The Aga Khan Award for Architecture

Petronas Office Towers

Kuala Lumpur, Malaysia

Architect:

Cesar Pelli and Associates

Client:

Kuala Lampur City Center Holding Sdn Bhd

Date of Completion:

1997

1969.MAL

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2004 On Site Review Report 1969.MAL

by Galal Abada

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I. Introduction

The Petronas Towers were designed to be the centrepiece of a larger complex called the Kuala Lumpur City Centre (KLCC), a mixed-use development with a site area of 14.15 acres, which includes the towers, two other office towers, underground parking and service facilities. The project site is well located in the heart of the commercial district of the city, the 'Golden Triangle'. Each of the twin towers is eighty-eight storeys high and contains 218,000 square metres of floor space. Rising 452 metres, the towers were certified the world's tallest buildings by the Council of Tall Buildings and Urban Habitat in 1996. The two towers are connected by a sky bridge at the forty-first and forty-second floors – the sky lobby levels – to facilitate inter-tower communication and traffic. A multi-storey shopping and entertainment galleria connects the office towers at their bases, integrating the entire complex. Other public functions within the complex include the Petroleum Discovery Centre, an art gallery, an 865-seat concert hall and a multimedia conference centre.

II. Contextual Information

A. Historical background

In early 1981 the Malaysian Government decided to move the Selangor Turf Club and its horse-racing track from the heart of the city to the periphery and to redevelop the site to meet the demands of urban and economic growth. The site, occupying 100 acres of land in a burgeoning economic catchment area with access to the city's main ring road, offered an ideal location for the development of a new city centre that would reinforce Kuala Lumpur's emerging status as an international city in the twenty-first century. The KLCC was also intended to be a national landmark, reflecting the country's natural beauty and tropical greenery, as well as the vibrant colours and patterns of its rich cultural heritage. Moreover, it would affirm Malaysia's position on the world map.

In the 1990s the project became a principal part of the Wawasan 2020 (2020 Vision), proposed by Dr Mahathir Mohamad, the former prime minister of Malaysia, as part of his government plan for Malaysian progress at that time. Dr Mahathir saw the new KLCC as a major focal point of the Multimedia Super Corridor (MSC) – a strategic initiative by the public and private sectors to transform Malaysia into a world leader in information technology development. The MSC is a 50-kilometre-long, 15-kilometre-wide stretch of land that extends from the KLCC to the new Kuala Lumpur International Airport, including two new cities: Putrajaya, the new federal political and administrative centre; and Cyberjaya, a centre of information technology development and a home for the Multimedia University.

Following approval of the development by the Malaysian Government, an international competition was organized in 1990 to select a master plan for the new KLCC. The concept of the winning plan, by the US firm Klages, Carter, Vail & Partners (KCV), was an integrated

mixed-use development where people could work, live, shop and visit and enjoy all aspects of life in a convenient and pleasant environment – 'a city within a city'. The KLCC master plan advocated the development of 37 acres of the site into office buildings, a retail centre, hotels, residential buildings, a civic centre, museums, a performing arts centre and substantial public parks, gardens and lakes, all built to a high international standard. The remaining 63 acres were to be developed as public areas, including a sprawling 50-acre public park.

The Petronas Towers complex is located at the north-west corner of the KLCC development and comprises a total built-up area of 341,760 square metres of mixed-use accommodation, including the twin towers. The design of the Petronas Towers was selected from schemes presented by eight firms invited to participate in an international competition in June 1991: Kohn Pedersen Fox Associates, Murphy/Jahn, Michael Graves & Associates, Aldo Rossi, Johnson Burgee, Stirling Wilford & Associates, KKS, and Cesar Pelli & Associates. The competition entries were required to follow the KLCC master plan.

B. Local architectural character

Architecture in Kuala Lumpur is heterogeneous, expressing the city's diverse history and cosmopolitan culture. Public buildings, housing estates, mosques, churches and Buddhist and Hindu temples grace the city alongside skyscrapers and modern high-rise buildings. The British 'Raj' style, imported from India, shaped the administrative and public buildings of the colonial period in the 1890s, and these are located close to the city centre. This style combined accentuated verticality with features of Mughal Indian architecture and was characterized by prominent minarets, copper-clad onion domes and Moorish horseshoe arches. Chinese 'shophouses' are the most widespread urban building type and characterize the main commercial streets in Malaysian towns and cities. The shophouses are generally two storeys high, with the lower floor used for trading and the upper floor for residential purposes.

High-rise buildings characterize the central area of Kuala Lumpur. Postmodernist examples of the 'Malaysian Islamic architectural identity', employing Islamic motifs in both their massing and façades, exist side by side with modern expressionism and an eclectic mixture of other styles, including traditional Malay revival. There are tall buildings dating from the 1980s: the Menara Dato'Onn (175 metres), Kompleks Dayabumi (157 metres), Bangunan Tabung Haji (152 metres) and Manars Maybank (244 metres). There are also 1990s high-tech skyscrapers like the Manara Maxis (212 metres), the Menara KL 'Kuala Lumpur Tower' (420 metres), the Telekom Tower (310 metres), and the Empire Tower (238 metres). Brick, concrete, steel, glass, stone, marble and plaster are used in a variety of combinations, overshadowing local timber architecture.

C. Climatic conditions

The western part of Malaysia lies between latitude 1° and 7° N, longitude 1000° and 1190° E. It is located to the south of the Malay Peninsula and its major cities are Kuala Lumpur, Penang and Ipoh. Kuala Lumpur – latitude 3°8' N, longitude 101°44' E – is about 3° north of the equator. Malaysia is a hot and humid country and has a tropical climate. Typical characteristics include intense sunshine, resulting in high temperatures and levels of glare, as well as heavy rainfall. Average temperatures are mostly high throughout the year, with a

maximum of 29–32°C during the day and a minimum of 22–24°C at night in the coastal areas. Rainfall is heavier along the east coast than the west coast, during the winter months, ranging between 250 and 300 centimetres. Average humidity is between 60 and 70 per cent. Kuala Lumpur is not subject to seismic activity, nor to hurricanes and typhoons.

D. Site and surroundings

The Petronas Towers are strategically located in the 'Golden Triangle' of Kuala Lumpur – a site that is central not only geographically but also symbolically. Large colonial villas set in a relatively green area next to the Selangor Turf Club racecourse originally occupied the zone. For the last few decades Kuala Lumpur has been growing at a tremendous rate and has undergone many changes due to economic prosperity, changing lifestyles and land pressures in the city. These changes have given rise to a newly emerging central business district in the Golden Triangle. The economic boom years of the late 1970s and 1980s made the area very attractive for developers and speculators, giving rise to the building of numerous hotels, financial institutions, corporate headquarters and commercial buildings, which characterize the surroundings of the Petronas Towers today. The absence of a master plan or any development control regulations prior to the 1990s led to ad hoc developments with no relation to each other, and to uncontrolled expansion along major roads. As a result, the Golden Triangle zone lacks a distinctive urban form. However, Kuala Lumpur is clean and beautiful, with tree-lined streets, parks and public gardens, and it transforms into a wonderland of lights at night, earning it the name 'Garden City of Lights'.

The developers of the KLCC have implemented a comprehensive set of traffic improvement measures, including improvements to intersections, road widening and better public transportation to ease access and mobility within and outside the KLCC. There is a four-level car park located beneath the KLCC, while other nearby developments have been designed with their own parking facilities. Ample provision has been made for bus terminals and taxi stands around the area. The Putra LRT (Light Rail Transit) station opposite the project site links directly to its concourse level.

E. Topography

Located in the hills of the southern Malay Peninsula, Kuala Lumpur is situated at the junction of the Klang River and the Gombak River, a site that gives the city its name, Kuala (river mouth) and Lumpur (muddy estuary). The city is ringed by low mountains, but within the city only a small hill interrupts the level terrain. The project site is flat grassland but the bedrock below is very irregular: after millions of years of weathering, limestone bedrock in this region formed caverns, spires, ravines and steep-shouldered mountains. Sediment from erosion filled the valleys and metamorphosed into weak rock that weathered back into a type of stiff soil called 'Kenny Hill'.

III. Programme

A. What conditions gave rise to the formulation of the programme?

The design brief for the towers, prepared in April 1991, called for three major office tower blocks of approximately sixty to eighty storeys each and a twin tower convention hotel linked at the podium. The podium was intended to house supporting amenities, department stores, retail areas, restaurants, car parks, and so on, and to form a link between the two separate tower blocks for convenience and to provide architectural integration. The towers were intended to define a gateway into the new city centre. They occupied the designated parcels A, B, C within the north-west sector of the master plan. The brief for the 'North-west Development', the original project name, included a proposed public plaza at the intersection of Jalan Ampang and Jalan Ramli roads, as well as an exterior water courtyard and an interface with adjacent roadways or lagoons.

Cesar Pelli & Associates further refined the programme in July 1991 to include the following elements:

- Offices: twin towers (designated for offices rather than a hotel) of approximately eighty-five tenantable storeys; an additional sixty-storey office tower, and a thirty-storey office tower. Total gross area: 1,366,714 square metres.
- Retail: a multi-level retail centre of total gross area 699,654 square metres.
- Hotel: a 1,800-room convention hotel and conference centre. Total gross area: 491,289 square metres.
- Parking: integrated parking for 6,650 cars.

As the project developed, some requirements were slightly modified and the proposed hotel was not incorporated in the project but was built separately, adjacent to the Petronas Towers, by GDP architects, Kuala Lumpur. There are two other office towers adjacent to the complex, but developed and designed separately and not considered part of the Petronas complex. One office tower, the forty-nine-storey Menara Maxis had already been built.

B. Objectives

The brief called for the creation of 'a place that people can identify as unique to Kuala Lumpur and Malaysia'. The client wanted the towers to be beautiful and distinctively Malaysian and to act as symbols of the growing importance of the city, but to be functional as well as attractive. They were also to reflect the architectural tradition of the major Islamic countries and the unique cultural heritage of Malaysia, combining Malay, Chinese and Indian strands.

The main programme objectives as proposed by the brief were:

- to provide state-of-the-art facilities and offices to enable Petronas to reinforce Malaysia's future role as the dominant oil and gas and petrochemicals producer in Asia and the Pacific.
- to create a mix of commercial, tourist and community facilities and amenities as a world-class attraction and achievement in terms of design, engineering and construction.

- to develop the project in such a way that its visual integrity could not be disrupted by existing buildings or by possible future construction.
- to provide sites for department stores and shopping areas in which residents and visitors might purchase a complete array of international and local goods.
- to provide easy communication between the different facilities, offices, department stores, shopping areas, and entertainment areas, with state-of-the-art methods.

C. Functional requirements

According to the architect's report, the functional requirements were to provide 218,000 square metres of floor space (gross building area) in each of the towers, as well as a concert hall, a six-storey shopping and entertainment complex to include two department stores, shops, restaurants, cinemas, an art gallery, a specialized library and an interactive science discovery centre, as well as a four-storey underground car park for 5,400 cars.

IV. Description

A. Project data

Each of the two towers contains eighty-eight storeys. Tower One houses the Petronas Headquarters' offices and facilities, while Tower Two accommodates local and international private tenants, KLCC Holdings' offices and some vacant spaces. A smaller circular 'bustle' or annex, rising forty-four storeys, was added to each of the towers in order to provide more usable space. The towers are connected at the forty-first and forty-second levels storeys by a sky bridge to facilitate communication and traffic between the towers. Organized around this interchange are shared facilities such as the *surau* (prayer room), the Malaysian Petroleum Club (MPC) and executive dining rooms.

Towers:
- Tower One: Petronas Headquarters' offices.
- Tower Two: Mostly private tenants, KLCC Holdings' offices, some vacant areas for rent.
- Total gross floor area: 218,000 square metres in each tower, eighty-eight storeys.
- Total net floor area: 119,300 square metres in each tower, height: 452 metres.
- Typical floor-to-floor height: 4.0 metres.
- Finished ceiling height: 2.65 metres.
- Raised floor: 125 millimetres, levels eight–seventy-two.
- Sky bridge: centre-line span, 58.44 metres; width, 5.29 metres: height, 9.45 metres; 170 metres above street level.
- Height of pinnacles: 73.5 - 75 metres.

Net floor area varies on each floor because there are setbacks as each tower ascends:
- Levels eight–nineteen: 1,970 square metres (typical lift bank A).
- Levels twenty-eight–thirty-four: 2,030 square metres (typical lift bank B).
- Level forty: 1,850 square metres (typical lift bank express shuttle).
- Levels forty-one and forty-two, sky lobby levels: 1,736 square metres (typical lift banks C, D, E express shuttle).

- Level forty-three: 1,402 square metres
- Level forty-five: 1,483 square metres (typical lift bank C).
- Levels forty-seven–to fifty-six: 1,604 square metres (typical lift bank C).
- Level sixty-one: 1,286 square metres (transfer floor).
- Level seventy-six: 882 square metres (typical lift bank E).
- Level eighty-two: 608 square metres (typical lift bank E).
- Levels eighty-five–eighty-six: 358 square metres (boardroom shuttle).
- Central core standard gross area: varies from 510.60 to 417.36 square meters.

Vertical circulation: 29 high-speed double deck lifts and 10 escalators in each tower. Lower floors (levels eight–seven) are served by two banks of 6-1600/1600 kilogram double-deck elevators. Upper floors (levels forty-four–eighty-three) are served by one bank of 6-1600/1600 kilogram, and two banks of 3-1600/1600 kilogram double-deck elevators. Sky lobbies (levels forty-one and forty-two) are served by five 2100/2100 kilogram double-deck shuttle elevators.

