CHAPTER 7

CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

7.1 CONCLUSIONS AND RECOMMENDATIONS

From the investigations carried out during this study, the following conclusions can be drawn and some recommendations can be made as follows:

1.The design drift limit for medium height steel moment resisting frames should not exceed 0.017 storey height for seismic zone A as proposed by DZ4203.

2.For frames less than six-storeys the design drift limit could be increased by 10%.

3.The proposal of DZ4203 for zones B and C for a design drift limit of Z/50 is conservative for steel moment resisting frames.

4.The limit of plastic hinge rotation for serviceability and for maintaining stability for the effects of strength degradation should not exceed 0.030 radians.

5.The limit of 0.020 of inelastic drift index under dynamic time-history analysis without considering P-delta effect gives satisfactory limit for the augmentation of P-delta effect.

6.The P-delta effect is negligible for design drift index of less than 0.015 for seismic zone A.

7.Strength degradation is negligible for a design drift index of less than 0.015 for seismic zone A.

8.The effect of vertical acceleration can be ignored within the limits described above.

9.The axial force amplification factor could be taken as 1.4 times the axial force from the combination of 1.2D +1.2Ls + E.

10.It is considered necessary to limit the displacement ductility factor to 3.0 and beam curvature ductility factor to 5.0 and column curvature ductility factor to 3.0 to prevent excessive plastic hinge rotation and premature strength degradation in medium height steel moment resisting frames.

7.2 SUGGESTIONS FOR FURTHER RESEARCH

The effect of P-delta on two-bay steel moment resisting frames was investigated as thoroughly as possible. However there are a number of areas of particular interest beyond the scope of this research project that can be investigated.

1.The sensitivity of modelling when using various steel yield stresses.

2.The joint flexibility model.

3.Plastic hinge rotation capacity and strength degradation of flanged beam types such as UB, UC section.

REFERENCES :

1. Andrews, A.L., "Slenderness Effects in Earthquake Resisting Frames", Bulletin of The New Zealand National Society for Earthquake Engineering, Vol.10, No.3, September 1977.

2. Butterworth,J.W., Spring, K.C.F, " Column Design ", Section D, New Zealand Steel Study Group, Bulletin of The New Zealand National Society for Earthquake Engineering, Vol.18, No.4, December 1985.

3. Carr, A. J., Moss, P. J. , "The Effects of Large Displacements on The Earthquake Response of Tall Concrete Frame Structures" , Bulletin of The New Zealand National Society for Earthquake Engineering, Vol.13, No.4, December 1980.

4. Carr, A. J., "RUAUMOKO", Computer Program Library, Department of Civil Engineering , University of Canterbury.

5. Carr, A.J., "SIMQKE", A Program for Artificial Motion Generation, Computer Program Library, Department of Civil Engineering, University of Canterbury, 1986.

6. Chrisp , D. P. , " Damping Models for Inelastic Structures", Master of Engineering Report, University of Canterbury, 1980.

7. Jury, R. D. , "Seismic Load Demands on Columns of Reinforced Concrete Multistorey Frames", Research Report No. 78-12, Department of Civil Engineering, University of Canterbury, 1978.

8. Lukey, A. F., Adams,P.F., "Rotation Capacity of Beams Under Moment Gradient", Journal ASCE, ST6, June 1969.

9. MacRae, G.A., "EPF", Two Dimensional Elasto-Plastic Frame Analysis Program, Department of Civil Engineering, University of Canterbury, 1987. Unpublished document.

10. MacRae, G.A., "FORP", Program for rapid determination of fundamental period and inter-storey drift for framed structures, 1987. Unpublished document.

11. Montgomery, C. J., "Influence of P-Delta Effects on Seismic Design", Canadian Journal of Civil Engineering, No.8, 1981.

12. Moss , P.J., Carr , A.J., Buchanan , A.H., " Seismic Response of Low Rise Buildings ", Research Report No. 86-15, Department of Civil Engineering, University of Canterbury, June 1986.

13. New Zealand Standard: "Code for Design of Steel Structures", NZ3404, 1977.

14. New Zealand Standard: "Code of Practice for General Structural Design and Design Loadings for Buildings", NZS4203, 1984.

15. New Zealand Standard: "General Structural Design and Design Loadings for Buildings", Draft for Comment, DZ4203, 1986.

16. Oscar de Buen, "Chapter 4 , Steel Structures" in "Design of Earthquake Resistant Structures" ed. E.Rosenblueth, Pentech Press, Plymouth, England, 1980.

17. Otani, S., " Hysteresis Models of Reinforced Concrete for Earthquake Response Analysis " , Journal of The Faculty of Engineering, The University of Tokyo (B), Vol.XXXVI, No.2 (1981).

18. Patton, R.N., "Analysis and Design Methods", Section B New Zealand Steel Study Group, Bulletin of The New-Zealand National Society for Earthquake Engineering, Vol.18, No.4, December 1985.

19. Paulay,T., "A Consideration of P-Delta Effects in Ductile Reinforced Concrete Frames" , Bulletin of The New Zealand National Society for Earthquake Engineering, Vol.11, No.3, September 1978.

20. Sharpe, R.D., " The Seismic Response of Inelastic Structures ", Research Report No.74-13, Department of Civil Engineering, University of Canterbury, 1974.

21. Tompkins, D. N., " The Seismic Response of Reinforced Concrete Multistorey Frames ", Research Report No.80-5, Department of Civil Engineering, University of Canterbury, 1980.

22. Turkington , D. H. , " Seismic Design of Bridges on Lead - Rubber Bearings " , Research Report No.87-2, Department of Civil Engineering , University of Canterbury, 1987.

23. Walpole,W.R., Butcher,G.W., " Beam Design ", Section C, New Zealand Steel Study Group, Bulletin of The New Zealand National Society for Earthquake Engineering, Vol.18, No.4, December 1985.