Case Study

Time and Materials Comparison — Multifamily

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## 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 a 517,550-square-foot multifamily building with three dwelling levels featuring 189 total units, as well as a one-level parking garage. The main cold water distribution is routed in the parking garage, and the main hot water distribution is routed in the third-floor ceiling, with risers transporting water up to fourth floor and down to second floor.

## Basic assumptions

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

- PEX Logic
- CPVC Trunk and Branch
- Copper Sweat Trunk and Branch
- Copper Press Trunk and Branch
- Polypropylene (PP-r) Trunk and 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 Logic systems, bill of materials will include:

- ½"- 2" Uponor AquaPEX pipe and ProPEX fittings
- 1"- 2" Uponor PEX-a Pipe Support w/ cable ties (except in units)
- 1"- 2" ProPEX elbows
- ½"- 2" Uponor ProPEX Commercial ASTM F1960 ball valves
- Sweat adapters to transition to larger diameter copper pipe (where required)
- Engineered Polymer (EP) multiport tees where applicable
- Plugs at fixture terminations for lavatories, water closets, and sinks
- Uponor outlet boxes for ice makers and washing machines

**CPVC Systems**
For CPVC systems, bill of materials will include:
- ½"- 2" pipe and fittings (SDR-11 CTS)
- ½"- 2" elbows
- Fittings to be solvent-cement
- ½"- 2" Apollo Commercial ball valves with threaded adapters
- Caps at fixture terminations for lavatories, water closets, and sinks
- Sioux Chief Ox Boxes for ice makers and washing machines

**Polypropylene Systems**
For polypropylene systems, bill of materials will include:
- ½"- 2" Aquatherm pipe and fittings
    - CW pipe to be SDR-11
    - HW pipe to be SDR-7.4 MF
- ½"-2" elbows
- Fittings to be socket type
- ½"- 2" Apollo Commercial ball valves with threaded adapters
- Caps at fixture terminations for lavatories, water closets, and sinks
- Sioux Chief Ox Boxes for ice makers and washing machines

**Copper Systems**
For **copper sweat** systems, bill of materials will include:
- ½"- 2" type "L" pipe and fittings
- ½"- 2" elbows
- ½"- 2" Apollo Commercial sweat ball valves
- Caps at fixture terminations for lavatories, water closets, and sinks
- Sioux Chief Ox Boxes for ice makers and washing machines

For **copper press** systems, bill of materials will include:
- ½"- 2" type "L" pipe and press fittings
- ½"- 2" press elbows
- ½"- 2" Apollo Commercial press ball valves
- Caps at fixture terminations for lavatories, water closets, and sinks
- Sioux Chief Ox Boxes for ice makers and washing machines

**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 and fittings two-inches and smaller, that are part of the horizontal cold-water distribution system on the garage level, as well as the hot-water system on the third level. For PEX systems, the main piping also includes required adapters for conversion to larger pipe diameters and PEX Pipe Support and straps, which allow similar hanger spacing to metallic piping.

**Unit piping** includes all pipe and fittings within the unit, after the riser-branch. Unit costs include hot and cold-water isolation valves. Fixture terminations are plugged or capped for rough-in.

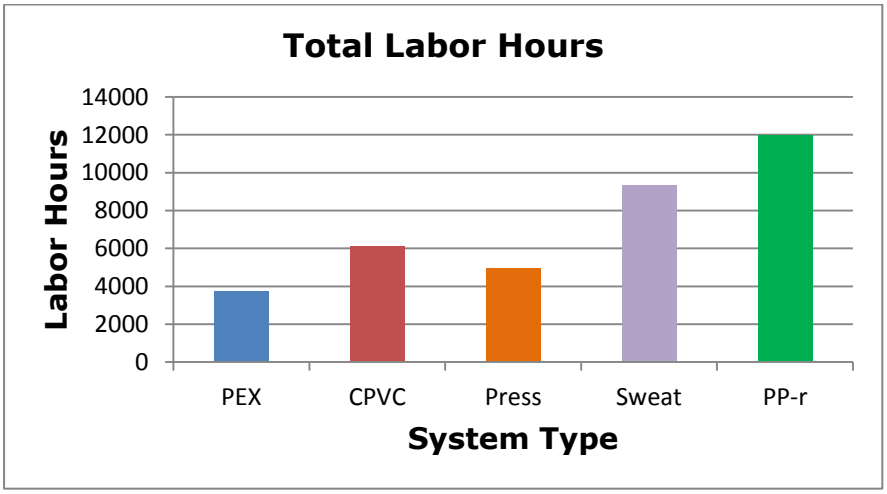
**Riser piping** includes all vertical piping and fittings. For cold-water risers, the piping starts in the parking garage and rises roughly 30 feet up to the fourth floor. For the hot-water risers, the piping starts in the third-floor ceiling space, and is distributed 10 feet up to the fourth floor, and 10 feet down to the second floor. Riser costs include isolation valves at the base.

