

# MECHANICAL-ELECTRICAL DESIGN REPORT

## CITY OF MADISON - YAHARA CLUBHOUSE

March 31, 2014

Michael Hein, PE  
HEIN Engineering Group

Information gathered for this report are based on a walk-thru field visit and discussion and as-built construction documents dated September 30, 1966.

### **ORIGINAL CLUBHOUSE FACILITY:**

The original clubhouse facility was built in the 1967 and consists of about 3600 SF on the main level and 2900 SF on the lower level with exposed northeast wall. The facility is also connected to a 2300 SF Lockerroom/shower facility by roof structure with 20 foot separation. The upper level is primarily used as clubhouse gathering space with food & beverage service and the lower level for a private gathering room with storage and mechanical space. The upper level is primarily wood construction with exposed wood deck ceiling with wood exposed laminate beams and the floor is supported on 8" concrete precast with 2" topping. The lower level is below grade poured reinforced concrete walls with exposure on one side. The upper level glazing is currently single-pane glass.

The existing HVAC systems consist of a split-system gas-fired furnace units with DX coils(R-22) and air-cooled pad-mounted condensers. The upper level is served by a 5-ton unit, the adjacent Lockerroom/shower facility is served by a 4-ton unit and the lower level is serviced by a 2½-ton unit. The upper level ductwork is routed from the lower level mechanical room to overhead soffit at the center ridge and the return air is ducted through slots at the perimeter to return air ductwork in the lower level. The Lockerroom/shower facility is ducted through the attic space connecting the two buildings.

Exhaust air from the facility is provided by three utility set fans: EF-A(2570 cfm) serving Lockerroom/shower space, EF-B(640 cfm) serving the Clubhouse toilets and EF-C(860 cfm) serving the food service area on the upper level of the Clubhouse. EF-A&B are located in an accessible above ceiling space over the Clubhouse office, and EF-C is located above the lower ceiling over the food service area in the upper level of the Clubhouse.

Natural gas service to the building is metered and services the furnaces and water heater for the building.

Water service to the building was originally from a well pump, but has been updated to municipal water service with a 4" line brought in for future sprinkler system and a 3" line for potable water to the facility. The water heater for the Clubhouse and Lockerroom/shower facilities are served from gas-fired commercial 100-gallon water heater with a water softener upstream. Domestic hot(1¼") and cold(2") water to the Lockerroom/shower facility is piped overhead in the attic/soffit space from the mechanical room.

The facility is served by a 400-amp 3-phase electrical service.

### **CURRENT FACILITY HVAC ISSUES:**

1. The existing furnace - split system AC system is at the end of its useful life and in the need for replacement.
2. The energy efficiency of the existing HVAC equipment is sub-standard compared to current code and City of Madison equipment standards.
3. The envelope of the Clubhouse is very poor and not designed for winter season usage without high energy use and occupant discomfort.
4. The existing HVAC loads for the Clubhouse with the desired 99 occupant load is 15.4 tons and 314 MBH heating load; exceeding the current equipment and ductwork capacities.
5. The return air slot system at the floor of the upper level Clubhouse exposes air to combustible materials and potential floor debris and dust - undesirable.

6. The Owner prefers the Clubhouse facility be separated mechanically from the Lockerroom/shower facility as that function will change in the future.
7. Temperature controls are not concurrent with City standards.

### **EVALUATION OF HEATING AND COOLING LOADS:**

The existing Clubhouse HVAC loads were evaluated under four scenarios as indicated in the table below. The energy recovery ventilator is assumed to provide 70% recovery rate. Improvements to the envelope include replacing the single-pane glass with low-e glass (Uv=0.4 & Sc=0.6) and adding R20 roof insulation.

|  | Heating Load | Cooling Load |
|--|--------------|--------------|
| HVAC Unit with existing envelope                   | 314 MBH      | 15.4 Ton     |
| HVAC Unit with ERV & existing envelope             | 264 MBH      | 14.0 Ton     |
| HVAC Unit with ERV & low-e glazing added           | 211 MBH      | 12.7 Ton     |
| HVAC Unit with ERV, low-e glazing & R20 roof added | 151 MBH      | 10.4 Ton     |