Dewan Filharmonik Petronas Concert Hall: three levels; 885 seats without stage extension; 783 seats with stage extension.
Suria retail/entertainment facilities: 140,000 square metres; six storeys; height, 33 metres; two mega-stores; 250 shops; two food courts; entertainment centre; thirteen-screen cineplex.
Galeri Petronas: 2,000 square metres.
Petrosains Petroleum Discovery Centre: 9,280 square metres.
Multimedia conference centre: about 6,000 square metres; three levels, including the top of Tower Two.
Malaysian Petroleum Club (MPC): about 5,000 square metres.
Parking: 251,000 square metres for 5,400 bays on four underground storeys.

B. Evolution of design concepts

In evaluating the competition entries, the selection committee looked for designs that complied with the KLCC master plan, were functional and efficient, and expressed the culture and heritage of Malaysia. According to Mr Tan Sri Datuk Seri Azizan Zainul Abidin, Chairman of Petronas and KLCC Holdings (Petronas owns 98 per cent of KLCC Holdings): 'We wanted something extraordinary and that is what Mr Pelli gave us. His design has elements of Islamic architecture identifiable with our country. The other architects' designs looked as if they could be built anywhere.'

Some events that occurred during the development of the project further modified parts of the design concept. The most significant modifications were:

- The early scheme for the tower design called for a twelve-pointed-star floor plan, but this was changed to an eight-pointed-star floor plan when the prime minister observed that the former geometry was more Arabic than Malaysian.
- The client decided to add a concert hall to the project on a third level between the two towers. The main entrance to the tower complex and the central lobby were totally redesigned.
- The late test borings indicated difficult underground conditions. Consequently, it was decided to move both towers 60 metres to the south-east. This required redesign of access

roads and created a large formal garden as a forecourt for the towers.

- The sky bridge was not a requirement of the brief but as the project progressed it became an essential feature. It was also realized that its mid-height location permits access from one tower to the other as an alternative exit path, avoiding the addition of two more fire stairs.
- The towers in their original design were not the world‘s tallest. In June 1993, the design called for twin towers 432 metres high, just 19.9 metres less than the Sears Tower in Chicago, the world‘s tallest building at that time. In response to the client’s request to break the world record, the architects pushed the total height of the towers to 451.9 metres by stretching the size of their spires.

An early concept for the floor plan of the towers consisted of two interlocking squares, forming an eight-pointed star. This was modified by placing eight semicircles in the angles of the corners to create more floor space. The final floor plan has 16 protrusions: eight points and eight lobes. The square core, which contains elevators, mechanical shafts and other services, connects to support beams that extend out to perimeter columns. Each tower tapers inwards at six intervals, with the walls of the upper levels sloping inwards. Both towers are topped by a 73.5-metre-high, 176-tonne structural steel ‘pinnacle’ comprising a mast, a ring ball and, at the very top, a spire ball. The ring balls, located about a third of the way up the masts, are made up of fourteen circular tubes of varying diameter and conceal tracks for equipment to wash the external façade above the eighty-eighth floor.

In the lobby between the towers, the walls are lined with light-coloured Malaysian wood set beneath a stainless-steel grid. The pattern of the marble floor is derived from one of the most popular Malaysian patterns, used in Pandan weaving and Bertam palm-wall matting. The colour of the marble on the floor is different for each of the two lobby levels to reinforce orientation when using the elevator system.

Also between the Petronas Towers is the Dewan Filharmonik Petronas, which houses the Malaysian Philharmonic Orchestra (MPO). Specifically designed for symphonic performances, its classic ‘shoebox’ form, used in nineteenth-century European concert halls, is divided into three levels: orchestra, grand tier and gallery. The floor of its large entrance lobby, decorated with chandeliers modelled on the steel spires capping the pinnacles of the towers, features a radial swirl of inlaid stainless steel on Terengganu green granite, a subtle variation on local patterning. The walls of this lobby are of turned glass rods backed by corrugated metal sheets that strongly reflect light. The shimmering steel and glass of these spaces melt into the warmth of wood veneer and velour inside the concert hall itself, where the soft, warm tones of the wall finishes defer to a luminous pipe organ at centre stage, creating a sense of intensively crafted and intricate space. The ceiling, of perforated metal trimmed in bronze, is a shallow vault with a circular dome at its focal point. Both walls and ceilings conceal sound-reflecting and sound-absorbing panels. All screens, shades and panels are adjustable so that the acoustic qualities of the hall can be changed for different performances. The stage can also be adjusted to accommodate both Western musical productions and Malaysian music and cultural performances.

Suria KLCC, a crescent-shaped retail and entertainment complex, is situated at the foot of the towers overlooking the KLCC Park. In Malay ‘suria’ means sun and the sun is represented

symbolically in the design of the articulated 'cupola' in the central atrium. This faceted roof sits 53 metres above the concourse level and appears to be partially open, with sunlight glinting around its eight triangular sections. To draw natural light down to ground level, metal and glass were layered to balance external ambient light with artificial internal lighting. The dome steps up in six horizontal levels, with clerestory windows at each level to shed light on the underside of the dome's surface. The roof also incorporates devices to channel and vent rising warm air, while diffusing and limiting heat gain from the strong tropical sunlight. The six-level Suria complex, rising from the concourse through to level 5, has two major department stores and over 300 shops, cafés and theme restaurants. These line two 'streets' that extend along opposite axes from the central atrium. These streets are naturally lit by a linear skylight and lead to circular hubs at each end of the mall.

Petrosains is an interactive science discovery centre, located at level four of Suria KLCC. The museum allows visitors to touch, feel and manipulate displays and exhibits aimed at stimulating interest in science and technology, particularly in petroleum science. Galeri Petronas is located in Tower Two with its entrance at level three of Suria KLCC. Exhibiting traditional and contemporary art, the gallery features various media, ranging from painting and sculpture to experimental work, all aimed at educating and stimulating the widest possible audience.

The design of the exterior façades employs arcades and canopies to evoke the 'five-foot way' character of traditional shop houses, using coloured ceramic tiles to reflect Malaysian art and culture. The five-foot way is an old Malaysian tradition specifying that all shophouses should include a minimum five-foot-wide veranda on the ground floor. This building tradition addressed the extremes of the tropical sun and rain, and created pedestrian linkages at ground level. Shopkeepers used the five-foot way to advantage by displaying their products at the front of the shop, sometimes spilling the display onto the five-foot way itself. The external pedestrian arcades, together with a promenade lined with trees and fountains adjacent to the lagoon in the KLCC Park, are for the general public as well as for shoppers. According to the architect, the front garden with its fountains evokes the typical Islamic garden design and the Alhambra in Granada in particular, but with tropical trees and flowers. At the base of each tower there is an outdoor lobby, enhanced by a dynamic sculpture.

C. Structure, materials, technology

1. Foundations

Excavations at the early stages of construction revealed major problems with the 'Kenny Hill' limestone bedrock. The 300,000-metric-ton weight of each tower was to be spread over a large concrete slab – a 'mat'. But each tower would exert 1,140 kilopascals of pressure, more than twice the weight-bearing capacity of Kenny Hill soil. The limestone bedrock below the towers turned out to slope steeply to one side, enough to cause the foundation to fail, making it much more expensive and difficult to build the foundations as planned. Consequently, it was decided to move the towers about 60 metres to the south-east, where the buildings would sit on a concrete mat anchored to soil, not bedrock, by concrete friction piles.

The foundation system of the towers consists of a 4.5-metre-thick piled raft supported on rectangular friction piles (barrettes) varying in depth from 40 metres to 105 metres, to control

predicted settlement under different thicknesses of Kenny Hill formation underlain by limestone. Each foundation consists of 104 barrettes (rectangular *in-situ* piles up to 1.2 by 2.8 metres). Barrette construction proceeded with crews lowering a cage of steel reinforcing bars into each hole and then filling the hole with concrete. Finally, casting a concrete mat atop the barrettes completed each foundation.

2. Superstructure

Each tower is supported by a ring of sixteen cylindrical columns of high-strength reinforced concrete, placed on the inner corners of the star-shaped plan to form a 'soft tube', with the columns linked by slightly arched ring beams, also made of structural concrete. The columns are nearly 2.4 metres in diameter at the base of the building, but taper as they rise through the floors, as well as sloping towards the centre of the towers, enhancing the building's svelte profile. At the centre of each tower is an approximately 23-by-23-metre concrete core. Concrete outrigger beams tie the perimeter columns to the cores at the thirty-eighth and fortieth levels, to provide additional stiffness to the structure. The core and cylindrical tube frame system is constructed entirely of *in-situ* high-strength concrete, as are twelve smaller perimeter columns and ring beams around each 'bustle'. The cores create two virtually "solid" walls running north-south and east-west. Structural steel was used for typical long-span floor beams supporting concrete-filled metal deck slabs, and each of the curved or pointed bays cantilevering beyond the perimeter columns is steel-framed.

3. Skybridge structural design

The structural design of the sky bridge was difficult because it had to accommodate differing movements from each tower. The solution was the simplest and clearest: an inverted V-shaped two-hinged arch that supports the bridge in the centre, accommodating all movement. The 'two-hinged arch' springs from supports at level twenty-nine and rises at 63° to support a pair of parallel two-span continuous bridge girders at level forty-one. The structure of the two-level bridge comprises a conventional frame of structural steel with large beams connected to columns, which rest on the continuous girders at level forty-one. The two-hinged arch supporting the bridge has rotational pins (spherical bearings) at each end of the struts. The main bridge girders have a rotational pin directly over the arch crown to permit the crown to rise and fall as the towers move closer or further apart. The arch is a centring device, equalizing the movement of both towers. As the towers move together or apart, the angle of the legs changes, the spherical bearings rotate at the spring points and the legs flex at their top end. The bridge mid-point sinks or rises, flexing the two main girders. The mid-span centring pin and two girder slip pads accommodate this movement. Expansion joints at the mid-point reduce the effect of girder flexure on the bridge glazing by limiting window panel movement to each half-span rather than allowing it to accumulate over the whole girder length. When the towers move in opposite lateral directions or when they 'twist' the arch spring points twist on the spherical bearings and the bridge end bearings slide in opposite directions, guided by 'sliding keeper' blocks on the bridge centre line. In the event that it loses its arch support, the bridge structure would not collapse but would deflect and stay in position.

4. Materials

High-strength concrete was used in the central core, perimeter columns, perimeter ring beams and outrigger beams permitting vertical core and column elements to be of economical size, saving rentable space. Concrete construction requires relatively light, simple equipment and is

appropriate to the skills of the local workforce, while simplifying connections in joints of difficult geometry and providing fire-rated shaft walls in the core. Concrete also aids wind resistance because of its inherent stiffness and damping properties, which reduce the buildings' response to gusts of wind. Use of steel beams and decking enabled fast and flexible construction to meet an ambitious schedule, while permitting last-minute or post-construction changes to accommodate special openings or loading requirements requested by the tenants. The steel framing system permitted local fabrication and innovative non-crane erection methods, while the decking provided the required fire ratings without the need for fire spray or thick or lightweight concrete fill.

The towers and their base are clad with stainless steel extrusions and custom-made 20.38-millimetre laminated light-green glass. The curtain wall of each of the triangular corners of the towers is flat with a 90° corner at its extremity, while the curtain wall of the semicircular protrusions is faceted. The curtain wall panel system comprises a total of 33,000 panels. Each panel rises one floor and spans from sill to sill, with vision glass below a stainless steel spandrel with a grey glass spandrel at the top. Horizontal 'bullnose' and 'teardrop' sunscreen brackets provide shading. Each sunscreen is the same width as one of the curtain wall panels and together they give the appearance of a continuous silver ribbon around the building. Both types of sunscreen have cast aluminium end caps and are fixed on brackets made of extruded aluminium and finished with oven-cured PVF2 fluorocarbon paint.

5. Technology

The project employs automatic controls and advanced communication systems to minimize energy consumption and maximize convenience of use, incorporating networking capabilities. Each floor or pair of floors in the towers has its own local area network for air conditioning and lighting, as well as a general-purpose control. The most significant systems used control vertical transportation, energy conservation, air conditioning, building control, building security, the fire alarm and the safety plan. (See Appendix 1 for more details.)

D. Origin of technology, materials, labour force, professionals

More than 60 per cent of the materials used in the project were sourced locally and significant transfer of technological know-how and skills was realized by close cooperation between international and local consultants and contractors throughout the project, from the United States, Canada, the UK, Singapore, Malaysia, Japan and South Korea. The Petronas Towers development marked the first use of high-strength concrete in Malaysia by local industry, at relatively low cost. Local materials such as Malaysian wood, Terengganu granite, marble and glass were extensively used. The components of the stainless-steel cladding and vision-glass curtain walls were fabricated locally in Malaysia by a US firm.

