POMPIDOU CENTRE

HI-TECH BUILDINGS PART TWO

POMPIDOU CENTRE PARIS 1977

HONGKONG SHANGHAI BANK 1985

BRIAN ROBERTS

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HONGKONG SHANGHAI BANK

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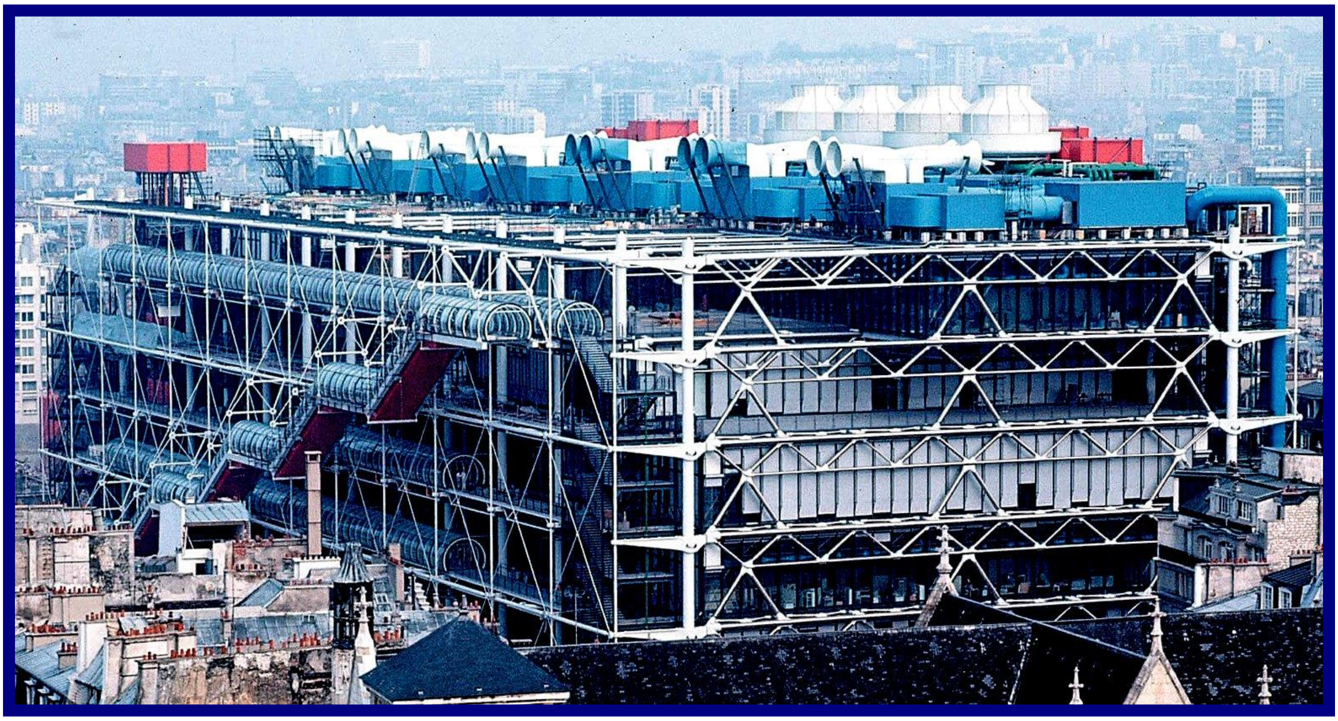
POMPIDOU CENTRE



POMPIDOU CENTRE PARIS

LOCATION Beaubourg area, 4th arrondissement
TYPE Public Library, Modern Art Museum, Music/Acoustic Research Centre
ARCHITECT Renzo Piano, Richard Rogers & Gianfranco Franchini
ENGINEER Arup
MAIN CONTRACTOR GTM
ENGINEERING SERVICES Arup

HONGKONG SHANGHAI BANK

LOCATION Statue Square
TYPE Bank Headquarters
ARCHITECT Norman Foster
ENGINEER Ove Arup and Partners
ENGINEERING SERVICES J. Roger Preston & Partners
MAIN CONTRACTOR Lok/Wimpey Joint Venture
MODULAR AIR CONDITIONING/TOILET PLANT ROOMS Japanese Sub-Contractor
REFRIGERATION/HEAT PUMP/SEA WATER CONDENSING SYSTEM Drake & Scull

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POMPIDOU CENTRE

Architecture and Building Engineering Services

The Pompidou Centre was the first major example of an "inside-out" building with its structural system, mechanical systems, and circulation exposed on the exterior of the building. All of these functional elements of the building were colour-coded: green pipes are plumbing, blue ducts are for climate control, yellow indicates encased electrical wires, while safety device (e.g., fire extinguishers) and circulation elements are red.

According to the architect Piano, the design was meant to be "not a building but a town where you find everything- lunch, great art, a library, great music." National Geographic magazine described the reaction to the design as "love at second sight." In 2007, the Pritzker Prize Jury said the Pompidou "revolutionised museums, transforming what had once been elite museums into popular places of social and cultural exchange, woven into the heart of the city."

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POMPIDOU CENTRE

Example of the colour coding of external services.

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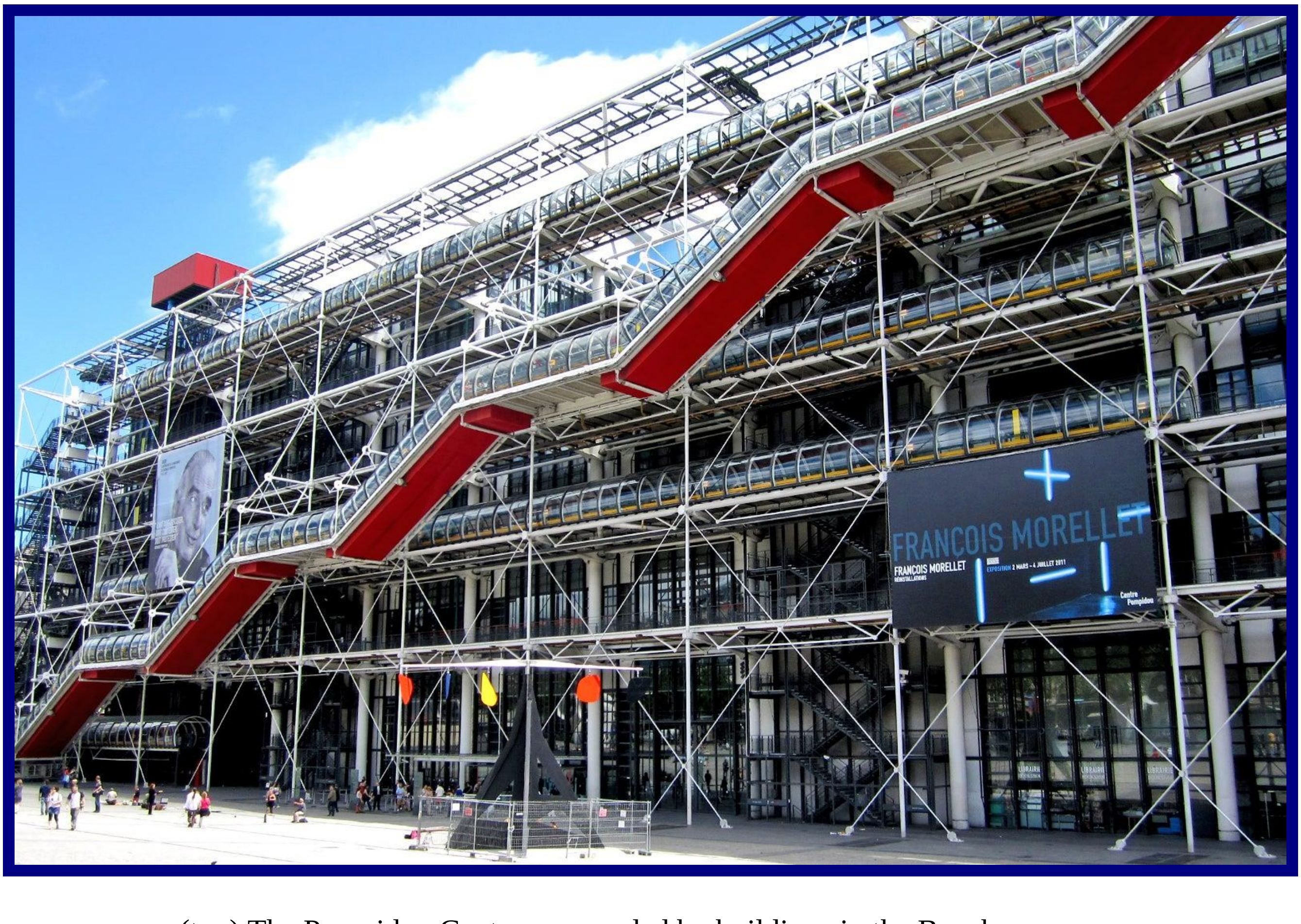

