

# Technical Assignment 4

## Thesis Proposal



City of Hope: Amini Medical Center  
Duarte, CA

**Christopher Bratz**  
Pennsylvania State University  
Architectural Engineering  
Mechanical Option

Faculty Advisor:  
Dr. Jelena Srebric

December 12<sup>th</sup>, 2008

## Table of Contents

**Executive Summary**.....3

**Proposal Objective**.....4

**Existing Mechanical Systems Overview**.....4

    Cooling Plant & Building Cooling System.....4

    Control Features.....4

**Depth Redesign Proposal**.....5

    Proposal.....5

    Justification.....5

    Integration & Coordination.....5

**Breadth Redesign Proposal**.....5

    Electrical Proposal.....5

    Acoustical Proposal.....5

**Tools & Methods**.....6

**Schedule**.....6

**References**.....7

APPENDIX A – Spring Semester Schedule

## **Executive Summary**

The past semester has been dedicated to providing an analysis of the existing mechanical conditions related to the Amini Medical Center. This report will briefly discuss the existing mechanical systems then address the depth and breadth redesign scenarios.

The mechanical redesign proposal replaces the existing primary-secondary chilled water system with a Variable-Primary-Flow chilled water system in an attempt to reduce the building's energy consumption. Many aspects will be evaluated including, plant size/equipment size, pipe sizing, control schemes, pressure drop, sequence of operation, flow rates, water supply/return temperature, operation & first cost, along with other factors.

The breadth proposals require changing the lighting and observing acoustical issues with the new chiller equipment and pumps. The lighting changes will require evaluation of cost, pay back, energy consumption, lighting quality, along with the effect on LEED and the mechanical system will be evaluated. The acoustical issues will take a look at equipment noise pollution to adjacent areas along with any vibration noises that could develop.

In order to compare these systems, assumptions and models will be made using the TraneTrace 700 simulation program. After all scenarios are researched and the energy models are complete, a comparison between the two systems will be made. Validation or rejection of the redesign will be the resulting conclusion of the comparison. A schedule for the work to be performed is presented at the end of this report.

## **Proposal Objective**

The purpose of this thesis proposal is to provide alternate design scenarios for the Amini Medical Center that will be extensively researched, designed, and compared to the existing design. The design comparison will include, but not limited to, system first cost, annual operation cost, life cycle cost, maintenance, feasibility, and energy consumption. These alternate design concepts in no way suggest the original design to be flawed; they merely provide alternate scenarios to analyze and apply knowledge gained from the past few years of schooling.

## **Existing Mechanical Systems Overview**

For an extensive description of the Amini Medical Center's existing mechanical systems, please refer to Technical Assignment 3. The following overview contains only information relevant to the proposed changes.

### ***Cooling Plant & Building Cooling System***

#### **Cooling Plant**

The Amini Center is served by a central plant composed of three centrifugal water cooled chillers and one steam absorption chiller. The system is a primary/secondary system providing chilled water for a good portion of the campus. The plant capacity is a nominal 7,150 Tons supplying a primary loop of 13,104 gpm and a secondary loop of 12,600 gpm. The points of connection for the Amini Center are a 12" chilled water supply (CHWS) and a 12" chilled water return (CHWR) lines located at the South end of the building.

#### **Building Cooling System**

The CHWS & CHWR lines enter/leave a mechanical room on the first floor of the building. According to the designers load calculations, only 6" CHWS & CHWR lines were necessary to serve the Amini Center. The chilled water entering the building is supplied at 42°F.

Two secondary pumps located in the first floor mechanical room provide circulation of the chilled water to the AHU and FCU cooling coils throughout the building.

### ***Control Features***

Controls and sequences of operation play a large role in the overall scheme to achieving energy savings, occupant comfort, and proper IAQ. Some of the control features for the Amini Medical Center can be seen below.

#### **General Control Features**

The building is equipped with automated DDC system.

