IAPMO's Water Demand Calculator Will Save You Money, Water and Labor Costs.

EXECUTIVE SUMMARY

Reacting to needs to address profound water quality and wasted water and energy concerns resulting from oversized water supply pipes in home and buildings, IAPMO led a research project to develop a new statistically based pipe sizing method. This multi-year effort resulted in the development of the Water Demand Calculator (WDC).

Along with addressing those concerns, applying the WDC also provides significant construction cost reductions resulting from the use of smaller water pipes, fittings and related components. This paper illustrates the potential economic benefits of applying the WDC over traditional pipe sizing methods.

IAPMO commissioned Stantec Architecture to calculate the material and labor costs saving potential of applying the WDC as compared to applying the sizing methods contained in baseline plumbing codes, specifically, IAPMO's *Uniform Plumbing Code*®, the International Code Council's (ICC) *International Residential Code*® (IRC) and the ICC's *International Plumbing Code*® (IPC).

BACKGROUND

IAPMO's WDC represents the first significant update for water pipe sizing in buildings in over 80 years, since the development of Hunter's Curve. Much has changed in the way Americans use water since then. In fact, plumbing fixtures and appliances use only of fraction of the water they consumed since the mid-1980s. See Table 1.

TABLE 1
Water consumption by water-using plumbing products and appliances – 1980s to 2021[1]

Water-using Fixture or Appliance	1980s Water Use	1990 Requirement	EPAct 1992 Requirement	Baseline Plumbing Code	'Green Code' Requirements	% Reduction in since 1980s
Residential Bathroom Lavatory Faucet	3.5+ gpm	2.5 gpm	2.2 gpm	2.2 gpm	1.2 gpm	66%
Showerhead	3.5+ gpm	3.5 gpm	2.5 gpm	2.5 gpm	2.0 gpm	43%
Toilet – Residential	5.0+ gpf	3.5 gpm	1.6 gpm	1.6 gpm	1.28 gpm	74%
Residential Clothes Washer	51 gallons/load	No requirement	26 gallons/load (2012 standard)	No requirement	13 gallons/load (Energy Star)	75%
Residential Dishwasher	14 gallons/cycle	No requirement	6.5 gallons/cycle (2012 standard)	No requirement	3.5 gallons/cycle (Energy Star)	75%

GPM = US Gallons Per Minute, GPF = US Gallons Per Flush

As a result, the plumbing systems in our single- and multi-family homes and buildings are oversized, which results in:

- increased water aging and declining water quality resulting in an increased risk from biofilm development, Legionella and other opportunistic pathogens
- wasted energy and water
- an increase in annoying hot water delivery times
- unnecessary material and labor costs during construction

THE WATER DEMAND CALCULATOR

The WDC was developed specifically to address the water quality and water and energy efficiency problems associated with oversized building water pipes. However, use of the WDC also provides significant cost saving efficiencies.

To ensure a fair comparison, the most economic design options offered in the entirety of the UPC, IRC, and IPC were investigated and applied, including the application of the code appendices. Visit https://www.iapmo.org/water-demand-calculator/ to learn the technical details about how the WDC works and how to download it.

[1] *The Drainline Transport of Solid Waste in Buildings*, PERC 1 Report - Chart by J. Koeller, P. DeMarco (updated)

THE BUILDING PROTOTYPES

Three building prototypes were developed: an average size, 2,379-square-foot single family home, a 6-unit multi-family residence, and a 45-unit multi-family residential unit. The prototypes were specifically developed to represent typical homes and multi-family residences that are currently being constructed.

THE PLUMBING MATERIAL AND LABOR CALCULATIONS

Construction and labor costs vary regionally in the United States, so three metro areas that represent high costs (New York City), mid-range costs (Pittsburgh) and low costs (Oklahoma City) were selected for the study. Material costs were calculated using trunk and branch copper systems and PEX manifold systems.

