## 10. Analysis 2 – Supply Water System

*(Mechanical Breadth & Critical Industry Issue)*

### 10.1 Introduction

When the developer obtained the finished set of plans from the architect, they went right to the general contractor for any value engineering ideas they had that may help to reduce cost or obtain more LEED points. A big VE item that was added was the Sovent System. This system helped to reduce the amount of waste pipe that was needed in the building by utilizing one stack for the drain, waste, and venting of waste products. I would like to take a closer look at VE ideas for the supply water.

### 10.2 Problem Statement

I would like to see if any value engineering ideas could have been used on the supply water piping. Then I would like to see if these materials could have saved time on the schedule, reduced the cost of the project, or helped to use fewer harmful products and make the project more LEED friendly.

### 10.3 Goal

I will start out the research by looking extensively at the existing system in the building which supplies the water to the different units. This system is a hybrid system that uses both copper and CPVC pipe. I will look at both methods of the pipes and see what can be done to speed up the installation process and lower the cost of installation. I will look at an alternative method of soldering the copper pipes, especially with Propress fittings, and see if prefabrication is an option for this project.

After the redesign of the system is proposed, I will check this new system to the existing system and see if there is any cost saving or schedule reduction. A LEED analysis will be performed to see how beneficial the new system may be, and what impact it played on gaining points.

### 10.4 Research Steps

1. Research the existing system by interviewing the MEP Engineer, general contractor, and the owner's representatives. I will also look at construction progress photos to learn as much as possible.
2. Speak with other members of the construction and design community to learn about what products could be used to help speed up and/or reduce project cost.
3. Redesign the system using these new products and possible prefabrication options (Mechanical Breadth & Critical Industry Issue).
4. Compare the two systems in a cost and schedule analysis.
5. Learn what impact the redesigned system would have on obtaining LEED points.
6. Recommendation & Conclusion

## 10.5 Tools

1. LEED Point Checklist
2. R.S. Means Cost Analysis
3. Microsoft Excel
4. Websites & Engineering Journals
5. Arlington Country tax rebate information
6. National Plumbing Code
7. MEP Engineer, General Contractor, and Owner's Representatives

## 10.6 Expected Outcome

I expect that by using materials such as the Propress fittings, and utilizing construction techniques such as prefabrication, the schedule should accelerate the installation of the supply water system. I do think that the initial cost will increase because the Propress fittings will be more expensive, but I believe that the cost for the fittings will be offset by the labor cost for installation. I do expect to gain more LEED points because the harmful glues and soldering that contains VOC's will not have to be used if the Propress fittings are used.

## 10.7 Existing Supply Water System - CPVC

The supply water system that was constructed for Turnberry Tower Arlington was a hybrid of copper pipe and CPVC pipe. The CPVC branches off of the copper riser pipes and runs directly into the residential units.

The CPVC pipe varies in size in the units between ½", ¾" and 1" diameter pipes. The pipe is connected with different elbows, tees, and reducers that are cemented together with glue. The glue has a VOC content that was said to be within the limits to achieve a LEED rating.
The pipes that are running above the finished ceiling in the units are connected with hangers. These hangers are connected to the above concrete deck with the use of the embeds that were placed during concrete erection. The picture below in Figure 10.1 shows the CPVC supply water pipe with hangers

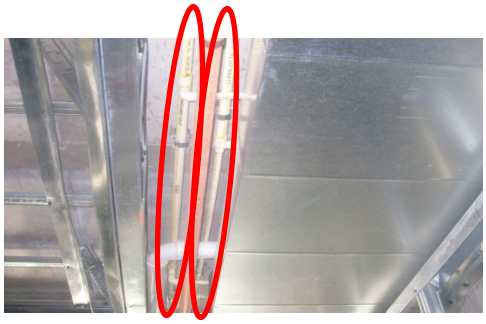

Figure 10.1 – Use of CPVC Pipe

## 10.8 Use of Propress Supply Water System

An alternative system that is becoming well known is the Propress system. This system, in place of a traditional PVC or CPVC piping system, uses copper pipes to run water throughout the building. *Figure 10.2* shows different parts of the system that can be used.


