2.2.4 COLUMNS

2.2.4.1 PRECAST COLUMNS

GENERAL DESCRIPTION

Precast structural columns can be used either with in situ floors or in total precast systems. In the former, single- or two-storey lengths are usually within onsite crane capacity. Precast frames utilise the maximum length practical to transport and erect for the project. They can be pretensioned to control erection stresses. Architectural finishes are readily provided.

Prestressing is often used in piles and may be useful in columns where there are high transverse loads. The deflection of an uncracked section is much less than a cracked section; it is about 2.5 times as stiff. This reduces the relative movement between floors.

DESIGN

For "total-precast" buildings, experience is that single-storey columns are the most economical. For buildings with in situ floors, they can be two-storey with a section left out for the floor but should be braced below the floor if possible. The connection should be easily accessible during construction by locating it in a zone between floor levels and about 1.5 m above a floor, ie where bending is usually at a minimum. It should be located at floor level when there is a change in column section.

The capacity of a reinforced column is determined by the interaction of axial load and bending moment for each load case. The relationships determining this interaction for a given column size and reinforcement can be found in standard texts. The design of a particular section is a trial-and-error process and is more easily accomplished using a load-moment interaction curve calculated for the section. In its simplest form the curve is constructed by calculating four points on the boundary. These points plot the axial strength at zero moment on the vertical axis and the bending capacity at zero axial loads on the horizontal axis. The other two are the point at which the neutral axis coincides with the furthermost tension reinforcement and the point at which the tension reinforcement just begins to yield.

If the bending moment on a column causes significant lateral deflection the effective eccentricity of the axial load at mid-height is increased, increasing the moment, creating an iterative effect. AS 3600 Section 10 defines when a column is sufficient for this to be taken into account. The design procedure applies an amplification factor to the moment acting on the column so that the short column interaction design curves can be used.

Rules for design of reinforced columns are set out in AS 3600 Section 10. Strength-interaction design charts based on these rules are available in the Reinforced Concrete Design Handbook published by the Cement Concrete and Aggregates Australia, St Leonards, Sydney.

A preliminary guide to the load capacity of prestressed columns is given in 2.2.4.1 Precast Columns, Sheet 2 of this Handbook.

COLUMN-TO-COLUMN CONNECTIONS

Arrangements (a), (b) and (c) use separate dowel bars.
Arrangements (d) and (e) use column reinforcement as dowels.
Arrangements (b), (c) and (d) eliminate possible corrosion-staining of the lower units, where this is important.

NOTES:
1 Column reinforcement omitted for clarity
2 If one dowel is longer than the others, it can be used as a guiding device during erection

Dowel Alternatives

GENERAL ARRANGEMENT

Bleed holes
Grout holes
Injection holes
Dowel bars
Packer

Socket Connection

Steel base-plate welded to main reinforcement above and below the plate
Cast-in bolts
Dry-pack mortar

Bolted Connection

Precast column
Packer plate
Grout stop

Grout

Dowelled Connection

NOTE: Main reinforcement not shown
2.2.4 COLUMNS

2.2.4.1 PRECAST COLUMNS

DESIGN-ACTION CAPACITY CHARTS FOR PRESTRESSED COLUMNS

Notes:
1. Strands are 12.7-mm diameter, 7-wire, stress-relieved strand
2. Distance to centre of strand is 65 mm
3. Minimum prestress is 1.5 MPa
4. Ties are provided in accordance with AS 3600 Section 10
5. FRL = 120/120/120
6. Curves are for partial development of prestress near end of element where stress at flexural capacity is approximately equal to effective prestress after losses
7. When points of maximum stress are beyond the development length of the strand section, resistance will be greater than shown
8. The horizontal portion of the curves is for minimum eccentricity of 0.05D.

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4-H20 bars as supplementary reinforcement

12.7 dia. 7-wire stress-relieved strand

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Design Bending Moment, $\phi M_u$ (kNm)

Design Action, $\phi N_u$ (kN)

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4-H20 bars as supplementary reinforcement

12.7 dia. 7-wire stress-relieved strand

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Design Bending Moment, $\phi M_u$ (kNm)

Design Action, $\phi N_u$ (kN)