(top) The Pompidou Centre surrounded by buildings in the Beaubourg area.

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The external "stepped" escalator within a tube.

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Close-up view of the external elevator system.

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Inside the tube of the external elevator system.

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POMPIDOU CENTRE

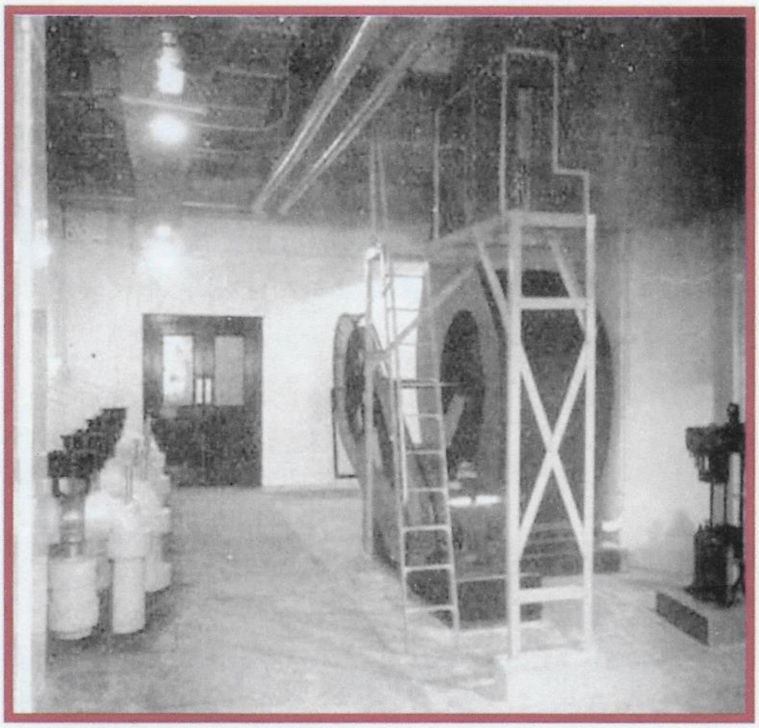
(top) External climate control air circulation ducting.

HONGKONG SHANGHAI BANK 1936

1936 The Hongkong & Shanghai Banking Corporation, New Head Office, Hong Kong
Air conditioned by G N Haden & Sons Ltd who provided ammonia refrigerating machines (410 hp) serving six air handling plants (229,000 cu.ft/min supply air), contract value being £75,000

HONGKONG SHANGHAI BANK 1936

1936 HKSB air conditioning plant



1936 HKSB fan room

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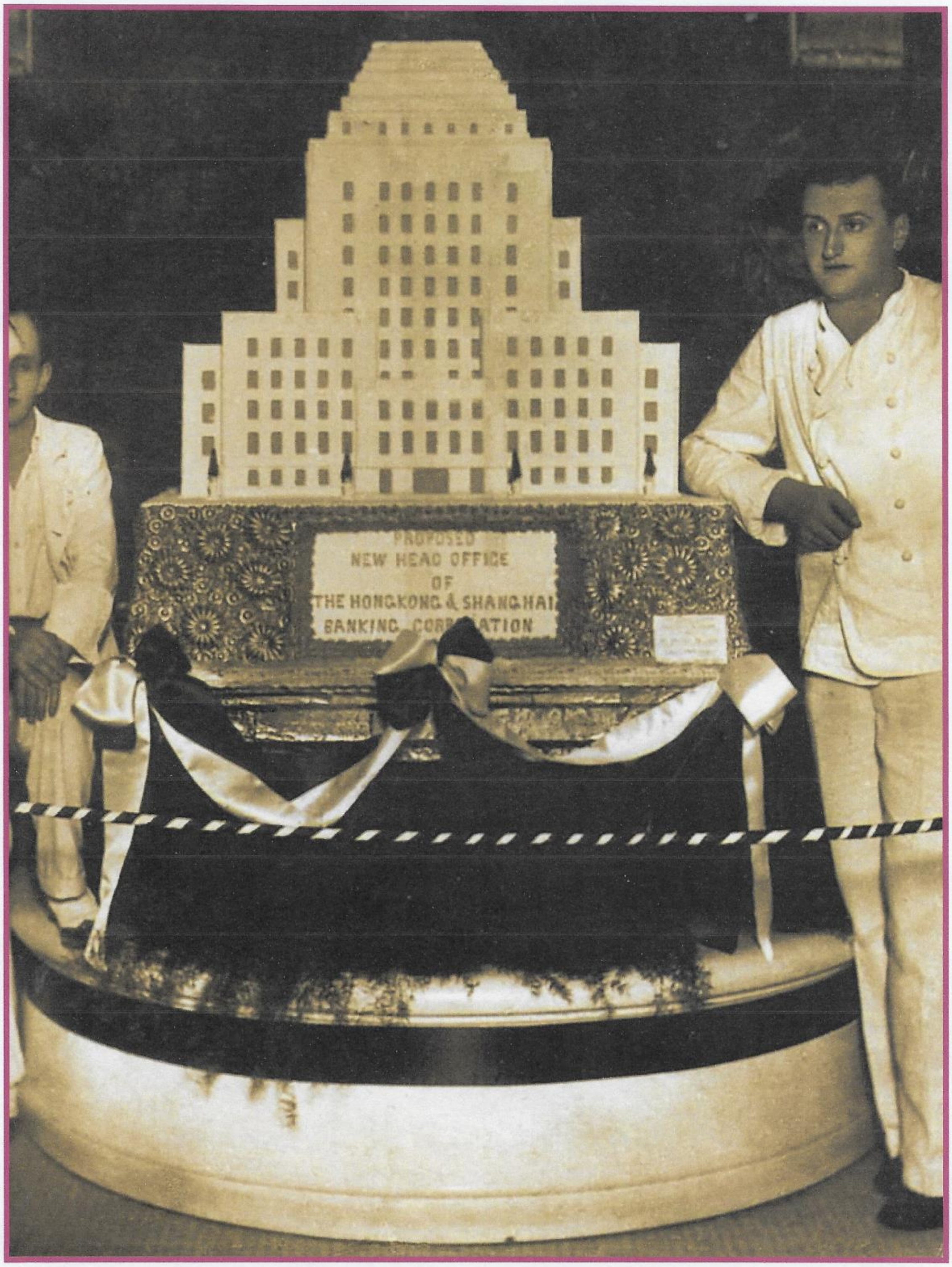

