

## Chapter 6

### Prototype

The usage of the 3D CAD in this Air Handling Unit (AHU) design improvement is extensively improve pace and the quality of the design. In this Air Handling Unit (AHU) design improvement, the "Solid Work 99" 3D CAD software is used as the tools. Researcher used Solid Work 99 software to draw all parts that concerned in this Air Handling Unit (AHU) design improvement.

Parts are stored in the design database and assembled together, in the Assembly Module of the Solid Work. The digitally parts and assembly displayed in the virtual reality mode on the computer screen. Materials and color is applied to parts and assembly. After the render process of the 3D CAD system the design team can see the "close-to-real" images of the Air Handling Unit (AHU) on the computer screen. The images of the Air Handling Unit (AHU) from different angles are printed out and presented to the management for the design proposal.

Listed in below figures, the computer generated images of the Air Handling Unit (AHU) final design that used for management proposal.



Figure 6.1 Complete Unit Design

The figure 6.1 is the computer graphic generated from the "Photo work" Modules form the Solid Work Software. The output shows the completed assembly of the Concept-4 Air Handling Unit.

The researcher is working on the detail design of the AHU parts that used to produce the actual prototype and the drawing of the parts is shown in the Appendix 1.

### 6.1 Prototype unit

The "Concept 4" prototype is built according to the drawing generated by the Solidwork software that used by the researcher to design the "Concept 4" AHU. All major parts of the AHU are built and tested to verify the design, following are the sample picture of the parts that manufactured according to the detailed design of the "Concept 4" and the picture of the prototype AHU unit, which are shown in Figure 6.2

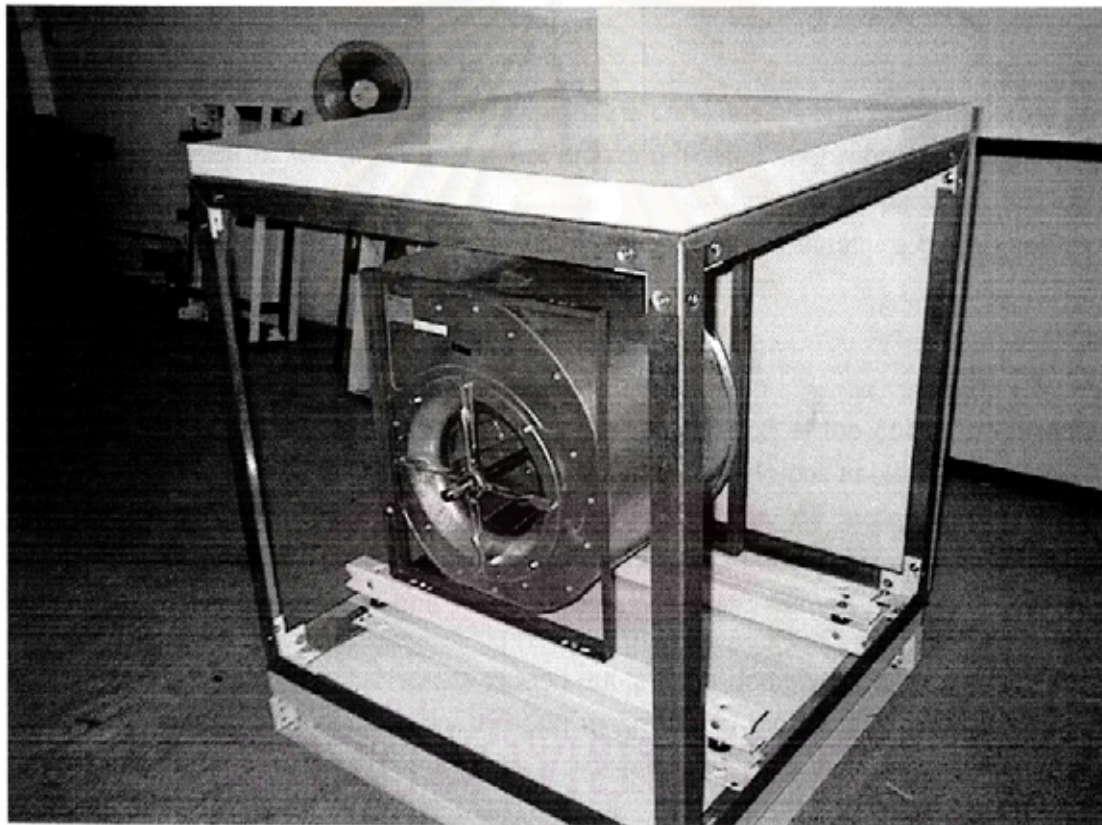


Figure 6.2: Partial assembly of the prototype "Concept 4"

Figure 6.2 illustrate the fan section of the prototype of the "Concept 4" double skin Air Handling Unit (AHU). The wall panel is removed to show the construction of the AHU

## 6.2 Design Verification

The prototype is built to verify the design. In building and testing the prototype following issues of design is verified and the prototype is benchmarked against the old references model using the QFD Matrix A1.

### 6.2.1 Structure design,

The structure post and corner pieces is perfectly design, the post can held to the corner pieces and from the very smooth surface of the external side of the AHU structure. Thus, insulation is insulated the external structure by means of adhesive for using as the wall and floor panel gasket and thermal bridge protection. The knock down structure increased the flexibility to transport from factory to site. One module can be completely assembled within 20 minutes, timing by the researcher.

