be determined. [**Appendices to the report give a statement of some rules which have been used in determining the strength of slabs.**]

Shear Reinforcement.

It is always desirable to provide reinforcement to resist the shearing and diagonal tension stresses in reinforced concrete beams. The diagonal tension stresses depend on the vertical and horizontal shear, and also on the longitudinal tension at the point considered. As the longitudinal tension in the concrete at any given point is very uncertain, the amount and direction of the diagonal tension cannot be exactly determined.

It is the general practice to determine the necessary reinforcement by taking the vertical and horizontal shearing only into consideration.

The following equations may be used to determine the necessary resistance to shearing.

When S, the total shear in lb. at a vertical section, does not exceed 60ba, no shear reinforcement is required.*

When S exceeds 60ba, vertical shear members may be provided to take the excess and proportioned by the following rule:—

$$\frac{As \, . \, ss \, . \, a}{p} = S - 60ba$$

or

$$As = \frac{(S - 60ba) \, p}{a \, ss};$$

where s^s is the unit resistance of the steel to shearing, and p is the pitch, or distance apart of the vertical shear members or groups of shear members, of area As.

In the case of T beams b^s, should be substituted for b.

In important cases, when extra security is required, the resistance of the concrete to shear, represented by 60ba, should be disregarded.

When the shear members are inclined at an angle of about 45° to the horizontal, the area As may be decreased in the proportion of $\frac{1}{\sqrt{2}}$.

These equations, though based on somewhat uncertain assumptions, give reasonable results. But experience shows that:—

(a) In general, floor slabs require no special reinforcement against shearing, and that the bending up of alternate bars near the end is sufficient.

(b) In beams, especially in T beams, shearing reinforcement should be provided at distances apart not exceeding the depth of the beam.

(c) It is desirable to bend up one or more of the bars of the tension reinforcement near the supports. When bent at an angle of about 45° the effect of this may be taken into account in the manner set out above; when bent at a small angle to the horizontal the effect is very indeterminate.

(d) As the resistance of the shear members to the pull depends on the adhesion and the anchorage at the ends, it is desirable to use bars of small diameter, and to anchor the stirrups at both their ends. In all cases the stirrups must be taken well beyond the centre of compression.

Pillars and Pieces Under Direct Thrust.

Definition.

The length is to be measured between lateral supports (neglecting ordinary bracketing).

The effective diameter of a pillar means the least width and should be measured to the outside of the outermost vertical reinforcement.

The effective area of a pillar means the area contained by the outermost lateral reinforcement, and should be measured to the outside of the outermost vertical reinforcement.

Loading and Length of Pillars:—

If the load is strictly axial the stress is uniform on all cross-sections.

Lateral bending of the pillar as a whole is not to be feared, provided:—

(a) That the ratio of length to least outside diameter does not exceed 18.

(b) That the stress on the concrete does not exceed the permissible working stress for the given pillar.

(c) That the load be central.

(d) That the pillar be laterally supported at the top and base.

Construction.

Lateral reinforcement properly disposed raises the ultimate strength and increases the security against sudden failure, by preventing the lateral expansion of the concrete and the sudden disruption of the pillar.

Practical considerations lead to the addition of longitudinal bars, and the formation of an enveloping network of steel.

The total cross-sectional area of the vertical reinforcement should never be less than 0.8 per cent. of the area of the hooped core.

There should be at least six vertical bars when curvilinear laterals are used, and four for square pillars having rectilinear laterals.

In the case of rectangular pillars in which the ratio between the greater and the lesser width (measured to the outside of the vertical bars) exceeds one and a half the cross-section of the pillars should be subdivided by cross-ties; and the number of vertical bars should be such that the distance between the vertical bars along the longer side of the rectangle should not exceed the distance between the bars along the shorter side of the rectangle.

The most efficient disposition of the lateral reinforcement would appear to be in the form of a cylindrical helix, the pitch or distance between the coils being small enough to resist the lateral expansion of the concrete.

(Continued Next Week).

The Canadian Northern Railway Company has at present actually under contract 1,823 miles of railway in Canada, and as soon as the location surveys in British Columbia are completed the mileage will be increased to 2,215. This development is remarkable. It means that before the close of the present year the company will have under construction a mileage nearly if not quite equal to one-sixth of the present railway mileage of Canada.

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*The value of Sp is shown in the appendix to be $\frac{B_1 - B_2}{a}$