Celebrating the opening of the HKSB at the Peninsula Hotel, 1936
"Grand Oriental Hotels: From Cairo to Tokyo, 1800-1939," undated

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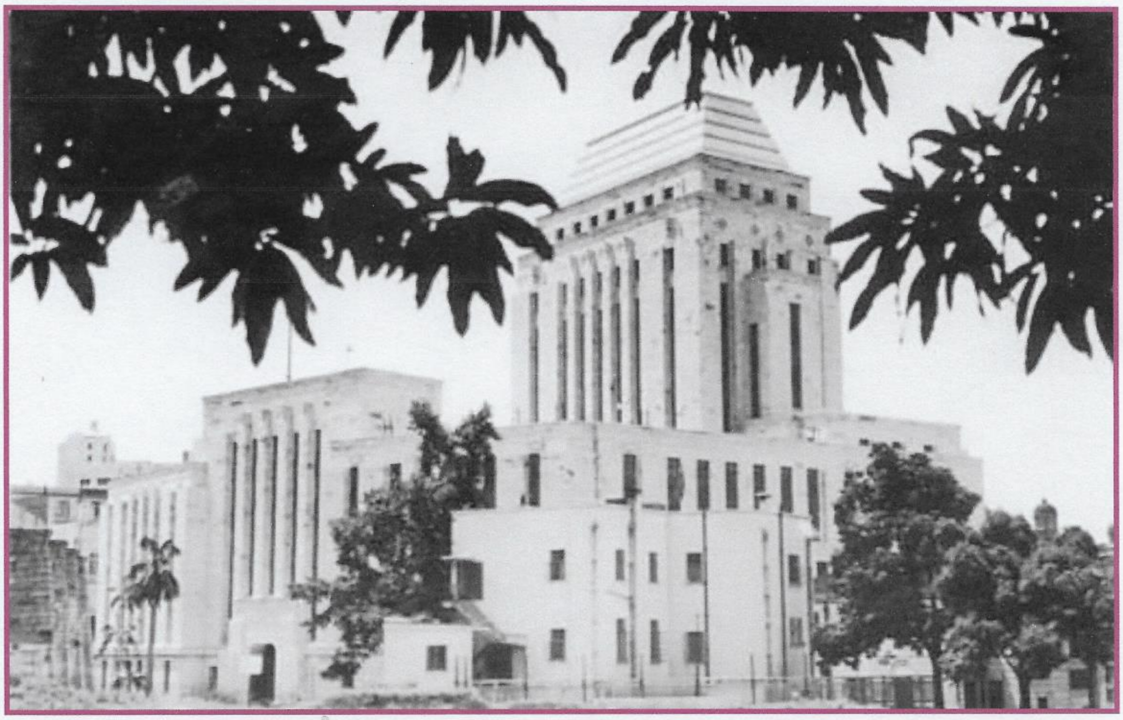

