and are provided with windows they admit considerable light, but if the building is high and wide, monitor windows usually do not admit a satisfactory light.

A better type of roof, where light is essential, is the sawtooth roof. This roof is made up of a series of pitched roofs, rising towards the north and stepping down with a vertical step, in which windows are installed. These windows, facing towards the north, admit a diffused light, which illuminates the floor below without casting shadows. If the windows in the sawtooth construction are arranged to swing, they provide as good ventilation as the old monitor type. The disadvantage with sawtooth construction is that it presents a number of valleys where snow may lodge. In some cases steam pipes have been installed to melt the snow. This serves the purpose, but is rather expensive. In buildings where there is considerable steam in the air condensation gutters are necessary under monitor and sawtooth windows.

Roof.—The most unsatisfactory problem in shop building is probably the roof. It first must be watertight; second, if the building is to be heated in winter, it must be of such material that condensation will not occur on the under side; third, it should be fireproof; fourth, it must compete with a large number of cheap roofs which are lacking in one or all of these qualifications. A standard roof construction consists of three-inch hollow book tile, laid on steel tees. This tile is covered with some good prepared roofing, which is cemented and tacked to the tile. This roof is very expensive, but it fulfills all the requirements stated above. It costs, including supports, about thirty cents per square foot.

Another good roof is 2-inch dressed and matched sheathing, laid on wood or steel purlins and covered with a good prepared roofing. It is just as good and much cheaper than a book tile roof, but, of course, is not fireproof. It will cost about 20 cents per sq. ft., including supports.

In some instances a thin concrete slab laid on steel or concrete purlins has been used. Considerable condensation occurs under such a roof in cold weather. Furthermore, it is very difficult to keep a tin roof slab from being damaged by frost while being laid in cold weather.

If the shop is not to be heated in winter time, corrugated iron laid on steel purlins makes a very inexpensive fireproof roof, costing about 12 cents per square foot in place, including supports. It is fairly watertight, but, of course, is very cold in winter.

There are, of course, many other kinds of roofs, but the price for any roof comes between the limits here given.

There is not so much choice in the materials of construction of the side walls of a building as the roof. They may be of brick, stone, concrete, corrugated iron or glass. In this vicinity brick is the most usual and satisfactory material. Buildings with high stories are usually made with steel frames, the walls being simply curtain walls bricked in between the columns. Hollow brick should be used for the inside layer of brick to prevent condensation of the side walls.

Concrete for side walls is more expensive and less satisfactory than brick. Concrete blocks are sometimes used, and are probably all right where enough cement is put in the blocks. Such walls are, however, weak, due to the lack of bonding between the blocks.

A 12-in. common brick wall in this part of the country will cost about 38 cents per sq. ft. in place. With a good facing brick and some architectural decoration the cost may be increased to from 40 to 60 cents per sq. ft.

In the modern factory building the question of material of the outside walls is not an important feature, because from 75 to 100 per cent. of the wall area is occupied with windows and doors. The old style shop building did not, as a rule, admit enough light. Our new buildings probably admit too much. It is a mistake to assume that a workman needs as much light to work by as there is out under the open sky. Too much light is almost as bad for the eyes as too little. Most of the inconvenience of working indoors comes from working with a strong light from one side which casts shadows. Windows should be so arranged that light will reach every point from at least two directions and be of as near the same intensity in both directions as possible.

Another question upon which there is usually some argument is the kind of windows to be used. The three types most in use are the standard wooden sash, the rolled steel sash and the fire underwriters' sash of sheet steel or copper. The underwriters' sash is very little used for shop buildings because of the expense. They will, however, greatly reduce the insurance rate upon such walls of the building as have a bad fire exposure.

The most satisfactory sash at the present time, for factory work, is the rolled steel sash. This is a comparatively new product, having been on the market for only a few years. Where large areas are to be glazed the small size of the steel muntins and mullions permits the maximum amount of light to enter the building. Several factories have been built with the side walls almost entirely of glass, the only obstructions in the walls being the columns and the brick work at the floor line. Steel sash have a few disadvantages which should be taken into consideration. The ventilation is usually secured by pivoting a part of the sash near the middle. In factories where screens are necessary it is not possible to have ventilation because the screen will not permit the ventilator to swing. In this northern climate storm sash are desirable because of the loss of heat through the glass by conduction. Steel sash are too heavy and too expensive to use for storm sash. If wooden sash be used the advantages obtained by the use of steel inside sash are lost.

The cheapest sash to use is undoubtedly the double hung wooden sash with which we are all familiar.

Four General Classes.—Factory buildings of more than one story naturally divide themselves into four general classes, according to the materials of which they are constructed. This classification is really made by the fire underwriters inasmuch as the different types take different insurance rates. In fact, the rate of insurance is the consideration which most often determines the type of construction.

These classes are, frame construction, slow burning timber construction, structural steel and reinforced concrete.

In the frame construction class should be included all buildings having either brick or timber walls, wherein the floors are of wood and the joists narrow and spaced close together. Such buildings are, of course, the cheapest which can be built. By far the larger number of the present factory buildings are of this type. When an industry is in an experimental stage and the process of manufacture and the machinery are likely to be changed with experience, it is more economical to build in this manner. If a building is anything more than a temporary structure the extreme fire hazard, the danger to employees upon the upper floors and the lack of rigidity for supporting machinery are disadvantages which should be taken into consideration.

In the slow-burning mill building construction, as described by the fire underwriters, the walls must be of