V. Construction Schedule and Costs

A. Project history

Design

1990	KLCC development master plan	– Redevelopment of 103 acres of Selangor Turf Club initiated – 66 acres of new public areas, including a 50-acre park to be provided
August 1991	Petronas take a majority stake in KLCC development	– Cesar Pelli & Associates win international competition – Appointment of design consultant team – Plans for 14-acre north-west KLCC landmark development and 400,000 square metres of mixed-use development
December 1992	Schematic revised design	– Revised north-west KLCC landmark development master plan
January 1993	Dvlp'mnt/final design	– Final design approval

Construction

January 1992	Commencement of project planning	– Scheme proposes: – Twin eighty-eight-storey, 452-metre-high towers and sky bridge – 1.5 million sq ft, six-level retail mall, cineplex and restaurants – 5,400 underground parking bays
April 1993	Commencement of excavations	– Largest concrete pour for raft foundation: 13,200 cubic metres continuously over fifty-four hours
August 1993	Foundations	– Foundation works reach 150 metres below ground level
April 1994	Superstructure works	– 80,000 cubic metres of super high-strength concrete – 18,500 tons of reinforcement steel per tower – First use of high-strength concrete (Grade 80) in Malaysia – Structural system designed to withstand 135 kilometre-per-hour winds
July 1995	Commencement of sky bridge	– Total 750 tons spanning 60 metres at 170 metres above street level
January 1996	Fit-out of interiors	– Commencement of fitting out the interiors with furniture
March 1996	Jacking up of pinnacles	– The spire of Tower One was jacked up on 6 March 1996 – The spire of Tower Two was jacked up on 11 March 1996
October 1996	Elevators	– Fifty-eight sets of high-speed double-decker lifts travel up to 6.0 metres per second

Completion

January 1997	First batch of Petronas personnel moved in	– Total projected occupancy is 4,500 per tower – Visitor population 1,500 per day
May 1998	Opening of Suria KLCC	
August 1998	Opening of Dewan Filharmonik	
August 1999	Opening celebration ceremony	

B. Total costs and main sources of financing

The owner of Petronas and KLCC Holdings did not make accurate cost information regarding the project available to the architect or to the Project Reviewer, as this is considered to be confidential. However, a number of reports published in Malaysia claimed that the total cost of the project was USD 800 million. Other sources from within KLCC Holdings report the cost to be USD 'one billion' (USD 500 million per tower). According to the same sources, the total cost of the whole project is estimated at USD two billion. When Mr Tan Sri Datuk Seri Azizan Zainul Abidin, chairman of Petronas and KLCC Holdings, was interviewed during the Project Review, he mentioned that the cost is very close to USD 800 million. Cesar Pelli comments: 'USD 800 million could be the total cost. This is cheap given the level of technology used and the imported materials and systems such as the high amount of stainless-steel cladding and the elevator system, among others.' It is not clear whether this cost estimate is for the whole Petronas Towers complex or for the towers alone. According to the Mrs Arilde Arrif, KLCC Holdings' executive director, the cost for infrastructure works for the whole KLCC, including the Petronas Towers complex, the KLCC park and the surrounding developments, is about USD 150 million. Petronas and KLCC Holdings made the finance available.

C. Comparative costs

In general, the cost per square metre in a regular high-rise building in Kuala Lumpur using medium-level technological solutions was MYR 140–350 at the time of construction, depending on finishing. However, interviews with a number of key architects in Kuala Lumpur who have designed and built skyscrapers – including Kenneth Yeang, Hijjas Kasturi and Jimmy Lim, among others – revealed that the average cost per metre was generally MYR 220–300 (USD 85–117) per square metre (USD 1 = MYR 2.56 at the time of construction in 1996), depending on finishing and the level of technology.

D. Qualitative analysis of costs

The cost per square metre in the Petronas Towers is estimated to be about MYR 500 (USD 195) per square metre.

E. Maintenance costs

Accurate and detailed figures of maintenance costs were not made available. However, according to on-site interviews, the maintenance package offered to private tenants in Tower Two and Suria KLCC, was about USD 1.5 per square metre monthly. The maintenance service package includes chilled water for air conditioning, energy consumption, water and regular maintenance (cleaning, safety measures, security, etc.). Costs for power supply and water costs are based on actual consumption.

VI. Technical Assessment

A. Functional assessment

In general, the complex functions very successfully. The office spaces are open-plan and spacious, with high flexibility allowing efficient use. Standardized layouts are used for tenants on typical office floors. These layouts incorporate well-coordinated architectural elements, lighting, power distribution, telecommunications distribution and air conditioning. Standardized partitioning and furniture layouts can also be used, requiring minimal modification of the lighting, power distribution, telecommunications and air-conditioning systems. A survey of several offices in both towers, including a number of Petronas and KLCC Holdings' offices and some private tenants, revealed that the office spaces are characterized by a wide variety of internal subdivisions and furniture layouts and are used in diverse ways, and this is possible because of the flexibility offered by the columnless spaces of the design. The use of standardized layouts, modular furniture and modular wall systems to modify tenant spaces minimizes construction time, cost and disruption, while meeting the programmatic requirements.

The efficient usable area of a typical floor is about 70 per cent. The core is relatively compact – approximately 23 by 23 metres – and occupies 23 per cent. Although the cores contain the lift systems, stairs, mechanical, electrical and plumbing shafts and equipment, and toilets, this ratio is relatively low in comparison to other skyscrapers. Cesar Pelli believes that: 'This is a good ratio for very tall buildings. Although high-rises such as the World Trade Center in New York had cores that occupied as little as 15 per cent of the total, demand for very large office floors is less in Kuala Lumpur.'

The vertical circulation system used in the towers is very clear and is appreciated by all users and visitors. The concert hall is actively used with a high degree of satisfaction. Its internal organization and acoustic qualities are much enjoyed by the general audience and musicians.

B. Climatic performance

The Petronas Towers respond remarkably well to the tropical climate of Kuala Lumpur using several techniques. The glass curtain walls have stainless-steel sunshades to diffuse the intense equatorial light. These 'tropical walls' make a positive contribution in two ways: they minimize the heat and glare entering the building but at the same time they reflect the play of light and shadow, expressing the tropical environment. The use of tinted laminated glass also

helps to reduce heat gain from the sunlight and ultraviolet (UV) transmission. However, it was noticed during the On-Site Review that in some offices natural light is not sufficient to light the spaces and occupants have to use artificial lighting. To minimize the contrast of brightness between the exterior and interior, a continuous wooden screen wall shields the perimeter of the towers' first floors, reinforcing the sense of the tropical locale. The integrated energy conservation plan performs very effectively in the tropical climatic conditions. The use of exhaust air to pre-cool and dehumidify fresh, warm air has proved to be highly cost-effective as it reduces the amount of energy required to air condition the building by 50 per cent.

C. Choice of materials and level of technology

The choice of materials is outstanding in terms of use and in achieving the objectives of the project. The materials respond effectively to the functional requirements of the project and the local conditions. The structures of the towers are mostly concrete, which is a familiar material to local contractors and is twice as good as steel in reducing a tall building's tendency to sway in the wind. In general, the building makes successful use of high technology, building materials and space.

1. Ageing and maintenance problems

The tower complex is ageing excellently considering that it was completed in 1998. There are no apparent maintenance problems. Interviews with some of the tenants and visitors to the complex revealed that they are highly satisfied with the maintenance and cleaning standards. KLCC Holdings has established a specialized facility management firm, the KLCC Urusharta Sdn Bhd, to deliver a facilities management service for the Petronas Towers, KLCC park, infrastructure and other developments. The scope of maintenance and facility management tasks is categorized into several parts: building control system, vertical transportation, power distribution and energy management, telecommunications, fire alarm system, housekeeping, safety and security management and tenant services.

It is expected that maintenance of the towers' curtain walls will comprise only routine cleaning for the first twenty-five years. This will be carried out by four large maintenance units, one at the top of each tower and one above and one below the sky bridge. Full cleaning is undertaken every six months to maintain the lustre of the stainless steel. In a tenants' service survey conducted in 2002 to evaluate the overall maintenance service, the range of opinion about the maintenance service was wide: excellent, 13 per cent; good, 50 per cent; OK, 29 per cent; poor, 10 per cent.

2. Design features

The towers have become the most popular example of modern architecture in Malaysia. Their elegant form make them the country's most significant urban icon – the most dominant landmark on the skyline of Kuala Lumpur and a national symbol of modern Malaysia.

However, the complex is not well integrated into its surroundings. At a micro-level, the massing of the project and the way it is juxtapositioned with nearby high-rise buildings (for example, the Menara Maxis and the Mandarin Hotel among others) and highways (the Jalan Ampang and the Jalan Ramli) exacerbates the fragmented character of the Golden Triangle

area and affects the appearance of the towers. Conversely, the complex integrates perfectly with the KLCC park and its lakes and fountains to the rear. It has been argued that this contextual problem results from the KLCC master plan, which called for several adjacent towers, including the Petronas Towers, within the same complex. When he was interviewed for the Review, Cesar Pelli said: 'This really was a problem. We tried to make some modifications to the master plan to avoid the problem, but these were rejected by the owner because of the commercial objectives of the project.' Pelli believes that the client did not give much consideration to the impact of the project on its surroundings and that the scheme therefore did not place enough emphasis on urban issues.

There are a number of other idiosyncrasies. Cesar Pelli was asked to adjust the orientation of the towers so that they are directed towards Mecca, although this was not his original intention and he did not understand the need for the change. KLCC Holdings' representatives have confirmed this fact, saying that it was a good thing. In addition, the toilets were located so that they are oriented away from Mecca, a design tradition usually applied only to mosques. The garden plaza in front of the complex is divided into two parts by a road; the first part is close to the complex and the second part is located near to the traffic crossing. This surprising and unnecessary division has separated the two parts from each other, leaving the second part almost derelict.

According to Cesar Pelli, there may be no real new technological innovation in the project, but the adopted technology is very sophisticated and makes use of new creative ideas. The main design features are:

- The sophisticated high-technology and intelligent systems, such as the vertical transportation system, automatic controls and communications systems, which minimize energy consumption.
- The use of modern materials – for example, stainless-steel cladding – to create a sense of climatic responsiveness.
- The modern Malaysian atmosphere created by the interior elements and the mix of natural and modern materials in the entrance lobby of the towers and the interior of the concert hall.
- The exterior of Suria KLCC, inspired by the arcades, coloured materials and decoration of shophouses.
- The floor plan design, featuring a simple use of geometrical patterns and expressing the dominance of Islamic culture and art in Malaysia.
- The sky bridge and space between the two towers, suggesting a symbolic gateway to the city.
- The innovative soft tube concept of the structural design, which accommodates strong winds through the use of high-strength reinforced concrete for vertical members and structural steel for horizontal members.
- The conical spires, inspired by stalactites, which step back six times to reinforce the distinctive silhouette of the towers and suggest an abstract 'ceremonial symbolism' of the kind found in local architectural features such as Malay and Moorish onion domes or the rooftops of Indian temples.

- The shaded windows with deep overhangs, which respond to the tropical climate.
- The cladding of the towers, combining linen-finish stainless steel and projecting

sunshades to give the towers a rich sense of depth and texture.

VII. Users

A. User profile

The Petronas Towers complex is very actively used. The towers are in use for about twelve hours a day, from 8.00am to 6.00pm, five days a week, by about 10,000 Petronas staff in Tower One and 6,000 tenant staff and visitors in Tower Two. The concert hall is open daily for school trips and children's music lessons, together with its regular evening open hours according to its seasonal programme. A large variety of people, particularly national and international tourists, use the complex for many purposes. Entry to the sky bridge is free and there are 1,200 visitors a day. The Suria opens daily from 9.00am to 9.00pm, although its food courts open to 11.00pm. The average daily number of shoppers and visitors to Suria ranges from 6,000 on weekdays to 12,000 on weekends. Many people come to the complex because it is an attractive place to be, and it has become the most highly frequented and fashionable visiting place in Kuala Lumpur.

B. User response

The Petronas Towers are an object of national pride. They are perceived by local citizens as a highly significant symbol and an important landmark because of their beauty, uniqueness and technological advancement. Some are proud that the complex, as the world's tallest building, has put Malaysia on the international map. The Reviewer circulated a one-page questionnaire on site and numerous interviews and informal discussions were held with various citizens. The results of the written responses are in general agreement with those obtained from the interviews. (See Appendices 2 and 3.)

The project met with exceptional coverage during design and construction and even after its occupation in the regional and international media in many languages, although unfortunately few locally published articles and reports were found during the Review. Many reports and details have also been published on the Internet. Almost all publications expressed admiration of the achievement and the innovation of the project and focused on its technological, aesthetic and symbolic aspects and its status as the world's tallest building and a favourite tourist destination in Kuala Lumpur. There are also a number of architectural books, monographs and videos on the project. Interestingly, two children's books on the building have been published in the United States, telling its story and highlighting its particular attributes.

VIII. Persons Involved

Owner: Kuala Lumpur City Centre Holdings Sdn. Bhd.
Architect: Cesar Pelli & Associates
Design principal: Cesar Pelli FAIA
Project principal: Fred Clarke FAIA (Collaborating Designer)
Design team leader: Jon Pickard AlA
Project manager: Larry Ng AlA
Designers: John Apicella, David Coon, Edward Dionne, Peter Follett, Alison Home, Russell Holcomb, Gregg Jones, Vlad Simionescu, Heather Young, David Chen, Jerome del Fierro, Roberto Espejo, Sophie Harvey, Kristin Hawkins, Steven Marchetti, Robert Narracci, Dean Ober, Mark Outman, Enrique Pelli, Neil Prunier, Roger Schickedantz, BJ Siegel, David Strong, Jane Twombly.
Architect-of-record: Berhad Architectural Division, Kuala Lumpur
Associate architect: Adamson Associates, Toronto
Landscape design: Balmori Associates, New Haven, Connecticut; NR Associates, Selangor
Structural engineers: Thornton-Tomasetti Engineers, New York; Ranhill Bersekutu Sdn. Bhd., Kuala Lumpur
MEP engineers: Flack + Kurtz, New York; KTA Tenaga Sdn. Bhd., Kuala Lumpur

Consultants
Interior designer: STUDIOS, San Francisco
Retail: Walker Group, CNI, New York
Lighting: Howard Brandston & Partners, New York
Curtain wall: Israel Berger & Associates, New York
Acoustics: Shen, Milsom & Wilke, Inc., New York
Vertical transportation: Katz Drago Company, Inc., Toronto
Exterior maintenance: Lerch Bates & Associates, Temecula, California
Security: Techcord Consulting Group, Calgary
Graphics: Emery Vincent, Melbourne
Life safety: Rolf Jensen & Associates, Deerfield, Illinois
Traffic: Wilbur Smith Associates, Singapore
Parking: Central Parking Systems, Nashville
Site/civil: Ove Arup and Partners, Manchester, UK; Arup Jururunding, Kuala Lumpur
Wind-tunnel testing: Rowan Williams Davies and Irwin (RWDI), Guelph, Ontario
Contractors Tower One: Mayjaus (Malaysia Japan Us) joint venture
MMC Engineering & Construction Co. Ltd.
Ho Hup Construction Sdn. Bhd.
Hazama Corporation / JA Jones Construction Co. Ltd.
Mitsubishi Corporation
Contractors Tower Two: SKJ joint venture
Samsung Engineering & Construction Co. Ltd.
Dong Engineering & Construction Co. Ltd.
Syarikat Jasatera Sdn. Bhd.

