the supports of beams. The vertical shear is generally taken partly by the concrete and partly by the tension bars which run over the support. Horizontal shear is taken partly by the concrete, partly by the diagonal tension bars, and partly by stirrups.

Compressive stresses occur chiefly in the tops of beams and in columns. Compression in beams is almost always taken by the concrete alone. Compression in columns is taken partly by the concrete, partly by vertical steel bars. Vertical compression in columns induces a horizontal tension or bursting stress. Concrete is so weak in tension that a concrete column without reinforcement usually fails in tension, either by bursting or by buckling. The tendency to buckle is best resisted by vertical steel bars; the tendency to burst, by steel hoops or a steel spiral near the surface of the column.

One method of holding steel in place in a typical beam containing three tension bars is by stirrups that touch the forms only at two points and are, therefore, well protected against fire. The stirrup should not be relied upon to support the tension bars in place, but hangers should be used. As these hangers are of no further value after the concrete is in place, the fact that they are supported directly on the forms, and are thus not fireproofed is of no importance. The middle portion of the tension bars in beams and girders is thus held in place by hangers; the ends are held in place by being laced with wire to one another and to the vertical reinforcement in the columns. The bars in the floor slab are supported off the forms as follows: In order to obtain continuous action over beams every alternate tension bar in the floor slab is sprung up where it crosses a beam, being supported at the edge of each beam by a short piece of band iron about 1 1-2 inches narrower than the thickness of the floor slab, and bent to an angle of about 60 degrees, so that it will stand on edge by itself. In the middle of each span a bar runs at right angles to the tension bars, on top of the tension bars, and is held at any desired distance above the floor by staples into the floor cover and by the lifting tendency of the tension bars which are sprung up over the beams. The other tension bars are then raised from the floor by lacing them with wire to this central bar.

To insure fireproofing in columns, four sticks are used in tamping the concrete columns, and these sticks are run down one on each side of the column between the hoop or spiral reinforcement and the form, thus insuring an amount of fireproofing equal at least to the thickness of the stick. The vertical reinforcement is placed inside the hoop or spiral reinforcement.

Third.—How to mix concrete well, by hand or machine, needs no discussion. How to place it well is another matter. In the case of floors the trick is simple. Concrete should not, unless it is absolutely necessary, be dumped from a wheelbarrow directly against the form but should be dumped on the soft concrete already in place. The mortar, flowing more freely than the stone, keeps always ahead of the mass, and stone falling in this mortar find a perfect bed; whereas if a barrowful of concrete is dumped into a dry beam the stone may become jammed between the forms and the steel and form a pocket into which the mortar will not enter.

A few years ago I visited a very large concrete job on which the old-fashioned specifications were in force —that concrete must be placed in thin layers. Nobody on the job seemed to know the trick of placing concrete properly; and consequently the contractor, in order to obtain smooth workmanship, was placing an inch or two of clear mortar in the bottom of all beams and girders, before filling them with concrete. The expense entailed by this may be imagined.

The place to dump the first barrowful of concrete when starting a piece of floor is either on the floor slab or in a column. As long as the mass is kept moving it will be homogeneous, but if it is allowed to set in a diagonal shape two evil results will follow: First, the cement and water, the most fluid part of the mass, will flow forward leaving behind a layer consisting chiefly of sand, with which the concrete, subsequently placed, will not mix, and which has very little value as fireproofing; second, the scum which rises to the surface of wet concrete, containing as it does the finest dust present in the sand and stone, sets with a very smooth, glassy surface to which fresh concrete will not adhere. This joint, therefore, if work is stopped on it long enough to allow the scum to harden, will be very weak in shear and tension.

In concreting columns it is necessary to proceed slowly at the bottom of the column and to tamp the first foot with great care. After the mortar flushes to the surface over the entire section of the column, there is little danger of voids veing left in the part of the column above the first foot if a sufficiently wet mixture is used. Walls should be similarly handled.

Economy in Handling Materials.—The exterior column is usually made square for architectural reasons. The interior column is octagonal, partly for architectural reasons, partly to save concrete. This saving is due to the fact that in a column reinforced with a spiral, the concrete outside the spiral is not figured as adding compressive strength to the column, and, therefore, if this column is square, the concrete in its four corners is wasted. Of course, the question arises whether the concrete saved pays for the additional carpenter work. As a rule, the two items almost counterbalance each other, so that the matter of appearance is more important than the matter of economy.

Two opposite sides of the column are held together by bolts; the other two opposite sides, by hardwood wedges between the bolts and the forms as close as possible to the end of the bolt. In some cases the sides are made up of narrow strips, to facilitate the reduction in size of the columns from floor to floor. In warm weather there is no need of having more column forms than one complete set for one storey, even when work is progressing at the rate of a storey in five or six days. In a ten-storey building each column form is then used ten times, once in each storey. Each of these narrow strips represents the reduction in diameter