Figure 10.2 – Propress System

What makes the Propress system different from the traditional copper pipe system is that it eliminates the need for soldering the pipes. The fittings are a clean and simple way to connect the pipe and they only need the use of a special drill to complete the connection. This eliminates the use of an expensive person to solder which in turn saves money . It also saves time on scheduling in order to complete the installation. This will save time and money since much more piping can be installed in the same amount of time. *Figure 10.3* shows the three stop process to connect ends of pipes.

Figure 10.3 – Installing Propress Fittings

## 10.9 Redesigning the CPVC System Utilizing the Propress System

With the help of the mechanical subcontractor, I was able to redesign the supply water system using the Propress system for a typical residential unit in the building. The takeoff notes can found below in *Table 10.1*. The complete takeoff notes can be found in Appendix E. The price used for copper was $3.10 which was the price of copper in 2006 when the original bids were estimated for this project.

| Propress System (2006) | | | | |
|---|---|---|---|---|
| Item | Mat. Cost | Total Hrs. | Labor Cost | Total Cost |
| Pipe | $956.42 | 10 | $648 | $1,604 |
| Fittings | $2,010.92 | 41 | $2,735 | $4,746 |
| Hanger Components | $405.87 | 34 | $2,261 | $2,667 |
| Misc. Compenents | $54.57 | 0 | $0 | $55 |
| **Total** | $3,427.78 | 85 | $5,644 | **$9,072** |

Table 10.1 – Propress System Takeoff Notes Summary

## 10.10 Comparing the CPVC System vs. Propress System

After taking a look at the numbers I see both systems will utilize the same amount of pipe and same components to make the systems work. The material cost of the CPVC system will be $1670 and the material cost of the Propress System will be $3428. The material cost increase for the Propress System is because of the price of the actual copper.

The material cost is slightly made up for in the installation of the system. The installation of the CPVC system would be $6754, and it would take 102 man hours to complete each residential unit. The Propress system would cost $5644 and would take 85 man hours to complete. The total cost of the CPVC supply water system to install (with labor) per residential unit will be $8424 and the total cost of the Propress system to install (with labor) per residential unit will be $9072. The results can be found below in *Table 10.2*. The price for copper used came from the 2006 cost of copper which was $3.10 per pound. The price for CPVC was approximately the same in 2006 as it is today.

| **Comparing CPVC vs. Propress Supply Water Systems (Per Typical Unit)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CPVC System | | | | | Propress System (2006) | | | | |
| Item | Mat. Cost | Total Hrs. | Labor Cost | Total Cost | Item | Mat. Cost | Total Hrs. | Labor Cost | Total Cost |
| Pipe | $856.48 | 10 | $649 | $1,505 | Pipe | $956.42 | 10 | $648 | $1,604 |
| Fittings | $350.26 | 58 | $3,844 | $4,194 | Fittings | $2,010.92 | 41 | $2,735 | $4,746 |
| Hanger Components | $405.87 | 34 | $2,261 | $2,667 | Hanger Components | $405.87 | 34 | $2,261 | $2,667 |
| Misc. Compenents | $56.90 | 0 | $0 | $57 | Misc. Compenents | $54.57 | 0 | $0 | $55 |
| **Total** | $1,670 | 102 | $6,754 | **$8,424** | **Total** | $3,428 | 85 | $5,644 | **$9,072** |

Table 10.2 – Comparing Systems

The mechanical subcontractor has used the Propress system before so there would be no cost incurred for the tools to install the equipment and no time lost to account for the learning curve to use the equipment.

