alternatives are selected as the best, pay back periods longer than 2 to 4 years will not justify their use in this application.

5.2 REDESIGN SUMMARY

Integration of as many building systems as possible for total building energy optimization is the goal of the mechanical systems redesign for the Milton Hershey School New Supply Center. The air side mechanical systems as well as the chiller and boiler plants are all altered in the redesign. The walk-in freezers condenser water loop is also used in an effort to integrate more building systems as well as recover the waste heat. The mechanical redesign directly affects other building systems that need attention as well. The structural system and electrical service all will change due to the mechanical changes which paves the way for a variety of cost analyses that will prove whether or not the redesign beneficial.

The redesign of the air side mechanical system will comprise of the replacement of ten VAV or CAV air handling units with dedicated outdoor air systems (DOAS). The remaining four air handling units that are direct fired make-up air units that serve the kitchen, bakery, and loading dock spaces will remain. Since the DOAS can not meet the cooling load of the spaces they serve, a water source heat pump system will act as the parallel cooling scheme.

The chilled water plant redesign will eliminate the electric driven centrifugal chillers and replace them with direct fired absorption chiller-heaters. The chiller-heaters will utilize their simultaneous heating and cooling ability and meet the cooling loads while handling most (if not all) of the HVAC and domestic hot water demands.

The waste heat rejected from the walk-in freezers will pass through heat exchangers and account for the water source loop heat addition as well as pre-heat the domestic water. As in the original design of the supply center, if recovering this waste heat is not sufficient to cool the condenser water loop back to operating temperatures (65°F), chilled water from the plant will meet the remaining load.

6.0 BUILDING LOAD ANALYSIS

The chilled water plant at the supply center sees various load profile changes throughout the year. However, since the chilled water system also handles the walk-in freezers heat rejection, it forms a base load that is near constant for the existing system. Figure 6-1 illustrates a typical cooling load profile during cooling season. Carrier’s Hourly Analysis Program (HAP) is used to generate the data.