Estimated energy use with ERV, low-e glazing, R20 roof, 90% boiler efficiency & SEER 16 cooling:

|          |                               |   |             |               |
|----------|-------------------------------|---|-------------|---------------|
| Heating: | 1310 Therms/yr @ \$0.90/Therm | = | \$ 1,180/yr |               |
| Cooling: | 5794 KWH/yr @ \$0.13/KWH      | = | \$ 753/yr   |               |
|          | Total                         | = | \$ 1,933/yr | \$ 0.33/SF/yr |

### **ENGINEER'S COMMENTARY:**

The existing Yahara Clubhouse facility is 45 years old and is not constructed to operate efficiently for winter operation. The proposed uses for the Clubhouse have evolved and the City Parks department now anticipates using the facility both winter and summer, as well as, functioning as community space with an occupancy of up to 99 people.

The HVAC system should be replaced as part of an overall plan to upgrade and renovate the existing facility for the proposed use. The envelope needs significant improvements to operate efficiently and compliment the HVAC sizing appropriately.

Consideration should be given to extending separate services to the Lockerroom/shower building in the future to eliminate the current dependency on the Clubhouse mechanical room.

Consideration of providing a sprinkler fire protection system in conjunction with the remodeling should be considered to protect the facility and safety of the occupants given the distance to fire service.

### **RECOMMENDATIONS:**

We evaluated several HVAC concepts for this facility including geothermal systems, variable refrigerant flow systems and gas-fired furnaces, but believe that central variable-volume air handling unit with air-cooled condenser and digital capacity scroll compressors best matches the project HVAC requirements and cost efficiencies. Geothermal systems have a difficult time competing against natural gas for heating costs. Variable refrigerant system are more expensive and are better adapted for multiple zoning situations which we do not have. The furnace units simply do not provide the level of control and life expectancy.

The central air handler and variable volume system with modular hot water boilers is a concept the City of Madison has modeled other buildings around and has knowledgeable background of the system for future maintenance and repairs.

### **CENTRAL AIR HANDLING UNIT:**

The air handler proposed will be provided with a mixing box, minimum fresh air inlet, air blender, MERV 13 filter section, DX cooling coil section, hot water heating coil section and fan section provided with premium efficiency fan motor with VFD drive for capacity control. The air handler unit terminal units will include 4 new VAV boxes with space controls. The energy recovery ventilator will be rated at 825 CFM and provide 70% heat recovery for minimum fresh air at the air handler. A 12-ton air-cooled condenser will be provided with digital scroll compressors to provide variable capacity efficiently. Economizer operation will exhaust air from the space using an inline relief fan with control damper based on building static pressure.

Hot water heating plant proposed for the facility would consist of two 175-200 MBH sealed-combustion condensing boilers for redundancy and high efficiency. The boiler plant would be reset with outside temperatures and designed around 150 deg F maximum design temperatures for condensing operation near 95% efficiency.

The return air system will be replaced with a central return grille, while removing the perimeter slot return.

A new direct-digital control system will be added to provide a responsive and flexible temperature control system and building management through the City Honeywell Control platform with remote access to building monitoring.

