outdoor temperature drops), is set according to a schedule based on the ship's itinerary.

Duct work for all systems described is designed for conventional velocity. However, if power is available, and suitably strong duct construction and adequate sound absorbing facilities are provided, high velocity systems may be used.

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CHAPTER 49

WATER SERVICES

Sizing Cold Water Supply Piping, Procedure for Sizing Cold Water Systems, Cooling Water Piping, Estimating Heating Load and Storage Capacity, Methods of Heating Water, Computing Heat Transfer Surface, Hot Water Supply Piping, Control of Service Water Temperature, Safety Devices, Solar Water Heaters, Domestic Hot Water by Heat Pump

PROPER design of the water distributing system in a building is necessary in order that the various fixtures may function properly. The amount of either hot or cold water used in any building is variable, depending on the type of structure, usage, occupancy, and time of day. It is necessary to provide piping, water heating, and storage facilities of sufficient capacity to meet the peak demand without wasteful excess in either piping or equivalent cost.

SIZING COLD WATER SUPPLY PIPING

One of the important items that must be determined before any part of the water-piping system can be sized, is the probable rate of flow in any particular reach of piping. The rate of flow in the service line, risers, and main branches, however, will rarely be equal to the sum of the rates of flow of all connected fixtures. In fact, the probability that every fixture in a large group will be in use at the same time is so remote that it would be very poor engineering practice to design the piping to take care of such simultaneous flow.

The demand load in building water supply systems cannot be determined exactly and is not readily standardized. The two main problems to be considered are: (1) the satisfactory supply of water for a given fixture, and (2) the number of fixtures which may be assumed to be in use at the same time.

The minimum flow that will be satisfactory to the consumer depends greatly on the consumer, his standard of living, his professional needs, size of family, garden requirements, and similar factors. Depending on these factors, the per capita water consumption for domestic use usually varies between 20 and 80 gal per day. Experience indicates that the type of dwelling also has considerable influence on the water consumption.

In *apartment houses* the per capita daily water consumption is generally higher than in single-family houses. This is due to the use of a central metering system which is not conducive to the saving of water, and to the long hot water lines which cause high heat losses and an increase in the wasting of the cooled water. In designing water supply systems for apartment houses, a daily per capita water consumption of 50 gal may be considered a safe design figure.

Although a considerable number of *housing projects* have been developed throughout the United States, conclusive water consumption data have not yet been gathered. Nevertheless, it seems that the daily per capita water consumption in housing projects falls in between the consumption in apartment houses and that in single dwellings at the same geographical location.