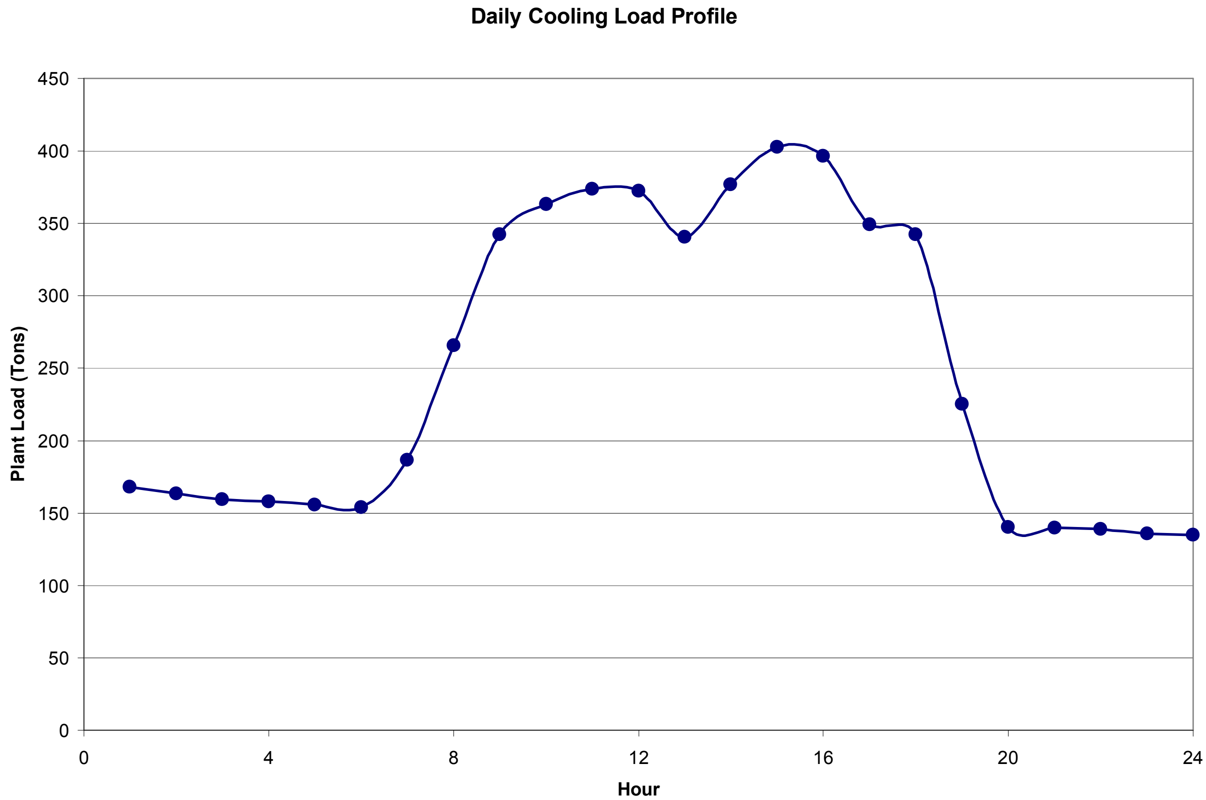

Figure 6-1 Existing Chiller Plant Daily Load Profile

As the figure illustrates, the supply center operates like most buildings, having peak cooling demand during the building's operational hours. The proposed redesign thermal load profile is much different in the fact that less cooling demand is required due to the use of a DOAS and a water source loop. Figure 6-2 shows the redesigned plant's load profile and is shown on the next page.

As the graph shows, the 106 ton base load produced from cooling the walk-in freezers' condenser loop forms the base load in this particular example. As the building becomes occupied the load increases, but not drastically. The domestic hot water demand increases when the building is occupied, and this water is pre-heated by the condenser water loop. For most cases during the year, this pre-heat process transfers enough heat out of the condenser loop so that it operates at the appropriate temperature (65°F). When this occurs, the chilled water plant no long has to meet this base load.

The following sections, 7.0 and 8.0, explain how the HVAC systems operate in more detail, and contain schematics that illustrate how the heat recovery scheme shifts the plant load profile downward.

