using the subgrade drag formula, or for structural strength, using common reinforced concrete design procedures.

Regardless of the intended purpose of the reinforcement, it must be structurally stiff (strong enough to support working loads) and/or widely spaced (individual elements spaced wide enough so that workers can walk between them). Further, it must be supported at the proper position, so as to provide its intended advantages. All requirements for a quality slab-on-grade should be detailed and clearly shown on the design drawings.

DESIGN EXAMPLES

These design examples illustrate the selection of reinforcing steel for the purposes of controlling cracks caused by shrinkage. The subgrade drag equation is used for calculation of the steel areas, which are determined here for both a common joint spacing as well as for a wide joint spacing. The reinforcing steel is not to be continuous through any of the contraction or construction joints. This holds for both wires and bars.

The amount of reinforcement required is estimated on the basis of the subgrade friction drag theory which equates the tensile force in the steel to the force required to overcome the subgrade friction.

$$A_s f_s = W (L/2) F$$

For these design examples, assume that a 200mm slab is required. Column spacings are 16m center-to-center and construction joints will have this spacing for strip placement of the concrete.

1. 8m JOINT SPACINGS:

This joint spacing, commonly encountered in the field, of 8m using a saw-cut contraction joint, may be reinforced with **bars** (CSA G30.12 or G30.16) or **welded wire fabric** (CSA G30.5 or G30.15). The appropriate areas are selected using the subgrade equation as follows:

- **For Grade 400 reinforcing bars:**

A_s = F L w / 2 f_s where F (friction factor) = 1.5 (commonly used value), L = 8m, * w = 4720 N/m^2 and f_s = 2/3 f_y where f_y is 400 MPa.

A_s = 107mm^2/m of slab width, required each way.

Use 10M bars at 500mm C.-C. in each direction, ie, maximum spacing allowed in CSA CAN3-A23.3, clause 7.83, A_s = 200mm^2/m.

* Based on a design density for reinforced concrete of 23.6kN/m^3.

- **For CSAG30.5 plain welded wire fabric:**

The subgrade drag equation is the same except for the use of f_y which is 450 MPa.

A_s = 95mm^2/m of slab width, required each way.

Use MW37.4 wire at 305mm spacings in each direction, designated as 305 x 305 MW37.4 x MW37.4 or 12 x 12 W5.8 x W5.8 equivalent to 6 x 6 6/6. Both styles are available as standard product.

2. 16m JOINT SPACINGS:

This is a wide joint spacing and could be considered as a "no joint" slab design. No saw-cut contraction joints are used longitudinally; however, if strip placement of the slab is used, then a contraction joint would be cut at 16m spacings transversely along the pour strip. In the subgrade drag equation, the length L is now 16m and the yield strength, f_y, is either 400 MPa (bars) or 485 MPa (deformed wire), as follows:

- **For Grade 400 reinforcing bars:**

A_s = F L w / 2 f_s where F = 1.5, L = 16m, w = 4720 N/m^2 and f_s is 2/3 f_y = 2/3 x 400 MPa = 266 MPa.

A_s = 213mm^2/m of slab width, each way.

Use 10M bars at 450mm spacings c.-c., each way.

- **For CSA G30.15 deformed welded wire fabric:**

The subgrade drag equation is the same except for the use of f_y which is 485 MPa.

A_s = 176mm^2/m of slab width, required each way.

Use MD58.1 wire at 305mm spacings in each direction designated as 305 x 305 MD58.1 x MD58.1 or 12 x 12 D4/D9.

The steel areas selected using the subgrade drag equation are for shrinkage (and temperature) effects. If the reinforcement is intended to be structurally active and to resist bending stresses produced by loading to the slab, then the subgrade drag equation is not appropriate.