

Figure 4 In-Plane Forces

3.8 IN-PLANE FORCES

In-plane forces in panels generally result from lateral forces being transferred through bracing diaphragms to panels that act as shear walls. In these cases it is rare for the shear stress in the panel to be critical. The critical factor is usually stability of the compression edge of the panel and this should be checked for buckling due to induced axial loads.

The simplest method of checking for lateral buckling is to calculate the reaction induced at the base of the compressive end of the panel by the combined imposed axial loads and in-plane forces. This reaction can then be assumed to spread into the panel at 60° to the horizontal plane. If this edge is stable at the critical section under the combination of this load plus lateral loads then buckling will not occur. If not, a thickened edge or a thicker panel should be used **Figure 4**.

An alternative frequently used where single panels cannot carry the applied force is to connect adjacent panels together so that the compression edge of one panel is tied to the tension edge of another. In this case the fixings between panels must be designed to carry the induced vertical shear forces. (Note that the design of the fixing and panel will need also to consider the forces induced by shrinkage and thermal movements along the length of the wall.)

Panels with large openings and subjected to large in-plane forces should be regarded as frames within the wall plane and analysed accordingly.

Overturning and sliding of the panels due to in-plane forces should be checked, and where necessary ties provided to the footing or floor slab.

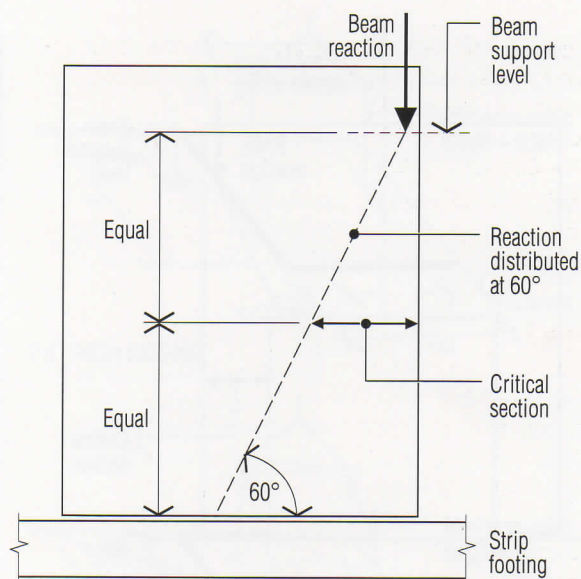


Figure 5 Concentrated Loads

3.9 CONCENTRATED LOADS

For design purposes, roof or floor loads that occur as concentrated reactions on the panels can be distributed over a length of panel at the critical design height.

The easiest and most direct method of evaluating this condition is based on the assumption that the reaction spreads into the panel at 60° to the horizontal plane **Figure 5**.

It follows that the design value for axial force decreases linearly from the top to bottom of the panel.

3.10 PANELS WITH OPENINGS

Where window or door openings occur within a panel, the imposed axial and lateral loads plus the self-weight of the entire panel must be carried on the section each side of the opening **Figure 6**.

An accurate analysis of this condition is possible only by use of finite-element methods or yield-line theory to establish applied bending moments.

For most situations an approximate analysis based on hand calculations combined with the use of the design charts will give results that are sufficiently accurate. This method involves dividing the panel into vertical and horizontal strips and checking each strip for the applied loads.

In order to restrict the possibility of local buckling at the edge of the opening, the effective height used in this check is to be based on the full panel height and not the opening height.

For narrow openings it is usually only necessary to increase the loads acting on the legs by the ratio of the total width to the leg width.

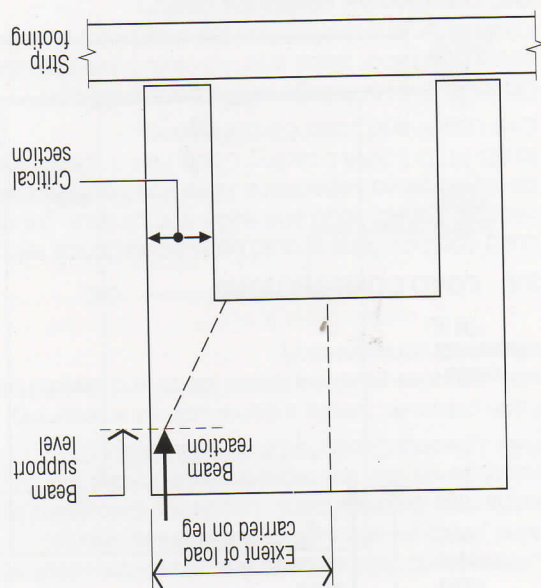


Figure 6 Panels with Openings

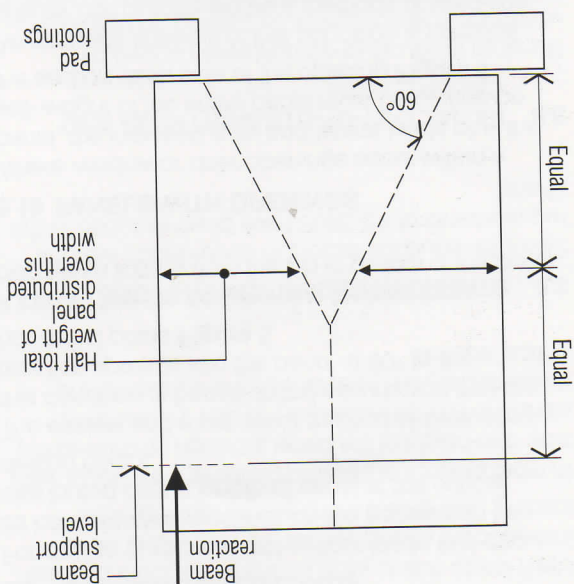


Figure 7 Effect of Isolated Footings

For wide openings it may be necessary to provide a thickened section (stiffening rib) at each vertical edge and a horizontal header beam at the top (and bottom) of the opening.

Where the ratio of leg width to panel thickness is less than three ($b/t_w > 3$) and loads are high, consideration should be given to designing the leg in accordance with the requirements of AS 3600

Section 10.

The design of stiffening ribs or integral columns can be treated in several ways.

If the concentrated load is small it may be sufficient to thicken the panel immediately below the load and to design this section to carry the applied loads in accordance with the design charts.

Alternatively, where concentrated loads are beyond the range of the charts, the thickened section of panel immediately below the load can be designed as a column in accordance with Section 10 of AS 3600. In this case, if compression is the controlling factor, confining ties are required to contain the compression reinforcement. It is usually more economical to increase the width or depth of the stiffening rib to ensure that bending is the controlling factor so that only flexural reinforcement is required.

Since shear stresses are usually relatively low it is seldom necessary to provide shear reinforcement.

3.12 STIFFENING RIBS

Where panels are supported on isolated footings it is necessary to allow for the effect of the concentrated reaction.

This is treated in a similar manner to a concentrated load at the top of the panel. In this case, the design value for axial force decreases linearly from the bottom to top of the panel **Figure 7**.

3.11 ISOLATED FOOTINGS