### Labor

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

| Building Section | Labor Hours by Building Section | | | | |
|---|---|---|---|---|---|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| Main Piping | 216.51 | 224.80 | 227.73 | 298.95 | 299.66 |
| Units | 3353.81 | 5361.27 | 4200.69 | 8060.25 | 10442.49 |
| Risers | 165.82 | 512.33 | 492.98 | 981.89 | 1195.91 |
| **Total** | **3736.14** | **6098.40** | **4921.40** | **9341.09** | **11938.06** |

**Table 1: Labor Hours by Building Section**




**Graph 1: Total Labor Hours**

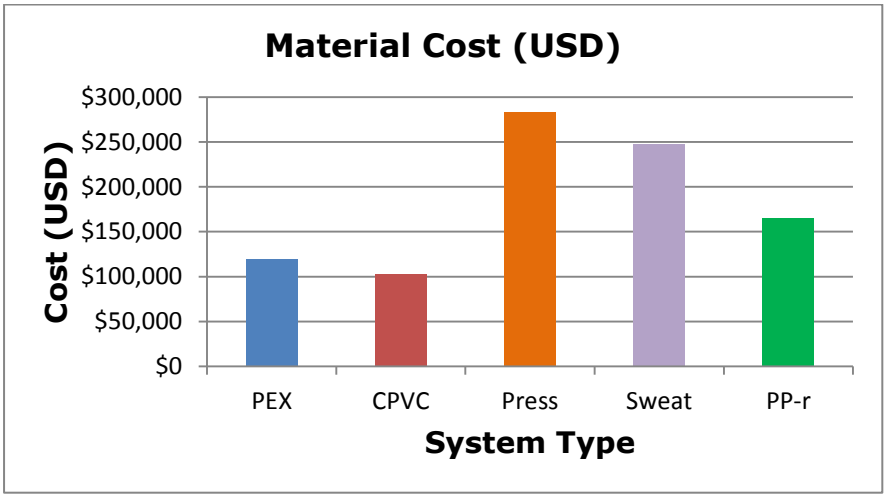
It can be seen that the PEX system required 24% less labor than the copper press system, and 38% less labor than the CPVC system.

**Material Costs**

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

| Building Section | Material Cost by Building Section (USD) | | | | |
|---|---|---|---|---|---|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| Main Piping | $23,492.12 | $12,610.06 | $35,358.90 | $34,255.30 | $16,245.63 |
| Units | $64,477.84 | $60,998.25 | $193,791.18 | $164,339.01 | $114,588.81 |
| Risers | $31,538.07 | $28,958.96 | $54,500.69 | $48,538.04 | $34,305.17 |
| **Total** | **$119,508.02** | **$102,567.27** | **$283,650.77** | **$247,132.35** | **$165,139.61** |