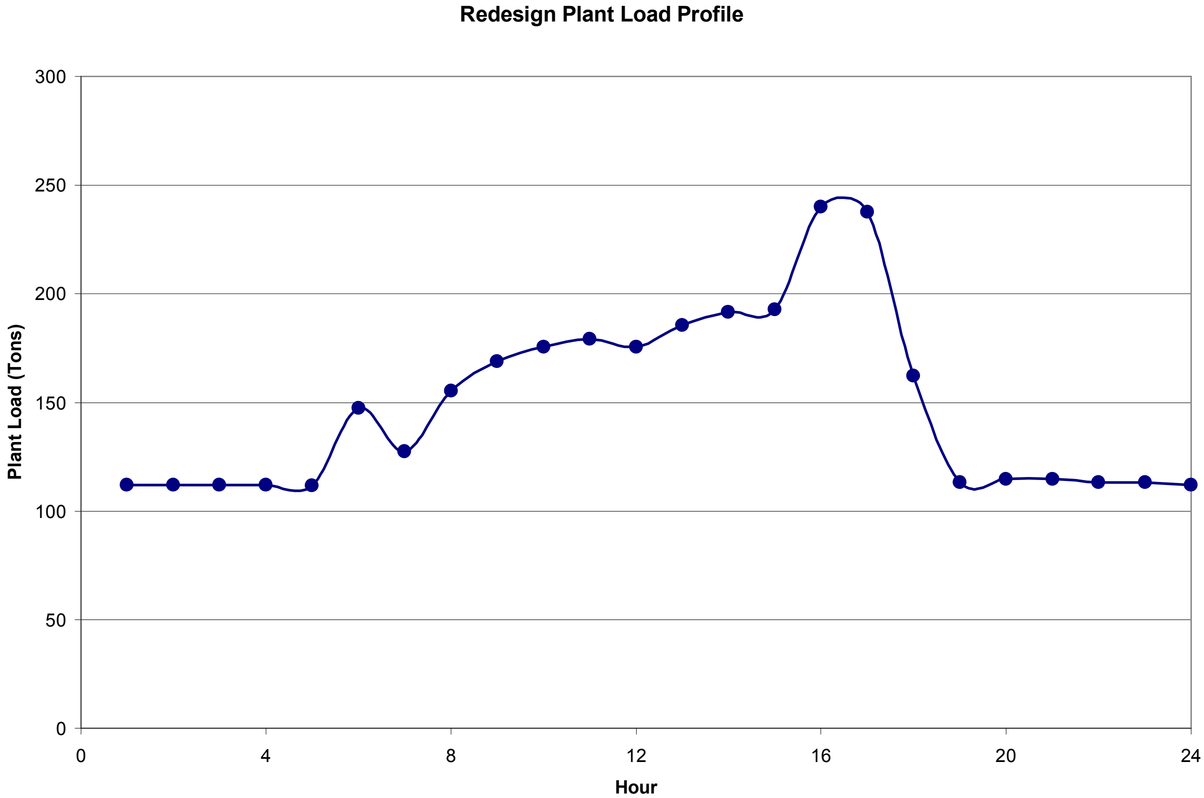

Figure 6-2 Redesigned Chiller Plant Daily Load Profile

Using Carrier's software, the heating loads also are easily obtainable. However, using a dedicated outdoor air system slightly raises the required amount of heating done by the boiler plant. Figure 6-3 shows the existing systems daily heating plant load profile (with the load in MBH). This data is from a winter day, therefore, shows a high HVAC heating demand.

Figure 6-4 illustrates the boiler plant's heating load profile with the redesigned system. The profile is slightly shifted upward, unlike in the cooling scenario, and the peak heating load is close to 200 MBH higher. The space loads are the same in both situations, however, the majority of the heating is now performed by the parallel water source heat pump system, and this is not directly seen by the boiler plant. The boiler plant is needed occasionally to add heat in the water source loop to maintain the winter temperature of 68°F, but this is a much smaller demand than continuous hot water production required for terminal re-heat coils and AHU per-heat coils that existing system utilizes. The main reason for the increase in heating demand in the new system is because the dedicated outdoor air units need cold outside air heated to 55°F without any type of recirculation that would pre-heat the air in VAV systems.

