## what they are doing

supports has neither tension nor compression in the fibres at the end of the beam; the horizontal tension and compression found at the centre of the beam entirely disappear by the time the end of the beam is reached. This, of course, is done by transferring the tensile stress in the steel at the bottom of the beam to the compressive fibres in the top and this by means of the intermediate concrete. Therefore it follows, that for this reason the cement or concrete used must be of a proportion and strength to corroborate with the elastic test of the steel, and yet give sufficient adhesion to prevent slipppping.

Going further into the question of "re-enforced" with plain bars, it might be advisable to make an example to prove the above statements.

A bar, one inch square in the middle of a beam will be, practically speaking, under a tension of 15,000 pounds to the square inch the bar being one inch square, the actual tension is 15,000 pounds. At a point one inch beyond the centre the movement in the beam is reduced to an extent that the tension in the bar is 14,900 pounds; this means that 100 pounds pull has been taken up by the concrete. The surface for the length of one inch equals 4 square inches, which shows an adhesion of 25 lbs. per sq. inch between the steel and the concrete, and this figured out for the total length of the bar would tend to prove that the plain bar has even a surplus over the maximum coefficient of safety. The adhesion between plain bars and concrete, when the work is properly executed, is considerably greater than this, consequently there is little question as to the bond in, or near the centre of the beam, although it is obvious that the adhesion will decrease as it nears the end of the beam. Even taking this into consideration for all ordinary purposes, the plain bar is "good".

It is possible, however, that long continued vibration such as is experienced in many kinds of factories will lessen the adhesion on plain bars. In this case the deformed steel might be used to better advantage, but it is a question if any better results will be obtained. It is very evident that the deformed bar will not pull through so easily, but if the adhesion is gone, the reenforcing qualities do not exist any longer, no matter what the shape of the steel may be.

Microspopical examination of the surface of steel and concrete which has been moulded around it, shows that the adhesion chiefly depends on the roughness or porous nature of the steel, the cement entering into the indentations of the metal and thus forming a bond.

There is no intention whatever to argue the merits of any patent bar and it is possible that time will reveal their merits. Also positive information is lacking as to the permanency of adhesion of either, owing to the fact that there are comparitively few re-enforced structures which have been built for a very long period of years. In any case, whichever method is used, the applicability of all formulae to determine the strength of a structure is dependent, not only on the quality of the steel and the concrete, but also on a thorough apprehension of the behavior of both when in bond. If this is known with other minor details, it must follow that the structure is perfect, or if not perfect, at least fulfils the requirements called for at the lowest possible cost.