CHAPTER 7

CONCLUSIONS

7.1 GENERAL

Cold-formed channel sections of two different web depths and three thicknesses having the same flange width of 50 mm subjected to axial and eccentric compression on both positive and negative eccentricity for four different slenderness ratios was studied. The channels were tested with fixed-fixed end condition. The ultimate load predicted by IS: 801-1975, BS: 5950 (Part 5)-1987, NAS Manual -1996 were compared with the numerical investigation. Experiments were also conducted on CFC 150x50x2 mm for $\lambda = 40$ applying the load concentrically and eccentrically. The load versus axial shortening behaviour, load versus lateral deflection behaviour and load versus strain behaviour was studied for the specimens tested. Numerical investigations were carried out on different cross sections using a finite element program ABAQUS and the experimental studies were validated for the initial stiffness and the ultimate load carrying capacity with the experimental results. The following conclusions were drawn.

7.2 EXPERIMENTAL STUDY

- The ultimate load carrying capacity of axially loaded plain channels obtained from tests was found to be twice compared to the channel loaded with 40 mm positive eccentricity.
• The load carrying capacity of channels loaded through 40 mm negative eccentricity was 40% more than the capacity of the channel loaded through 40 mm positive eccentricity.

• The load versus axial shortening behaviour was linear upto 90% of the ultimate load for the channel tested.

• All the specimens exhibited compressive strains except for the specimen loaded through negative eccentricity.

• The initial stiffness of the channels loaded concentrically was two and a half times more than that of channels loaded through eccentricity either positive or negative.

### 7.3 NUMERICAL STUDY

• Sections with lower flat width to thickness ratios of both the stiffened and the unstiffened elements showed sudden increase in the load carrying capacity almost twice when the slenderness ratio was decreased from 120 to 40.

• Irrespective of the cross section when the loads were applied through the centroid, Finite Element Analysis overestimated the experimental ultimate loads by 15%, whereas if the channels were loaded through negative or positive eccentricity Finite Element Analysis overestimated the experimental ultimate loads upto 10%.

• For concentrically loaded channels and channels loaded through positive and negative eccentricity, the Finite Element Analysis prediction overestimated the experimental values of the order of about 5 to 18%. The North American Standards and the British Standards underestimated the Finite Element
Analysis values and experimental results upto 24% when the channels were loaded axially. When the loads were applied eccentrically, all the codes underestimated the experimental and Finite Element Analysis results upto 80%.

- The flexural buckling was triggered by local buckling for slenderness ratio between 80 and 120. Failure was by combined local buckling in the flanges and flexural buckling about minor axis for the slenderness ratio of 40 and 80.

- The mode of failure for sections having slenderness ratio 100 and 120 was predominantly by overall flexural buckling about the weak axis.

- The initial stiffness of the channels showed upto 95% decrease for channels loaded through positive eccentricity compared with axial loading.

- Prediction by the Finite Element Analysis overestimated the ultimate load predicted by all the Standards upto 90% irrespective of the cross sections.

- The Finite Element Analysis overestimated the North American Standards by 33% for concentrically loaded channels and for the eccentrically loaded specimens the variation is from 53 to 82%.
7.4 CODAL COMPARISIONS

- Channels show that the British Standards always underestimated the Finite Element Analysis whether the channel is loaded through positive, negative or no eccentricity upto 90%. The percentage of underestimation is less for channels loaded concentrically.

- The ultimate load predicted by the North American Standards always underestimated the Finite Element Analysis whether the section is loaded through positive, negative or no eccentricity. The percentage of underestimation is less for specimens loaded concentrically.

- Irrespective of the slenderness ratio and the eccentricity of loading, North American Standards underestimated the ultimate loads predicted by Finite Element Analysis upto 85%. Whereas the Indian Standards overestimated the FEA for channels loaded axially upto 20%.

- Irrespective of the standards whether North American Standards, Indian Standards and British Standards, Finite Element Analysis failed to predict the ultimate loads closely for channels loaded through large positive or negative eccentricities.
7.5 **SCOPE FOR FURTHER WORK**

- Similar experiments can be conducted on sections with different flange widths and the behaviour can be studied.

- Eccentricity along the strong axis can be chosen for different width and load can be applied through biaxial eccentricity and the behaviour can be studied.