Galal Abada
May 2004

Appendix 1: Technology

Vertical transportation in the towers is controlled by a unique, specially designed system. The towers are serviced by a total of seventy-six lifts, of which fifty-eight are double-deck lifts. The double-deckers make better use of the core space and require less room for hoisting, thus maximizing the efficiency of passenger transportation. Each double-deck unit is capable of carrying twenty-six persons per deck. The shuttle elevators can carry twenty-six persons per deck, or fifty-two per trip, while each of the other double-deck lifts is designed to take twenty-three passengers per deck. Travelling time is between 3.5 metres per second and 7 metres per second, depending on which zone the lifts are servicing.

The integrated energy conservation concept of the towers is based on an innovative 'cool' recovery system, which cools outside air as it enters the building by using exhaust air as a heat sink. Exhaust air from the building is routed through heat wheels and run-around coils which cool incoming air from the outside or provide heat where needed. Outside the towers, sunshades are geometrically optimized to cut solar gain by about 15 per cent. Glazing was also evaluated in relation to operating costs and single glazing was selected. Other remarkable features that are used to minimize air-conditioning costs are variable-speed chilled-water pumps and high-temperature-difference chilled-water systems. Using variable-speed chilled-water pumps to bring chilled water to pressure zones helps to reduce pumping costs. Air-handling equipment has two-way control valves that admit only enough chilled water to meet the load. The pumping-control system reacts to the instantaneous building load, minimizing energy use. An energy-transfer station consisting of heat exchangers, control valves and hydraulic bridges maintains the optimum temperature settings.

The air-conditioning system selected for the towers uses floor-by-floor air-handling units, utilizing chilled water. The floor-by-floor system solves problems of acoustics, compactness and ease of maintenance and control. The system is served by the district cooling centre, a 30,000-ton chilled water plant built separately, which combines natural gas-driven cogeneration equipment with various forms of chillers driven by steam turbine and electricity.

The building control system (BCS) provides central management and monitoring for air-conditioning control, lighting control, and electrical and chilled water monitoring, as well as providing energy management services. The BCS is linked to the life-safety system, which is designed to override the BCS in the event of an emergency. If fire breaks out on a floor, the BCS allows for a pressure differential between that and the adjacent floors, permitting the fire to be contained during the evacuation process.

The building security system (BSS) is designed to operate via a local area network (LAN), which has a two-tier structure, whereby the primary network links the controllers to the command centre and the secondary facilitates communication with the end devices. High-level software running on the integrated security network captures all data to ensure automated coordination among the BSS subsystems, which include: a card access and alarm monitoring system, voice intercoms, audio alarm surveillance and monitoring systems and a closed-circuit television system.

The telecommunications system is a structured cabling system comprising vertical and horizontal cabling, inter-building cabling and connection to telecommunications carrier companies. The hub of the system is a central telecommunications office (CTO), which serves as a local communications

exchange and gateway to the outside world. The CTO also enables tenants to access various value-added services such as video conferencing, electronic mail and central phone services. The system is designed as a local loop communications system providing direct connections from the main subscriber distribution frame to the end user using a fibre-optic network.

The fire alarm system (FAS) is designed using special fire detection systems that include smoke and heat detectors, manual call points, tamper and flow switches for sprinkler-system monitoring, a public address system and a firemen‘s telephone / two-way intercom system. Each tower has a separate fire alarm system but is networked via an LAN to allow management to be centralized at the central fire command centre (CFCC*)*, located at street level, which monitors status and controls the fire alarm and detection systems, automatic sprinkler system, smoke control system, lift status, emergency power and firemen‘s telephone system, and is linked directly to the Fire and Rescue Department of Malaysia. During normal building operations, the fire safety system is monitored and controlled by the building control system (BCS), but in the event of fire, the fire alarm system takes over control.

The fire safety plan of the towers is designed so that if a fire occurs on a floor served by the high-rise elevator banks, the shuttle elevators will be available for use in evacuating occupants. The plan specifies phased evacuation, including relocation of occupants on the fire floor and the floors above and below. Other floors would be evacuated or occupants relocated only if required subsequently. Each tower can be split into two segments at levels forty-one and forty-two, because of the elevator zoning arrangements and the sky bridge, a protected zone providing horizontal egress to the adjacent tower. A study of the evacuation time assuming phased evacuation to the sky lobby indicates that the time to clear each of the top three floors ranges from 40 seconds for floors eighty-five to eighty-six, and 69 seconds to 1.3 minutes for floors thirty-five to thirty-seven. With the sky lobby considered as a safe discharge level for stairs serving the floors above, the maximum total time to exit ranges from 5.9 minutes to 17.8 minutes.

Exterior lighting is instrumental in giving form and presence to the towers at night. The primary goal of the exterior lighting scheme was to light the surfaces of the towers in a dynamic and intriguing manner. As part of this scheme, the internal shafts of the towers are also lit to radiate a core of light and creates a visual impression of height, reinforces and accentuates the void between the towers and clearly expresses their form. All floodlighting fixtures house metal halide lamps, ranging from 70 watts to 150 watts to 400 watts. Long-range projectors use 1,800-watt sources. The five setbacks above the sky bridge are highlighted by uplights mounted at the apex of each of their sixteen corners. Each pinnacle and spire receives the light of more than 100 floodlights mounted on the five tiers. The vertical illumination creates a plume of light that extends above the two towers at night. The pinnacles glow from within from eight 400-watt floodlights and the top of each spire is lighted by sixteen 1,800-watt narrow floodlights, their brightness so intense that the spire ball itself appears to be a lamp.

Appendix 2: Users/Employees Questionnaire, Tower One and Tower Two

Total number of cases: 58.
Male, 40%; Female, 60%.
Age group: 16–24, 4%; 25–34, 62%; 35–44, 23%; 45–55, 11%; over 55, 0%.
Education level: high school, 16%; university, 57%; postgraduate/other studies, 27%.

		Very much like it/ Excellent or sufficient	Like it/ Good or adequate	Don't like it/ Fair or inadequate	Don't like it at all/ Do not know
1)	Personal appreciation of the Petronas Towers complex	55%	43%	2%	-
2)	Contribution to Kuala Lumpur	60%	30%	6%	4%
3)	Expression of Malaysian art and culture	20%	56%	20%	4%
4)	Location of Petronas Towers in KLCC area	53%	29%	12%	6%
5)	Integration of the complex into the surroundings	38%	45%	15%	2%
6)	Working atmosphere in Petronas Towers	63%	27%	8%	2%
7)	Functional efficiency of space in the working area	15%	77%	6%	2%
8)	Consideration of personal safety	27%	61%	6%	6%

9) Reason for appreciating the Petronas Towers

– The tallest building	24%
– Islamic / Malaysian character	8%
– Uses advanced technology	17%
– Facilities provided by the Kuala Lumpur City Centre	15%
– Combines several functions	36%

10) Favourable elements of the complex

– Twin towers	31%
– Shopping mall	22%
– Concert hall	11%
– Front plaza / garden	21%
– Ground-floor interior design	8%
– Top of the towers	7%

Table 1: Survey results of the users/employees questionnaire in Tower One and Tower Two

It is clear from Table 1 that the majority of users and employees think that the working atmosphere in the towers ranges between excellent and good. There are major differences in the answers provided by the various categories of people; hence only a small proportion thought that the functional efficiency of the working space was inadequate. It is evident from the table that only a minority in each category of the people interviewed thought that the consideration of personal safety was inadequate. Therefore, one can generalize and say that working spaces in the towers are adequate and efficient and provide a good working atmosphere.

Appendix 3: Citizens/Visitors Questionnaire

Total number of cases: 24.
Male, 58%; Female, 42%.
Age group: 25–34, 17%; 35–44, 57%; 45–55, 17%; over 55, 9%.
Education level: high school, 40%; university, 50%; postgraduate/other studies, 10%.
Malaysian, 70%; tourist, 10%; visitor, 20%.

		Very much like it/ Excellent	Like it/ Good	Don't like it/ Fair	Don't like it at all/ Do not know
1)	Coming to Petronas Towers Complex	33%	50%	17%	-
2)	Personal appreciation of the Petronas Towers complex	25%	75%	-	-
3)	Location of Petronas Towers in KLCC area	16%	75%	9%	-
4)	Contribution to Kuala Lumpur	75%	25%	-	-
5)	Integration of the complex into the surroundings	16%	75%	9%	-
6)	Front plaza / garden as a public space	58%	40%	2%	-
7)	Expression of Malaysian art and culture	40%	33%	9%	9%

8) Favourable elements of the complex
- Towers 20%
- Shopping mall 23%
- Concert hall 27%
- Art gallery 7%
- Front plaza / garden 10%
- Ground-floor interior design 3%
- Top of the towers 10%

9) Reason for coming to Petronas Towers:
- Business 11%
- Shopping 28%
- Visiting 6%
- Cultural 32%
- Recreation 6%
- Eating and drinking 17%

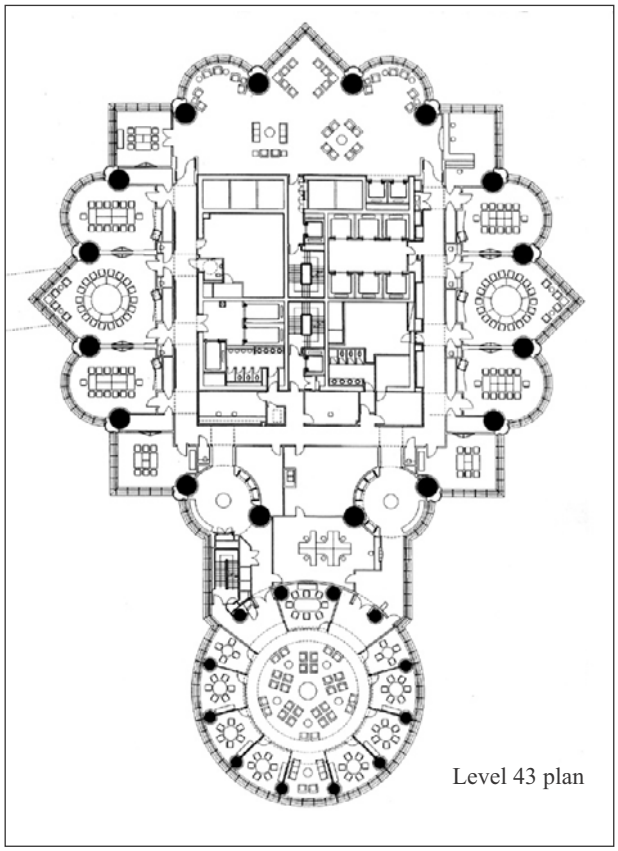
10) Why do you like the Petronas Towers Complex?

–	The tallest building in Kuala Lumpur	25%
–	Islamic character	12%
–	Uses advanced technology	21%
–	Creates the Kuala Lumpur City Centre	12%
–	Combines several functions	24%
–	International / modern style skyscraper	6%

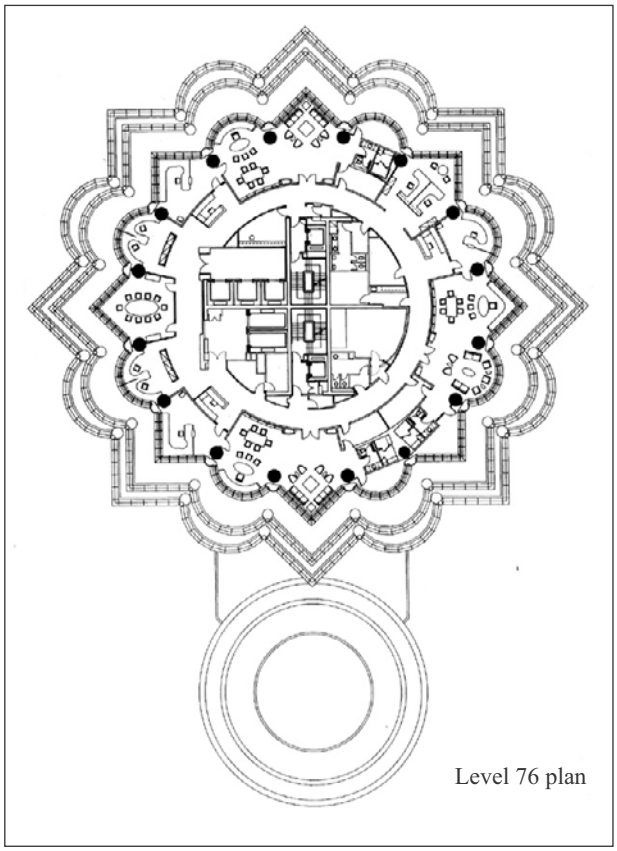
Table 2: Survey results of the citizens/visitors questionnaire

The majority of citizens think that the project represents a great contribution and a significant landmark for Kuala Lumpur. However, they do not fully support the way in which the project is integrated with the surroundings streets and adjacent buildings in the city centre, although they like its location. While many of those interviewed felt that the project successfully expresses Malaysian art and culture, some believed that the building is an inadequate expression of Malaysian art and culture.

