields the sun off the building face and act as a heat sink[iv]. Of course, in a tropical climate where winter temperatures hover in the high twenties to low thirties, it is useful to minimize heat absorption. Therefore, the steel columns are clad with stainless steel to reflect the sun, and the entirely exposed columns and beams are open to cross ventilated cooling.

The core uses extensive passive heating and cooling strategies and has no mechanical support[v] because its programmed functions of circulation and washrooms involve low occupancy duration. Instead of an internal service core, the concrete core of the building faces the exterior and is located on the east side of the tower. This orientation allows the core to shade the building from direct sun rays and its material construction allows it to become a heat sink that will reradiate absorbed heat into the interiors at night. The escape stairs are unenclosed and the elevator lobby and washroom spaces have shaded window openings that give in view and natural ventilation[viii].

East Side: Building core shades direct east sunlight and acts as heat sink

North-East: North side is glazed as it receives little sunlight.

The majority of the building's double-glazed, operable curtain walls lie flush to the façade only on the north and south side. Being near the equator, the Malaysian afternoon sun shines from high in the sky, a slight overhang is enough to block shallow penetrating rays into the building. For most of the west half of the building, external solar shades are installed. The southwest and northwest are protected by aluminum fins offset approximately 40cm away from the building face[iii]. These devices are utilized where high-angled rays may hit the curtain walls. But for more far reaching direct light, deeper, single panel aluminum louvers offset from the building twice as far as the fins is installed.[iii]

Where extensive west-side shading is concerned, the alternately shaped floorplates partners with terraces to create indentations in the building form that help it shade itself. The landscaped terraces that appear on every office level also allows for full height sliding glass doors that let in fresh air and greened transitional spaces for a respite from computer screens[vi]. The stepped terraces can be traced spiraling back down to the berm and the surrounding landscape, generating an atrium where employees may feel part of a progressive organization that has clear environmental awareness. Internally, enclosed rooms are placed as a central core rather than being situated at the periphery. This ensure good natural lighting and views out for the peripherally located workstations. Because the building is circular in plan, there are no dark corners[iv].

Left: Interior view of external solar shades on the west side

Middle: The spiralling stepped terraces allow fresh air through glass doors

Right: Close-up of west-facing shading devices

Studies have shown greater occupancy happiness and employee productivity where the building can provide for a connection with exterior spaces whether it is natural daylight or sky gardens that let workers relax and feel as if they belong to a whole. [ix] Commerzbank and other new commercial office tower projects have followed suite and is part of an increasing mandate to not only make our buildings healthier for our environments, but for people as well.

The major visible architectural elements topping off the office levels include a cantilevering rooftop pool and a gym with a curvilinear roof; these facilities are open to employees. [v] The pool 'greens' the rooftop by insulating and reflecting the overhead sun. The overhang of the curvilinear roof is enough to shade most of the entire south façade from the high angled afternoon sun. Crowning the building is a tubular steel trellis that shades the top floor amenities and is designed to accommodate solar panels in the future[iii] that will further increase the building's ecological efficiency.

The overhang of the curvilinear roof shades the south façade from high angled afternoon sun

3_LEED 2.1 CHECKLIST:

At the time Menara Mesiniaga was constructed in 1992, LEED ratings had yet to be invented. However the design innovations to make a more energy efficient tower have a real impact. Therefore, the IBM Headquarters designed by T.R. Hamzah & Yeang will be run against the LEED rating system to see how these decade old concepts would fair in a contemporary quantified system. The building is hypothesized to only achieve a CERTIFIED rating in LEEDS, not because it has comparatively less extensive implementation of environmental design principles, but for the fact it is expected to lose points because it did not have the specific LEED outline to strive for. The LEED rating system has design flaws that lend itself to an unbalanced 'weighting' of points. Such as providing bike racks for building occupants earn the same points as much more intensive and beneficial efforts as installing a green roof. [x]

Sustainable sites:

The IBM Headquarters at Subang Jaya fulfills the requirements to be considered in this category. It is not on prime farmland or the bottom of an old flood plain. The surrounding environment is zoned for commercial use. [ii]

Points	**Category:**
(of 14)	Sustainable sites
	Subcategory:
Channeling development to urban areas:	
1	- The IBM tower is developed along a major route between downtown Kuala