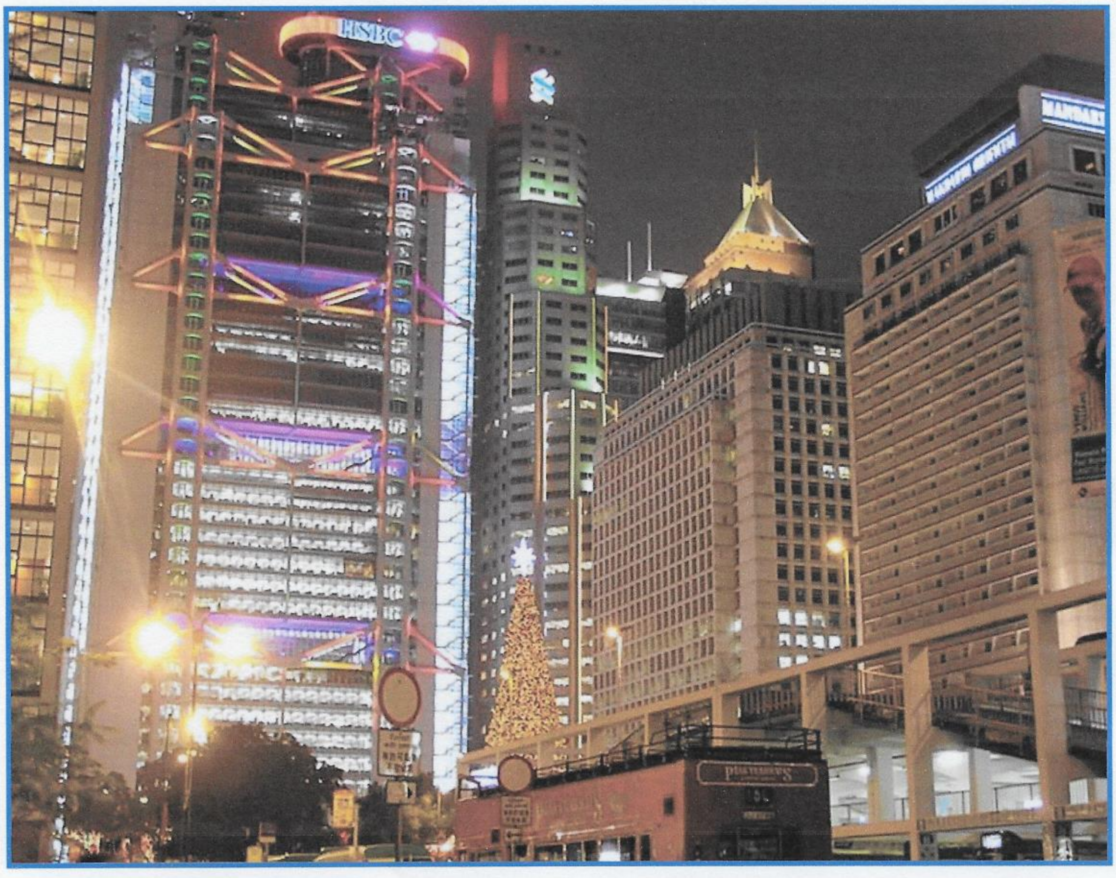

The Old and the New

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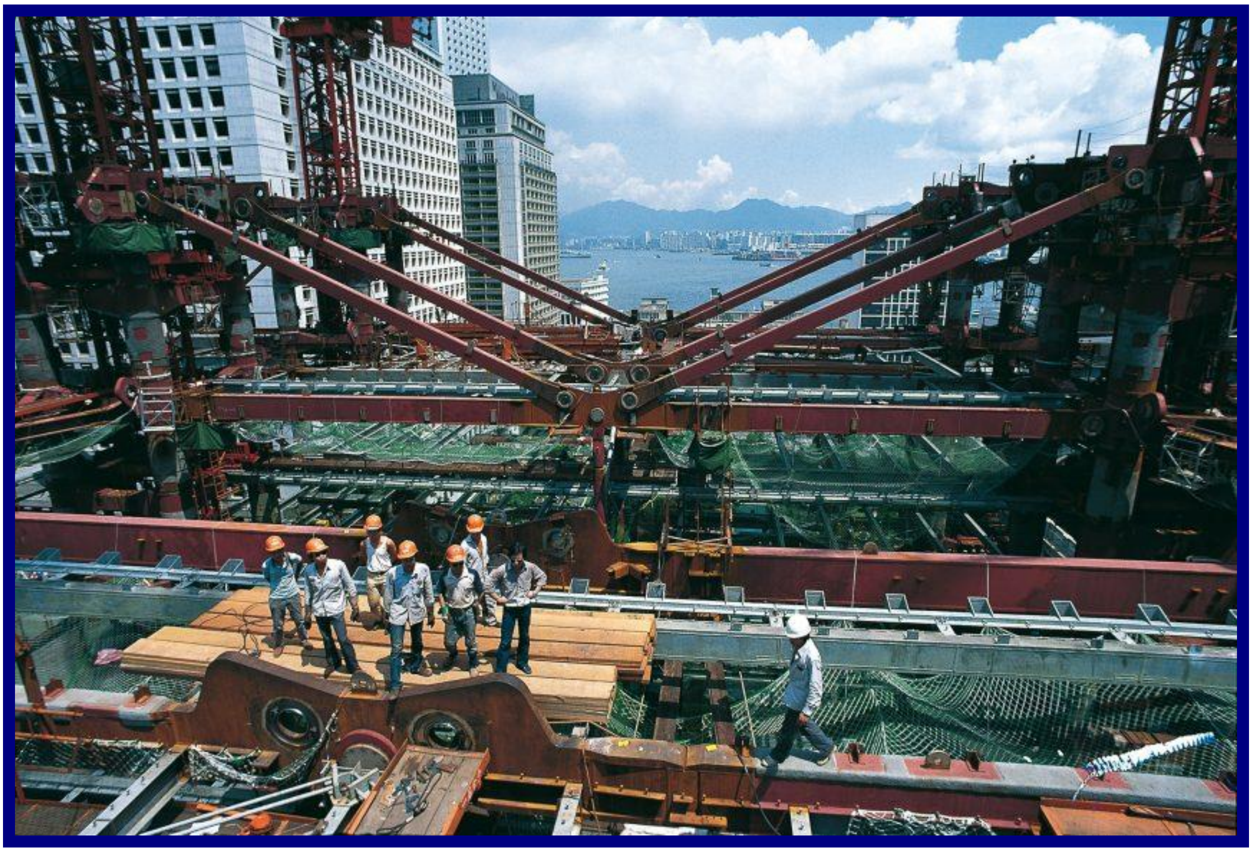

Under construction.

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Nearing completion.

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The building is 180 metres high with 47 storeys and four basement levels.

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The building design consists of five UK prefabricated steel modules.

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The building incorporates some 45,000 tons of steel and 4,500 tons of aluminium.

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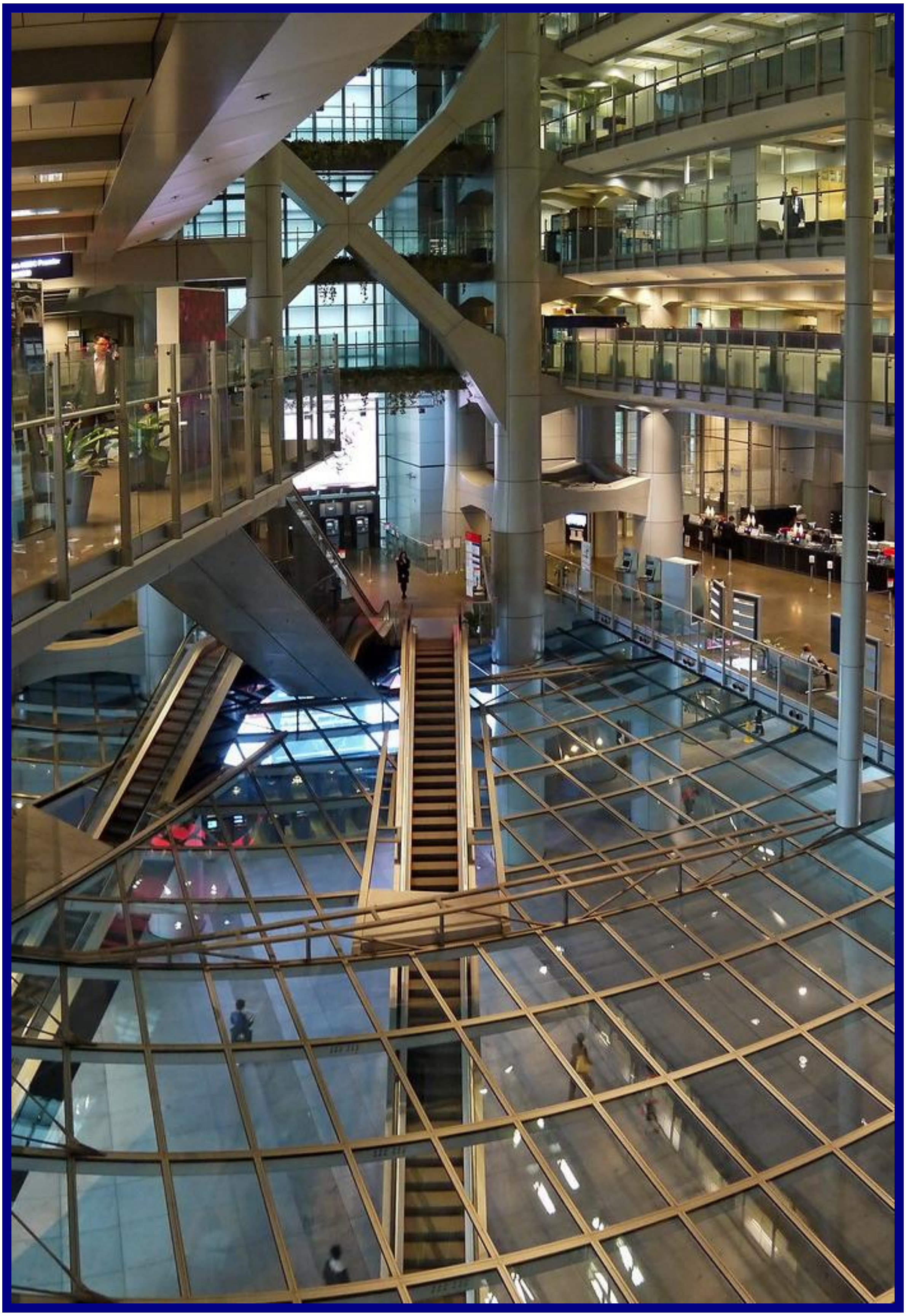

The building atrium contains an inter-floor elevator system.