## 10.11 LEED Impact

The CPVC was being assembled and connected using glues and cement agents that give off harmful Volatile Organic Compounds (VOC's). To qualify for the Indoor Air Quality Credit 4.1 (Low Emitting Materials: Adhesives & Sealants), the VOC level given off needed to be below the LEED required levels that were:

| | |
|---|---|
| Adhesive Primer for Plastic | 550 g/L |
| Contact Adhesive | 80 g/L |

The actual materials used were not able to be found, but were said to be below the required VOC levels set forth by the specifications and LEED.

Since the products used to connect the CPVC pipes were below the LEED required levels, using the Propress system will not have an impact on gaining LEED points. There is not another point that is able to be obtained for using a product that does not give out a VOC level. Indoor Air Quality Credit 4.1 (Low Emitting Materials: Adhesives & Sealants) will be obtained if either system is utilized.

## 10.12 Conclusion & Recommendation

The first item to compare is the cost difference between both systems. A takeoff was performed for the supply water system using both the CPVC system and the proposed Propress system for a typical residential unit. The takeoff included material cost, labor hours to install, and installation costs for the entire system per unit. The total cost for the CPVC system would be $2,080,728 and the total cost for the Propress system would be $2,240,784, as seen below in *Table 10.3*.

| Cost of Supply Water System to Units in Turnberry Tower Arlington | | | | | | | |
|---|---|---|---|---|---|---|---|
| CPVC System | | | | Propress System (2006) | | | |
| Cost Per Unit | Total Cost for 247 Units | Man Hours per Unit | Total Hours for 247 Units | Cost Per Unit | Total Cost for 247 Units | Man Hours per Unit | Total Hours for 247 Units |
| $8,424 | $2,080,728 | 102 | 25,194 | $9,072 | $2,240,784 | 85 | 20,995 |
| **Time Savings Using Propress System over CPVC System (Man Hours)** | | | | | | | **4,199** |
| **Cost Savings Using Propress System over CPVC System ($)** | | | | | | | **($160,056)** |

Table 10.3 – Total Cost Comparing Systems

There is a cost increase of approximately $160,000 if the Propress system is used for Turnberry Tower Arlington. The bulk of the cost increase comes from the price of copper in the third quarter of 2006. Even though on average, 17 man hours is saved per residential unit, the cost savings from the less labor does not offset the high cost of copper.

The reason believed that this system was not used was because of the fast rising cost of copper. As the cost of copper keeps rising, so does the likelihood that it will disappear off the site and be stolen. This construction site was constantly monitored so the expensive supplies and materials such as copper would not be stolen. On this project, a dedicated room was built and fit with an alarm so if someone did try to break in and steal the copper they would be caught. In addition, a security guard was on duty after hours to protect the site from theft and damage.

Even if the Propress system was used and the mechanical subcontractor, general contractor, and architect wanted to take the chance that copper would not have been stolen, the project would cost much more than the CPVC system. At the beginning of construction in 2006, the price of copper was around $3.10 a pound. No one could tell if the price of copper was going to continue to rise or start to decrease because of the huge construction boom in both the Unites States as well as overseas in places like Dubai and China.

Since Turnberry Tower Arlington is going for a LEED certication, a reason to pay the additional $160,000 would be to gain the extra LEED point that may have come with using the Propress system. To obtain the Indoor Air Quality Credit 4.1 (Low Emitting Materials: Adhesives & Sealants), the VOC level of the adhesive materials used to connect the piping needed to be below the given levels. The Propress system utilizes a mechanical bond so no VOC's are released in the air, but the adhesives and cement products that would be used for the CPVC system would be below the required LEED levels. Thus, both systems would meet the LEED requirements so that would mean to go with the less expensive system.

Even though the Propress system was a viable option during the beginning of construction, because of the price of copper in 2006, using CPVC Pipe for the supply water system of Turnberry Tower Arlington was the right decision. Currently in the first quarter of 2009, the cost of copper is significantly lower, and when the numbers are run the cost of the Propress system would be significantly less. Thus, if Turnberry Tower Arlington was being designed today, I would recommend using the Propress system for the supply water system.