Due to the VFDs on the chilled water pumps, 2-way valves are provided on the cooling coils to take advantage of pump savings when possible.

#### **Sequences of Operation**

##### ***Chilled Water Plant/Pumps***

On a call for cooling by any one of the air distribution systems, the chilled water valve shall open and both pumps shall energize. Pump VFDs shall modulate to maintain differential pressure setpoint. Upon failure of one pump, the other shall operate to maintain necessary setpoint.

Building CHWS and CHWR temperatures shall be monitored. If the differential temperature is above the setpoint by 15°F, then the chilled water bypass valve shall open. If the differential temperature setpoint is 9°F or less, then the chilled water bypass valve shall close.

## **Depth Redesign Proposal**

### ***Proposal***

The depth of research and design for this thesis is planned to focus on changing the central cooling plant of the City of Hope Campus/Amini Center. This plan will focus on changing the primary-secondary chilled water system to a Variable-Primary-Flow (VPF) chilled water system. In changing the system, many aspects will be evaluated including, plant size/equipment size, pipe sizing, control schemes, pressure drop, sequence of operation, flow rates, water supply/return temperature, operation & first cost, along with other factors.

### ***Justification***

According to a Trane Newsletter, the VPF system uses fewer pumps and connections than the primary secondary system, which in turn helps reduce the initial cost of the system. Operation savings can also be seen due to using larger (more efficient) pumps than the smaller inefficient pumps of the primary secondary system. These points along with control sequencing will be the driving force of the thesis.

### ***Integration & Coordination***

Due to changes to the cooling system, size will be a factor that will need to be evaluated. It is believed that the new design will be able to use the existing equipment space and maybe actually free up some floor space.

Noise will also be of concern due to the size of the equipment being provided. Methods for reducing noise impact will need to be assessed.

## **Breadth Redesign Proposals**

### ***Electrical Proposal***

Throughout the Amini Center, many T8 lighting fixtures are implemented. Due to strict lighting power densities and the attempt for LEED Gold certification, better lighting fixtures will be looked at in order to reduce the energy consumption of the building. In many of the office area where T8 fixtures are dominant, T5 fixtures will be looked at to reduce wattage while maintaining an equal lighting level. Outdoor metal halide lights will also look to be replaced with more efficient lights, specifically LED lights. The cost, pay back, energy consumption, lighting quality, along with the effect on LEED and the mechanical system will be evaluated.

### ***Acoustical Proposal***

Due to the size and type of equipment being selected in the redesign, acoustical aspects will be evaluated to ensure there are no noise issues with the surrounding spaces. Wall types and enclosures for the chiller plants will be assessed to reduce any noise pollution.

## **Tools & Methods**

To evaluate the load, cost, and energy effects associated with the redesign; TraneTrace 700 software will be used. In order to use this program, many assumptions will have to be made regarding the existing system and the redesigned system. Because little is known about the central cooling plant, a base model will need to be simulated for annual energy consumption. The redesigned system will be evaluated for first cost, and simulated for annual energy consumption and cost. The results will then be compared and discussed.

## **Schedule**

Please refer to Appendix A for schedule of work.

---

## **References**

ASHRAE. 2008, 2008 ASHRAE Handbook – HVAC Systems and Equipment. American Society of Heating Refrigeration and Air Conditioning Engineers, Inc., Atlanta, GA. 2001.