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Natural sunlight is the major source of lighting inside the building.

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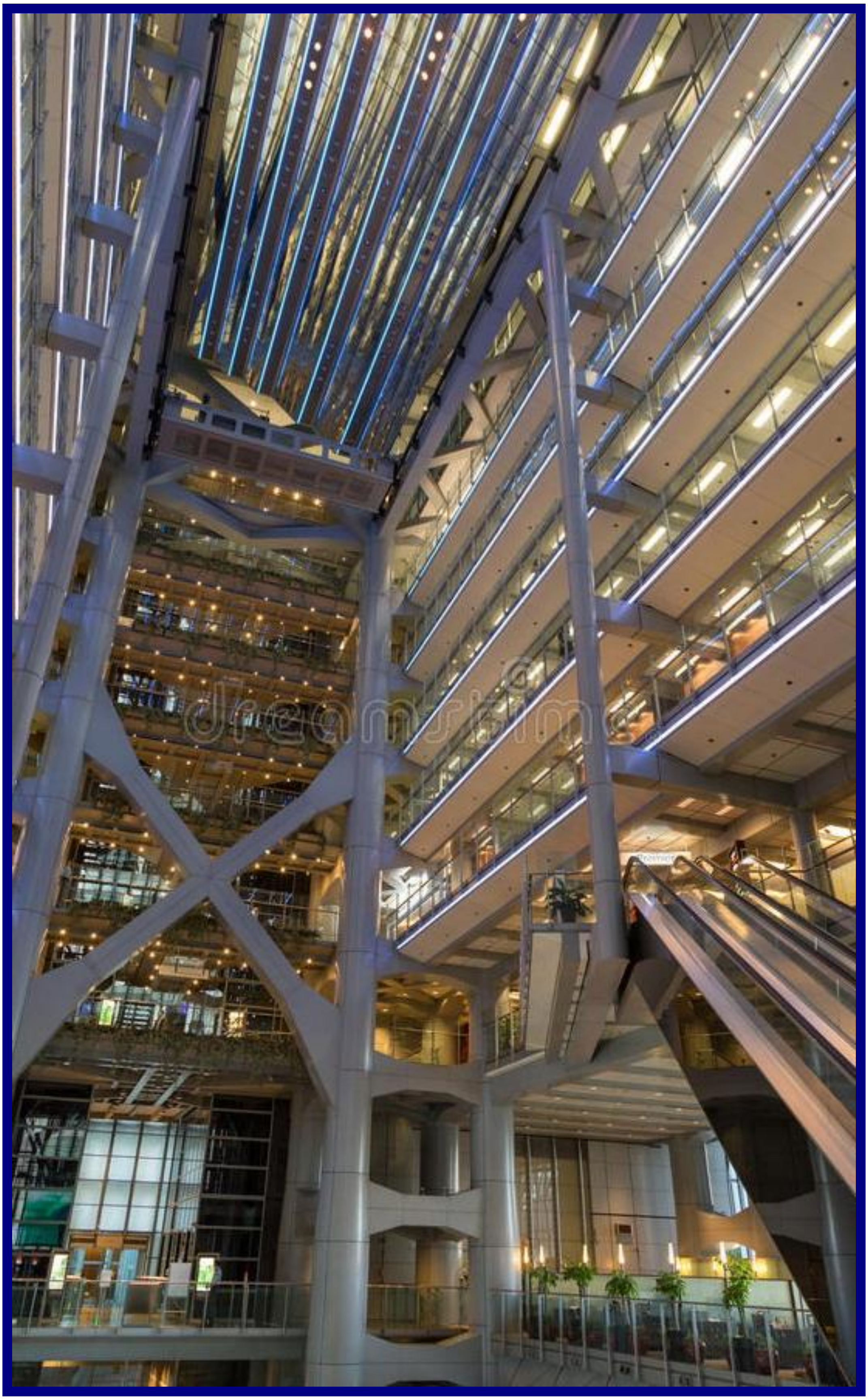

Giant mirrors at the top of the atrium provide natural supplementary lighting.

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Pictures with red background are from
"Hongkong Bank, New Headquarters: Building Services,"
J Roger Preston & Partners, 1986

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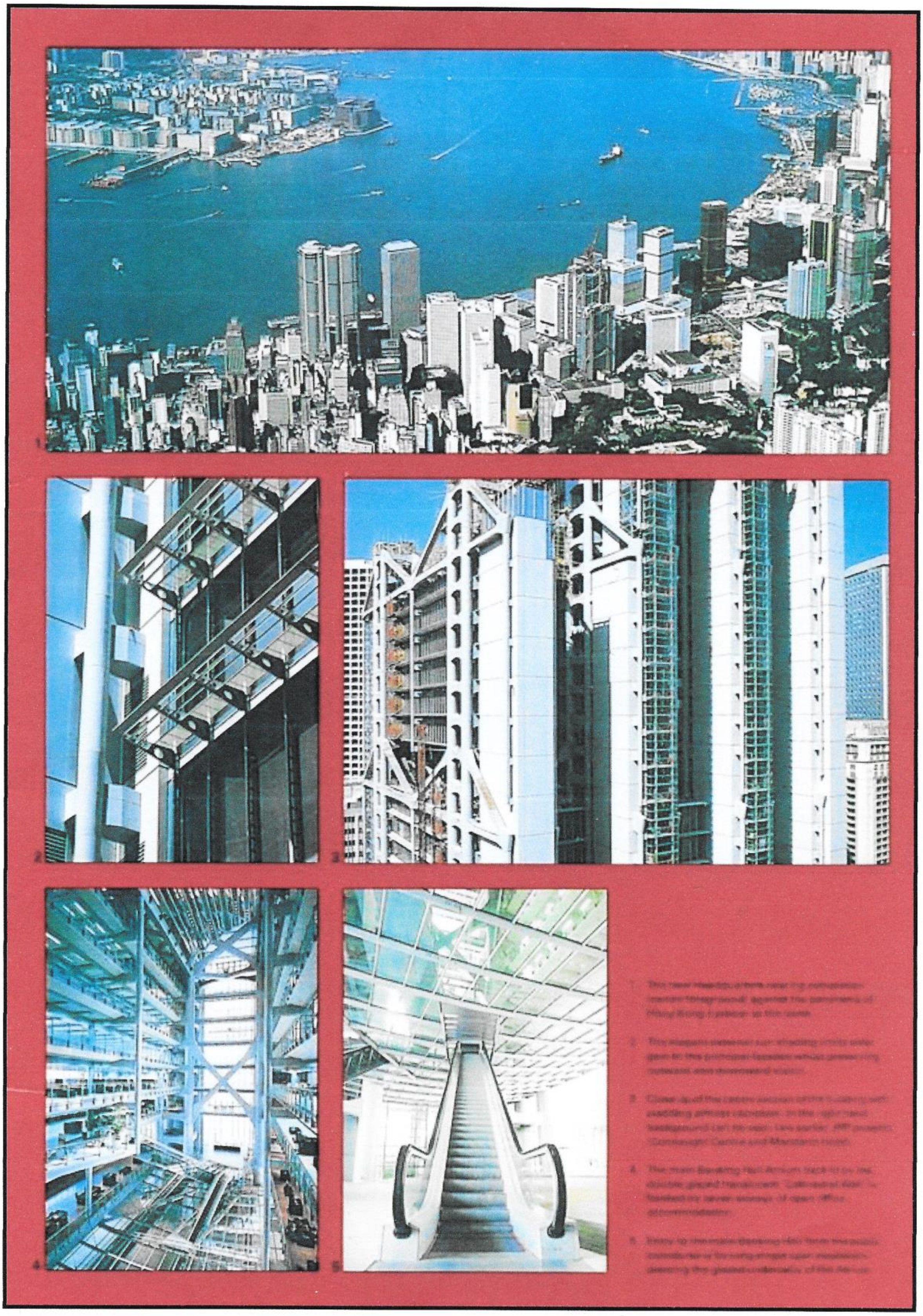

