New Connection Details to Connect Precast Cap Beams to Precast Columns Using Ultra High Performance Concrete (UHPC) For Seismic and Non-Seismic Regions

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Extended Abstract

Several connection details have been developed for the connection of precast cap beams to precast columns in Accelerated Bridge Construction (ABC) applications. Currently, the suggested details involve some form of either reinforcement or portion of the precast column to penetrate inside the cap beam. Such details present many challenges in the field, such as necessitating bundling of reinforcement in the cap beam or creating a congested reinforcement arrangement. Furthermore, closer inspection of some of the test data indicates that for currently used details, cap beams could sustain some minor damages during major seismic events, whereas they are designed to be capacity protected. Additionally, construction of such details demands precision.

To overcome these challenges, two new connection details for seismic and non-seismic regions are envisioned. Both details completely eliminate penetrating of column into the cap beam. In the first detail, the rebar of the cap beam and the column are spliced in the column and joined with a layer of Ultra High Performance Concrete (UHPC). The use of UHPC in the splice region allows the tension development of reinforcing bars over a short length. High workability of UHPC and large tolerances inherent with the suggested details can facilitate and accelerate the on-site construction. In the second detail, to confine the plastic hinge with a limited length in the column, two layers of UHPC were employed. Confining the plastic hinge is achieved by sandwiching desired length of the column, using normal strength concrete (plastic hinge region) in between two layers of UHPC. The most interesting aspect of this detail is the exact location and length of the plastic hinge.

The primary goal of this research is to provide a description of the newly developed details, verifying their structural performance and recommendation of a design guide. These goals are achieved through a diverse experimental and numerical program focused on the proposed connections. Results show that both details are equally applicable to seismic applications and able to achieve adequate levels of ductility. Lack of failure in splice region indicated that UHPC can provide a good confinement and shear capacity even when confining transverse reinforcement was not used.