American Standard Inc. 2002. Trane Engineers Newsletter – Vol. 31, No. 4. Trane, La Crosse, WI

**Appendix A**  
Spring Semester Schedule



# January 2009

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
				1 New Year's Day	2	3
4	5	6	7	8	9	10
11	12 Classes Resume	13 Fix Energy Model for existing conditions	14 Fix Energy Model for existing conditions	15 Fix Energy Model for existing conditions	16 Fix Energy Model for existing conditions	17 Fix Energy Model for existing conditions
18 Fix Energy Model for existing conditions	19 Martin Luther King Jr.'s Birthday	20 Research VPF System and Begin Design	21 Research VPF System and Begin Design	22 Research VPF System and Begin Design	23 Research VPF System and Begin Design	24 Research VPF System and Begin Design
25 Research VPF System and Begin Design	26 Research VPF System and Begin Design	27 Research VPF System and Begin Design	28 Research VPF System and Begin Design	29 Research VPF System and Begin Design	30 Research VPF System and Begin Design	31 Research VPF System and Begin Design

# February 2009

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
<b>1</b> Research VPF System and Begin Design	<b>2</b> Perform Cost information on redesign	<b>3</b> Perform Cost information on redesign	<b>4</b> Perform Cost information on redesign	<b>5</b> Perform Cost information on redesign	<b>6</b> Perform Cost information on redesign	<b>7</b> Perform Cost information on redesign
<b>8</b> Perform Cost information on redesign	<b>9</b> Compare Results and look for errors	<b>10</b> Compare Results and look for errors	<b>11</b> Compare Results and look for errors	<b>12</b> Compare Results and look for errors	<b>13</b> Compare Results and look for errors	<b>14</b> Compare Results and look for errors
<b>15</b> Begin Electrical Breadth	<b>16</b> Presidents Day	<b>17</b> Begin Electrical Breadth	<b>18</b> Begin Electrical Breadth	<b>19</b> Model New lighting Design separate form other redesign	<b>20</b> Model New lighting Design separate form other redesign	<b>21</b> Model New lighting Design separate form other redesign
<b>22</b> Record data and make comparison	<b>23</b> Record data and make comparison	<b>24</b> Record data and make comparison	<b>25</b> Record data and make comparison	<b>26</b> Begin Acoustical Breadth	<b>27</b> Begin Acoustical Breadth	<b>28</b> Begin Acoustical Breadth

# March 2009

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
<b>1</b> Begin Acoustical Breadth	<b>2</b> Begin Acoustical Breadth	<b>3</b> Begin Acoustical Breadth	<b>4</b> Begin Acoustical Breadth	<b>5</b> Begin Acoustical Breadth	<b>6</b> Begin Acoustical Breadth	<b>7</b> Begin Acoustical Breadth
<b>8</b> Write up Acoustical Breadth	<b>9</b> Write up Acoustical Breadth	<b>10</b> Write up Acoustical Breadth	<b>11</b> Write up Acoustical Breadth	<b>12</b> Finish All modeling	<b>13</b> Finish All modeling	<b>14</b> Finish All modeling
<b>15</b> Finish All modeling	<b>16</b> Finish All modeling	<b>17</b> Finish All modeling	<b>18</b> Finish All modeling	<b>19</b> Work on Final Report	<b>20</b> Work on Final Report	<b>21</b> Work on Final Report
<b>22</b> Work on Final Report	<b>23</b> Work on Final Report	<b>24</b> Work on Final Report	<b>25</b> Work on Final Report	<b>26</b> Work on Final Report	<b>27</b> Work on Final Report	<b>28</b> Finish Final Report
<b>29</b> Work on Presentation	<b>30</b> Work on Presentation	<b>31</b> Work on Presentation				

# April 2009

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			<b>1</b> Work on Presentation	<b>2</b> Work on Presentation	<b>3</b> Work on Presentation	<b>4</b> Work on Presentation
<b>5</b> Last minute Final Report fixes	<b>6</b> Last minute Final Report fixes	<b>7</b> Last minute Final Report fixes	<b>8</b> Final Report Due	<b>9</b> Finish and practice presentation	<b>10</b> Finish and practice presentation	<b>11</b> Finish and practice presentation
<b>12</b> Finish and practice presentation	<b>13</b> Presentation Day	<b>14</b> Presentation Day	<b>15</b> Presentation Day	<b>16</b> Presentation Day	<b>17</b> Presentation Day	<b>18</b>
<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>
<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>		