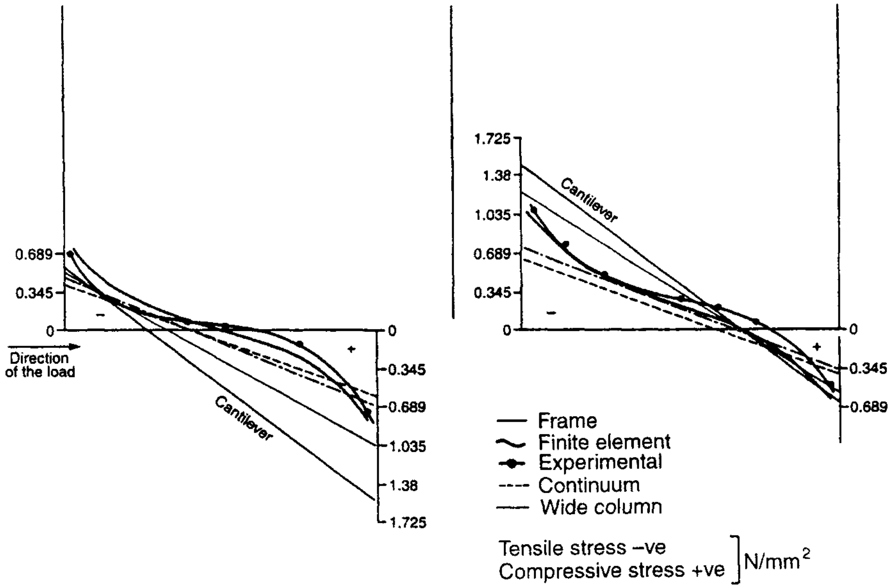

Fig. 6.6 Stress distribution across the shear walls at the base for an equivalent uniform load of 894 N/m^2 over the loaded face of the building (only one-half of the structure is shown).

6.4 LOAD DISTRIBUTION BETWEEN UNSYMMETRICALLY ARRANGED SHEAR WALLS

When a system of shear walls of uniform cross-section throughout their height is not symmetrical through either uneven spacing of walls or non-uniform distribution of mass, the resultant of the wind loads will not pass through the shear centre, i.e. the centroid of the moments of inertia, and a twisting moment will be applied to the building as illustrated in Fig. 6.7(a). Similarly, torsion will be induced in a symmetrical building, if the resultant of the applied forces does not pass through the shear centre.

The load W on the structure can be replaced by a load acting at the shear centre as in a symmetrical case, together with a twisting moment equal to We as in Fig. 6.7(b) or (c). In the case of symmetry, the load is distributed to each wall in proportion to its stiffness, since the deflection of walls must be the same at floor level. Hence

$$W_A = \frac{WI_A}{I_A + I_B + I_C} = \frac{WI_A}{\Sigma I} \tag{6.7}$$

$$W_B = \frac{WI_B}{\Sigma I}, \qquad W_C = \frac{WI_C}{\Sigma I} \tag{6.8}$$

Owing to twisting moment (We), the walls are subjected to further loading of magnitude W_A', W_B' and W_C' respectively. The loading in walls A and B will be *negative* and in wall C will be *positive.*

Assume the deflection of walls due to twisting moment is equal to Δ_a, Δ_b and Δ_c as shown in Fig. 6.8. As the floor is rigid,

$$\Delta_b = \Delta_a x_b / x_a \tag{6.9}$$

$$\Delta_c = \Delta_a x_c / x_a \tag{6.10}$$

Also

$$\Delta_a = W'_A h^3 / KEI_A \tag{6.11}$$

where K is the deflection constant and

$$\Delta_b = W'_B h^3 / KEI_B \tag{6.12}$$

Substituting the value of Δ_b from (6.9) and Δ_a from (6.11), we get

$$(\Delta_a / x_a)\, x_b = W_B h^3 / KEI_B$$

or

$$(x_b / x_a)\,(W'_A / I_A) = W_B / / I_B$$

or

$$W'_B = (W'_A I_B / I_A)\,(x_b / x_a) \tag{6.13}$$

Similarly,

$$W'_C = (W'_A I_C / I_A)\,(x_c / x_a) \tag{6.14}$$

Now the sum of the moments of all the forces about the shear centre of all the walls must be equal to the twisting moment. Hence

$$W'_A x_a + W'_B x_b + W'_C x_c = We$$

or

$$W'_A\,[x_a + (I_B / I_A)\,(x_b^2 / x_a) + (I_C / I_A)\,(x_c^2 / x_a)] = We$$