Piles, particularly those in soft soils, may be subjected to large lateral deflections in the event of an earthquake. The lateral deflections can result in high local curvature and moment demands at various locations along the pile length. Of particular concern is the pile-to-pile cap interface. At this location very high moment demands result from the assumed fixity of pile-pile cap connection. In order for this behavior to occur as assumed, the connection must be able transmit lateral forces to the pile and remain essentially rigid.

Severe pile damage has been observed in past earthquakes. Pile design for seismic loading assumes that the pile can develop and maintain its moment capacity through large deformation demands. Indeed, significant research has shown that well-detailed piles can develop and maintain large moments. Although a pile may be detailed to resist large forces, it is also necessary that the pile-pile cap connection be able to transfer these forces. A limited number of investigations, discussed below, have investigated the behavior of the pile-to-pile cap connection.

The objective in designing the pile-to-pile cap connection is to provide a connection capable of developing the moment demands on the pile while remaining essentially rigid. Conservatively, this requires the connection to be able to develop the probable capacity of the pile while remaining elastic.

Two 18-inch prestressed pile to cast-in-place pile cap subassemblage tests were conducted. These tests were conducted to determine the adequacy of the pile-to-pile cap connection under seismic load conditions. The connections were tested under combined axial and reversed cyclic loading conditions. The moment-to-shear ratio at the face of the pile cap was 12-feet. In addition, extensive theoretical analysis was conducted of pile-pile cap embedment regions.
Recommendations for prestressed pile to cast-in-place pile cap embedment regions resulting from this study are as follows:

1. The simple plain embedment of a prestressed pile into a cast-in-place pile cap can be designed to develop the capacity of the pile.

2. The required plain embedment length may be determined from either of the presented Equations (1) or (2). Equation (1) tends to result in slightly more conservative embedment capacity results for longer embedment lengths, while Equation (2) is more conservative for shorter embedment lengths. Conservatively, the required embedment length may be taken as the width of the pile. A minimum absolute embedment length of 12 inches is recommended.

These recommendations apply to square piles up to 36 inches square. The recommendations presented do not include any factors accounting for errors in placement and pile length. As such, it is the opinion of the investigators that a minimum specified embedment of 18 inches be provided.

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