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Seismic Load Resisting Building Framing Systems of Large Precast Elements

Comportement aux séismes de structures préfabriquées en béton

Erdbebenbeanspruchte Stahlbetonrahmen in Grossfertigteilbauweise

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1. INTRODUCTION

New Zealand is located on the seismically active Pacific rim where the Indian and Pacific plates meet. Thus for multi-storey construction the loads from potential earthquake shaking are the dominant horizontal loads to be considered in design in all but the tallest buildings. Framing members for multi-storey buildings tend to be relatively large and reinforcing relatively congested in order to comply with New Zealand seismic design philosophy.

The most popular form of seismic load resisting systems in multi-storey buildings are reinforced concrete perimeter frames. There is relatively little structural steel used.

Recent multi-storey reinforced concrete buildings constructed in New Zealand have included substantial use of precast elements for major structural members.

2. BUILDING FRAMING SYSTEM

In this display the perimeter seismic load resisting frame of a 13 storey building in Wellington, New Zealand, is illustrated. The building is octagonal in plan with an area of approximately 860m^2 per floor. The major and minor axis of the octagon are 37.3m and 27.3m respectively. All facets of the octagon are nominally of equal length, with three columns located on each facet giving a total of 24 columns in the perimeter frame. The frame members were designed to the New Zealand Concrete Design Code (1) using capacity design for both beams and columns, the general principle being that the beams yield in flexure while shear in beams, and flexure and shear in columns, are maintained in the elastic range.

Figure 1 shows the partly erected perimeter frame. The precast units in the perimeter frame consist of a column member two storeys in height, with two levels of beam stubs cast as an integral part of the precast unit, see figure 2. This configuration gave the precast units an overall weight of approximately 11 tonnes.

The display shows details of the precast units, particularly the beam column joints, the cast-in-situ beam splices, and grouted column splices.

The insitu beam splices were detailed so that the reinforcing to be placed on site in the insitu section was minimal. The splice consisted of overlapping hooks on the longitudinal bars with stirrups that could be slid into position once the adjacent precast members were located.

The column splices were located at mid storey height to keep the splice region clear of the most highly stressed section of the columns. The reinforcing bars were joined using NMB splice tubes which are a steel sleeve filled with an epoxy grout. The same grout was used for the butt joint between column sections. The grouting operation for both the butt joint and the splice tubes was carried out concurrently once a full floor of precast units was erected and temporarily braced.

3. CONCLUSIONS

Precast reinforced concrete moment resisting frames are a viable alternative to more conventional cast-in-situ frames from the point of view of speed of erection and structural integrity.

4. ACKNOWLEDGEMENTS

The author wishes to thank the Aurora Group Limited for permission to present the details of the precast system illustrated in the display.

5. REFERENCES

NZS 3101 Part 1: 1982, "Code of Practice for the Design of Concrete Structures", Standards Association of New Zealand.

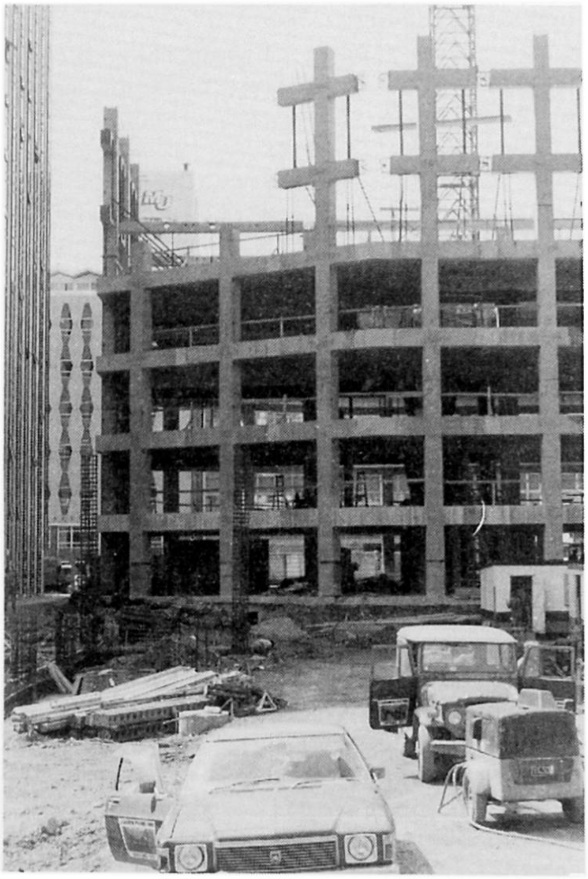

Fig 1. Partly Completed Perimeter Precast Frame

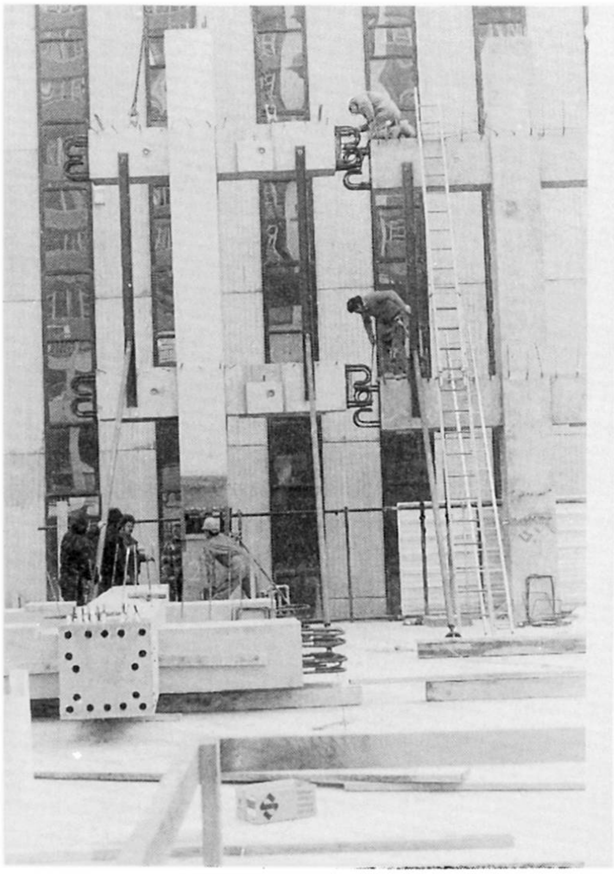

Fig 2. Precast Units During Erection