HONGKONG SHANGHAI BANK, HONG KONG

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

Hadens of Trowbridge: The family and the firm 1816-2004
A CIBSE Heritage Group Publication by
Frank Ferris, Brian Roberts & Paul Yunnie
Celebrating the opening of the HKSB at the Peninsula Hotel, 1936

Grand Oriental Hotels: From Cairo to Tokyo, 1800-1939, undated
Pictures with red background are from "Hongkong Bank, New Headquarters: Building Services, J Roger Preston & Partners, 1986"
1. The new Headquarters nearing completion—facing foreground—against the silhouettes of Hong Kong Harbour to the north.

2. The elegant external sun shading units are gain to the principal facades whilst preserving outward and downward vision.

3. Close-up of the central section of the building with cladding sheet materials. In the right hand background can be seen two earlier FRA projects (Concert Centre and Mandarin Hotel).

4. The main Banking Hall is double glazed translucent Catherdal Wall is flanked by seven stairs of open office accommodation.

5. Entry to the main Banking Hall from the public entrance is by large atrium stairwells allowing the glazed underside of the atrium.
6. A view of sea water shaft No. 3 adjacent the harbour moaker showing one of the main sea water pumps in the upper background.

7. The three 750 mm diameter sea water pipes in the sea water tunnel intentionally leave ample space for future pipes.

8. Main high voltage electrical switchgear.

9. Chillers and heat pumps at the second basement level.

10. Diesel fire pumps provided and their electrical counterparts at third basement level.
Modular air conditioning system
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.

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

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Installation Costs</th>
<th>Annual Energy Costs</th>
<th>Annual Maint. Costs</th>
<th>Cumulative Present Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,767,566</td>
<td>401,120</td>
<td>40,000</td>
<td>14,013,000</td>
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<td>2</td>
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<td>396,860</td>
<td>60,000</td>
<td>13,813,000</td>
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<td>3</td>
<td>1,683,833</td>
<td>408,160</td>
<td>60,000</td>
<td>14,494,000</td>
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</tbody>
</table>

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.
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
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.

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.
The Old and the New