**Table 2: Material Cost by Building Section (USD)**



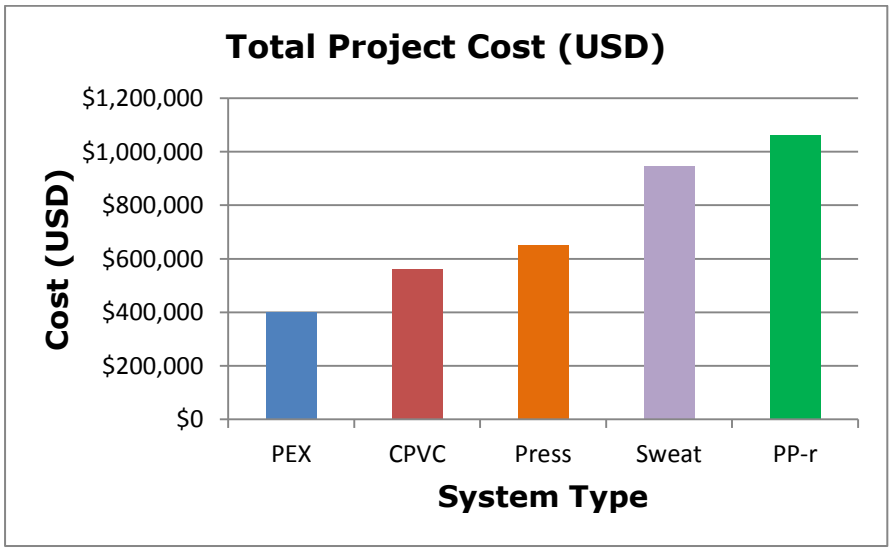

**Graph 2: Material Costs (USD)**

It can be seen that in terms of material costs, the three plastics-based systems come in the lowest, with CPVC at 14% less than the PEX system, and 37% less than the PP-r system.

The total labor hours from **Table 1** are then added to the materials costs from **Table 2** to show the total project costs in USD. **Table 3** and **Graph 3** highlight the total project costs.

| Building Section | Total Project Cost by Building Section (USD) | | | | |
|---|---|---|---|---|---|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| Main Piping | $23,492.12 | $12,610.06 | $35,358.90 | $34,255.30 | $16,245.63 |
| Units | $64,477.84 | $60,998.25 | $193,791.18 | $164,339.01 | $114,588.81 |
| Risers | $31,538.07 | $28,958.96 | $54,500.69 | $48,538.04 | $34,305.17 |
| **Material Cost** | **$119,508.02** | **$102,567.27** | **$283,650.77** | **$247,132.35** | **$165,139.61** |
| Labor Cost @ $75/hr | $280,210.30 | $457,380.00 | $369,105.00 | $700,581.75 | $895,354.50 |
| **Project Total** | **$399,718.32** | **$559,947.27** | **$652,755.77** | **$947,714.10** | **$1,060,494.11** |

**Table 3: Total Costs by Building Sections**




**Graph 3: Total Project Cost (USD)**

Although CPVC's material costs were roughly 14% less than PEX, the reduction in labor hours for the PEX system resulted in a 28% lower overall project cost when compared to CPVC and 38% lower overall project cost than copper press.

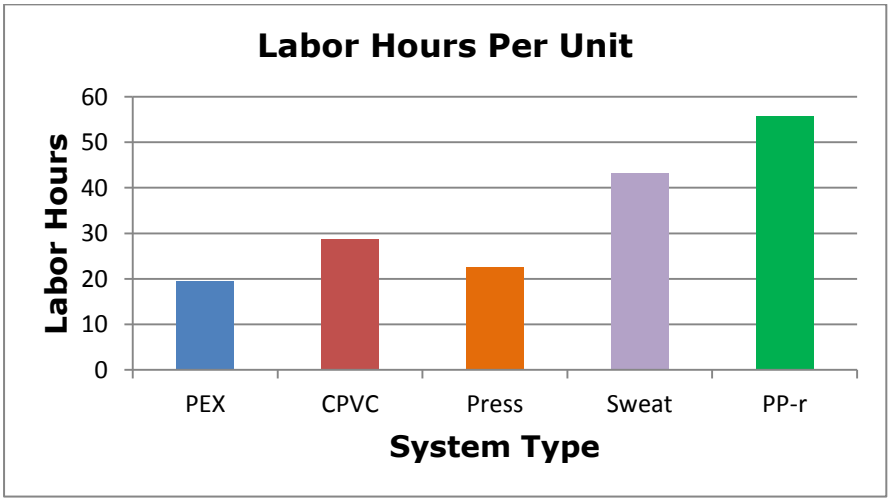
## Individual Unit Comparison

To examine the costs at an individual unit level, the materials and labor were broken down for a typical unit. As seen in **Figures 1 and 2,** the unit features

**Table 4** and **Graph 4** show the labor hours required to pipe each unit.

| Unit B1 (ea) | Unit B1 Comparison (hrs) | | | | |
|---|---|---|---|---|---|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| **Labor Hours** | **19.36** | **28.65** | **22.48** | **43.11** | **55.80** |

