CHAPTER-14

DISCUSSION OF TEST RESULTS: (UNIAXIAL ECCENTRICITY)

14.1. Moment-curvature Diagrams:

The moment curvature diagrams for the series A, B, C, D confined with rectangular binders (ties) were similar to the moment curvature diagrams of the series I, J, K, L confined with rectangular helical binders. From the columns of these series, it is clear that the difference between rectangular binders (ties) and rectangular helical binders is practically not much with regard to curvatures. In the series H, the effect of high confinement and with considerable cover is that there is a significant increase in curvatures. The curvature at ultimate load is quite considerable in case of columns of the series, E, F, G, M, G0. The moment-curvature curves are fairly flat beyond ultimate load in case of high confinement i.e., when the pitch of the binder is small and also when the diameter of the binder is larger (Vide Fig. 12.1 to 12.15).

14.2: Load deflection diagrams:

The load-deflection relationships exhibit a behaviour similar to that of the moment-curvature relations. The increase in deflection with increase of binder steel (i.e., more confinement) is significant from the curves (Vide Fig. 12.16 to 12.29). There is not much marked difference in the behaviour of columns with rectangular binders (ties) over rectangular helical binders.
14.3: Influence of load level: The tendency of axial load is to reduce the deformation. It can be seen from the Tables 12.1 to 12.3 that ultimate curvatures and deflections are much reduced when the axial load is high for the same confinement. Further when the axial load is higher, there is a steep fall in the moment-curvature and load-deflection diagrams after the ultimate load but the corresponding curves in case of low axial loads are fairly flat. (Vide Fig. 12.1 to 12.29).

14.4: Type of failure: The columns experiencing tensile type of failure have deformed more compared to columns failed due to compressive failure for the same confinement (Vide Figs. 12.1 to 12.29).

14.5: Influence of binder spacing: The ultimate curvatures and deflections are relatively more when the spacing of binders is less for the same axial load. When the ultimate load is near the balance load, the type of failure is influenced by the binder spacing. The moment curvature diagrams and the load-deflection diagrams are fairly flat when the spacing of the binder is small.

14.6: Comparison of theoretical and experimental results:

14.6.1. Ultimate Loads:

The ultimate loads predicted by the confined concrete theory are less than experimental values in most of the columns.
The proposed confined concrete theory is conservative compared to Hognestad's theory (unconfined concrete theory) in predicting ultimate loads. As most of the deformations are available at 0.9 P_u or 0.85 P_u as being discussed below (Vide Tables 13.1 to 13.3), the predicted ultimate load is not so much conservative if these deformations (curvature or lateral deflections or strains) are to be considered.

14.6.2: Ultimate Curvatures:

The curvatures predicted by the proposed confined concrete theory are available only at 0.9 P_u or 0.85 P_u on the descending portion of the moment curvature curves. According to some investigators the curvatures or deflections can be taken into account up to 10 to 20% drop of the ultimate load (Vide references 36, 37, 38, 40). These curvatures could not be predicted by the Hognestad's unconfined concrete theory (Vide Tables 13.1, 13.2, 13.3).

14.6.3: Ultimate Strains:

The concrete strains on the compression face of the eccentrically loaded rectangular R.C. columns as per the predictions of the confined concrete theory are available only at 0.9 P_u or 0.85 P_u as in the curvatures. The Hognestad's unconfined concrete theory is assuming a constant ultimate strain of 0.0038. But the confined concrete theory assumes a varying ultimate strain depending
the confinement index $C_1$ and is true as per the experimental results (Vide Table 13.6).

14.6.4: Type of Binders:

There is not much difference between a rectangular binder (i.e., tie) or rectangular helical binder in improving the strength, curvature, lateral deflection or strains even in eccentrically loaded R.C. rectangular columns (Vide Tables 13.1 to 13.7). The assumption in the proposed confined concrete theory (Chapter 5 of the present work), that the difference between the simple rectangular binder and helical binder in improving the concrete properties is negligible and so is logical.

14.6.5: Percentage of Longitudinal Reinforcement:

Within the experimental range of using different percentages of longitudinal reinforcement (2 to 3.8%) the confined concrete theory is found to be valid.

14.6.6: Cover of concrete: In the present study the cover of concrete is not a main variable. However the buckling of longitudinal bars is presented in case of columns provided with greater cover (Vide Tables 12.1 to 12.3).

14.6.7: Type of failure:

In certain columns in which the compression type of failure is likely as per Hogestad's unconfined concrete theory, may be influenced by degree of confinement (i.e.,
value of $C_1$) so that the failure will be of tension type of failure. This is true only in case of the ultimate load level nearer to the balanced load (interaction relation). In other words, the load level should not exceed $P_u/f'_c BD = 0.5$ if the deformation is also a criterion in addition to strength (Vide references 40, 42).

14.6.8: Yield Curvature: The curvature corresponding to the first yielding of tension steel ($\varphi_y$) is computed based on the unconfined concrete theory as explained in section 13.6 of this work. The ductility factor i.e., $\varphi_u/\varphi_y$ depends on the load level for a given $C_1$ value. The greater the load level below the balanced point the lesser the ductility factor.