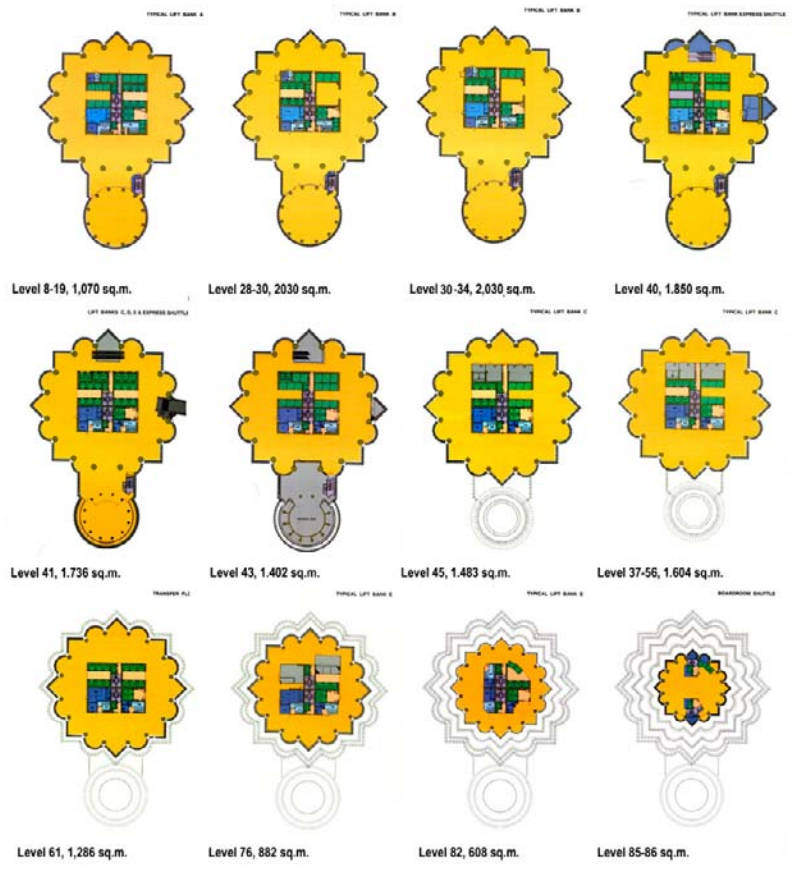
Master plan



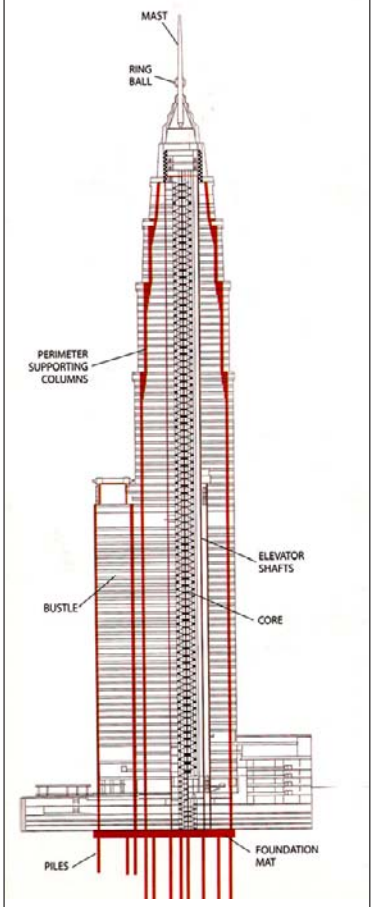
Level 43 plan



Level 76 plan

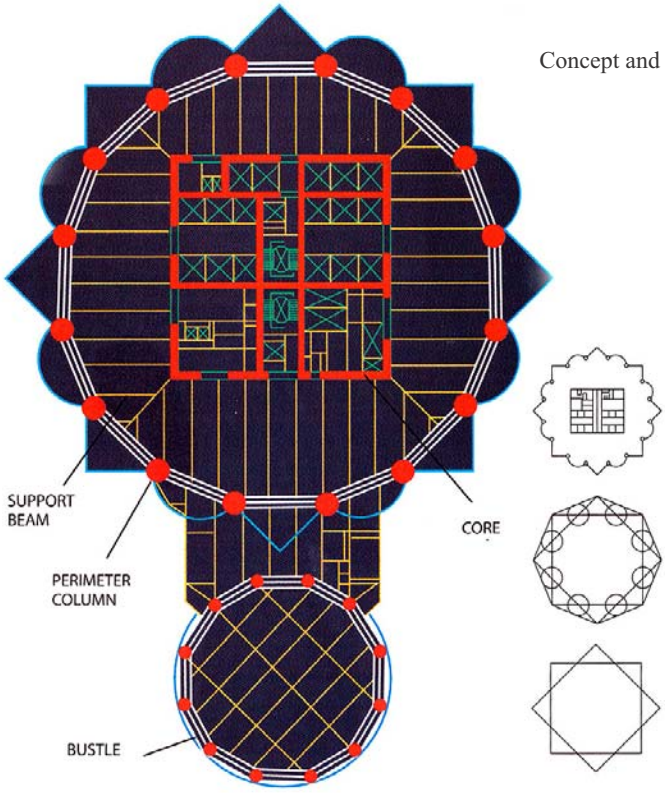


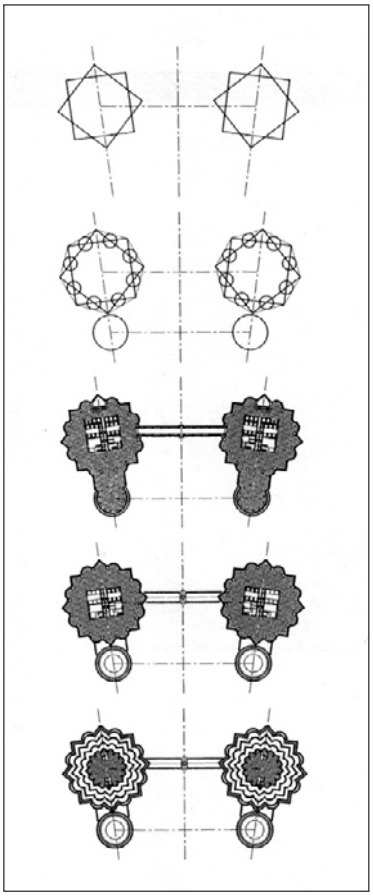
Tower typical plans



Section

Concept and structure

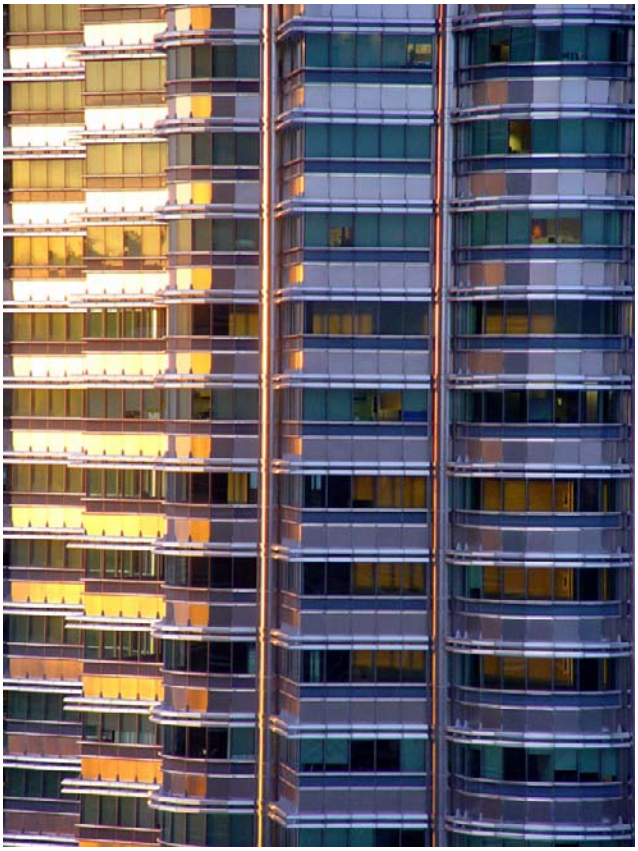




The conical form of the structure is continued inside the building.

The two towers are connected by a skybridge at the sky lobby levels on the 41st and 42nd floors for inter-tower communication and circulation.

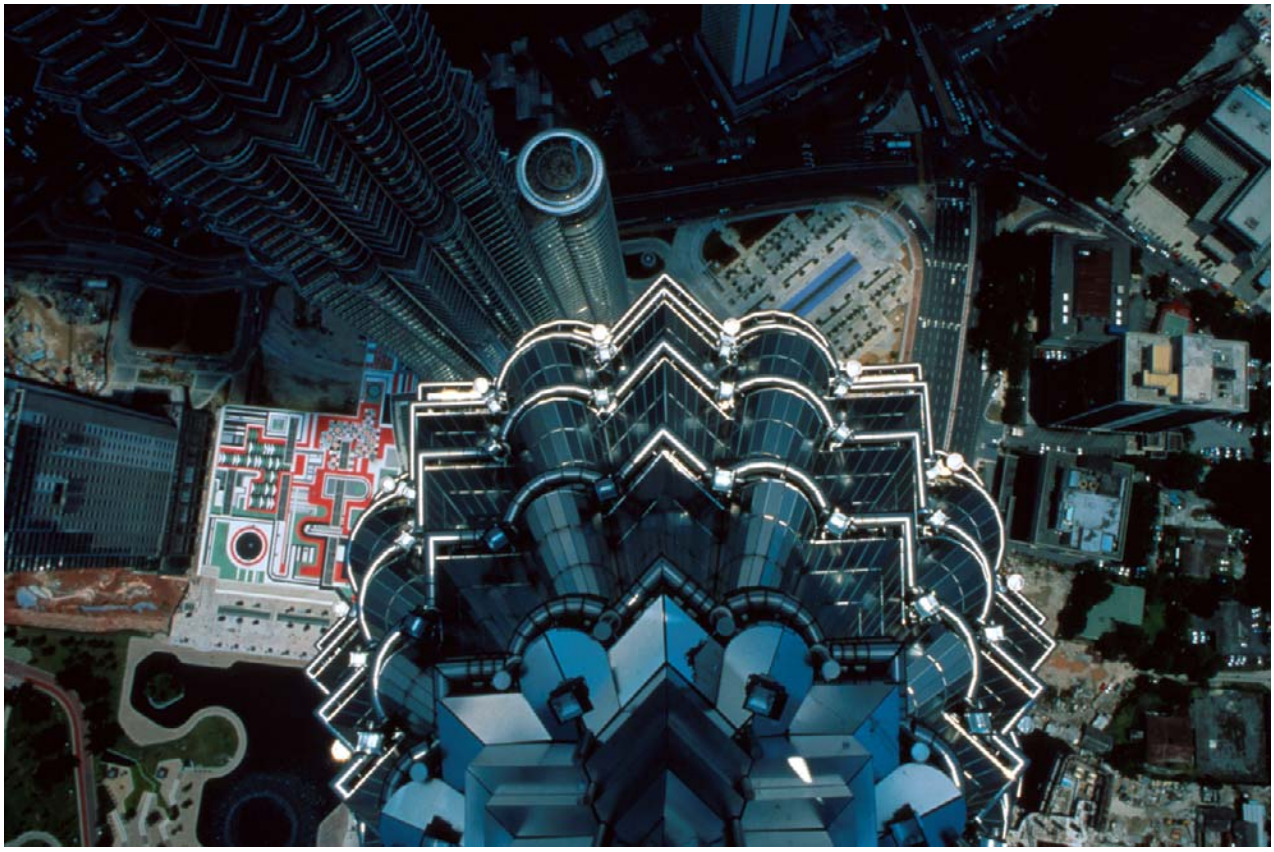
A shopping and entertainment galleria connects the office towers at the base, integrating the entire complex.



The towers and the base are clad with stainless steel extrusions and custom-made 20.38mm laminated light green glass.

The Petronas Towers are an object of national pride. They are perceived by local citizens as a highly significant symbol and an important landmark because of their beauty, uniqueness and technological advancement.

View from the spire ball with a promenade adjacent to the Lagoon on the KLCC park lake, lined with trees and fountains for the general public as well as for shoppers.



The towers are serviced by a total of 76 lifts, of which 58 are double-deck lifts.

The core consists of a hollow square of walls containing elevators, mechanical shafts and other services, connected to support beams that extend out to perimeter columns.

A concert hall for the Malaysian Philharmonic Orchestra is located between the towers.

The large entrance lobby incorporates a geometric design on the floor that features a radial swirl of stainless steel inlaid on green granite.

1969 . MAL . Petronas Office Towers

Identification

Title :	**Petronas Office Towers**	*No :*	**P001969**
Title in French :	Tour de bureaux de Petronas	*Type :*	**Nominated**
Short Title :	Petronas Office Towers		
Column Title 1 :			
Column Title 2 :			
Architect Label :	Cesar Pelli		

Location

Address : City Centre

City /Country : **Kuala Lumpur / Malaysia**

Description

Project Personnel

```
AR 1 PELLI Cesar                          M005613 Y USA
CL 1 IBRAHIM Tan Sri Dato' Omar                 N MAL
```

Building Types

```
322 Large Office Facility
```

Timetable

	Commencement :	*Completion :*
Commission :	12/1991	
Design :	01/1992	12/1993
Construction :	04/1993	08/1999
Occupancy :	01/1991	

Area and Surface

Site and Building Area (in square m2)

Total Site Area :	~~58'000~~ 641 000
Total Ground Floor Area :	39'929
Total Combined Floor Area :	790'000

Economics

Amount in :	Malaysian Ringgits	*US Dollar :*	*Exchange Rate :*	*Date (mm/yyyy) :*
Total Cost :				
Land Cost :				
Square Meter Cost :				

Status

```
01 N Nominated
01 P Presented to MJ
98 N Nominated
98 X Inelig. Not Complete
```

Documentation Status :

Nominators / Technical Reviewers

```
NO 1 ALLISON Gerald L.                    M002193 Y USA
NO 1 ALLISON Gerald L.                    M002193 Y USA
```

Material Inventory

Materials

Correspondence

Source of information

Notes

Record log

Created on : *By :* *Last Modified on :* 20.12.2000 *By :* SD

Petronas Office Towers, Kuala Lumpur, Malaysia

The Aga Khan Award for Architecture

ARCHITECT'S RECORD
2001 AWARD CYCLE

I. IDENTIFICATION

Project Title: Petronas Towers

Street Address: Kuala Lumpur City Centre

City: Kuala Lumpur Country: Malaysia

II. PERSONS RESPONSIBLE

A. Architect/Planner

Name: Cesar Pelli & Associates

Mailing Address: 1056 Chapel Street

City: New Haven, Connecticut Postal Code: 06510

Country: USA Telephone: 203.777.2515

Facsimile: 203.787.2856 E-mail: mailroom@cesar-pelli.com

Principal Designer: Cesar Pelli FAIA

B. Client

Name: Tan Sri Dato' Omar Ibrahim, Managing Director

Mailing Address: Aras 36 & 37, Menara 2 Petronas, Kuala Lumpur City Centre

City: Kuala Lumpur Postal Code: 50450

Country: Malaysia Telephone: 011.603.261.8390

Facsimile: 011.603.264.8853 E-mail: info@klcc.com.my

C. Project Affiliates / Consultants

Please list those involved in the project and indicate their roles and areas of responsibility (e.g. engineers. contractors, economists, master craftsmen, other architects, clients, etc.). Please cite addresses and telephone numbers separately.