**Table 4: Unit B1 Labor Hours**



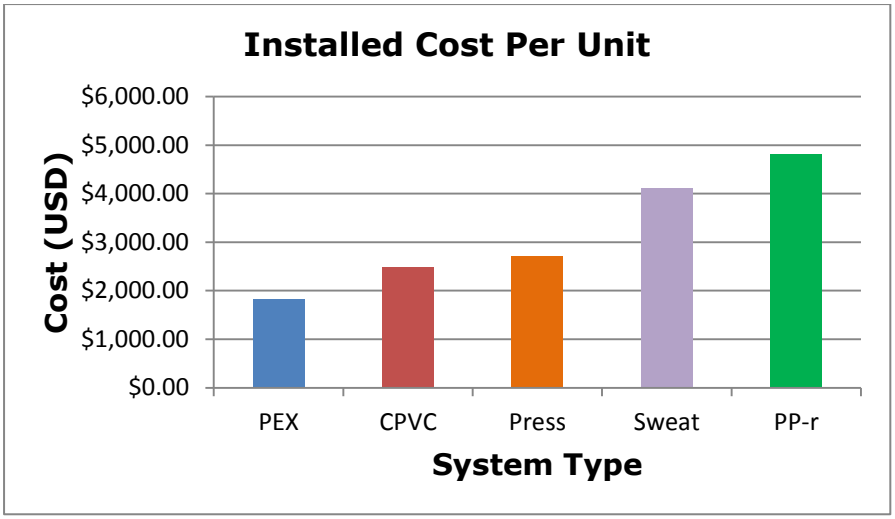

**Graph 4: Unit B1 Labor Hours**

As shown by **Table 4** and **Graph 4**, the PEX unit required 13% less labor than the copper press system, and 32% less than the CPVC system and 65% less than the PP-r system.

**Table 5** and **Graph 5** show the total cost of the unit.

| Unit B1 (ea) | Unit B1 Comparison (USD) | | | | |
|---|---|---|---|---|---|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| Material Cost (USD) | $365.20 | $326.31 | $1,029.21 | $870.11 | $614.59 |
| Labor Cost @ $75/hr | $1,452.00 | $2,148.75 | $1,686.00 | $3,233.25 | $4,185.00 |
| **Total Installed Cost** | **$1,817.20** | **$2,475.06** | **$2,715.21** | **$4,103.36** | **$4,799.59** |

**Table 5: Total Unit B1 Cost**




**Graph 5: Total Unit B1 Cost**

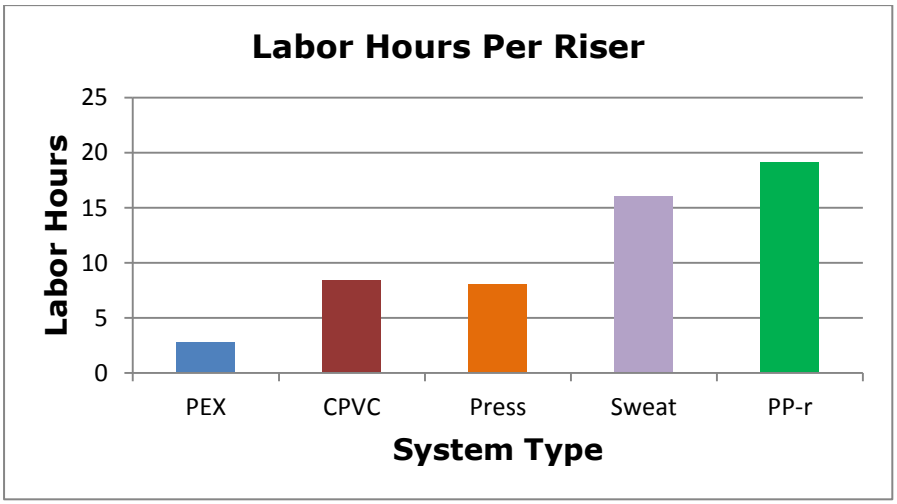
After labor costs at $75/hour are added to the materials cost, the total installed cost for the PEX unit is 26% lower than the CPVC system, and 62% less than the PP-r system.