	Lumpur and the domestic airport.[i] Its extension of the urban development in a space efficient high-rise tower earns it a point.
1	- Its high profile environmentally responsive design increased the surrounding land value and triggered adjacent high density development.[ii]
Locating near rail or bus lines:	
1	- Along major downtown to suburb route, serviced by many modes of public transportation.
1	- Providing bicycle storage and showers for 5% of occupants:
Parking for bicycles as well as popular and efficient motorbikes.	
1	- Rooftop employee amenities include showers, changing rooms, saunas, etc.
Reducing development footprint:	
1	- The multi-level high-rise frees the surrounding ground floor for landscaping.
Storm water management plan and system:	
1	- The landscaped sky gardens and sloped berm retain moisture and gradually return rainwater back into the ground.
Providing shaded, light-colored, or open-grid paving, underground or structured parking (50% of spaces)	
1	- Parking is underneath the vegetated berm. The plants absorb the sun's heat for photosynthesis and insulates the building
Cool or vegetated roofs:	
1	- Rooftop swimming pool insulates the building from high intensity sun.
Total:	
9/14	

Water Efficiency:
The building takes advantage of the rainy climate to help it conserve water. It stores rainwater to water most of the vegetation, the weather and water collection minimizes the size of irrigation system installed.

Points	**Category:**
(of 5)	Water efficiency
	Subcategory:
Reduce water consumption for irrigation by 50%:	
1	- Rooftop rainwater collection and building water runoff onto the landscaped berm minimizes the need for irrigation.[i]
Use captured rain and/or do not install landscape irrigation systems:	
1	- Captured rain used to irrigate sky gardens.[iii]
Total:	
2/5	

Energy and Atmosphere:
The exact difference in energy cost savings of the climate responsive Menara Mesiniaga may be hard to quantify with a mechanically regulated building of the same program, function, and orientation. Educated guesses will be made.

Points	**Category:**
(of 17)	Energy and Atmosphere:
	Subcategory:

Reduce design energy costs by 10%, 20%, 30%, 40%, 50% or 60%:	
4	- External core shading east-side sun.
	- Naturally ventilated service core.
	- External shading devices.
	- Energy efficient curtain walling.
	- Operable windows.
	- Shaded sky gardens and shaded lobby entrance.
	- Rooftop insulating pool, landscaped berm and vegetated sky gardens.
Supplying 5%, 10%, 20% of total energy use via on-site renewable resources:	
1	- Rooftop trellis designed to support solar panels that will generate electricity for the building as well as shade the roof.
Using independent commissioning authority:	
1	
Providing owner with a manual for recommissioning building systems:	
1	- Ex: future installation of solar panels on roof trellis.
Contracting to review building operation with O&M staff:	
1	- Contract proposal includes instructions for building management that will maintain its eco-efficiency.[ii]
Total:	
8/17	

Materials and resources:
The points award system for intensive use of recycled or reused materials makes it hard for the Malaysian IBM building. Regional recycled construction materials companies have not yet been established. City and industry practices do not create a helpful infrastructure to regain value of construction waste.

Points	**Category:**
(of 13)	Energy and Atmosphere:
	Subcategory:
2	- Low embodied energy: exposed reinforced concrete for structural frame and service core.
1	- Aluminum shading louvers may be recycled.
1	- 50% of building materials manufactured regionally.[ii]
Total:	
4/13	

Indoor Environmental Quality:
Smoking must be prohibited in the building to be considered for points in this category. The main strengths of the building in providing for improved IEQ lies in the extensive opportunities for natural ventilation. The lack of released specification information makes it difficult to analyze the building's grading.

Points	**Category:**

(of 15)	Indoor Environmental Quality:
	Subcategory:
1	- naturally ventilated service core
1	- exposed escape stairs
Providing an average one operable window and one lighting control zone per 200 sq.ft. for occupied areas within 15ft. of the perimeter wall:	
1	- Operable curtain wall.
1	- Floor to ceiling sliding glass doors to terrace.
Providing individual controls for airflow, temperature, and lighting for 50% of occupants.	
2	
Achieving daylight factor of 2% in 75% or 90% of all space occupied for critical tasks:	
3	- Shaded full height curtain walls in all office levels.
	- Workstations on the periphery allow daylight penetration to glass partitioned offices at the center of the office floors. [iii]
	- Circular building plan means there are no dark corners.
Total:	
9/15	

Innovation and design process:

Considering much of the design aspects of the Menara Mesiniaga as original and innovative to an often branded-as-wasteful building type, this category is easily satisfied by the environmentally pioneering structure and Yeang's progressive design team.

Points	**Category:**
(of 5)	Innovation and design process:
	Subcategory:
Exceptional performance above the requirements set by LEED:	
Innovative performance in green building categories not addressed by LEED:	
Total:	
5/5	

Total LEED points for all six categories:	
37/69	**SILVER LEED RATING**

4_CONCLUSION:

Under LEED 2.1 refined in 2003, the 1992 ecological sky scraper achieved a silver rating. This is unexpectedly more successful than anticipated. On Ken Yeang's original principles of a bioclimatic skyscraper, its passive low energy strategies as well as pioneering improvements in occupancy comfort has proved worthy even in today's standards.

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