

DOMESTIC HOT WATER DISTRIBUTION OPTIONS

by [Roy E. Swain, P.E.](#)

For projects such as schools, there are three main methods of distributing domestic hot water around the building: a central system, a zone system, and a fully distributed system.

SAMPLE BUILDING:

The sample building for comparing these options is a 33,000 square foot, one story elementary school with a full kitchen. The one-way distance from the mechanical room to the most remote fixture is 450 feet.

CENTRAL SYSTEM:

In the mechanical room are located one or two "indirect-fired" water heaters. These tanks contain heat exchanger coils through which circulates hot water from the boiler plant. We use double wall heat exchangers to protect against contamination of the domestic water with boiler water chemicals.

To keep hot water available throughout the building, we specify a second pipe through which hot water continually circulates. This system uses a 1/6 horsepower pump (equivalent to a 100-watt light bulb) to keep the hot water temperature within a 5° F range.

All fixtures are required by code to be within 100 feet of the hot water mains, to reduce the delays before hot water reaches the fixture. Generally, we limit the distance to 50 feet, and delays are typically 15 seconds or less.

ZONE SYSTEM:

Under this design, the main hot water load - the kitchen - continues to be served from the mechanical room using the same equipment as described under "Central System". In addition, the 31 fixtures distributed throughout the classroom areas are served by three zone electric water heaters in locations such as custodian rooms. The zone water heaters are within 100 feet of the fixtures so that no recirculation piping is required, and 100 feet of the hot water main piping is also eliminated.

Offsetting these savings are the additional costs of the three water heaters and their electrical service. The net savings for the sample building is about \$7,000 or \$0.20 per square foot.

However, the delays at the fixtures before hot water arrives are quite long, as long as 30 seconds or more. Also, both the operating costs and equipment replacement costs are higher for this system vs. the Central System.

DISTRIBUTED SYSTEM:

Under this design, the main hot water load - the kitchen - continues to be served from the mechanical room using the same equipment as described under "Central System".

In addition, 31 point-of-use electric water heaters are provided - one at each sink, lavatory, and mop basin. These are instantaneous water heaters at the lavatories, 2-gallon under-sink models at the

sinks, and 20-gallon units at the mop basins.

This system eliminates all the hot water supply and recirculation piping to the classroom area, at a savings of about \$16,000. However, 31 electric heating elements at an average 3300 watts each add up to 100 KW additional electrical capacity required for the building. This would increase the electrical costs by \$16-24,000. The net increase in cost would be 0 to \$8,000, or 0 to \$0.20 per square foot.

Operating costs would be the highest of the three system options, because of electricity consumption and also electric demand charges. Equipment replacement costs would also be the highest. However, the performance of the system would be the best of the three alternatives, with virtually unlimited hot water available at every fixture, with no delays whatsoever.

SYSTEM COMPARISON TABLE			
	Central System	Zone System	Distributed System
Construction Cost	Baseline	\$0.20/sq.ft. less	0-\$0.20/sq.ft. more
Energy Cost	Lowest	Medium	Highest
Equipment Replacement Cost	Lowest	Medium	Highest
Amount of Hot Water	Excellent	Good	Excellent
Availability of Hot Water	Good	Poor	Excellent

CONCLUSION:

A comparison of the systems is shown in the above table. If cost is no object, and the best performance is desired, select the Distributed System. If construction cost savings are paramount, at the expense of performance and operating costs, select the Zone System. (But be prepared for years of complaints about how long it takes to get hot water). For all normal applications similar to the Sample Building, we recommend the Central System, with moderate first cost, good performance, and lowest operating costs. The Central System is our standard design.