## Individual Riser Comparison

The individual labor required for riser CH-2 are shown below in **Table 6** and **Graph 6**. An example of the riser can be seen in **Figures 3 and 4**.

| Riser CH-2 | Riser CH-2 Comparison (hrs) | | | | |
|---|---|---|---|---|---|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| **Labor Hours** | **2.75** | **8.37** | **8.07** | **16.02** | **19.13** |

**Table 6: Riser CH-2 Labor Hours**

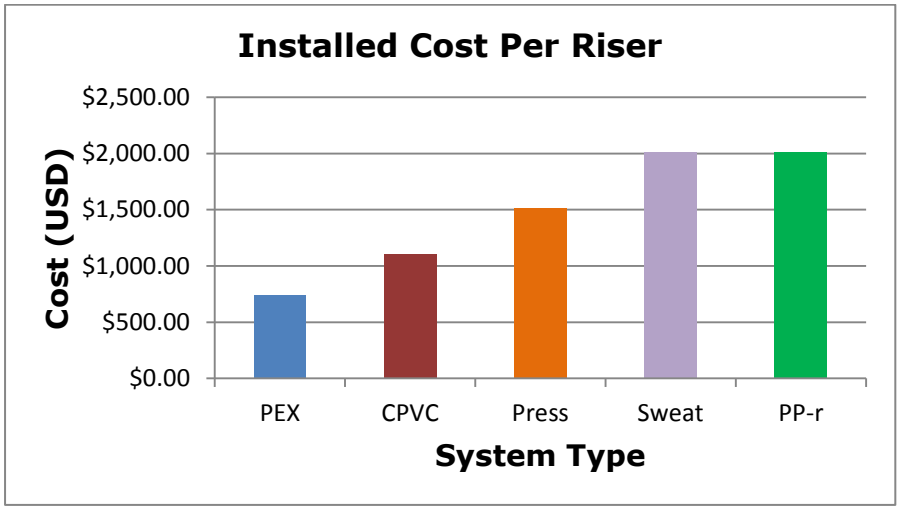



**Graph 6: Riser CH2 Labor Hours**

As shown in **Table 6** and **Graph 6**, the PEX riser requires 65% less labor than the Copper Press system, and 67% less labor than the CPVC system.

| Riser CH-2 (ea) | Riser CH-2 Comparison (USD) | | | | |
|---|---|---|---|---|---|
| | PEX | CPVC | Copper Press | Copper Sweat | PP-r |
| Material Cost (USD) | $533.39 | $478.40 | $911.47 | $811.80 | $574.12 |
| Labor Cost @ $75/hr | $206.40 | $627.75 | $605.25 | $1,201.50 | $1,434.75 |
| **Total Installed Cost** | **$739.79** | **$1,106.15** | **$1,516.72** | **$2,013.30** | **$2,008.87** |

**Table 7: Total Riser CH-2 Cost**




**Graph 7: Total Riser CH2 Cost**

**Table 7** and **Graph 7** show that the total installed cost for the PEX riser is 33% less than the CPVC riser, and 51% less than the Copper Press system.

