			Maximum Heat Flow Rate (Btu/Hr.)		
Test No.	Insulation	Windows	Steady-State Calculation Method	Dynamic Response Calculation Method	Measured Heat Flow
1	none	single-glazed	15,135	11,558	11,372
2	inside	single-glazed	4,470	2,814	2,748
3	outside	single-glazed	4,748	3,047	2,811
4	outside	double-glazed	4,499	2,525	2,700
5§	outside	double-glazed	8,150	6,144	6,321

§ Range of temperature limits increased.

Figure 8-30 Test results of measured heat flow compared to steady-state and dynamic response calculation methods. (*From National Concrete Masonry Association,* TEK Bulletin 58, *NCMA, Herndon, VA.*)

equation. Researchers recognized the need for a simpler method of hand calculation that would make the concept of thermal inertia more readily usable. In response to this need, the Masonry Industry Committee sponsored a study by the engineering firm of Hankins and Anderson that resulted in development of the *M* factor, a simplified correction factor expressing the effects of mass on heat flow.

The *M* factor is not a new calculation procedure, but is simply used to modify steady-state calculations to account for the effect of wall mass. The *M* factor is a dimensionless correction factor. It is not a direct measure of the thermal storage capacity of walls. It is defined as the ratio of the cooling or heating load calculated by dynamic response methods to that computed with standard ASHRAE calculation methods.

The modifiers were plotted on a graph with variables of wall weight and number of degree-days (*see Fig. 8-31*). When the wall weight is very light, and in areas where the number of degree-days is high (colder climates), the *M* factors approach 1.0 (no correction). Ambient conditions in cold climates more closely approximate a steady-state condition and the traditional *U*-factor evaluation for heat loss is more accurate than for warmer regions. *The M factors from the curves modify only heat-loss calculations and should not be used in cooling calculations.* The *M* factor is a simple means of quantifying the effect of thermal inertia on heat-loss calculations without the aid of a computer. It permits a more accurate prediction of dynamic thermal performance than steady-state methods, and is deliberately conservative. In very cold climates, one can give a credit of about 10% to a heavy wall, where the more detailed computer calculations indicate a much greater actual benefit. The results of some computer calculations for various wall weights are shown in *Fig. 8-32.* The difference between the static and dynamic methods was approximately 20% for the lightweight structure, and about 30% for the heaviest wall. The relationships of heating load to wall weight determined in this and other studies appear to validate the accuracy of the *M*-factor concept.

8.6 ADDED INSULATION

The thermal performance of masonry walls and their resistance to heat flow can be further improved by adding insulation. In severe winter climates where diurnal temperature cycles are of minimum amplitude, the thermal inertia of brick and block walls can be complemented by the use of resistance insulation such as loose fill or rigid board materials (*see Fig. 8-33*). Hollow

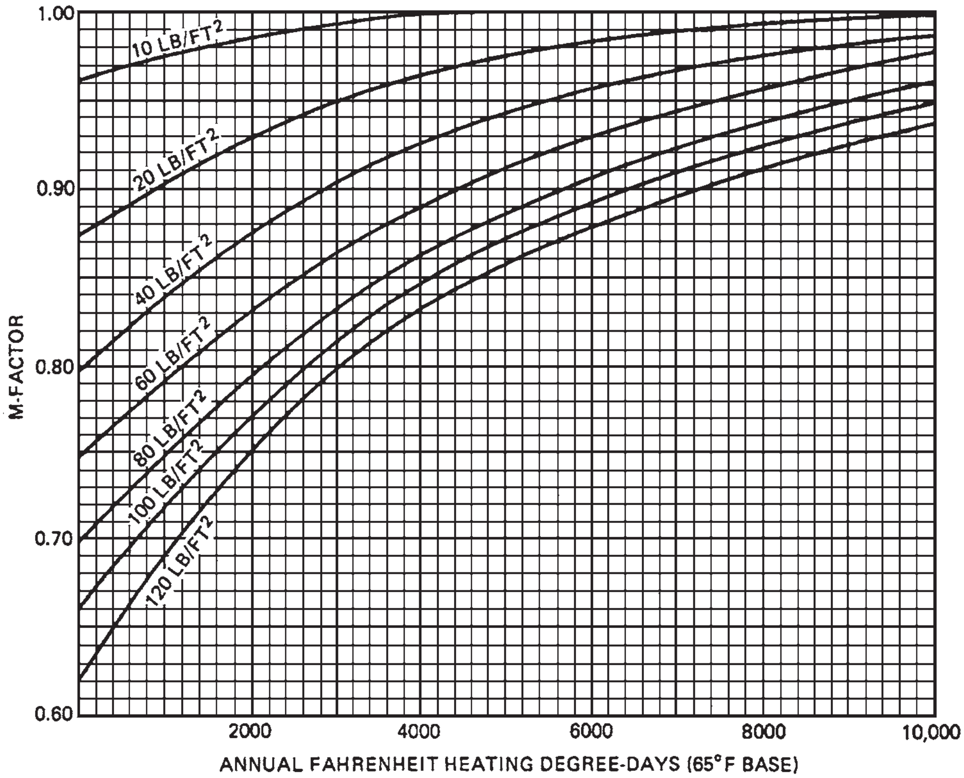

Figure 8-31 Thermal storage capacity correction graph for heat-loss calculations—*M*-factor curves. (*From Brick Industry Association,* Technical Note 4B, *BIA, Reston, VA.*)

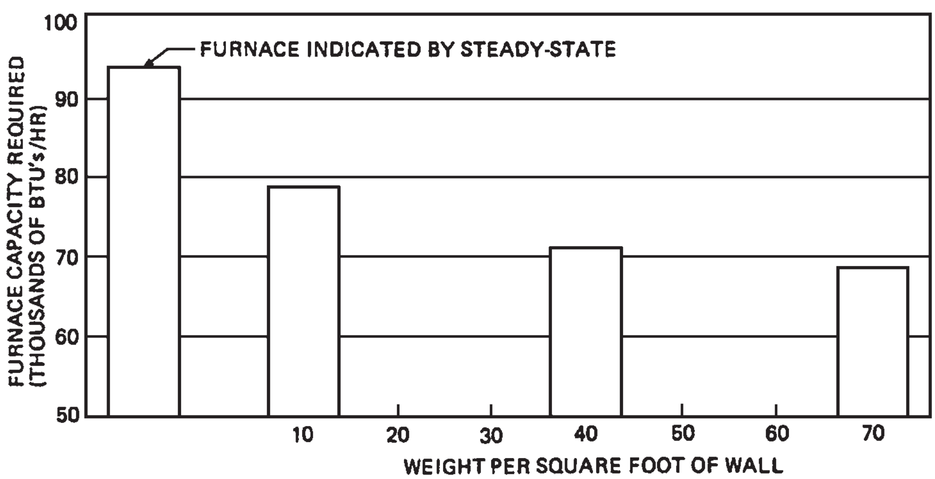

Figure 8-32 Furnace size required for heating load is reduced as weight of wall increases. (*From National Concrete Masonry Association,* TEK Bulletin 82, *NCMA, Herndon, VA.*)

units can easily be insulated with loose fill or granular materials, and multi-wythe cavity walls and veneer walls over wood or metal frame construction have open cavities for rigid insulating boards (*see Fig. 8-34*). The proper selection of insulating materials for masonry walls depends on more than just thermal performance.