### 6.2.2 Panel design

Panel assembly is fast and simple, the panel installation to the structure have slightly problem since the guide hold is not provided. Researcher recommended that the guide pin should be installed to the structure and guide hole at the panel so first panel alignment shall be easier. When the panel is fastened to the structure by the self-taper bolt, the gasket is sealed and the airtight is formed.

### 6.2.3 The Coil and Drain Pan

The dummy coil is used to check the installation of the coil in the prototype unit. From several trials on replacing coil by sliding and lifting coil in-out and installed the coil back to operating position. One can show that, the design coil section provide the vast degree of coil removing flexibility. The coil can quickly removed by removing only few number of screws that used to bolt the coil to the coil holding frame.

The drain pan can easily slideed out and the design slope of the drain pan is sufficient enough to completely dry the pan when tested by pouring the water into the drain pan.

### 6.2.4 Fan and Filter Section

Fan and filter suppliers supply the fan assembly and filter assembly for test installation. The fan installation is simple, the supplier supplying the complete set of fan which is composed of Backward Curve fan, pulleys, belt drive, motor, the vibration absorption, and fan base frame. When running test the fan the vibration is not carried to the structure and the sound level is typically low compared to the competitors in the market.

There is some problem of the filter section since the 305 internal dimension modular size is to small for holding the filter holding frame. The space allowance to install

is too limit, the researcher recommended to increase the internal module size to be at least 330 mm or more for easing the installation of the filter sections.

### 6.3 Benchmarking of new prototype

The built prototype of "Concept 4" is benchmarked over the reference brand that used to be benchmarked over the "Customer Demands" and "Substituted Quality Characteristics" in QFD matrix A1. Following table 6.1 and 6.2 shows the benchmark results of the "Concept 4".



สถาบันวิทยบริการ  
จุฬาลงกรณ์มหาวิทยาลัย

	Score 9, 3, 1 and 0			
	Bad	Moderate	Good	Excellent
Air Humidity Control		①①③③*	②	④
Air Tight at the operating Pressure		①①③	③	②④*
Connected to Air Distribution Systems	③		①①②③④*	
Deliver Cooled Air			①①②③④⑤*	
Multi-Stages, selectable modular component		③	①①②③④*	
No Thermal Bridge		①	①③⑤	②④*
On Floor Installation			①①②③④⑤*	
On Hanging Plat Form installation		③	①①②④	②*
Easy to maintenance			①①②⑤	②④*
Small Foot Print		③	①①②③④*	
Access to the internal components			①②	③④⑤*
Accurate Air Volume		①①②③⑤		④*
Air Tight Service Door		①①③	⑤	②④*
Clean internal construction	①②		③⑤⑤	④*
Color Finished Exterior	①②	③	③②*	④
Easy to remove & install wall panel	①③⑤	④	⑤	②*
Good Fan Performance	③①②③⑤			④*
Lighting Equipment	③①③⑤	*		②④
Long Maintenance Life		③⑤	①③	②
Low Noise Generation	③	③①③		②④*
Low Vibration		①	③③⑤	②④*
Modularity Sizing	①②⑤	③	③②*	
Monitoring equipment installable			①①②③④⑤*	
Strong Construction			③①⑤	⑤
Appearance		①	③③⑤*	②④
Air Volume Control			③①②③⑤*	④
Controlling equipment installable			①①②③④⑤*	
Deliver Hot Air		⑤	③①②③*	④
Dry Drain Pan	③	③①	②	④*
Flexible Configuration		⑤	③①③	②④*
Multi Material Insulation	③①②③④⑤			*
Multi Material Interior		⑤	③①②③④	*
Non-Corrosive		③①③⑤	②*	④
Protection of Water Carry Over from Coil			⑤	③①②③④*
Safety Protection for moving and dangerous part		③①②③⑤	④*	
Anti Trap-in	③①②③④⑤*			
Wiring Terminal	③①②③⑤	*		④
Air Cleanliness Control		①③⑤	③⑤*	④
Knock down	⑤	①②④	⑤	②
Color Finished Interior	③①③⑤		*	②④

Table 6.1 The Benchmarking of "Concept 4" to the "Customer Demands" using QFD Matrix A1

From table 6.1 all major customer demand is improved from old AHU seen from comparing the "Concept 4" which represented by the symbol "\*" and the reference AHU that represented by symbol "⊙"

On the technical benchmarking following results are obtained and displayed in table 6.2

The table contains numerous rows, each representing a technical characteristic or component. Each row is evaluated against two benchmarks: 'Concept 4' and 'Substituted Quality Characteristics'. The results are indicated by symbols: an asterisk (\*) for 'Concept 4' and a circle with an asterisk (⊛) for 'Substituted Quality Characteristics'. The symbols are arranged in columns across the rows.

Table 6.2 The benchmarked “Concept 4” over the reference AHU and “Substituted Quality Characteristics”

From table 6.2 the benchmarked “Concept 4” show the dramatically improve in term of technical design of the “Concept 4” over old reference AHU. The symbol used for in comparing are; the “Concept 4” is represented by the symbol “\*” and the reference AHU is represented by symbol “⊛”. The enlarged version is shown in Appendix 7