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Numerical Simulation of Encased Composite Column Bases Subjected to Cyclic Loading

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Abstract : Energy dissipation in ductile moment frames occurs mainly through plastic hinge rotations in its members (beams and columns). Generally, plastic hinge locations are pre-determined and limited to the beam ends, where columns are designed to remain elastic in order to avoid premature instability (aka story mechanisms) with the exception of column bases, where a base is 'fixed' in order to provide higher stiffness and stability and to form a plastic hinge. Plastic hinging at steel column bases in ductile moment frames using conventional base connection details is accompanied by several complications (thicker and heavily stiffened connections, larger embedment depths, thicker foundation to accommodate anchor rod embedment, etc.). An encased composite base connection is proposed where a segment of the column beginning at the base up to a certain point along its height is encased in reinforced concrete with headed shear studs welded to the column flanges used to connect the column to the concrete encasement. When the connection is flexurally loaded, stresses are transferred to a reinforced concrete encasement through the headed shear studs, and thereby transferred to the foundation by reinforced concrete mechanics, and axial column forces are transferred through the base-plate assembly. Horizontal base reactions are expected to be transferred by the direct bearing of the outer and inner faces of the flanges; however, investigation of this mechanism is not within the scope of this research. The inelastic and cyclic behavior of the connection will be investigated where it will be subjected to reversed cyclic loading, and rotational ductility will be observed in cases of yielding mechanisms where yielding occurs as flexural yielding in the beam-column, shear yielding in headed studs, and flexural yielding of the reinforced concrete encasement. The findings of this research show that the connection is capable of achieving satisfactory levels of ductility in certain conditions given proper detailing and proportioning of elements.

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