RESULTS

Table 2 shows the total material and labor cost savings of applying the WDC based on a U.S. dollar/percentage basis as compared to applying the UPC, IPC, or IRC. These values represent the cost savings that can be expected when applying the Water Demand Calculator on one single-family home or multi-family building.

TABLE 2
Cost Savings (US Dollars / Percent)

NEW YORK CITY		
Single-Family Home Savings $ / %		
Savings vs.	Copper	PEX
UPC ($)	$401	$56
UPC (%)	2%	0.3%
IRC ($)	$1,126	$81
IRC (%)	4%	0.4%

PITTSBURGH		
Single-Family Home Savings $ / %		
Savings vs.	Copper	PEX
UPC ($)	$299	$48
UPC (%)	2%	0.4%
IRC ($)	$857	$72
IRC (%)	6%	1%

OKLAHOMA CITY		
Single-Family Home Savings $ / %		
Savings vs.	Copper	PEX
UPC ($)	$277	$287
UPC (%)	2%	3%
IRC ($)	$804	$74
IRC (%)	7%	1%

NEW YORK CITY		
6-Unit Multi-Family Savings $ / %		
Savings vs.	Copper	PEX
UPC ($)	$3,995	$9,482
UPC (%)	3%	8%
IPC ($)	$7,602	$9,012
IPC (%)	5%	8%

PITTSBURGH		
6-Unit Multi-Family Savings $ / %		
Savings vs.	Copper	PEX
UPC ($)	$3,150	$8,509
UPC (%)	4%	12%
IPC ($)	$6,156	$8,212
IPC (%)	7%	12%

OKLAHOMA CITY		
6-Unit Multi-Family Savings $ / %		
Savings vs.	Copper	PEX
UPC ($)	$3,037	$7,821
UPC (%)	5%	15%
IPC ($)	$6,033	$8,668
IPC (%)	9%	16%

NEW YORK CITY		
45-Unit Multi-Family Savings $ / %		
Savings vs.	Copper	PEX
UPC ($)	$52,409	$33,154
UPC (%)	8%	5%
IPC ($)	$58,877	$26,494
IPC (%)	9%	4%

PITTSBURGH		
45-Unit Multi-Family Savings $ / %		
Savings vs.	Copper	PEX
UPC ($)	$40,686	$28,226
UPC (%)	10%	8%
IPC ($)	$44,987	$22,535
IPC (%)	11%	6%

OKLAHOMA CITY		
45-Unit Multi-Family Savings $ / %		
Savings vs.	Copper	PEX
UPC ($)	$38,800	$28,520
UPC (%)	12%	10%
IPC ($)	$42,441	$22,761
IPC (%)	13%	8%

FINDINGS

The Stantec report found that:

1. Due to reduced GPM requirements, the application of IAPMO's Water Demand Calculator resulted in notable construction cost savings associated with each of the three residential prototypes. The primary cost savings are associated with reduced diameter water service entrances, interior cold water mains / branches, interior hot water mains / branches, fittings, labor, and appurtenances.

2. The Water Demand Calculator is a Uniform Plumbing Code alternative to Hunter's Curve for estimating water supply demand for residential buildings. This represents the first practical application of an improved method since the 1940's that does not result in excessive over design and oversizing pipes.

3. The Water Demand Calculator works in conjunction with commonly accepted rules and procedures for sizing cold and hot water systems.

4. Utilizing the Water Demand Calculator for sizing of residential cold and hot water mains, branches and risers will result in:
   a) Shorter water dwell times in residential plumbing systems, improving water quality and thus, most importantly, improving public health and safety.
   b) Reduced water service entrance, interior cold water mains / branches, interior hot water mains / branches, fittings, labor, and appurtenances.
   c) Faster hot water delivery times throughout the hot water systems, will also save energy, water and reduce utility bills for the entire life of the plumbing system.

More Yet to Come...

Use of the WDC will also provide cost savings by reducing utility connection fees, which vary considerably across the country. Stay tuned... there's more good news yet to come!