**Figure 1: Unit B1 Logic Design**

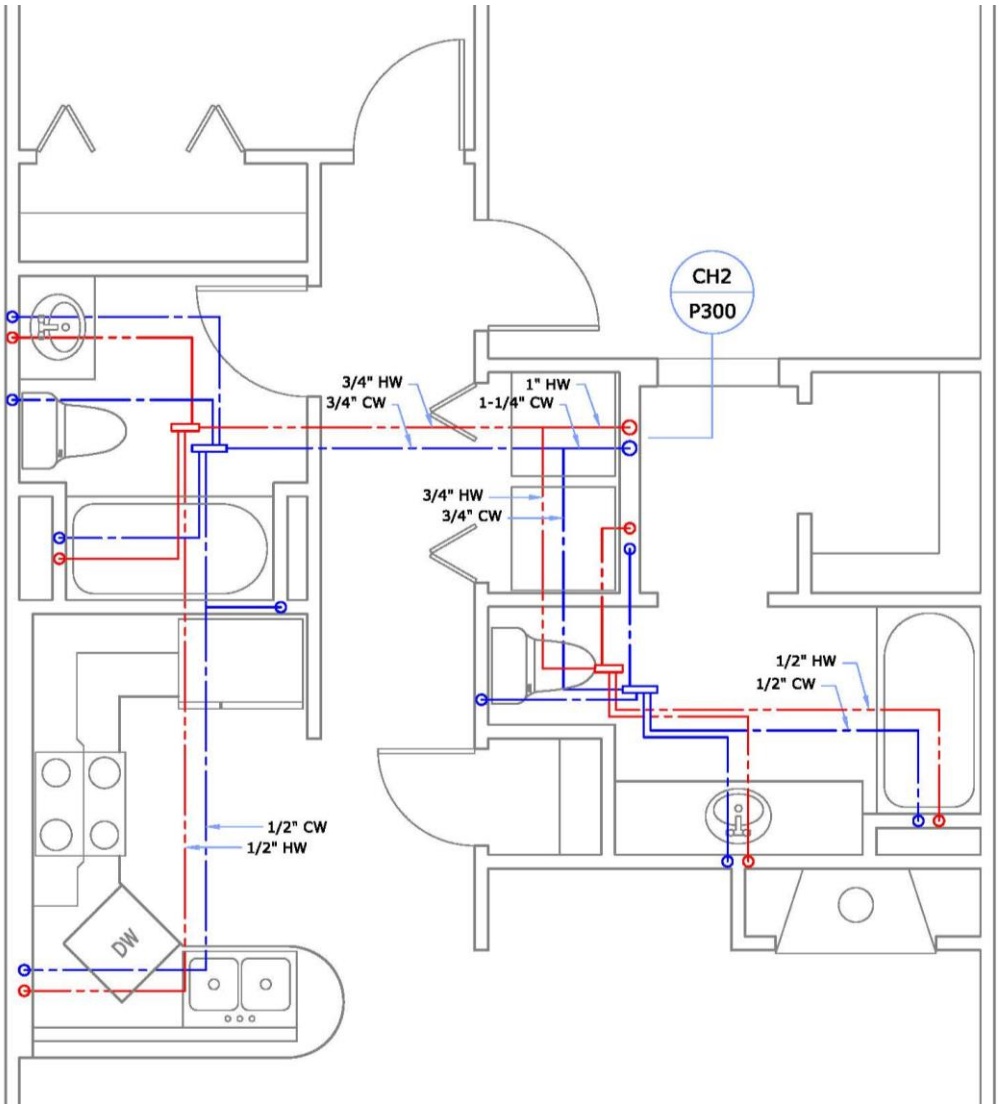


**Figure 2: Unit B1 Trunk and Branch Design**

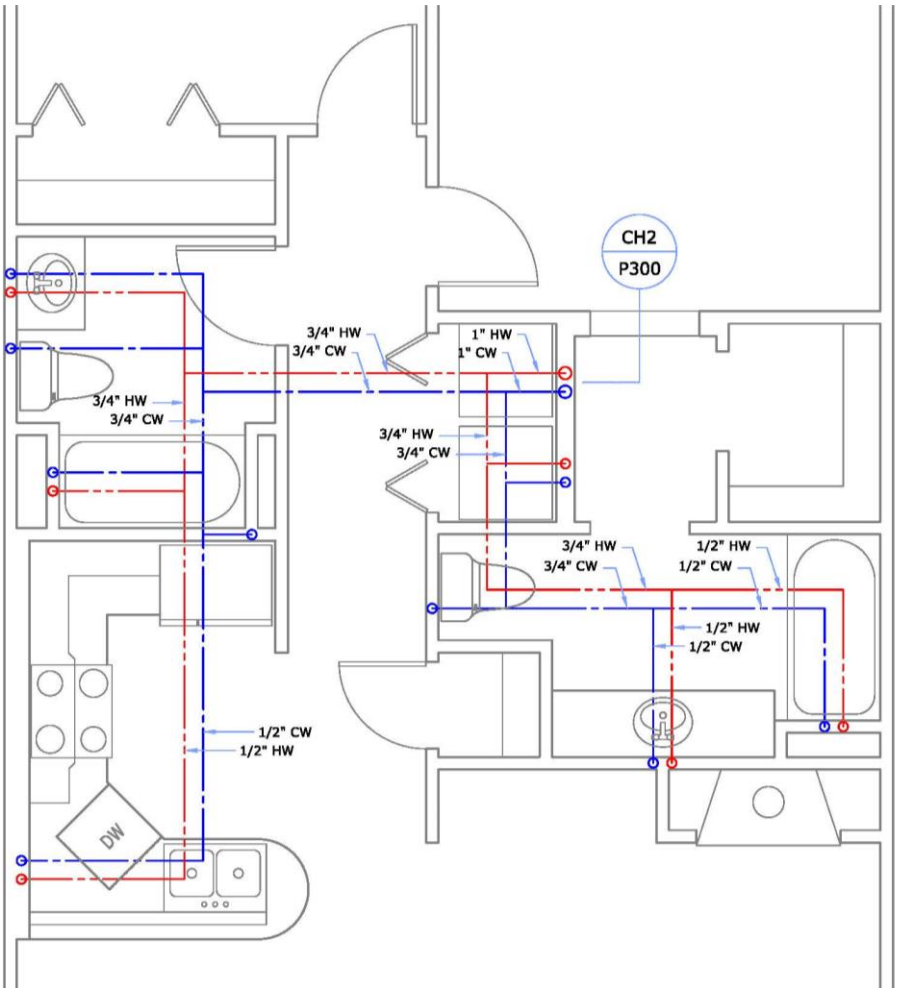