Name	Role
Please see attached list	

Petronas Office Towers, Kuala Lumpur, Malaysia

III. TIMETABLE

(please specify year and month)

A. Commission: December 1991

B. Design — Commencement: January 1992 — Completion: December 1993

C. Construction — Commencement: April 1993 — Completion: August 1999

D. Occupancy: Began January 1997

Remarks:

IV. AREAS AND SURFACES

(please indicate in square metres)

A. Total Site Area: KLCC - 100 acres; Petronas - 14.5 acres

B. Ground Floor Area: 32,929 square meters

C. Total Combined Floor Area: 790,000 square meters
(including basement(s), ground floor(s) and all upper floors)

Remarks:

V. ECONOMICS

(please specify the amounts in local currency and provide the equivalent in US dollars. Specify the date and the rate of exchange in US dollars at the time.)

FINANCIAL INFORMATION REGARDING THE PROJECT WAS NOT MADE AVAILABLE TO CESAR PELLI & ASSOCIATES.

	Amount in Local Currency	Amount in US dollars	Exchange Rate	Date
A. Total Initial Budget				
B. Cost of Land				
C. Analysis of Actual Costs				
1. Infrastructure				
2. Labour				
3. Materials				
4. Landscaping				
5. Professional Fees				
6. Other				
D. Total Actual Costs (without land)				
E. Actual Cost (per sq. meter)				

Remarks:

Petronas Office Towers, Kuala Lumpur, Malaysia

VI. PROJECT DESCRIPTION

To meet the demands of urban growth in Kuala Lumpur, the Malaysian Government allowed the Selangor Turf Club and its surrounding land, which is strategically located in the *Golden Triangle* commercial district, to be developed as a new 'city-within-a-city . Cesar Pelli & Associates was selected to design Phase One of the Kuala Lumpur City Centre development following an international design competition.

With a site area of 14.15 acres, Phase One comprises more than 10,700,000 s.f. of mixed- use development, including the twin 88-story Petronas Towers of 4,500,000 s.f.; two additional office towers (designed by others); retail/entertainment facilities; and, below grade parking for 7000 cars. Public functions within the complex include the Petroleum Discovery Centre, an art gallery, the 850-seat Dewan Petronas Filharmonik concert hall, and a state-of-the-art multi-media conference centre. A multi-story shopping and entertainment galleria connects the office towers at the base, integrating the entire complex.

Designed as the corporate headquarters for the national petroleum company, Petronas, the two stainless steel-clad towers are connected at the Sky Lobby levels (41st and 42nd floors) by a Skybridge, facilitating inter-tower communication and traffic. Organized around this circulation system are shared Petronas facilities such as the Conference Centre, the Upper Surau (prayer room) and the Executive Dining Room.

Malaysian colors, patterns, traditions and crafts have been incorporated throughout the buildings so that they appear not as foreign elements but as new and exuberant citizens of Malaysia. The geometry of the twin towers is based on Islamic traditions as is the development from simple to complex forms. The lobby core walls are finished with light-colored Malaysian woods within a stainless steel grid. The pattern of the marble lobby floor derives from popular regional "Pandan" weavings and bertam palm wall mattings. Reinforcing a sense of the tropical locale and optimizing the use of Malaysian crafts, a continuous wooden screen wall shields the perimeter of the lobby wall to minimize the contrast of brightness between the exterior and interior.

VII. MATERIALS, STRUCTURE, AND CONSTRUCTION

Exterior Cladding	Horizontal ribbons of vision glass and stainless steel spandrel panels. 85,000 square meters of cladding area above Level 6.
Foundation	Two raft foundations 4.5m thick, each containing nearly 13,200 cubic meters of grade 60 concrete, which weighs approximately 32,350T; with 208 Barrette piles (rectangular section piles 2.8m x 1.2m), varying from 60 meters to 115 meters in length.
	A perimeter diaphragm wall, 800mm thick.
Structure	A core and cylindrical tube frame system constructed entirely of cast-in-place high-strength concrete (up to Grade 80). Floor framing at tower levels are concrete fill of conventional strength on composite steel floor deck and composite rolled steel framing.

VIII. PROJECT SIGNIFICANCE AND IMPACT

In the design of the Petronas Towers, Cesar Pelli & Associates responded to the climate, to the dominant Islamic culture, and to the sense of form and patterning perceived in traditional Malaysian buildings and objects. Adapting a contemporary design to a place requires respect, control and considerable sensitivity.

The most important artistic decision was to make the towers figurative and symmetrically composed. The symmetrical arrangement was avoided by early modernists precisely because of its symbolic quality. The towers are not only symmetrical but figurative, creating an also figurative space between them. This space is the key element in the composition. Each tower has its own vertical axis, but the axis of the total composition is in the center of the void. Lao Tse has taught us that the reality of a hollow object is in the void and not in the walls that define it.

The power of the void is increased and made more explicit by the pedestrian bridge that connects the two towers at the 41st and 42nd floors, the skylobby floors. The bridge with its supporting structure creates a portal to the sky, a 170m high portal; a door to the infinite. These qualities make the Petronas Towers unique, unlike any Western skyscraper. These are universal qualities, not necessarily Malaysian but as they will appear for the first time in Kuala Lumpur, they will be forever identified with the place. In the same way that the Eiffel Tower is identified with Paris, although its structure and form were not in any way derived from Parisian or French architecture.

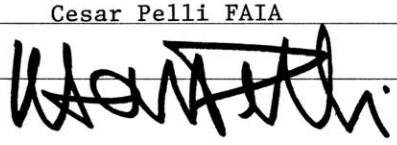
The buildings are rooted in the place in other ways. The geometry of the towers is based on Islamic geometric traditions. The plan of the buildings is based on the geometry of two interlocked squares, one the most important geometric form underlying Islamic designs.

The skyscraper as a building type was born and developed in northern cities with cold climates. Light and sun were welcome and the walls were glassy and taut. The Petronas Towers are in the tropics. Views are still important and the windows are continuous horizontal ribbons, but they are of modest height and protected from the sun by projecting shades. The sunshades make a three-dimensional wall that together with the facets of the plan create buildings with a great deal of shade, shadow and dappled light: tropical walls.

Malaysian colors, patterns, traditions and crafts have been incorporated throughout the buildings to make of these buildings not foreign elements but new and exuberant citizens of Malaysia.

The Towers are completely clad in stainless steel and will shine and glow with multiple reflections in the Malaysian light. The Petronas Towers are respectful of traditional Malaysia, and they also express the new Malaysia that is being made: a rapidly industrializing country with a dynamic economy. These buildings have roots in the Malaysian soil and they grow towards a shining future.

Name (please print) Cesar Pelli FAIA

Signature  Date 13 December 2000

Petronas Towers
Project Affiliates / Consultants

Architect-of-Record Malaysia	KLCC Berhad Architectural Division, Kuala Lumpur, *This group is no longer existant*
Associate Architect	Adamson Associates 55 Port Street East Mississauga, Ontario L5G 4P3 Canada 905.891.8666 905.891.1403 Fax
Landscape Design	Balmori Associates 129 Church Street New Haven, CT 06510 203.772.4074 203.785.0732 Fax
	NR Consultants 19-B Jalan PJS, 10/24, Bndar Sre Subang 4600 Petaling Jaya Selangor, Malaysia 603.736.5639 603.731.2805 Fax
Structural Engineers	Thornton-Tomasetti Engineers 641 Avenue of the Americas New York, NY 10011 212.741.1300 212.645.9236 Fax
	Ranhill Bersekutu Sdn. Bhd. 24th Floor, Menara Maybank 100 Jalan Tun Perak, Box 74 & 75 50050 Kuala Lumpur, Malaysia 011.603.238.2155 011.603.238.2880 Fax
MEP Engineers	Flack + Kurtz, New York, NY 475 Fifth Avenue New York, NY 10017 212.532.9600 212.689.7489 Fax
	Tenaga Ewbank Preece Sbn. Bhd. Level 2, Block B, Kompleks Pejabat Damansara Jalan Dungun, Damansara Heights 50490 Kuala Lumpur, Malaysia 011.603.255.6077 011.603.255.6093 Fax
Interior Designer	STUDIOS 99 Green Street San Francisco, CA 94111 415.398.7575 415.765.9078 Fax
Retail	Walker Group, CNI, 320 West 13th Street New York, NY 10014 212.206.0444 212.645.0461 Fax

Petronas Towers
Project Affiliates / Consultants

Lighting	Howard Brandston & Partners 141 West 24th Street, 3rd Floor New York, NY 10011 212.924.4050 212.691.5418 Fax
Curtain Wall	Israel Berger & Associates 232 Madison Avenue 11th Floor, Suite 1100 New York, NY 10016 212.689.5389 212.689.6449 Fax
Acoustical	Shen, Milsom & Wilke, Inc. 6 East 39th Street New York, NY 10016 212.725.2552 212.725.0864 Fax
Vertical Transportation	Katz Drago Company, Inc. 155 Gordon Baker Road, Suite 213 Toronto, Ontario M2H 3N5 Canada 416.492.5666 416.492.7415 Fax
Exterior Maintenance	Lerch Bates & Associates 26111 Ynez Road Building B, Suite C-15 Temecula, CA 92591 909.695.1810 909.695.1813
Security	Techcord Consulting Group 10655 Southport Road, S.W., Suite 900 Calgary, Alberta T2W 4Y1 Canada 403.278.1823 403.271.4200 Fax
Graphics	Emery Vincent 80 Market Street South Melbourne, Australia 3205 011.613.699.3822 011.613.690.7371
Life Safety	Rolf Jensen & Associates 1751 Lake Cook Road, Ste. 400 Deerfield, IL 60015-5294 708.948.0700 708.948.0866 Fax
Traffic	Wilbur Smith Associates 400 Orchard Road, #09-01 Orchard Tower Singapore, 0923 011.65.734.6804 011.65.733.6817
Parking	Central Parking Systems 2401 21st Avenue, South, Suite 200 Nashville, TN 37212 615.297.4255 615.297.6240

Petronas Towers
Project Affiliates / Consultants

Site/Civil	Ove Arup and Partners St. James's Building Oxford Street Manchester M1 6EL England 011.44.61.228.2331 011.44.61.236.1057 Fax Arup Jururunding 72-76 Jalan 3/62 Bandar Menjalara 52200 Kuala Lumpur, Malaysia 011.603.633.2223 011.603.633.2227 Fax
Wind Tunnel Testing	Rowan Williams Davies and Irwin (RWDI) 650 Woodlawn Road West Guelph, Ontario N1K 1B8 Canada 519.823.1311 519.823.1316 Fax
General Contractor	Tower 1- Mayjus (Malaysia Japan Us) Joint-Venture MMC Engineering & Construction Co. Ltd. Ho Hup Construction Sdn. Bhd. Hazama Corporation/ JA Jones Construction Co. Ltd. Mitsubishi Corporation Tower 2- SKJ Joint-Venture Samsung Engineering & Construction Co. Ltd. Kuk Dong Engineering & Construction Co. Ltd. Syarikat Jasatera Sdn. Bhd.

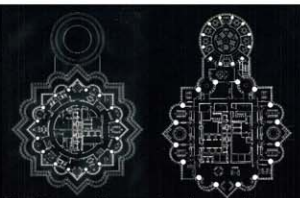
Petronas Office Towers

City Centre
Kuala Lumpur, Malaysia

Architects	Cesar Pelli New Haven, CT, United States of America
Clients	Tan Sri Dato' Omar Ibrahim Kuala Lumpur, Malaysia
Commission	1991
Design	1992 - 1993
Construction	1993 - 1999
Occupancy	1991
Site	6'641'000 m2
Ground Floor	39'929 m2
Total Floor	790'000 m2
Programme	Twin 88-storey office towers built for a petroleum company and located in the "Golden Triangle" commercial district. The programme includes offices, a petroleum discovery centre, an art gallery, a 850-seat concert Hall, a multi-media conference centre, underground parking for 7'000 cars, and a multi-storey shopping and entertainment gallery connecting the towers at their base. The complex has a concrete structure.

Building Type	*322*
1999 Award Cycle	*1969.MAL*


View from Northeast


Typical Upper Level Plan

Typical Lower Level Plan


Ground Level Plan

Evolution of Tower Floorplate


Sky Bridge

The project consists of two 88-story, stainless steel-clad office towers of 214,000 m² each. The towers are connected at the Sky Lobby Levels (floors 41 and 42) by a pedestrian Skybridge, facilitating inter-tower communication and circulation. Organized around the Sky Lobby are shared facilities including the Conference Centre, the Upper Surau and the Executive Dining Room. The design responds to the climate, to the dominant Islamic culture, and to the needs of Petronas company.