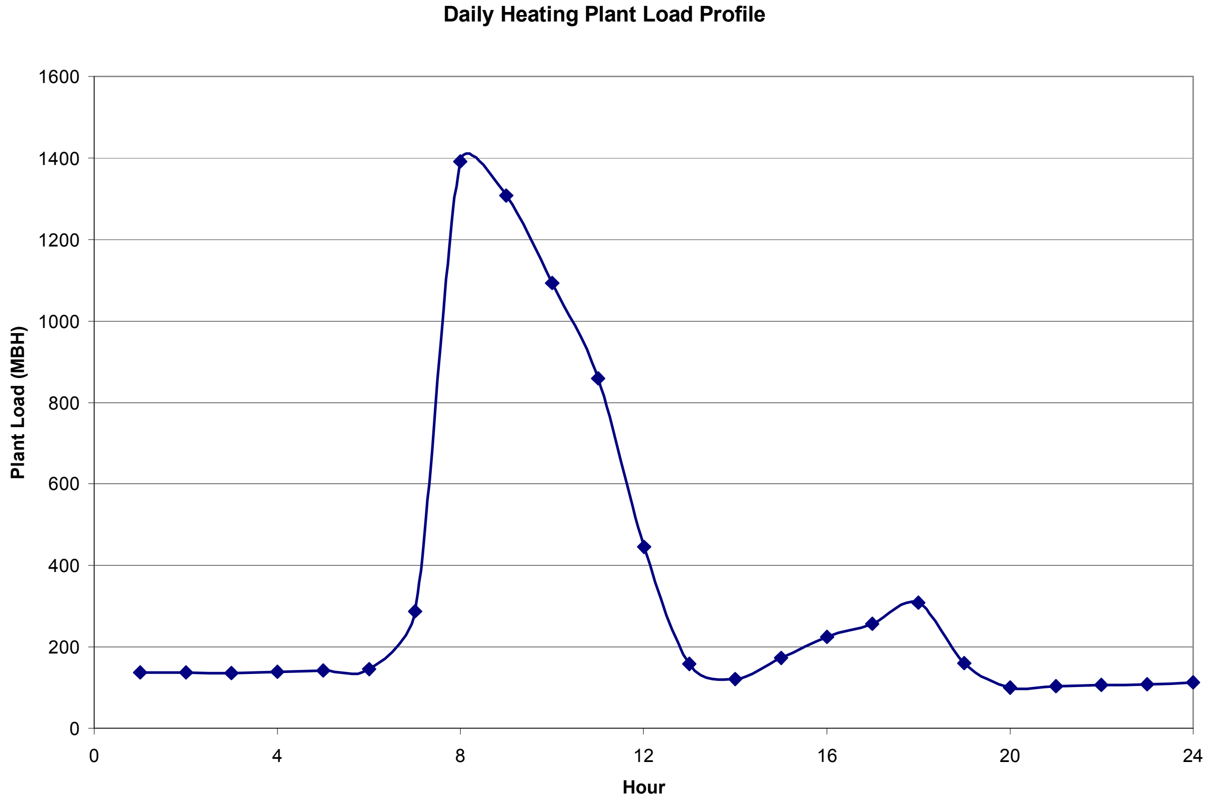

Figure 6-3 Existing Boiler Plant Daily Load Profile

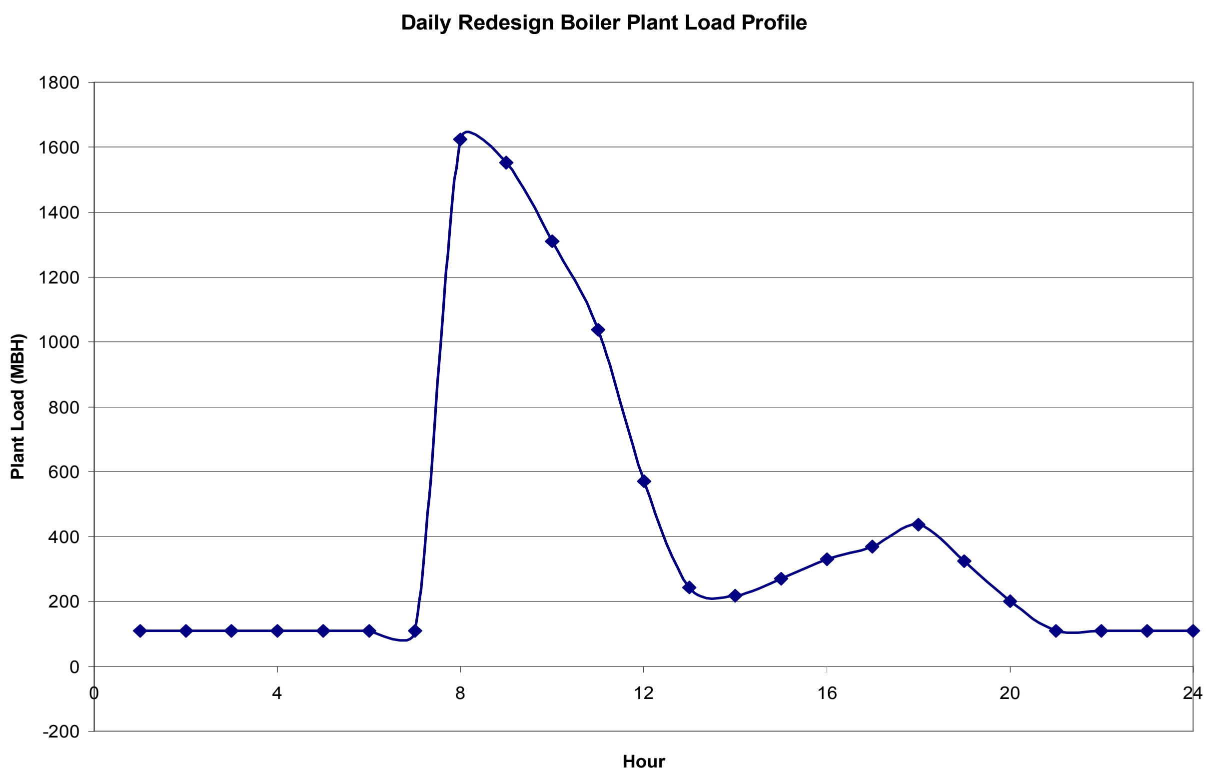

Figure 6-4 Redesigned Boiler Plant Daily Load Profile

The typical domestic hot water production demand is also important in this redesign. Originally, a separate hot water boiler is used to meet this load. The redesign system recovers heat from the walk-in freezers to pre-heat this water. The remaining load is met with the chiller-heater system as explained in section 8.0. Figure 6-5 shows the estimated typical, in-operation