Analysis II

"Gaining Plumbing LEED™ Points"

2.1 Executive Summary

At the beginning of the design process, it was originally assumed that the building would gain two of the required twenty six points required for LEED™ certification by being water efficient. However, during the design of the building, the decision was made to use the University's standard plumbing fixtures. This kept the building from gaining these two points and forced some value engineering decisions to be necessary elsewhere in order to make up for the missing points.

In order to display a breadth of knowledge in the field of Architectural Engineering, a design of the plumbing system for Widener University's Metropolitan Hall was created that would allow it to meet its original goal of increasing sustainability as represented by gaining both LEED™ points available for water conservation. After a study of the requirements to meet this goal, the design was created and shown to reduce water consumption by slightly more than the 30% required to meet the goal.

The more expensive fixtures needed to gain the LEED™ points will cost an extra $12,445.76, but will reduce water use by 6,030 gallons per day. This reduction in water use will save over $6,500 per year in utility costs at current Philadelphia water and sewer rates, paying the price increase off in less than 2 years.

2.2 Introduction

In order to show a breadth across the Architectural Engineering Curriculum a design of the plumbing system was created with the goal of attaining both of the water reduction points in the LEED™ rating system. In actuality the building was unable to achieve these points because the University was only willing to use their standard fixtures. If they could have been convinced to use more efficient fixtures they would have spent more up front, but would have saved enough in the first two years of building occupancy to make up for the extra cost.

2.3 LEED™ Requirements

The LEED™ Green Building Rating System for New Construction gives one point for achieving a 20% reduction in water usage, and another point if a 30% water reduction is achieved. The baseline for comparison is the Energy Policy Act of 1992 which gives the requirements shown in Table 1. Calculations for new buildings are to include only the following fixtures: water closets, urinals, lavatory faucets, showers, and kitchen sinks. The utility sinks in the building are not included. This is most likely because they are used for tasks like filling mop buckets where it does not matter how quickly water comes out of the faucet, the same amount of water is going to be used.

Table 1: Fixture Flow Requirement

Ratings of Energy Policy Act of 1992

Fixture	Flow Req.
Water Closets	1.6 gpf
Urinals	1.0 gpf
Showerheads	2.5 gpm
Faucets	2.5 gpm
Replacement Aerators	2.5 gpm
Metering Faucets	0.25 gal/CY

Adopted from Sloan Valve Company at: **http://archrecord.construction.com/resources/conteduc/archives/0505sloan-5.asp**

2.4 Design Changes

To begin the redesign, the original fixtures were analyzed to see which ones were using the most water. As a result of this study, the water closet and the shower jumped out as the most effective place to reduce water consumption. Studying product catalogs from several companies showed that the water closet could easily be reduced from 1.6 gpf to 1.0 gpf by using a pressure assisted design. This is the change that will be most noticeable to the owner and users because it is a completely different product than the one chosen in the original design.

To reduce water use by the showers, a flow controller (Figure 1) was added before the shower head. The flow control is a simple piece that screws onto the shower

neck just before the shower head. It is threaded on both ends so the shower head simply screws into it rather than directly onto the neck.

This will reduce water consumption from 2.5 gpm to 1.5 gpm. Although some people will notice that there is less water coming out of the shower head, most people will not be able to notice the difference.

Figure 1. 1.5 gpm Flow Control[1]

These two changes were still slightly short of the required 30% water reduction, so the lavatory sink was also changed to reduce water flow from 2.3 gpm to 2.0 gpm. The appearance of the new fixture was very similar to the appearance of the one originally chosen (Figure 2). With this change water use was cut to 13,950 gal/day, down from 19,980 gal/day for the original design (APPENDIX B). This is 69.82% of the original design, a savings of 30.18% from the original design and a 31.6% reduction from the requirements of the Energy Policy Act of 1992.

Figure 2. New Lavatory Faucet[2] *vs. Originally Designed Faucet*[3]

As part of the redesign, an attempt was made to avoid changing the appearance of the fixtures. The final design only broke this limitation once. This was because the water closet in the original design was a very institutional style, wall mounted, tankless toilet. In the redesign a more residential styled, floor mounted toilet with a pressurized tank was used (Figure 3). Besides the improvement in aesthetics, this change was necessary to reduce water use by using a pressure assisted toilet.

Figure 3. Pressure Assist Water Closet[1] vs. Wall Mounted Water Closet[2]

2.5 Cost/Schedule Comparison

Because better performing fixtures usually cost more, a comparison was made between the cost of the original design and the cost of the re-designed fixtures. As shown by Tables 2 and 3, the extra cost of the fixtures is $12,445.76. While this may seem like a big price increase, this cost is spread out over 355 total fixtures in the building, reducing water consumption by 6,030 gallons per day. Using standard Philadelphia area water and sewage rates (Appendix B) this results in a savings of $6,544.36 per year. The fixtures have a pay back period of 1.90 years.

Table 2. Original Design Cost

Quantity	Item	Cost (ea. $)	Cost Total
103	Water Closet	249.00	25647.00
103	Lavatory	115.15	11860.45
101	Shower Head	130.55	13185.55
48	Kitchen Sink	89.25	4284.00
			$54,977.00

Table 3. Redesign Fixture Cost

Quantity	Item	Cost (ea. $)	Cost Total
103	Water Closet	414.50	42693.50
103	Lavatory	66.07	6805.21
101	Shower Head	135.05	13640.05
48	Kitchen Sink	89.25	4284.00
			$67,422.76

Table 4. Pay Back Period

Original	Re-design	Saved	
19980	13950	6030	gal/day
599400	418500	180900	gal/month
5394600	3766500	1628100	gal/yr (9 mo. Occ.)
721.2032	503.5428	217.6604	Mcf
21856.72	15312.36	6544.36	Utility bill ($/yr)

1.90 Year Pay Back period

(12,445.76 / 6,544.36)

The construction schedule will not be affected by the change in fixtures because although one extra piece will need to be installed for the shower heads, the tank type water closet chosen in the redesign will take much less time to install (RS Means 2006). From looking at the master schedule for the project it does not appear as if the plumbing is on the critical path of the project, meaning that a small delay in the plumbing rough in or plumbing fixture installation will not hold up the project.

2.6 Recommendation

The best thing to do at this point is try to convince the owner that although they may be attached to their standard fixtures, it is possible for them to save a substantial amount of money in future utility bills if they are willing to spend the extra money to install more water efficient fixtures in their building. It will also give them points toward obtaining a LEED^{TM} rating for their building.