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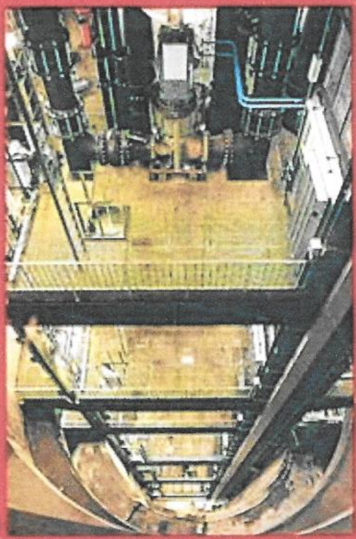

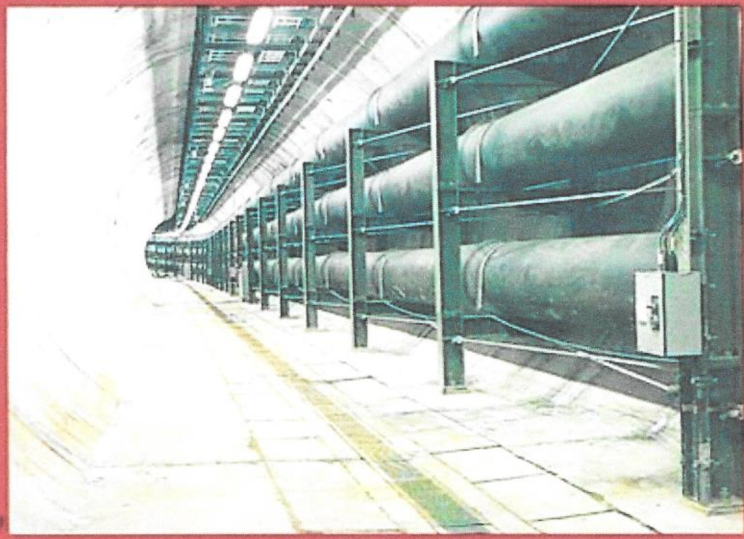

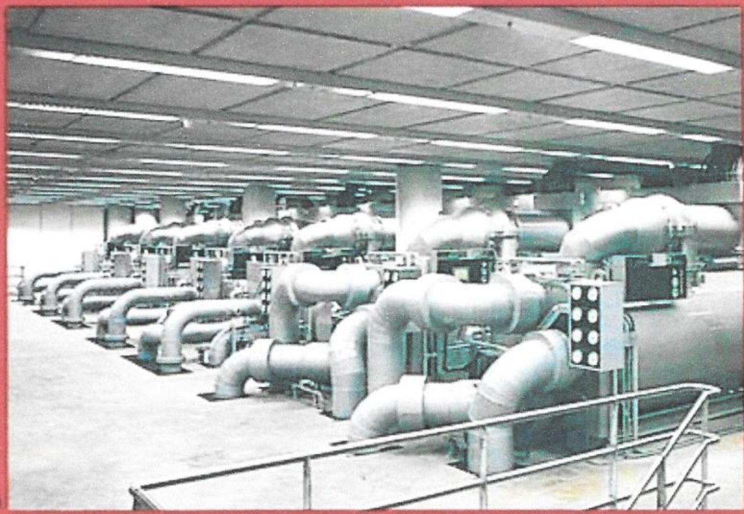

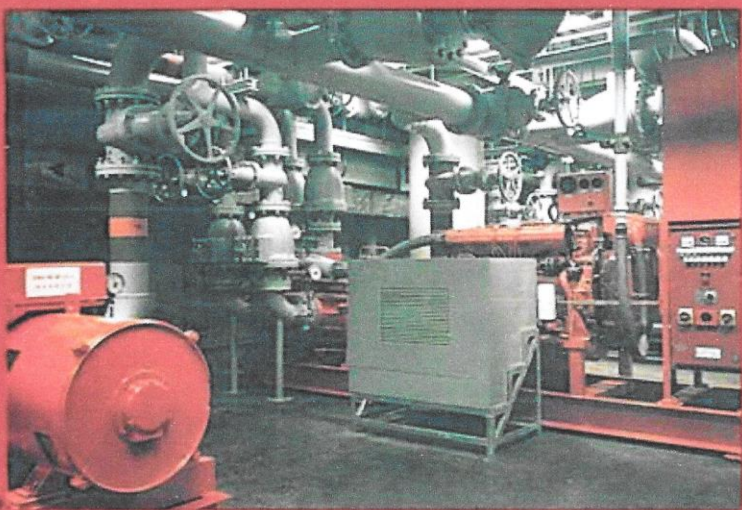

Photographs are of the refrigeration/heat pump/sea water condensing system.

