MDOT
Michigan Department of Transportation

BRIDGE ADVISORY
Bureau of Bridges and Structures

BRIDGE ADVISORY NUMBER: **BA-2018-03** DATE: July 17, 2018

SUBJECT: **Dapped Concrete Beam Ends**

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Dapped concrete beam ends are created by notching either the lower corner of the beam web, allowing the nib of the beam to rest on a beam or other support (see Figure 1), or by notching the upper corner of the beam web, providing a bearing support for a shallower section (see Figure 2). Although superstructure designs with dapped beam ends are uncommon on highway bridges, these superstructure types have been used in Michigan. The importance of closely inspecting the beam end, bearing seat, and surrounding area cannot be understated. The inherent design of the beam end leads to concentrated shear stresses at the reduced section and the joint creates a shelf where road salt and other debris can accumulate. In addition to the formation of shear cracks, inspectors should closely monitor dapped beam ends for flexure cracking, tension cracking, delamination, spalling, and corrosion of steel reinforcement. Dapped beam ends must also be load rated to verify the capacity for legal loads.

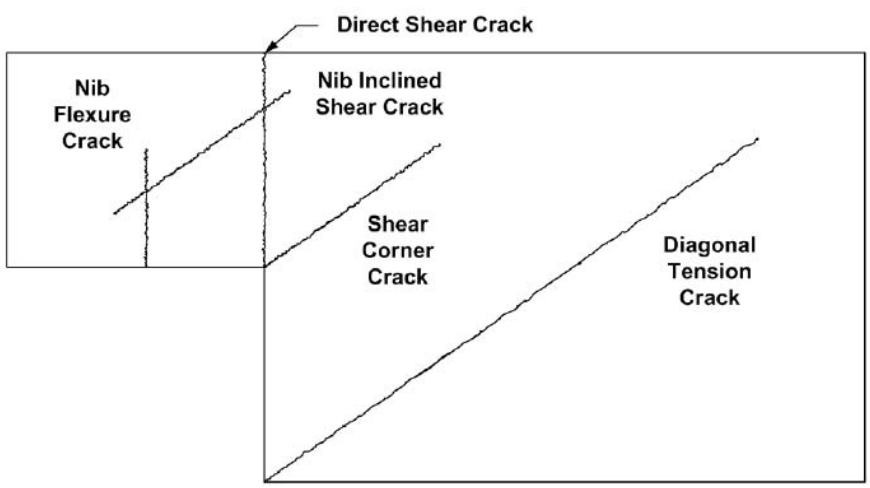

Figure 1: Crack Locations for Dapped End Double Tee Beams, Report No. FHWA NHI 12-049 (p. 9.8.6)

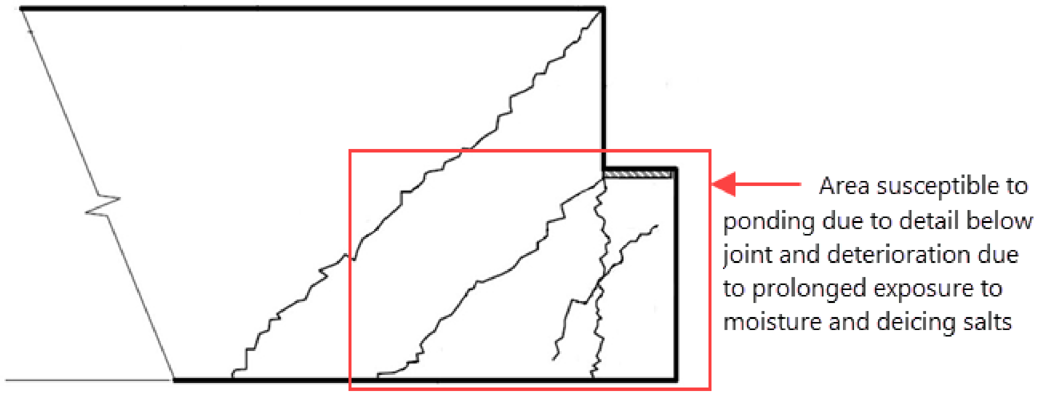

Figure 2: Crack Locations for Inverted Dapped End Beams

INSPECTING DAPPED CONCRETE BEAM ENDS

Bridge owners and inspectors are encouraged to schedule periodic detailed, hands-on inspections to detect new cracks as they develop and document any cracking that had previously formed. Cracking in both prestressed and conventionally reinforced beams should be monitored with increased inspection frequencies. Measuring crack widths in several locations will aid in determining changes during future inspections. Special attention should be paid to the bearing area of inverted dapped beam ends, where ponding of water due to the joint above and prolonged exposure to moisture and deicing salts could cause accelerated deterioration of concrete and reinforcing steel in these locations.