**Figure 3: Riser CH2 for Logic Units**

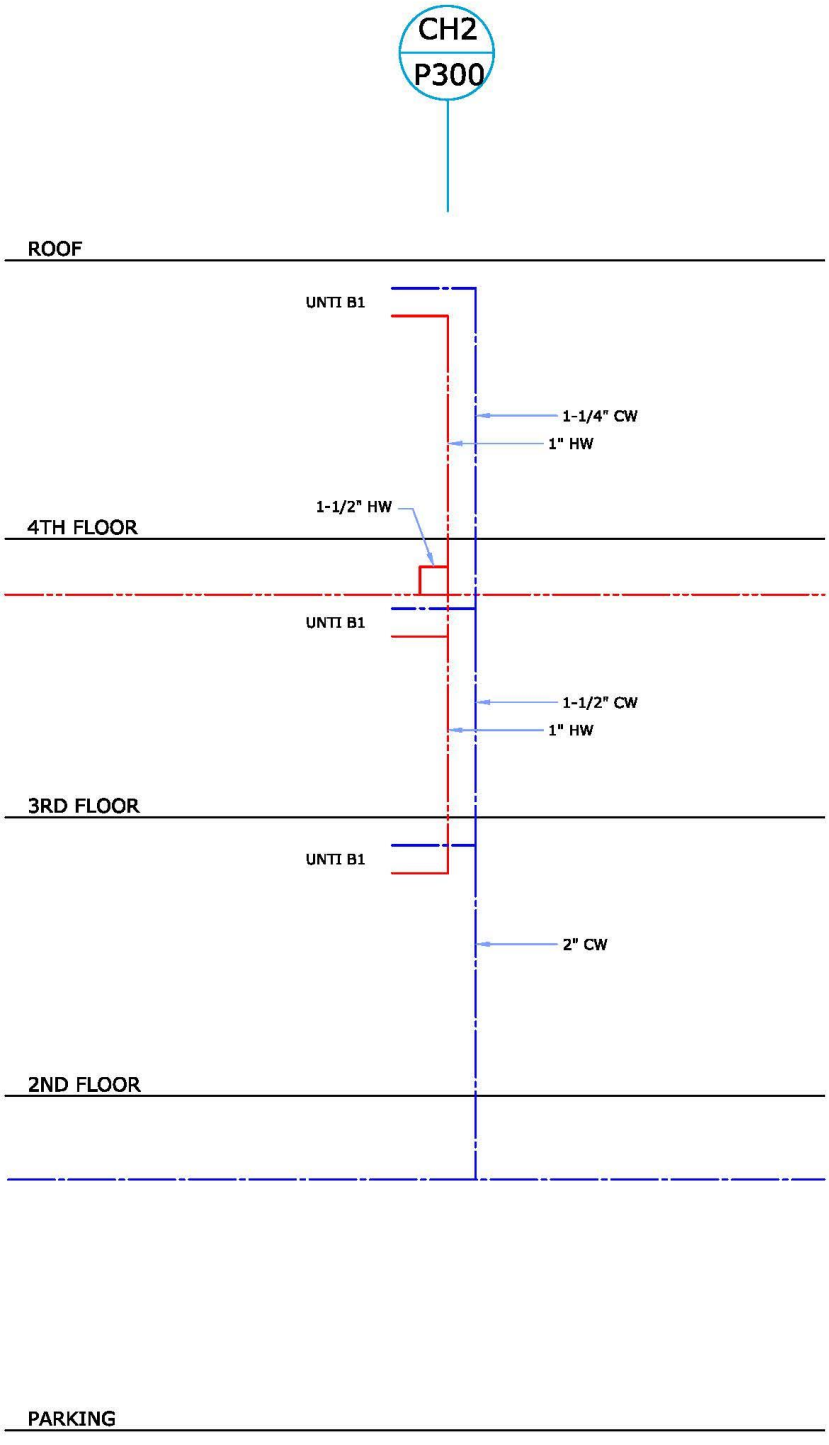


**Figure 4: Riser CH2 for Trunk and Branch Units**