daily domestic hot water demand load profile. Although it is difficult to accurately predict the hot water usage for a building, this hot water demand estimate follows the occupancy schedule for the spaces requiring the hot water.

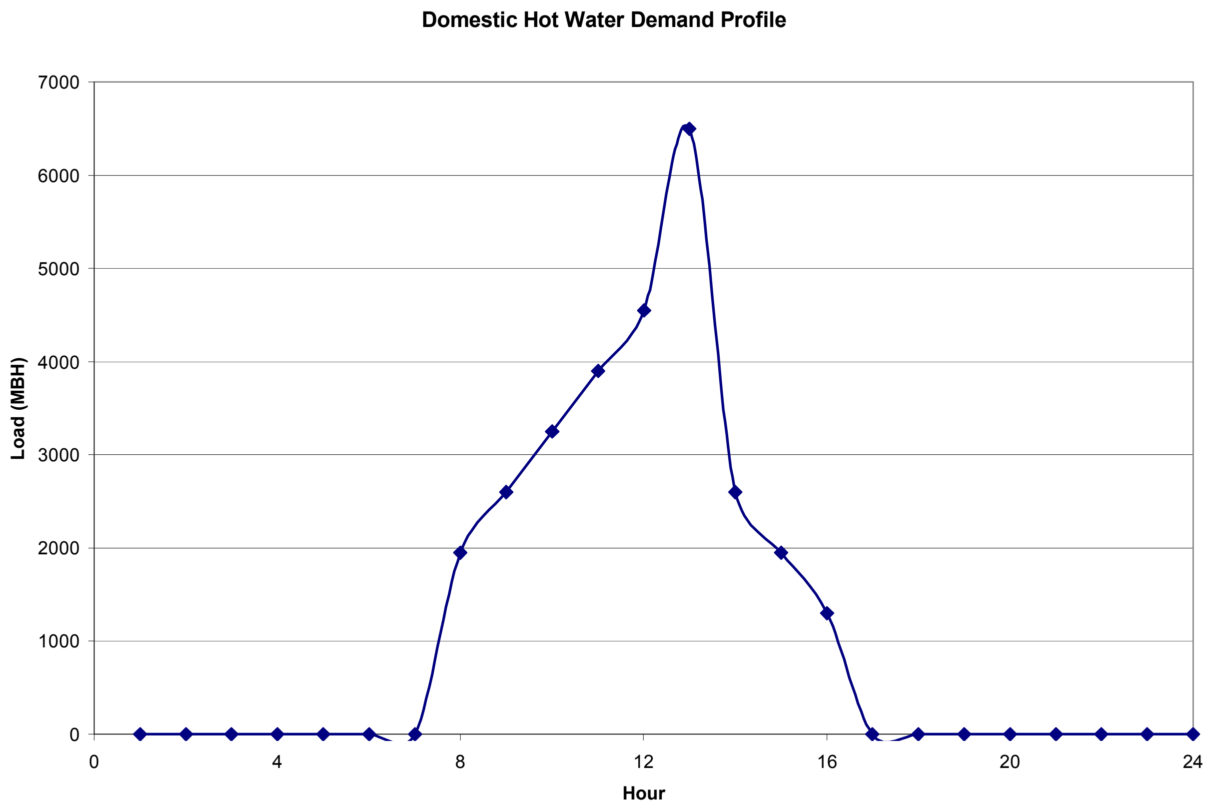

Figure 6-5 Domestic Hot Water Demand Profile

The peak load is designed for a 100gpm flow rate, with an entering water design temperature of 50°F and leaving design temperature of 180°F. This load profile, although is an estimate, is used for every analysis for consistency and comparison reasons.