

Case Study

Time and Materials Comparison-School

Daniel Worm, CPD

Executive Summary

With advancements in plumbing materials technology, the importance of remaining price competitive is ever increasing. However, material costs are only one part of a larger puzzle. Many of the materials offered today also claim to reduce labor times for installation, resulting in reduced installation costs for the installing contractor.

The purpose of this case study is to examine a project's overall plumbing piping cost, including labor and materials, and determine where trade-offs in lower cost materials may affect the overall cost, both positively and negatively.

Project Information

The project used for this comparison is an 88,300 sq. ft. high school with three-stories. The main trunk piping is routed in the ground-floor ceiling space, and is distributed up to the remaining two floors via risers.

Basic assumptions

The scope of this project is to compare project costs, both material and labor based, of five systems:

- PEX Trunk & Branch
- CPVC Trunk & Branch
- Copper Sweat Trunk & Branch
- Copper Press Trunk & Branch
- Polypropylene (PP-r) Trunk & Branch

Materials

Although the project uses pipe and fittings larger than two-inch, this study will only look at costs for pipe, fittings, and valves two-inches and smaller. For the PEX system where materials larger than two-inches are not readily available, it is assumed that the larger materials will be copper. Therefore, where applicable, adapters are included for conversion to larger pipe sizes. Project costs, both material and labor based, do not include materials over two-inches.

For pipe and fittings larger than two-inch, each system will convert to:

- Copper will convert to copper
- CPVC will convert to Schedule 80 CPVC
- PEX will convert to copper

Material costs are calculated at 2014 trade pricing information received from various parts of the United States. It is to the best of our knowledge accurate and current.

For each system type, the following materials are included in the project material costs:

PEX Systems

For PEX Trunk & Branch systems, bill of materials will include:

- 1/2"- 2" pipe and fittings
- 1"- 2" PEX-a Pipe Support w/ cable ties
- 1"- 2" elbows
- 1/2"- 1" PEX ball valves
- 1-1/4"- 2" Milwaukee Commercial ball valves with sweat adapters
- Sweat adapters to transition to larger diameter copper pipe (where required)
- Plugs at fixture terminations

CPVC Systems

For CPVC systems, bill of materials will include:

- 1/2"- 2" pipe and fittings
 - o Pipe to be SDR-11 CTS
 - o 1/2"-2" elbows
 - o Fittings to be solvent-cement

- 1/2"- 2" Milwaukee Commercial ball valves with threaded adapters
- Caps at fixture terminations

Polypropylene Systems

For polypropylene systems, bill of materials will include:

- 1/2"- 2" pipe and fittings
 - o CW pipe to be SDR-11
 - o HW pipe to be SDR-7.4 MF
- 1/2"-2" elbows
- Fittings to be socket type
- 1/2"- 2" Milwaukee Commercial ball valves with threaded adapters
- Caps at fixture terminations

Copper Systems

For **copper sweat** systems, bill of materials will include:

- 1/2"- 2" pipe and fittings
- 1/2"- 2" elbows
- 1/2"- 2" Milwaukee Commercial sweat ball valves
- Caps at fixture terminations

For **copper press** systems, bill of materials will include:

- 1/2"- 2" pipe and press fittings (type L)
- 1/2"- 2" press elbows
- 1/2"- 2" Milwaukee Commercial press ball valves
- Caps at fixture terminations

Labor has been calculated using the Mechanical Contractors Association of America (MCAA) Component Method approach. According to MCAA, *"The Component Method is based on the use of labor units that represent all activities necessary for the installation of one component (such as a 90° elbow or a tee). For piping, the unit is in manhours per foot and for components such as fittings, the unit is represented by each."*

From MCAA:

"A labor unit is expressed in terms of manhours to install a unit of material (such as a foot of pipe), an individual item (such as a fitting or valve), or perform a specific task (such as welding a joint). In developing the labor units set forth on this website, MCAA reviewed the many elements that make up installation labor."

They are:

- Receiving
- Unloading
- Stockpiling
- Distribution
- Handling and erection
- Fitting and joining
- Pressure testing

Labor rates are calculated at \$75/hr. This rate is based on extensive research of varying labor rates across the United States, and is not intended to cover all instances.