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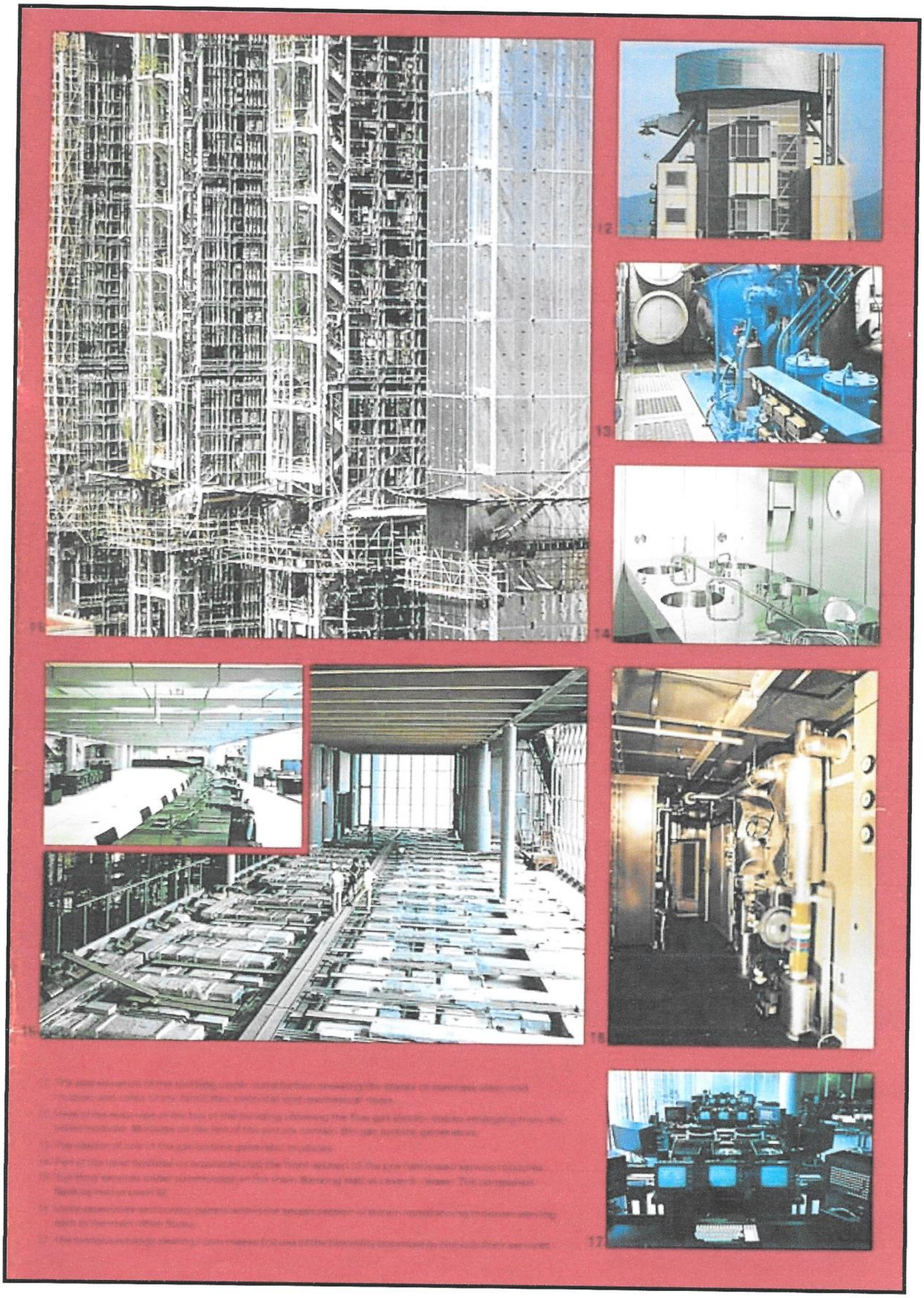

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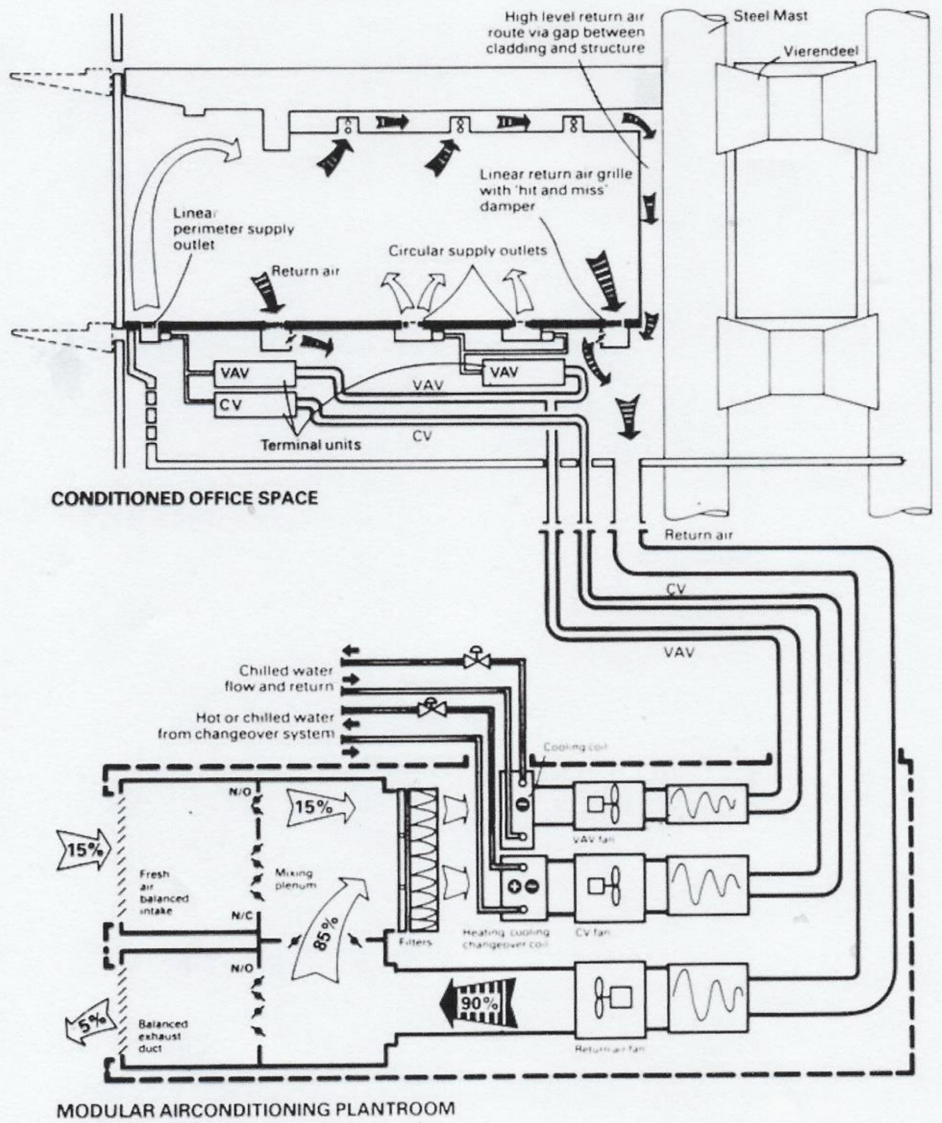
Figure 15: Diagram of air circulating systems for typical floor



Modular air conditioning system

HONGKONG SHANGHAI BANK

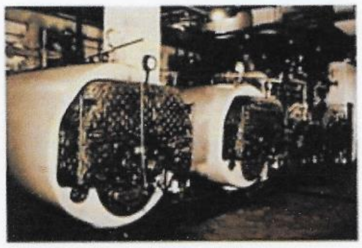
Following information from "COOL Hong Kong," ASHRAE Hong Kong Chapter, 2010

HVAC system

An extensive thermal analysis of the building led to early establishment of a target cooling load of 12,500 kW. Methods for rejecting this heat were then investigated.

There were two principal families of contenders: those using high level evaporative/air-cooled systems and those using sea water drawn from Victoria Harbour. The main disadvantage of the evaporative/air-cooled system was the extensive use of prime floor area at high level (some 2,500 sq m – approaching half the area of a football pitch) together with the significant use of vertical riser space throughout the height of the building. The disadvantage of the sea water system was the extensive civil works required to bring the pipe-work into the site because the Hong Kong Government would not permit closure of the waterfront roads.

The results of detailed cost-in-use analysis showed that the air-cooled schemes used some 30% more electrical energy than the sea water schemes and this taken with the need to preserve upper level floor space and provide high reliability and flexibility in the heat rejection systems determined the sea water proposals be adopted.



Boilers (1935)

Air conditioning plant (1935)

Heating

Although Hong Kong's heating season is short, winter temperatures can go close to freezing point in the urban areas and a real heating capability is required. Again, the cost in use of various systems was studied and it was apparent that heat reclaimed from the chillers was most attractive.