#### ESTIMATE HVAC CONSTRUCTION COSTS:

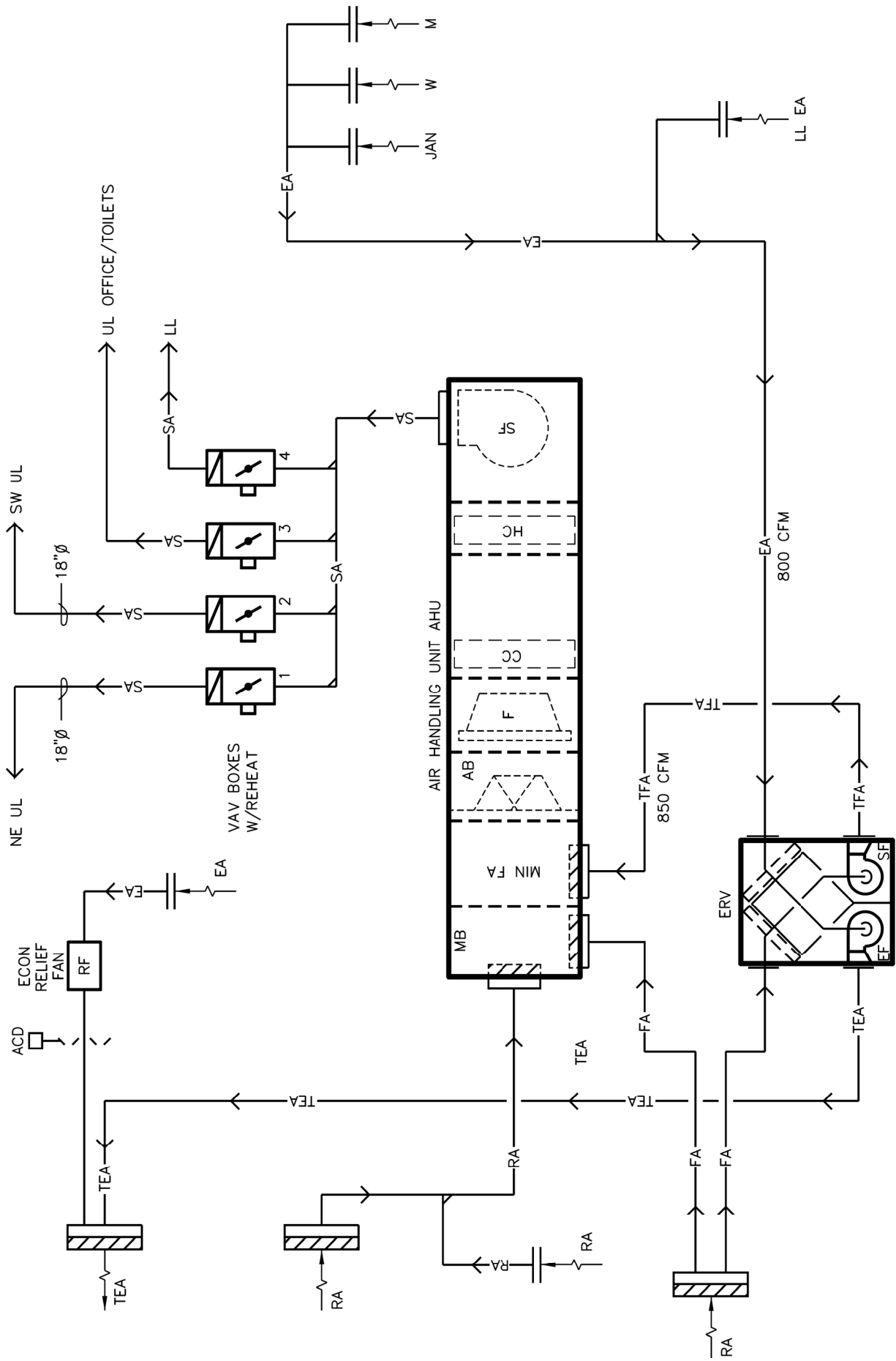
|                                    |   |              |
|------------------------------------|---|--------------|
| Air Handler 4800 cfm               |   | \$ 19,000    |
| Energy Recovery Ventilator 800 cfm |   | \$ 5,000     |
| Air-cooled Condenser 12 ton        |   | \$ 12,000    |
| Ductwork                           |   | \$ 36,000    |
| Piping                             |   | \$ 20,000    |
| Insulation                         |   | \$ 16,000    |
| Boilers and Hydronic Equipment     |   | \$ 20,000    |
| DDC Controls                       |   | \$ 35,000    |
| Demolition                         |   | \$ 10,000    |
| Cutting & Patching                 |   | \$ 6,000     |
| Permits, Trash, Misc.              |   | \$ 4,000     |
|                                    |   | <hr/>        |
| HVAC Total                         | = | \$ 183,000   |
| 20% OH&P                           | = | \$ 37,000    |
|                                    |   | <hr/>        |
| Construction Total                 | = | \$ 220,000 * |

\* Does not include contingency, additional cons to comply with BPW process & option to add perimeter heating loop

#### ATTACHMENTS:

HVAC Schematic  
 HVAC Floor Plan - Markups(3)  
 Energy Use Simulation Table

*End of Report*



# YAHARA CLUBHOUSE HVAC SCHEMATIC

NTS