Leaking joints and/or the application of deicing materials may cause the steel reinforcement within this area to corrode at an advanced rate compared to other portions of the structure. Efflorescence and rust staining on the underside surface should also be documented. Rust staining should initiate a response from the bridge owner or inspector to sound the concrete in an effort to verify the extent of debonding. Pneumatic scaling within the surrounding area to measure the remaining section thickness of steel reinforcement is not recommended.

LOAD RATING DAPPED CONCRETE BEAM ENDS

The PCI Design Handbook lists the following potential failure modes that should be investigated when analyzing dapped concrete beam ends. Research indicates that these failure modes are applicable to both prestressed and reinforced concrete beam ends. The five failure modes are illustrated in Figure 3.

1. Flexure (cantilever bending) and axial tension in the extended end.
2. Direct shear at the junction of the dap and the main body of the component.
3. Diagonal tension emanating from the reentrant corner.
4. Diagonal tension in the extended end.
5. Diagonal tension in the undapped portion.

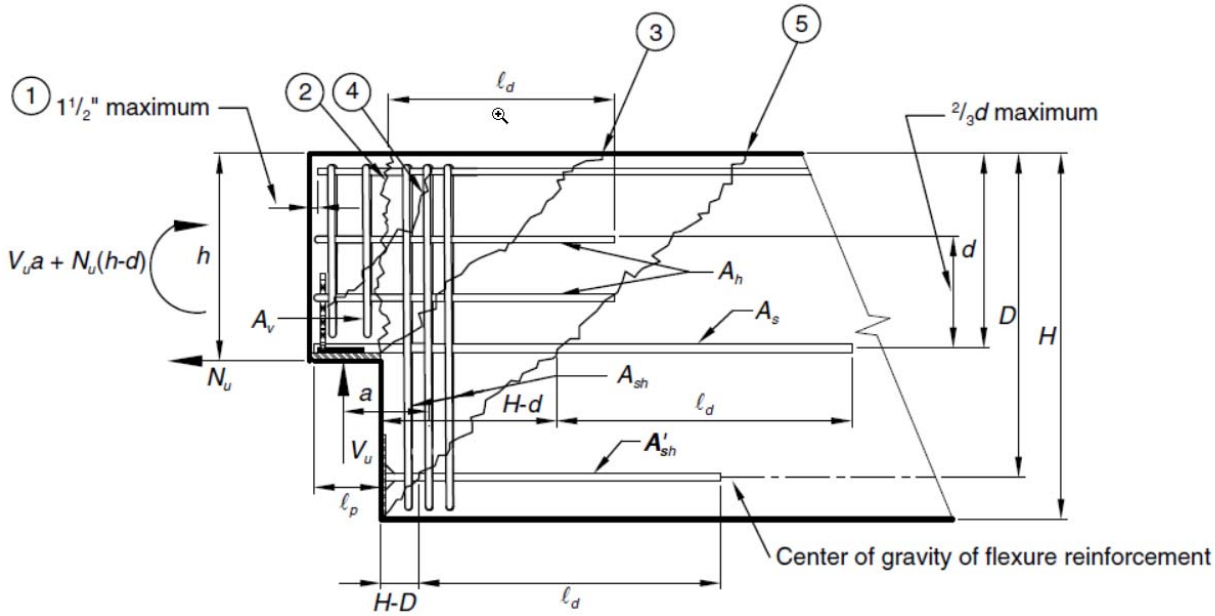

Figure 3: Potential failure modes and required reinforcement in dapped-end connections, PCI Design Handbook, 7th Edition (p. 5-80)

It is important to remember that section loss of the reinforcing steel within this location will impact the load carrying capacity of the entire structure. If further inspection or analysis is necessary, it is highly recommended to document these needs on a Request for Action (RFA) report in MiBRIDGE.