In order to optimize selection, manufacturers were invited to submit proposals for the generation of chilled water and hot water with seawater as the ultimate heating/cooling medium. Each manufacturer was provided with heating and cooling load profiles for the building (computer generated) and had to support their selection with calculated capital, running and maintenance costs, plus details of space requirements.

One manufacturer submitted three quite different schemes for consideration. Present values differed little more than 5% and after due consideration it was decided Scheme 3 be adopted.

Chiller/heat pump selection options
(US dollars – 1982)

Scheme	Installation Costs	Annual Energy Costs	Annual Maint. Costs	Cumulative Present Value
1	1,767,666	401,120	40,000	14,013,000
2	1,326,080	396,860	60,000	13,813,000
3	1,683,833	408,160	60,000	14,494,000

1 Scheme 1 employed 4 machines with intermediate titanium plate heat exchangers for sea water. Two of the machines were equipped with double bundle condensers for heat reclaim.

2 Scheme 2 used a total of 6 machines, all with titanium tube condensers/evaporators for sea water. Four machines provided cooling only, with the remaining two providing heating only.

3 Scheme 3 was as (2) but using intermediate titanium plate heat exchangers.

1 Queen's Road Central (1886)

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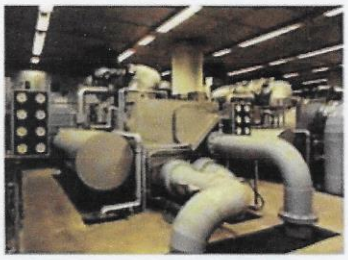


Chillers (1985)

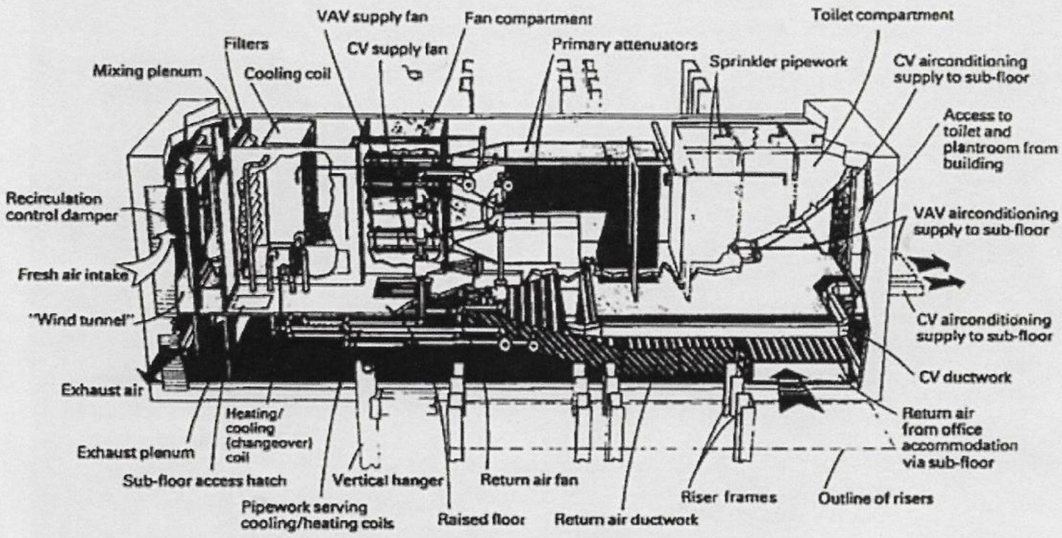
System layout

To bring seawater to the building's basement, a 350-metre tunnel, 70 metres below ground, was driven into the site from new intake and discharge facilities adjacent to Hong Kong's famous Star Ferry Pier. The seawater system pump house is located in a 12-metre diameter vertical pipeshaft near the intake. At site, a 45-metre shaft rises vertically into the basement of the bank where the seawater pipe-work is interconnected with the refrigeration/heat pump equipment.

At the upper level of the shaft are series of 11kV/380 volt transformers, supplied from the bank HV switchboard to provide power to the system, via the main low-voltage control panels and switchgear. On the lower levels are mounted the surge control equipment and the three main seawater pumps.

It was a fundamental consideration when various design alternatives were being considered that the system had sufficient standby facilities so that repairs and general maintenance could be carried out without affecting the operation of the building services, which would be required 24 hours per day, 365 days per year. To achieve this, three seawater pipes are installed, one for flow, one for return, and one which can be used either for flow or return. These pipes are interconnected throughout the system by a series of automatic valves to enable the water to be rerouted.

The majority of pipe-work is 700 mm diameter ductile iron lined with concrete, with the largest pipe at the intakes being 900 mm. This pipe material is expected to last the life of the building despite the very corrosive



Layout of typical modular toilet and air conditioning plant room

HONGKONG SHANGHAI BANK

nature of the harbour water. Approximately 450 tons of pipe-work is installed, running from the Star Ferry to the bank.

Another important consideration in designing the system was the considerable surge forces involved. At maximum load, nearly 400 tons of water are moving at approximately 2.5 metres per second and can generate great kinetic energy, if brought suddenly to a halt. Allowance was made in the design to prevent sudden changes in water velocity and also to absorb the pressures built up due to any velocity changes which do occur. By installing pressure vessels to absorb the pressure waves and by careful control of the valve closure times, it is possible to limit the surge pressure in the system from a possible maximum 30 bar down to 14 bar.

There are four modular plant rooms and flanking risers on each typical 3-bay floor. The positioning and arrangement of the units facilitated the modular construction, and the proximity of the risers made it logical to incorporate toilet facilities in the front section of each plant room. This arrangement provided an excellent buffer zone for noise and vibration, though the negotiation of pipe-work and ductwork through a highly serviced sanitary provision, and through the adjacent structural zone around the masts, proved a formidable task.

Fundamental to the economics of the modular approach is the degree of standardization achieved and the approach to replaceability. In the case of HSBC Main Building it was elected not to make the modules replaceable. While this gave rise to some economies in the structure it resulted in the need for ongoing maintenance and replacement to be performed wholly from inside the building. This applied not only to the air conditioning modules on the West side of each floor, but also to the modules containing boiler plant and standby generators at the top of the building.

Underfloor air distribution system (1985)

In general, only the modules on the West side of the building contain air conditioning plant – the rear of the East-side modules being reserved for domestic water systems, equipment, etc. Groups of air conditioning modules within each seven- or eight-floor zone of the building are identical. They are individually designed to achieve optimum performance within the space available and there is no doubt that this economy of space could never have been achieved using standard equipment and on-site erection methods.

Prior to commencement of production of the modules by the selected Japanese Sub-contractor, a full scale prototype air conditioning module was subjected to rigorous testing. This testing included proving the capacity of all components, exercising the control systems and checking for noise and vibration and ductwork leakage. Removal and replacement of all major system components was also checked and demonstrated to the client's maintenance personnel.

REFERENCES AND FURTHER READING

The Hongkong Shanghai Bank Lion.

HI-TECH BUILDINGS PART TWO

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1986 Hongkong Bank, New Headquarters: Building Services, J. Roger Preston & Partners.

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Photographs and information has also been taken from the CIBSE Heritage Group Archives and internet site (www.hevac-heritage.org), and from various internet sources including Wikipedia.

BRIAN ROBERTS, Budleigh Salterton, 2022