In framed buildings, structural steel and reinforced concrete are the two alternative materials. Structural steel frames were previously used in Calcutta area for multi-storeyed buildings. But now, for reasons of economy, reinforced concrete has replaced structural steel in the construction of multi-storeyed buildings of medium height. With the introduction of shear walls and shear cores, reinforced concrete systems are working out well for tall buildings as well. Further, a reinforced concrete structure has better fire resistance than that of a steel structure. So, in the present scene, brick and reinforced concrete are the two most prevalent structural materials in building construction.

1.3 LOADS

1.3.1 Vertical Loads

Structurally speaking, buildings are built to support loads. The load, which is ever present and ever acting on a building, is the dead load which consists of the self-weight of members, finishes, plaster, etc. Dead load should be calculated very accurately, as it comprises most of the building load. IS:1911-1967[1]* gives a schedule of unit weights of building materials and it is used extensively to calculate the dead load.

Next in importance to dead load, is the live load, which is caused by the use of building. Live loads are given in IS:875.[2] Live loads are generally high (150 kg/m^2 to 1000 kg/m^2) on floors depending on the activity that is carried on there, while it is of a low value (75 kg/m^2 to 150 kg/m^2) on a roof, which may or may not be accessible. Snow loads on roofs in hilly areas are also specified in IS:875. In snow-incident areas, roofs are to be made sloping so that snow cannot get accumulated to a great height. IS:875 gives the loading due to snow at 2.5 kg/m^2 per cm depth of snow. With 30 cm snow depth, the snow loading will work out to be 75 kg/m^2, which may be reasonable for sloping roofs.

Partition loads are also important to be considered. Wooden or similar light-weight partitions anywhere on a floor give a general loading of 100 kg/m^2 of floor area. But in most buildings, 115 mm thick brick walls are arranged to divide space, this gives a heavier loading on the floor. IS:875[2] gives the partition walls loading at one-third the weight of 1.0 m run of the partition wall. For 115 mm thick brick walls of 3.0 m height anywhere, the equivalent loading works out to be $(0.115 \times 1.0 \times 3.0 \times 1900)/3 = 218.5$ kg/m^2 of the floor area. For 230 mm thick brick walls, we generally take care to provide beams to support directly such walls. In multi-storeyed buildings, 115 mm

* The numerals refer to the serial number of references given in Appendix I at the end of the book.

thick brick walls anywhere add substantially to the load of the building and it affects the design of slabs, beams, columns and footings too. But in the present practice, for flexibility in the use of the building, this provision is made in most buildings and wherever possible, 115 mm thick brick walls should be replaced by wooden partitions to achieve lighter partition loading, which finally leads to economy in structural design. In practice, wooden partitions are provided in office buildings, while in hospitals and institutional buildings , 115 mm thick brick walls are used as partition walls.

1.3.2 Temperature and Shrinkage Loading

Temperature and shrinkage also act on a building and these can also be regarded as a load on it. Shrinkage is equivalent to –15 °C, where negative stands for fall of temperature.[3] The temperature differential is taken at $\pm\frac{2}{3}(t_1 - t_2)$, where t_1 and t_2 are the maximum and the minimum temperatures observed in a day (24 hours) for a given place or locality.[4] Fall of temperature together with shrinkage will govern the design, while the rise of temperature will be substantially reduced in effect by the action of shrinkage. The design temperature differential is given by the Indian Road Congress[5] at ±17 °C for moderate climates and at ±25 °C for extreme climates. The combined effect of temperature and shrinkage is given below:

For moderate climates: $\pm 17 - 15 = +2, -32$ (°C)
For extreme climates: $\pm 25 - 15 = +10, -40$ (°C)

IS:456 1978[6] (hereafter called simply the Code) states in its clause number 17.5.1 that "in ordinary buildings, effect due to temperature fluctuations and shrinkage and creep can be ignored in the design calculations". It is, however, not explained,[7] what is meant by an ordinary building. It is, of course, clear that temperature and shrinkage loading has an effect on the design of long concrete buildings,[8] which can be neglected if the length of building is restricted to 45 m (clause 26.3 of the Code). Thus, it can be surmised that temperature and shrinkage effect can be neglected in short-length buildings. It is also seen that by providing minimum specified steel percentages in concrete members, temperature and shrinkage effects can be absorbed in short-length buildings, while in long concrete buildings, these members have to be designed for this extra loading or a long building has to be cut up in two or more short-length buildings. Further, this loading can be made use of in the evaluation of the gap of an expansion joint.[8]

1.3.3 Wind Loading

Dead and live loads are vertical or gravity loads, while wind and earthquake