Study Results

To properly examine the various costs within a building's piping system, the materials and labor were broken up into three sections: main piping, units, and risers.

Main piping includes all pipe, fittings, and valves two-inches and smaller, on the ground floor. This includes public restrooms, valves and valve adapters for risers. For PEX systems, the main piping also includes required adapters for conversion to larger pipe diameters.

Unit piping includes all pipe and fittings within the unit, after the riser-branch. Units are not individually valved. In this case, the units include restrooms on all floors, and the kitchen on ground floor.

Riser piping includes all vertical piping, starting on ground floor, up to the third floor units. Risers are valved on ground floor.

Labor

Using the MCAA Component Method to estimate labor hours, the individual building sections were estimated and totalled, as shown in **Table 1**.

Table 1- Labor Hours by Building Section

| Building Section | Labor Hours by Building Section | | | | |
|------------------|---------------------------------|---------------|---------------|---------------|----------------|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| Main Floor | 141.05 | 174.62 | 158.18 | 296.78 | 312.67 |
| Units | 203.92 | 282.63 | 224.04 | 343.74 | 588.79 |
| Risers | 66.90 | 98.06 | 79.00 | 160.66 | 207.92 |
| Total | 411.87 | 555.31 | 461.22 | 801.18 | 1109.38 |

It can be seen that the PEX system required 10% less labor than the copper press system, and 25% less labor than the CPVC system.

Material Costs

The material costs were then determined for each building section and totalled. **Table 2** highlights the overall material costs by building section. As stated previously, these prices are calculated using average trade pricing.

Table 2- Material Cost by Building Section (USD)

| Building Section | Material Cost by Building Section (USD) | | | | |
|------------------|---|--------------------|--------------------|--------------------|--------------------|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| Main Floor | \$ 9,780.16 | \$ 5,431.72 | \$14,994.86 | \$ 8,894.46 | \$ 11,040.57 |
| Units | \$ 5,884.99 | \$ 5,502.95 | \$13,655.10 | \$ 7,755.19 | \$ 11,282.81 |
| Risers | \$ 2,442.05 | \$ 1,920.44 | \$4,351.69 | \$ 2,426.77 | \$ 5,596.59 |
| Total | \$18,107.20 | \$12,855.11 | \$33,001.65 | \$19,076.42 | \$27,919.97 |

It can be seen that in terms of material costs, CPVC comes in the lowest at 29% less than the PEX system.

Table 3 highlights the total project costs.

Table 3- Total Costs with Building Sections

| Building Section | Total Project Cost by Building Section (USD) | | | | |
|----------------------|--|--------------------|--------------------|--------------------|---------------------|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| Main Floor | \$ 9,780.16 | \$ 5,431.72 | \$14,994.86 | \$ 8,894.46 | \$ 11,040.57 |
| Units | \$ 5,884.99 | \$ 5,502.95 | \$13,655.10 | \$ 7,755.19 | \$ 11,282.81 |
| Risers | \$ 2,442.05 | \$ 1,920.44 | \$4,351.69 | \$ 2,426.77 | \$ 5,596.59 |
| Material Cost | \$18,107.20 | \$12,855.11 | \$33,001.65 | \$19,076.42 | \$27,919.97 |
| Labor Cost @ \$75/hr | \$30,890.25 | \$41,648.25 | \$34,591.50 | \$60,088.50 | \$83,203.50 |
| Project Total | \$48,997.45 | \$54,503.36 | \$67,593.15 | \$79,164.92 | \$111,123.47 |

Although CPVC's material costs were roughly 29% less than PEX, the reduction in labor hours for the PEX system resulted in a 10% lower overall project cost when compared to CPVC and 27% lower overall project cost than copper press.

Individual Restroom Comparison

To examine the costs at an individual unit level, the materials and labor were broken down for a typical restroom with both flush tank and flush valve type fixtures (lavatories and water closets) as seen in **Figures 1 & 2**. **Table 4** shows the labor hours required to pipe each restroom.