Malaysian colors, patterns, traditions and crafts have been incorporated throughout the buildings to make of these buildings not foreign elements but new and exuberant citizens of Malaysia. Drawn from Islamic geometric traditions, the plan of the buildings is based on two interlocked squares. The pattern of the marble lobby floor derives from regional bamboo weavings. A wooden screen wall of traditional design and made by local craftsmen shields the perimeter of the lobby wall to reduce glare and heat gain.

The towers are not only symmetrical but figurative, creating an also figurative space between them. The power of this void is increased and made more explicit by the Skybridge which creates a 170-meter portal to the sky, a door to the infinite.

To respond to the tropical climate, the windows of the towers are protected from the sun by projecting shades. These sunshades make a three-dimensional wall that together with the facets of the plan create buildings with a richness of shade, shadow and dappled light: tropical walls.

The many special qualities of their design make the Petronas Towers unique, unlike any Western skyscraper. Some of these are universal qualities, not necessarily Malaysian but as they appear for the first time in Kuala Lumpur, they will be forever identified with the place.

The 2001 Aga Khan Award for Architecture
Nomination Code MAL.P001969
Petronas Towers
Kuala Lumpur, Malaysia
Cesar Pelli & Associates

The 2001 Aga Khan Award for Architecture
Nomination Code MAL.P001969
Petronas Towers
Kuala Lumpur, Malaysia
Cesar Pelli & Associates

Petronas Office Towers, Kuala Lumpur, Malaysia

View from North Klang Expressway of towers rising above city

The 2001 Aga Khan Award for Architecture
Nomination Code MAL.P001969

Petronas Towers, Kuala Lumpur, Malaysia
Cesar Pelli & Associates

View south of towers at dusk

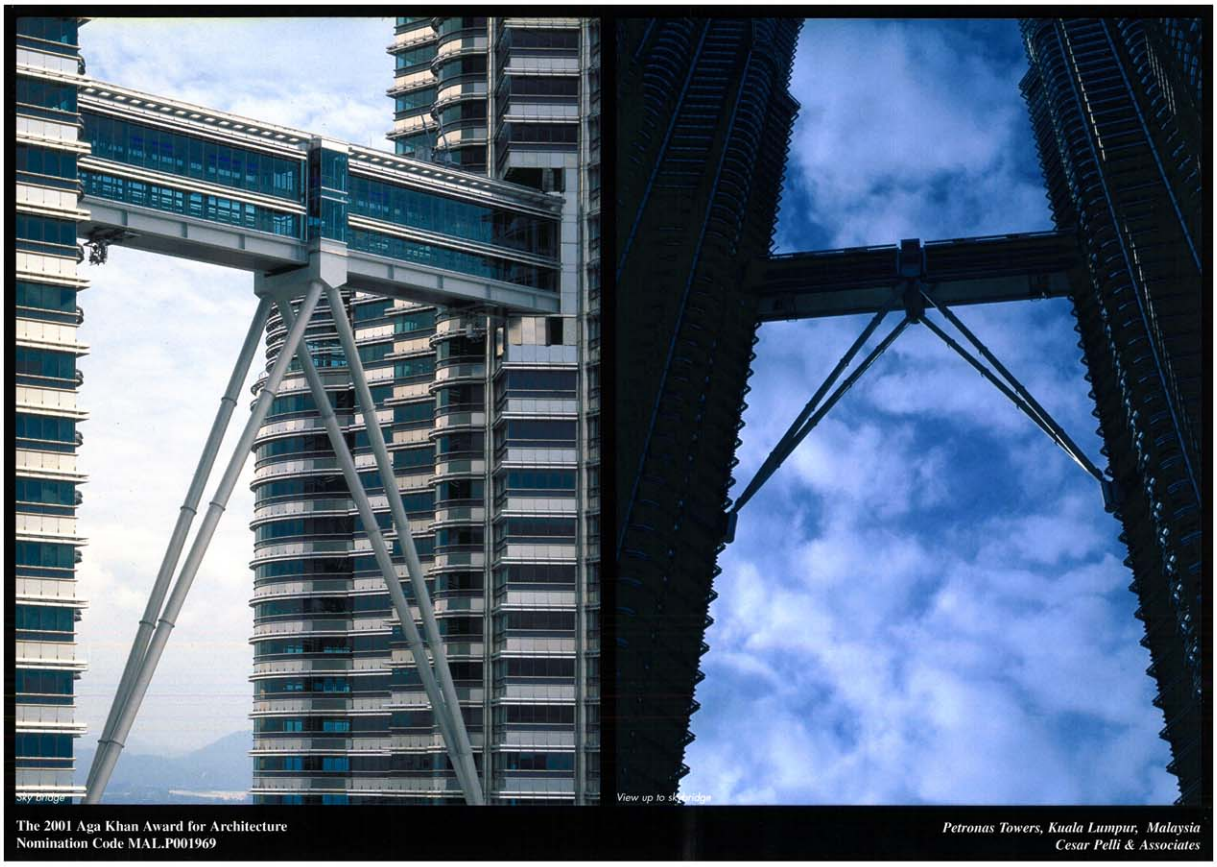
View south of towers at night

The 2001 Aga Khan Award for Architecture
Nomination Code MAL.P001969

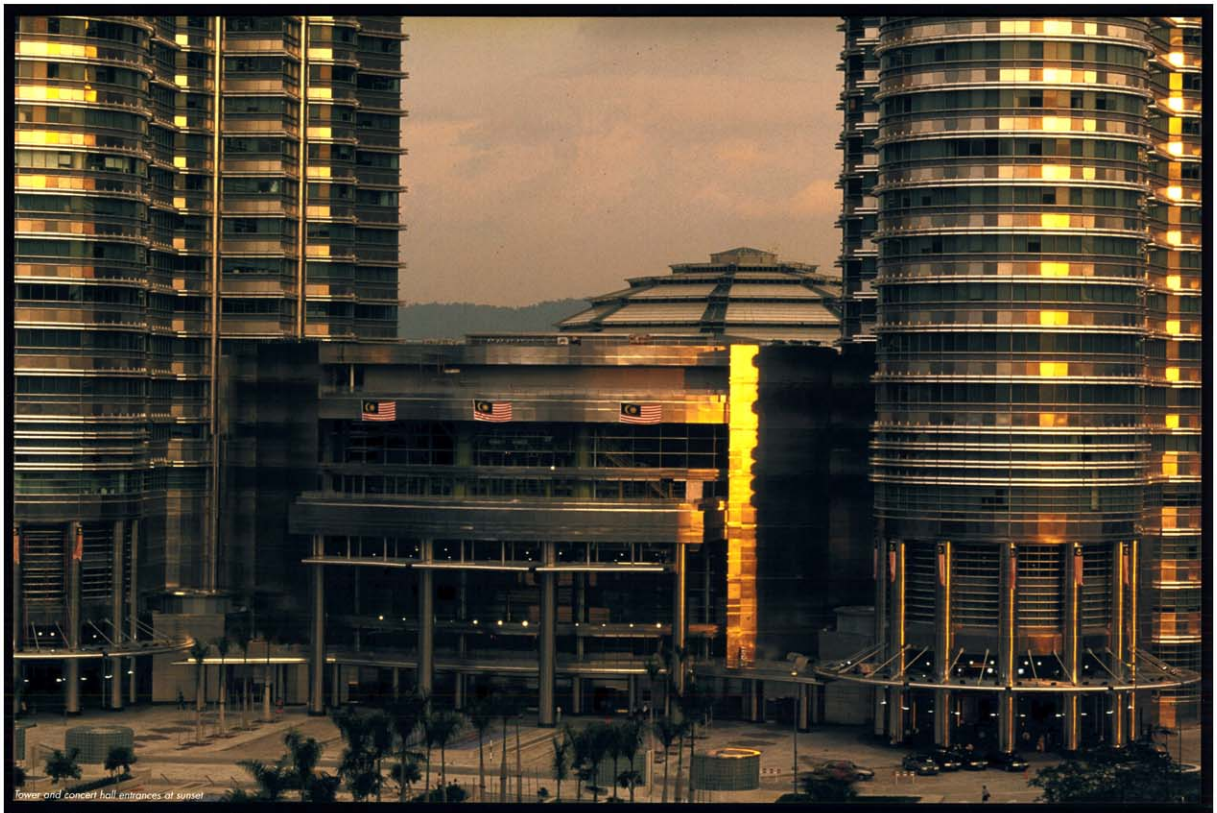
Petronas Towers, Kuala Lumpur, Malaysia
Cesar Pelli & Associates

Petronas Office Towers, Kuala Lumpur, Malaysia

Petronas Office Towers, Kuala Lumpur, Malaysia



Petronas Office Towers, Kuala Lumpur, Malaysia



Tower and concert hall entrances at sunset

The 2001 Aga Khan Award for Architecture
Nomination Code MAL.P001969

Petronas Towers, Kuala Lumpur, Malaysia
Cesar Pelli & Associates

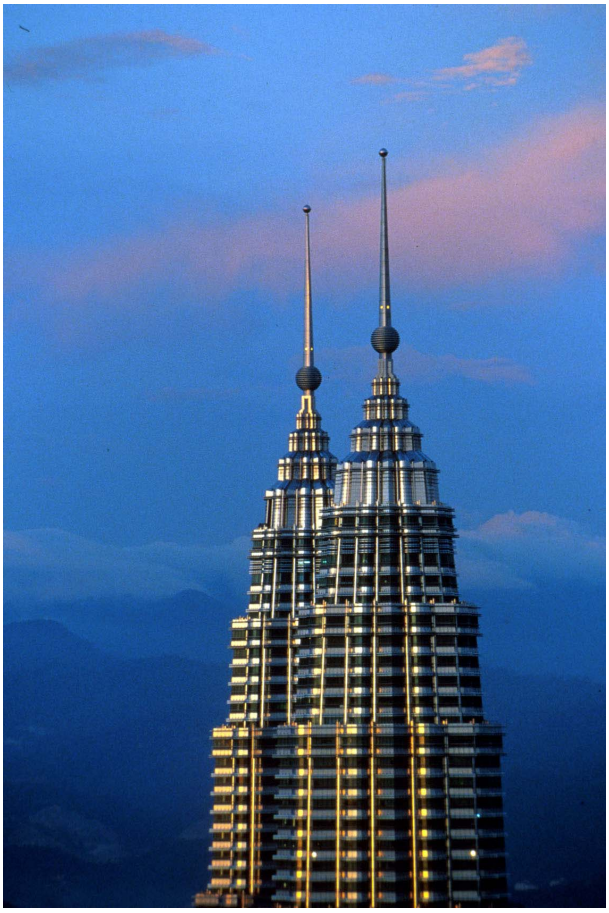
Custom chandeliers in concert hall lobby

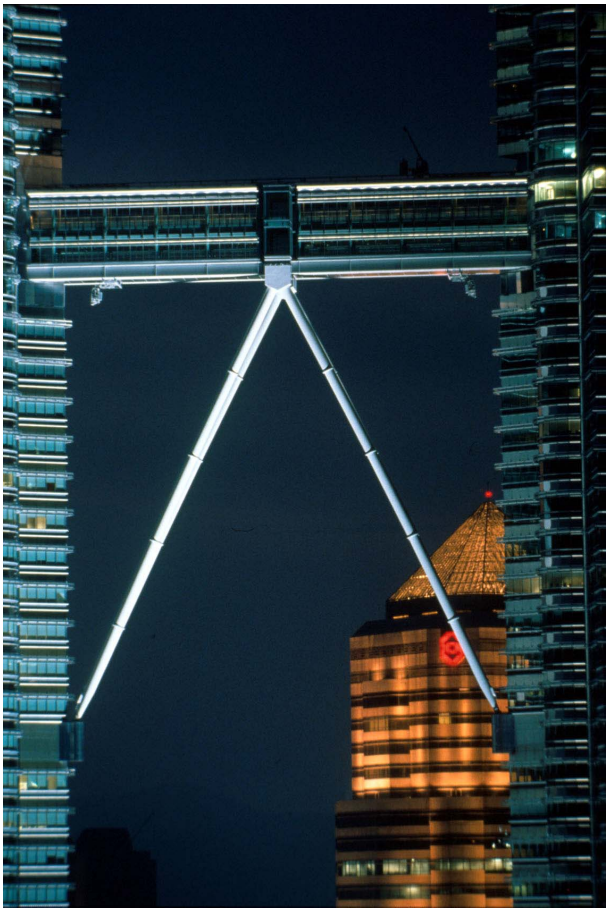
Concert hall lobby prior to performance

The 2001 Aga Khan Award for Architecture
Nomination Code MAL.P001969

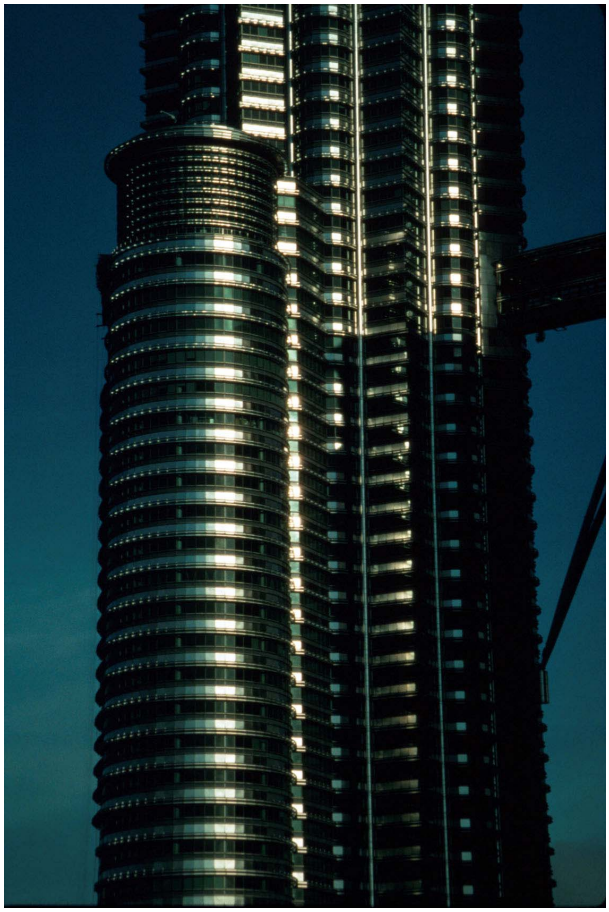
Petronas Towers, Kuala Lumpur, Malaysia
Cesar Pelli & Associates

