

## RC Punching Shear Design

### Analysis:

Input data for the design is a force and an area over which the force acts, e.g. column section and column load.

### Design Procedure Checks:

1. Maximum shear stress at the face of the load:

$$v_{max} = V / u_0 d \leq 0.8\sqrt{f_{cu}} \text{ or } 5 \text{ N/mm}^2$$

where  $u_0$  is the perimeter of the load area

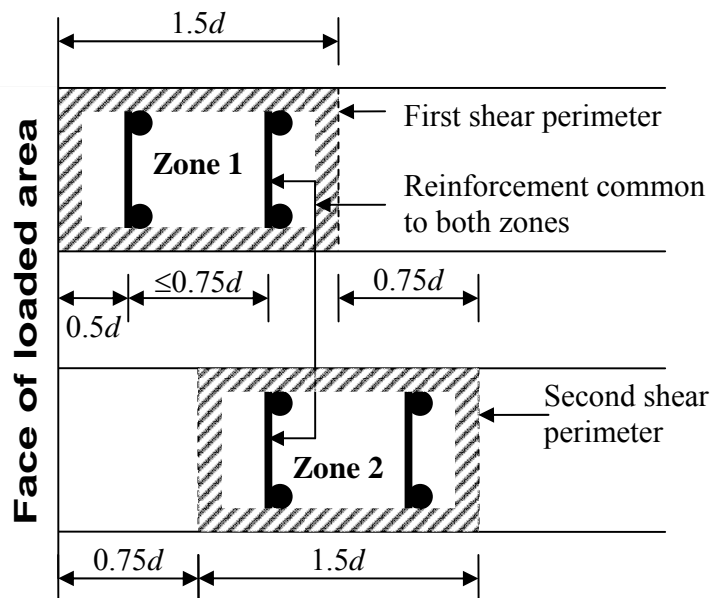
2. Shear stress at the critical section,  $1.5d$  from the face of the loaded area:

$$v = V / ud$$

$$u = 2a + 2b + 12d$$

where  $a$  and  $b$  are the plan dimensions of a rectangular load area. If:

- a)  $v \leq v_c$ : No shear reinforcement required.
  - b)  $v_c \leq v \leq 2v_c$ : Link reinforcement may be used.
  - c)  $v \geq 2v_c$ : Alternative proven system to be used.
3. If reinforcement is required on the critical perimeter above another perimeter is checked at a distance  $0.75d$  from the last. This procedure continues until  $v \leq v_c$  for the perimeter under consideration.



Definition of Zones and Reinforcement spacing requirements

**Reinforcement Design:**

The total amount of reinforcement required is:

a)  $v \leq 1.6v_c$ :

$$\Sigma A_{sv} \geq (v - v_c)ud / 0.95 f_{yv}$$

b)  $1.6v_c \leq v \leq 2v_c$ :

$$\Sigma A_{sv} \geq 5(0.7v - v_c)ud / 0.95 f_{yv}$$

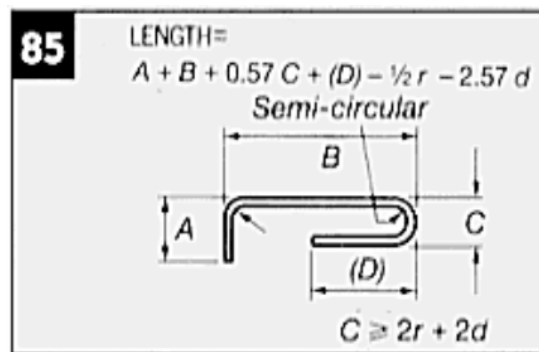
c) In either case:

$$\Sigma A_{sv} \geq 0.4ud / 0.95 f_{yv}$$

Referring to the previous diagram, the reinforcement is distributed evenly around the zone in 2 perimeters  $\leq 0.75d$  apart. The first perimeter cannot contain  $\leq 40\% \Sigma A_{sv}$  and is located about  $0.5d$  from the loaded area. The spacing of the reinforcement, on plan, around the perimeter  $\leq 1.5d$ .

**Arrangement of Reinforcement:**

Generally shape code 85 reinforcement is used in flat slabs. In other structures ordinary links may be used, however, save for flat slabs and pile-caps, punching shear reinforcement should not be required – the section should be of sufficient size not to require it – of course there may be exceptions to this.



As there will usually be top and bottom mats around the loaded area the spacing of the punching shear links should be chosen so that the mat spacing and the link locations coincide as much as is possible, subject to all the rules governing the rebar. Extra bars may be placed in order to facilitate hanging the shear links.