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Technical Note

AN ENERGY - SAVING IDEA FOR AIRCONDITIONING SYSTEMS IN PHASED CONSTRUCTION PROJECTS

Arturo Martin B. Santos, M.S.
Assistant Professor
Department of Mechanical Engineering
University of the Philippines
Diliman, Quezon City

ABSTRACT

In multiple-building projects wherein the buildings are constructed one by one, the number of standby chillers for the whole complex will be more than necessary if each building's air conditioning system is exclusive to itself. However, if the refrigeration plants of these buildings are interconnected, the number of standby units will be reduced compared to the conventional method of designing refrigeration plants for airconditioning in phased construction projects. This paper discusses the design concept undertaken by the DCCD Engineering Corporation for the Ayala Center in Makati.

INTRODUCTION

The Ayala Center is part of the 40 hectare Makati Commercial Center bounded by Epifanio De Los Santos Avenue, Ayala Avenue, Makati Avenue, and Pasay Road. The Ayala Center itself, which will be the central shopping area, is being developed in stages over a period of five (5) years (from 1990-1995).

A decentralized chilled-water plant with ring main will be utilized for a system-wide airconditioning system for the following reasons:

a) Minimal chiller standby capacity with load-sharing capabilities

b) No significant delay as the phased construction program progresses.

c) Flexible enough to allow the option of incorporating a Thermal Storage System in the remaining Quadrants and a Commercial-Center-wide Energy Management System in the later stages of construction.

This type of airconditioning system is the same system W.L. Meinhard and Partners, in their "Master Plan Study for Makati Commercial Center," found their 'Master Plan Study for Makati Commercial Center", found to be the most economically feasible among the systems they considered in their study. It also emerged as the most practically implementable system because of the unique construction phasing of the complex.

CONCEPT

The central ring main will be composed of two centrally located pipe rings (around the Glorietta) wherein the various chilling plants will be connected as they are constructed (see Fig. 1). One ring will serve as the supply route for the cooler chilled water provided by the donor building to the recipient building. The other ring will serve as the return route for the warmer chilled water from the recipient to the donor building.

This central ring main will serve as an integrating center to tie up each Quadrant's capacity and therefore serve the purpose of sharing standby capacity. Control of the system will be achieved through a Building Monitoring/Management system also designed by the DCCD Engneering Corporation.

In the future, it is possible to incorporate Thermal Storage systems in each of the remaining Quadrants and tie up these systems to the other Quadrants (without Thermal Storage Systems) via the central ring main.

PIPE RING SYSTEM AUXILIARIES DESCRIPTION

1. Each supply-and return-line will have its own booster pump system capable of supply or returning chilled water to the system farthest from it. The supply and return chilled water booster pumps will have auxiliary equipment as shown in Figs. 2 and 3.

2. Control of the required flow to or from the ring will be accomplished by opening or closing to the required degree motorized butterfly valves.

3. The control system of these butterfly valves will be eventually centralized in the Building Monitoring/Management System.

4. Should thermal storage be incorporated in the design of the remaining Quadrants, these will be capable of partially supplying the Quadrants without thermal storage with chilled water during hours of peak power demands.

5. The central ring will have stub-outs to anticipate the connection of the future airconditioning systems of the buildings that are yet to be constructed.

6. The supply chilled water booster pump system, shown in Fig. 2, operates as follows:

   a) The booster pump is turned on only when chilled water coming from its respective building aircondi-tioning (AC) system will be supplied to other areas.

   b) The modulating valve is fully closed when the booster pump is off. It serves to modulate the flow out of its respective building AC system when chilled water is supplied elsewhere. It is also fully closed whent he non-modulating valve is fully open.

   c) The non-modulating valve opens only when chilled water is being supplied of its respective building AC system.

   d) All these (booster pump, modulating valve, non-modulating valve) are off when chilled water is neither supplied to other areas nor is supplied this area from the chilled water ring.

7. The return chilled water booster pump system, shown in Fig. 3, operates as follows:

   a) This booster pump is turned on only when warmer return water coming from its respective building AC system will be returned to the ring (an amount equal to the amount of chilled water supplied from the ring).

   b) The modulatin g valve is fully closed when the booster pump is off. It is also fully closed when the non-modulating valve is fully open. It serves to modulate the flow of return water out of its respective building AC system.

   c) The non-modulating valve opens only when chilled water is being supplied other warmer return is returned via this line.

   d) All these (the booster pump, modulating valve, non-modulating valve) are off return chilled water is neither moving out nor moving into this system.

ADDITIONAL ADVANTAGES OF THE PIPE RING/SYSTEM

Table 1 shows the schedule of the equipment installation vis-a-vis the schedule of actual cooling load requirements as the Ayala Center (also called the Makati Commercial Center) goes through the different construction phases. It can be seen that the recommended base back-up capacity ranges from 12% to 20% of peak commercial center cooling requirements throughout the development stage. However, with the chilled-water pipe ring, an additional back-up capacity of 12.5% is available. This means that the system can accommodate equipment breakdowns representing 25-32% of peak load requirements 90% of the time.

Also, chillers operate more efficiently at full load. Because of the unique interconnection of chillers in this design, more chillers can be shut off if their capacity is not needed and the remaining chillers will be operating near full capacity - this saves or energy.