DESIGN LOADS - READERS' VIEWS

Editor's Note: In our last issue was an announcement from SANZ about review of NZS 1900 Chapter 8 and an invitation to readers to offer their views for publication in the Bulletin. The first two contributions received appear below.

K. E. WILLIAMSON :-

I have for some time been concerned about the cost penalty on flat roofed structures designed for a live load of 15 lbs. per sq.ft. as required by Table 1, Section (1) (1) of Chapter 8, and I am writing to request that S.A.N.Z. consider a revision to the standard in which the live loads for roofs would be as required by the Standards Association of Australia in their publication SAA Int. 350, "Minimum Design Loads on Buildings", Clause 13 a (i), which reads :

"In the case of ordinary roofs, either flat or pitched, without access except for maintenance, and including in the case of roof principals, temporary stacking of a small quantity of roof sheeting on the roof surface during repair operations, 5 lb. per sq.ft. of horizontal projection, except that for any part having a span less than 36 ft. the distributed load shall be derived from the following formula :

$$W_L = \frac{200}{L + 4}$$

where,

W_L = distributed live load in lb. per sq.ft.

L = the span in feet "

A lesser roof live load than 15 lbs. per sq.ft. is already permitted for buildings designed according to Chapter 11, Division 11.2 of N.Z.S.S. 1900 but this live loading is seldom permitted to be applied.

The Australian rules appear reasonable and an immediate economy would result in many cases.

A. L. ANDREWS :-

Arbitrary rules appear in the earthquake provisions of N.Z.S. 1900 Chapter 8. Rules of this kind are needed now, and will continue to be needed until we have available rational explanations for earthquakes and for the forces they generate. Arbitrary rules must be more carefully framed than rational ones. They should contain explanation, not required when there is an accepted rational background, and they should neither obscure the problem they week to solve nor discourage investigation for better solutions.

Not all the arbitrary rules in the present standard measure up to these criteria. One example of a bad rule is clause 8.37 for "horizontal torsional moments" (i.e. moment about a vertical axis). It requires designers to provide for "the increase in shear resulting from torsion due to an eccentricity between the centre of mass and the centre of rigidity." Were it not that a further provision insists that "negative torsional shear shall not be used to offset positive translational shear," it would not have mattered that there is not, in general, a unique rigidity centre on any floor in a multi-storey building. The spirit of the provision could have been observed, notwithstanding imperfection in the wording, by analysing the building for earthquake simulating loads applied through the mass centres. However, from the result, it would not be possible to separate "negative torsional shear" from "positive translational shear."

It is essential to recognise that only in exceptional cases could there be a unique "centre of rigidity" on any floor of a multi-storey unsymmetrical structure. The reason is the dis-similarity of the shapes of flexural and shear deformation. Unless all frames and vertical resisting elements in an unsymmetrical arrangement with more than one lateral load level have identical flexural to shear displacement ratios in every storey there will be, on any floor, as many rigidity centres as there are storeys. Attempts to locate a single centre are doomed to failure, and are harmful because they demand faulty reasoning.

In single storey structures the "centre of rigidity" approach is justifiable. In certain other buildings, principally of low or medium height, it may be defensible provided it is used with discretion. But, because it is not a valid approach in general code provisions should not recognise it. In particular, it is unreasonable to demand separation of element load components in a way that can only be done by using this rigidity centre idea.

The last requirement of the clause, that "where vertical resisting elements depend on diaphragm action for shear distribution at any level, the elements resisting the shear shall be capable of resisting an additional torsional moment assumed to be equivalent to the storey shear acting with an eccentricity determined by adding 5 per cent of the maximum building dimension at that level to the computed eccentricity" also needs recasting to avoid reference to computed eccentricity.

A suggested change :-

(i) Add to clause 8.36.3 "Distribution of Lateral Force"

"At each load level the lateral load shall be assumed to act through the mass centroid."

(ii) Revise Clause 8.37 "Horizontal Torsional Moments"

"Where diaphragms are used to distribute lateral load to vertical resisting elements, there shall be applied at each diaphragm level a torsion equal to one twentieth of the product at that level of the greater building plan dimension and the earthquake simulating lateral load. For analysis of multistorey buildings, all torsional moments shall be considered to act in the same direction. For element design, the total torsion moment shall be considered to act in whichever direction is required to produce the worst effect on the element."

Other arbitrary provisions are equally faulty. It is to be hoped that the revision committee will examine critically each of the clauses in this category, eliminating or altering as necessary.