the total resistance of the hooped material per unit of area will then be

$$= u + u.f.s.r.$$
$$= u\,[1 + f.s.r.].$$

Let cp = the working compressive stress on a prism of concrete (not hooped) = Wfu.

Wf = the working factor = cp/u.

Then the safe compressive stress on the hooped core = c, where

$$c \quad Wfu\ [1 + f.o.s.r.].$$
$$= cp\ [1 + f.s.r.].$$

The values of f, s and their product may be obtained from the following table:

Form of lateral reinforcement.	Form factor = f.	Spacing of laterals in terms of diameter of hooped core.	Spacing factor = s.	Value of f s.
Helical	1	0.2d	32	32
Helical	1	0.3d	24	24
Helical	1	0.4d	16	16
Circular hoops	0.75	0.2d	32	24
Circular hoops	0.75	3.3d	24	18
Circular hoops	0.75	0.4d	16	12
Rectilinear	0.5	0.2d	32	16
Rectilinear	0.5	0.3d	24	12
Rectilinear	0.5	0.4d	16	8
Rectilinaer	0.5	0.5d	8	4
Rectilinear	0.5	0.6d	0	0

Let p = the pitch of the laterals in inches [i. e., the axial spacing of the laterals].

d = the effective diameter of the hooped core in inches.

The spacing factor should not be taken at more than 32, even if p is less than .2d, but intermediate values of the spacing factor may be obtained from the equation,

$$s = 48 - 80\frac{p}{d}$$

It will be seen from the above table that the advantage of hooping disappears with an increase in the spacing of the laterals, irrespective of the volume of hooping or the value of r.

Before the safe stress on the hooped core can be obtained it will be necessary to give values to Wf and u. A table for this purpose will be found below.

The value of the working compressive stress on the concrete of the hooped core having been obtained, the maximum permissible pressure or load may be obtained from the equation:

$$P = c\ [A + (m - 1)\ Av],\ \text{where}$$

A = the effective area of the pillar.

$$m = \frac{Es}{Ec} = \text{modular ratio}$$

Av = Area of vertical reinforcement.

P = total safe pressure on pillar.

Working Stresses.

A safety factor of 4 at 90 days is recommended for all pillars.

The following table of working stresses is suitable if good materials are used, and is based on the assumption that test cubes have at least the strength given at the periods stated:

Table Showing the Value of u and C p for Pillars.

Proportions of concrete measured by volume.	Pounds of cement to 13½ cu. ft. of sand and 27 cu. ft. of shingles or broken stones.	Value of u at 28 days in pounds per sq. in.	Value of u at 90 days in pounds per sq. in.	Value of C p at 90 days in pounds per sq. in. (safety factor = 4) (working factor = ¼).
1 : 2 : 4	610	1,800	2,400	600
1 : 1½ : 3	810	2,100	2,800	700
1 : 1 : 2	1,220	2,700	3,600	900

It is assumed that the tests of the strength of the concrete are made on unrammed cubes and of the same consistency as the concrete used on the work.*

Limitation of Stress on Pillars.

The following limits of stress should be observed in pillars:

(a) The stress on the metal reinforcement (i. e., the value of m. c.) should not exceed 0.5 of the yield point of the metal.

(b) Whatever the percentage of lateral reinforcement the working stress on the concrete of pillars should not exceed (0.34 + 0.32 f) u where

f = form factor.

u = ultimate crushing resistance of the concrete.

Form of Laterals.	Form Factor.	Value of (0.34 + 0.42f) u.
Rectilinear	0.5	0.5 u
Independent circular hoops	0.75	0.58 u
Helical	1.00	0.66 u

If these limits are adopted, the working stress on hooped concrete will always fall within the "limit of continued endurance" for plain concrete.

Pillars Eccentrically Loaded.

If a pillar initially straight is loaded eccentrically, as when a beam rests on a bracket attached to the pillar, it may be regarded as fixed at the base and free at the loaded end. Then it must bend in the plane passing through the load, the deflection at the top being dn. Let e be the eccentricity of the load measured from the center of the pillar when straight. Then the bending moment at the base of the pillar is W (dn + e). But it is known that dn will be small compared with e, provided that W is small compared with $2EI/l^2$, and this will be the case in such conditions as are likely to occur in designing concrete pillars. Then the bending moment may be taken as We, and the extreme "fibre" stress at the edge of the base of the pillar, treating it as homogeneous, will be

$$f = W\left\{\frac{1}{A} \pm \frac{e}{S_m}\right.$$

very nearly, where A is the whole section of the pillar and Sm the section modulus relatively to an axis through the centre of gravity and at right angles to the plane of bending.

In dealing with reinforced pillars which are not homogeneous, it is convenient to substitute for the actual section of the pillar what may be termed the equivalent section, or section of concrete equivalent in resistance to the actual pillar. If A is the effective area of section of the pillar (including the area of reinforcement), and Av is the area of vertical reinforcement, then the equivalent section is

$$Ae = A + (m - 1)\ Av.$$

*The limit of 2,400 lbs. per sq. in. given in the previous report of the committee was adopted on the assumption that the cubes would be rammed with iron rammers under laboratory conditions.