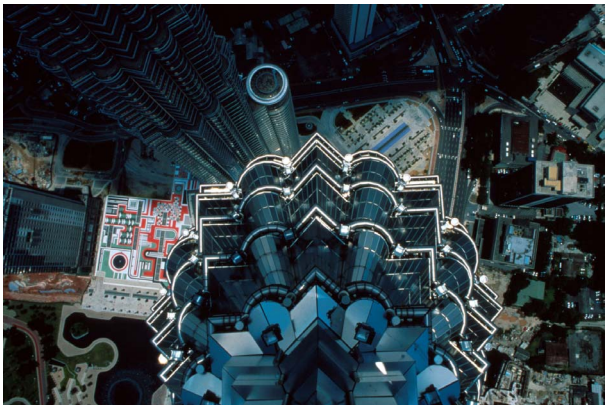
Petronas Office Towers, Kuala Lumpur, Malaysia



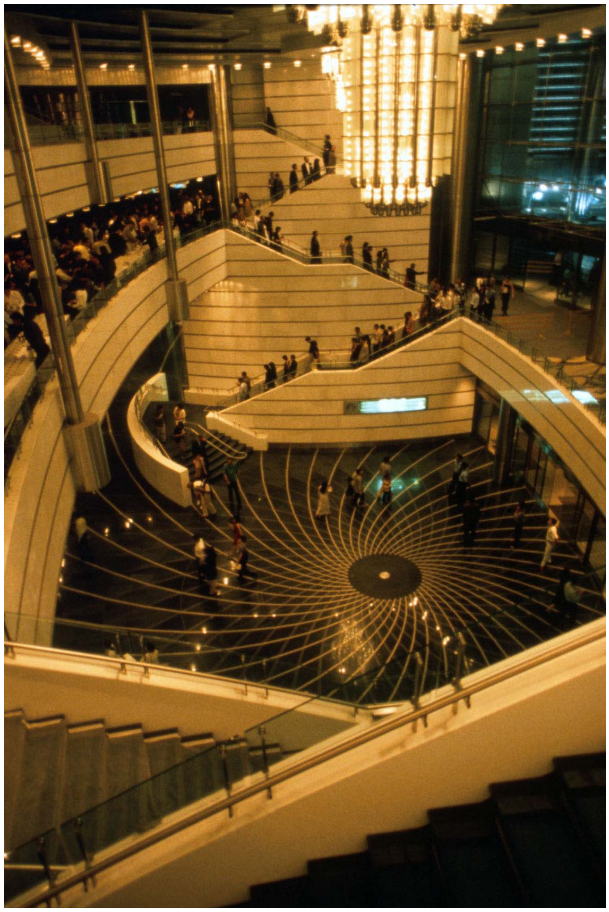


Petronas Office Towers, Kuala Lumpur, Malaysia

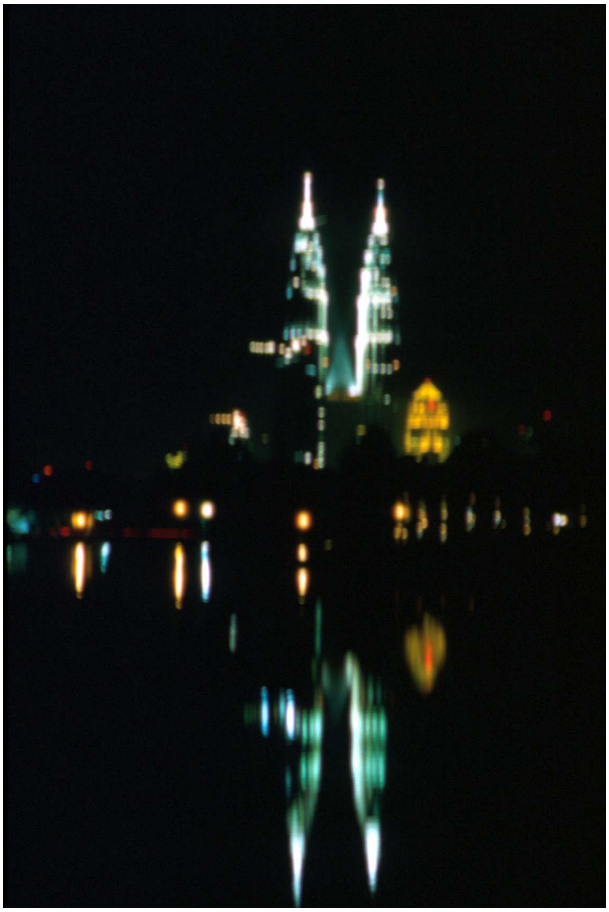




Petronas Office Towers, Kuala Lumpur, Malaysia



Petronas Office Towers, Kuala Lumpur, Malaysia



Petronas Office Towers, Kuala Lumpur, Malaysia

Petronas Office Towers
Kuala Lumpur, Malaysia

Acc No: S204538
VM Title: View from North Klang Valley freeway
Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
Notes:
CD/Location: CT00733 - IMG0001 / C1
VM Link: 1969 Petronas Office Towers

Acc No: S204539
VM Title: Dawn view
Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
Notes:
CD/Location: CT00733 - IMG0002 / C1
VM Link: 1969 Petronas Office Towers

Acc No: S204540
VM Title: View from Northeast
Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
Notes:
CD/Location: CT00733 - IMG0003 / C1
VM Link: 1969 Petronas Office Towers

Acc No: S204541
VM Title: View looking East of tower pinnacles
Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
Notes:
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VM Link: 1969 Petronas Office Towers

Acc No: S204542
VM Title: Sky bridge at night
Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
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Acc No: S204543
VM Title: Faceted curtain-wall
Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
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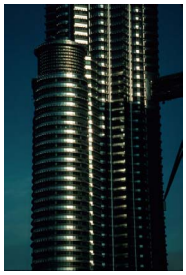
Petronas Office Towers
Kuala Lumpur, Malaysia



Acc No: S204544
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Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
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VM Link: 1969 Petronas Office Towers

Acc No: S204545
VM Title: Lower tower and entry canopy at sunset
Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
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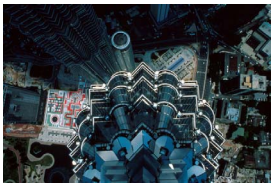

Acc No: S204546
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Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
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CD/Location: CT00733 - IMG0009 / C1
VM Link: 1969 Petronas Office Towers

Acc No: S204547
VM Title: Towers and concert hall entries at night
Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
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VM Link: 1969 Petronas Office Towers

Acc No: S204548
VM Title: Night view through lit fountains
Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
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VM Link: 1969 Petronas Office Towers

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Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
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VM Link: 1969 Petronas Office Towers

Petronas Office Towers
Kuala Lumpur, Malaysia

Acc No: S204550
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Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
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Acc No: S204551
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Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
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Acc No: S204552
VM Title: Tower lobby
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Photographer: GOLDBERG Jeff
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Acc No: S204553
VM Title: Malaysian architecture and towers beyond
Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
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VM Link: 1969 Petronas Office Towers

Acc No: S204554
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Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
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VM Link: 1969 Petronas Office Towers

Acc No: S204555
VM Title: View from Southeast
Date: 01.09.1998
Photographer: GOLDBERG Jeff
Copyright: Y
Technical Infos:
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VM Link: 1969 Petronas Office Towers

Petronas Office Towers
Kuala Lumpur, Malaysia

Acc No:	S204556
VM Title:	Towers at dawn
Date:	01.09.1998
Photographer:	GOLDBERG Jeff
Copyright:	Y
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VM Link:	1969 Petronas Office Towers

Acc No:	S204557
VM Title:	Towers from Tasik Titiwangsa Lake
Date:	01.09.1998
Photographer:	APICELLA J.
Copyright:	Y
Technical Infos:	
Notes:	
CD/Location:	CT00733 - IMG0020 / C1
VM Link:	1969 Petronas Office Towers

Petronas Office Towers
Kuala Lumpur, Malaysia

List of Visual Materials

No	VM Num	CD Id	IMG Ord	VM Title	Date	Photographer	Format	Copyright
1	D004102					Courtesy of Architect	A4	
2	D004103					Courtesy of Architect	A4	
3	D004104					Courtesy of Architect	A4	
4	D004105					Courtesy of Architect	A4	
5	D004106					Courtesy of Architect	A4	
6	D004107					Courtesy of Architect	A4	
7	D004108					Courtesy of Architect	A4	
8	D004109					Courtesy of Architect	A4	
9	D004110					Courtesy of Architect	A4	
10	R008498					Courtesy of G. ALLISON	10x15	Y
11	R008499					Courtesy of G. ALLISON	10x15	Y
12	S114031					AKAA	24x36	N
13	S114935					AKAA	24x36	Y
14	S204538	CT00733	IMG0001	View from North Klang Valley freeway	01.09.1998	GOLDBERG Jeff	24x36	Y
15	S204539	CT00733	IMG0002	Dawn view	01.09.1998	GOLDBERG Jeff	24x36	Y
16	S204540	CT00733	IMG0003	View from Northeast	01.09.1998	GOLDBERG Jeff	24x36	Y
17	S204541	CT00733	IMG0004	View looking East of tower pinnacles	01.09.1998	GOLDBERG Jeff	24x36	Y
18	S204542	CT00733	IMG0005	Sky bridge at night	01.09.1998	GOLDBERG Jeff	24x36	Y
19	S204543	CT00733	IMG0006	Faceted curtain-wall	01.09.1998	GOLDBERG Jeff	24x36	Y
20	S204544	CT00733	IMG0007	Tower 2, bustle curtain-wall	01.09.1998	GOLDBERG Jeff	24x36	Y
21	S204545	CT00733	IMG0008	Lower tower and entry canopy at sunset	01.09.1998	GOLDBERG Jeff	24x36	Y
22	S204546	CT00733	IMG0009	View down from Tower 2 ring ball	01.09.1998	GOLDBERG Jeff	24x36	Y
23	S204547	CT00733	IMG0010	Towers and concert hall entries at night	01.09.1998	GOLDBERG Jeff	24x36	Y
24	S204548	CT00733	IMG0011	Night view through lit fountains	01.09.1998	GOLDBERG Jeff	24x36	Y
25	S204549	CT00733	IMG0012	Playful forecourt fountains	01.09.1998	GOLDBERG Jeff	24x36	Y
26	S204550	CT00733	IMG0013	Concert hall lobby	01.09.1998	GOLDBERG Jeff	24x36	Y
27	S204551	CT00733	IMG0014	Concert hall, interior	01.09.1998	GOLDBERG Jeff	24x36	Y
28	S204552	CT00733	IMG0015	Tower lobby	01.09.1998	GOLDBERG Jeff	24x36	Y
29	S204553	CT00733	IMG0016	Malaysian architecture and towers beyond	01.09.1998	GOLDBERG Jeff	24x36	Y
30	S204554	CT00733	IMG0017	View from West	01.09.1998	GOLDBERG Jeff	24x36	Y
31	S204555	CT00733	IMG0018	View from Southeast	01.09.1998	GOLDBERG Jeff	24x36	Y
32	S204556	CT00733	IMG0019	Towers at dawn	01.09.1998	GOLDBERG Jeff	24x36	Y
33	S204557	CT00733	IMG0020	Towers from Tasik Titiwangsa Lake	01.09.1998	APICELLA J.	24x36	Y

MATERIALS IDENTIFICATION FORM

1	Completed Architect's Record (B)
2	Two A3 presentation panels in cover (C/D)
3	Eight additional A3 panels (C)
4	20 labeled slides in sleeve (H)
5	Slide Identification Form (G)
6	1 copy of *Scientific American* December 1997
7	1 copy of *ENR* reprint January 1996
8	1 copy of *Architectural Record* reprint January 1999
9	I copy in case of *Petronas Twin Towers, A Vision Realized* 1999

SLIDE IDENTIFICATION FORM

1	View from North Klang Valley Expressway of Towers rising above city*
2	Dawn view of towers in city skyline with hills beyond*
3	View from northeast*
4	View of tower pinnacles looking east*
5	Sky bridge at night*
6	View up tower showing faceted curtainwall*
7	Detail of tower two bustle curtainwall
8	Detail of lower tower and entry canopy at sunset*
9	View down from tower two ring ball
10	Towers and concert hall entries at night*
11	Night view through lighted fountains of concert hall entrance and lobby*
12	Playful forecourt fountains being enjoyed by children
13	Concert Hall lobby prior to performance
14	Interior of Concert Hall prior to performance*
15	Tower lobby*
16	Detail of Malaysian architecture with towers beyond*
17	View from west of towers in city skyline at sunset*
18	View from southeast of towers rising from city*
19	Towers rising above city at dawn*
20	View of towers at night from Tasik Titiwangsa Lake

*Please see attached photo release from photographer

Esto Photographics Inc
222 Valley Place
Mamaroneck NY 10543
www.esto.com
Tel 914 698-4060
Fax 914 698-1033

CESAR PELLI & ASSOC.

DEC 1 4 2000

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Competition	AGA KHAN Awards for Architecture 2001
Architect/Designer	Cesar Pelli & Associates
Project Title/Location	Petronas Towers, Kuala Lumpur Malaysia

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12/14/00

Susan Oristaglio, as disclosed principal

Fax to 203/787-2856

Petronas Office Towers, Kuala Lumpur, Malaysia