2.2.4 COLUMNS

2.2.4.1 PRECAST COLUMNS — Sheet 1

GENERAL DESCRIPTION

Precast structural columns can be used either with insitu 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 insitu floors, they can be two-storey with a section left out fot 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.

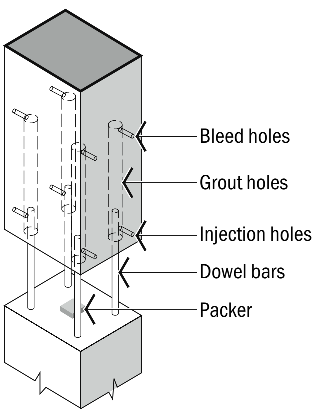
The capacity of a reinforced column is determined by the interaction of axial load and bending moment for each load case. The relationships determining this interaction for a given column size and reinforcement can be found in standard texts. The design of a particular section is a trial-and-error process 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 sufficiently slender 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



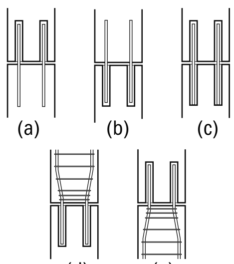
NOTES:
1 Column reinforcement omitted for clarity
2 If one dowel is longer than the others, it can be used as a guiding device during erection

General Arrangement

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.



Dowel Alternatives

CONNECTIONS

Column-to-Base Connections
Dowelled connections are most commonly used but require the column to be separately stabilised until the grout strengthens. Two or three props are required for stability. These are secured to the main structure and should be adjustable for plumbing of the column.

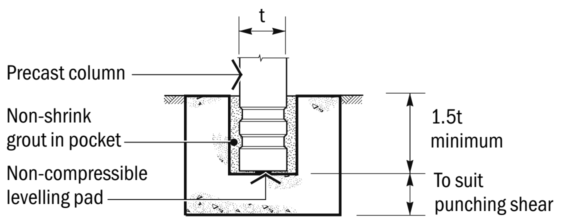
The most convenient base connection is a bolted plate; the most economical is the socketed connection (see *Column-to-Base Connections*). In the latter, a short length of the column is grouted into a pocket in the structure below. It is usually used only at footing level. A bolted-baseplate connection is the quickest to erect. The column is plumbed by adjusting the holding-down bolts, it is immediately stable and the crane can be released.

Column-to-Column (Splice) Connections
There are a number of techniques for forming a splice (see *Column-to-Column Connections*). Usually, the column bars project from the lower unit into core holes formed in the upper unit. This detail allows an insitu floor slab to be carried directly on the column. A duct size 2.5 to 3 times the bar diameter provides adequate tolerance. Proprietary grout sleeves are available to form the core hole, these minimise the bond length required. The column bars may also project from each unit and be connected by welding to splice angles or by fusion welding. This requires accurate alignment of the bars.

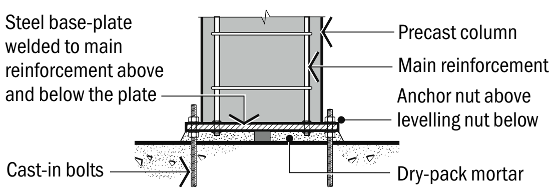
The horizontal joint between units must be wide enough to provide adequate tolerance and to permit free flow of grout throughout the bearing area. A width of 20 to 25 mm is generally adequate. The number of bars to be spliced at the joint should be a minimum to avoid congestion and to simplify erection. Eight bars is a practical maximum. It is often better to use higher-strength concrete or larger sizes so that if possible only 4 bars are used. Load can be transferred through the connection by bearing, with most of the column bars being discontinuous. Extra ties may be required to carry local stresses.

Bolted baseplates may also be used for column-to-column connections, although not as commonly as dowelled connections. The baseplate is flush with the outside of the column and the bolts are housed in recesses at the corners of the section.

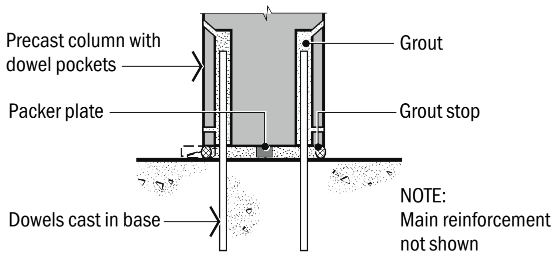
COLUMN-TO- BASE CONNECTIONS



Socket Connection



Bolted Connection



Dowelled Connection

2.2.4 COLUMNS

2.2.4.1 PRECAST COLUMNS

Sheet 2

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.