Table 4- Restroom Labor Hours

| Restroom 210 | Restroom Comparison (hrs) | | | | |
|--------------------|---------------------------|--------------|--------------|--------------|--------------|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| Labor Hours | 12.41 | 15.28 | 12.00 | 20.94 | 34.88 |

As shown by **Table 4**, the PEX restroom required 3% more labor than the copper press system, but 18% less than the CPVC system and 64% less than the PP-r system.

Table 5 shows the total cost of the restroom.

Table 5- Restroom Total Cost

| Restroom 210 | Restroom Comparison | | | | |
|-----------------------------|---------------------|-------------------|-------------------|-------------------|-------------------|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| Material Cost (USD) | \$878.48 | \$204.15 | \$588.10 | \$531.75 | \$280.00 |
| Labor | \$930.75 | \$1,146.00 | \$900.00 | \$1,570.50 | \$2,616.00 |
| Total Installed Cost | \$1,809.23 | \$1,350.15 | \$1,488.10 | \$2,102.25 | \$2,896.00 |

After labor costs at \$75/hour are added to the materials cost, the total installed cost for the PEX restroom is 25% higher than the CPVC system, but 37% less than the PP-r system.

Figure 1- Restroom 210

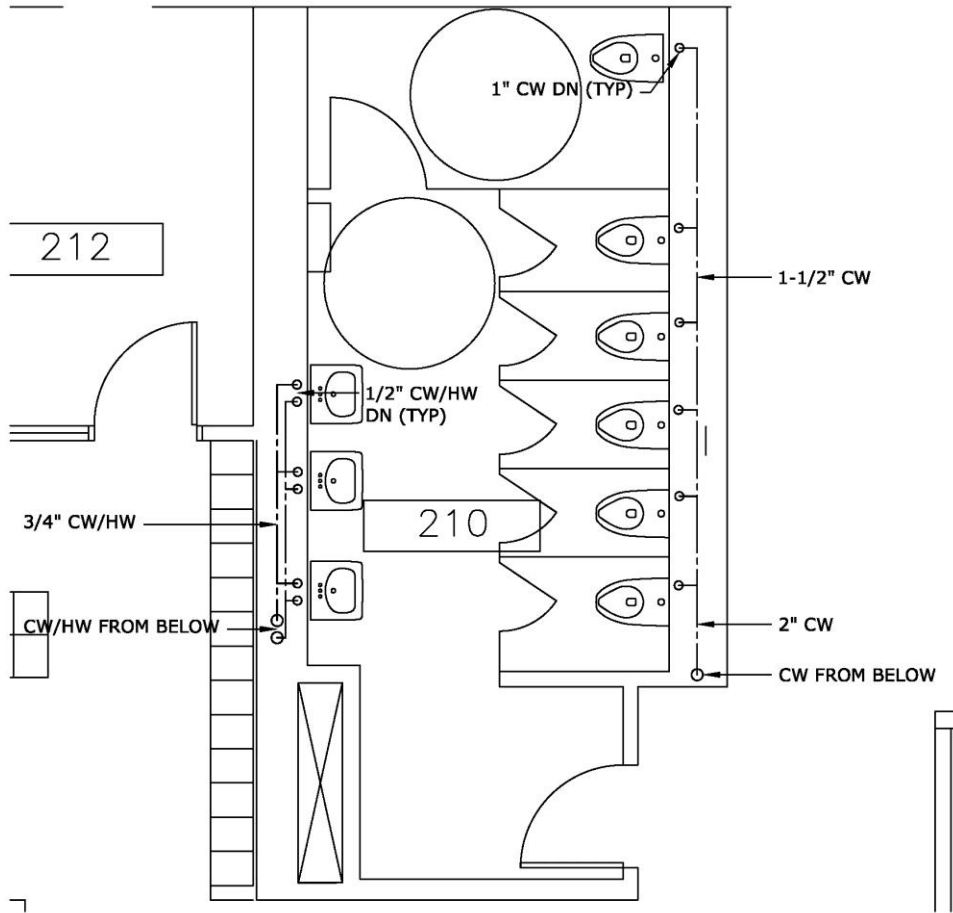


Figure 2- Restroom 210 Isometric

