PROFESIONAL INTERVIEW ESSAY NO.2

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QUESTION

During your service as a Mechanical Engineer at Arup Jururunding Sdn Bhd, you were involved in an Air Conditioning and Mechanical Ventilation (ACMV) System design for a public toilet at the Curve at Mutiara Damansara. Explain the procedures how you would design, install, test and commission the air conditioning system at the complex. What are the assumptions and criteria taken into consideration?

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ANSWER

The construction process of any building involves the design, installation work, testing and commissioning. For each of this process, there are a number of considerations to be made to ensure that the system works.

In any design work, there are four factors to be considered, namely:

- Compliance to technical specification
- Practicality of design
- Cost effectiveness
- Time limitation

Compliance to Technical Specification

Generally, in most projects, there should be a design brief provided by the client or a brief that has been agreed to by the client and prepared by the consultant. This brief should spell out the client's requirement; in my case, it was to air condition the toilets. Once the client's requirement has been identified, the next step is to start the design and ensure that it complies with the following codes and standard.

- CIBSE Guides – For space condition and load calculations
- UBBL 1984 – For ventilation rate requirement
- DW144 – Duct sizing

In the heat load calculation, the following criteria have to be considered.

- Internal gain – from people, lighting and equipment
- Fabric gain – heat transmission through the wall, floor and roof
- Infiltration gain – heat contributed from outside air that seeps into the toilet
- Fresh air load – amount of cooling required to cool the outside air to the design supply air temperature

Internal Gain

The amount of heat generated from people, lighting fixture and equipment can be referred to the CIBSE Guide A. The heat gained from people is from Table A7.1 and, as for lighting, from Table A7.6.

Fabric Gain

The calculation of fabric gain shall be based on the different temperature between the indoor (toilet space) and the outdoor, against the surface area and the *U*-value, *i.e.* $Q = U.A.\Delta T$. The *U*-value is based on the calculation of thermal coefficient for each surface element.

Infiltration Gain

Being a toilet, the system design has to ensure that odour from the toilet does not escape to the adjacent space. Therefore, the system has to be designed to ensure that the space is negatively pressurised. This is done by limiting the supply air rate to 90% of the exhaust air. By doing so, 10% of the supply air will be coming from the adjacent space. The infiltration gain is calculated based on the 10% supply air flow rate from the adjacent space.

Fresh Air Load

The UBBL 1984 under the third schedule clause 10 stated that all toilets are to be provided with a minimum ventilation rate of 10 air changes per hour (ACH). And, since toilet exhaust cannot be recirculated into the space due to foul odour, the system design shall incorporate a full fresh air system with 100% fresh air and exhaust. The fresh air load is calculated based on the 10 ACH air flow rate.

Practicality of Design

Once the technical requirement has been complied with, the type of system has to be decided. The practical aspects to be considered are:

- System efficiency
- Ease of maintenance
- Operation issues
- Track record

In deciding for a chilled water air handling system (AHU) for the toilet air conditioning system, the previously mentioned four items were considered. AHUs are found to have better efficiency compared to fan coil units (FCUs) due to the following reasons:

- Better fan motor efficiency (especially for bigger motors), *i.e.* eff1 or eff2 type motor.
- The bigger valves for AHU chilled water pipes normally have better authority, thus providing better controls.

AHUs are normally located where it is easier to access and maintain as compared to FCUs. As AHU is bigger, it may have less operation issues compared to FCUs such as frequent servicing due to valves choking (a smaller pipe size is prone to choking compared to a bigger one).

Cost Effectiveness

Noting that there are eight stacks of toilet with three levels each, the total number of toilets is 24. It is logical to centrally air condition the toilets by group of stacks and reduce the number of equipment. It is also cost effective to do it this way since the number of fittings and pipework are also reduced. When looking at the broader picture, the support from other services is also reduced such as power cabling, building automation interface, and cabling and fire signal.

Time Limitation

Making the system a central one also reduces the amount of man hours required for installation and testing. Consideration of the installation procedure has to be captured at a very early stage of the design process. It is also known as 'spatial planning' or space planning. It is

during this stage that the plant space is drawn to ensure the following:

- It could be installed
- It is accessible to be maintained later
- It has adequate clearance for optimal design

Once the three criteria have been met, only then can the secondary equipment planning be done. These include:

- Chilled water pipe sizing and routing to the equipment
- Supply and exhaust air ducting sizing, distribution and routing

Finally, when the physical work has been completed, the testing and commissioning stage will commence. Prior to testing, a physical inspection of the system shall be done to ensure that all installation follows the approved shop drawing and specification. A series of test is to be conducted before the full system test can be done. These are:

- Meggar test for the control panel – to ensure that the power supply is balanced and cables are terminated properly.
- Chilled water pipe pressure test – to ensure there is no leakage at joints and pipework
- Chilled water flow test – to ensure that adequate flow is achieved
- Air flow test at the equipment – to ensure specified equipment capacity is met
- Air flow test at grille outlets – to ensure that the air system is balanced

When all the tests have been completed, the full system test can be done. The full system test is intended to check whether the system is performing as per design by taking relevant measurements such as:

- Supply air temperature at grille
- Outdoor air temperature
- Off coil air temperature

Although all of the points discussed have been applied during the design, installation and testing stage for the project at the Curve, it is also a generic plan of action and procedure for any project and services. ■