

Appendix M

Vehicle Clearance under Central Avenue Railroad Overpass

TECHNICAL MEMORANDUM

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Topic: General Traffic Clearance Allowances due to Streetcar Overhead Wires
Date: June 17, 2013

Existing/Proposed Conditions

The railroad overcrossing of Central Avenue, just north of NE 14th Avenue, currently has a vertical clearance of 14'-7". In 2014, MnDOT is planning to reconstruct the railroad bridge and Central Avenue which will increase the clearance to approximately 16'-4".

Proposed Design

The streetcar alternative for the Nicollet-Central Corridor is proposed to run under the railroad bridge. Typically, a modern streetcar is powered by an overhead wire known as an overhead contact system (OCS). Recently, some new streetcar systems are being implemented using a hybrid vehicle that can run for limited distances under battery power and without overhead wires. Assuming the Nicollet-Central streetcar has a traditional "wired" streetcar technology, the proposed OCS wire will need to run under the Central Avenue railroad bridge structure. The wire will more than likely need to be attached to the underside of the bridge structure using a 9" to 10" deep bracket. This will leave a total clearance from the OCS wire to the driving surface of approximately 15'-7".

Consideration

Typically, the OCS wire for a streetcar is designed to be a minimum of 18' over a roadway surface that is used by general traffic. The controlling document, NESC Table 232-1 -- Vertical clearances of wires conductors and cables above ground, roadway, rail or water surfaces, requires: "Trolley and electrified railroad contact conductors and associated span and messenger wires – 0 to 750V to ground above roads, streets, and other areas subject to truck traffic is 18.0 ft."

Several exceptions are allowed to the dimensions shown in the table, and the two exceptions pertaining to the Nicollet-Central alignment are:

Exception (1) states: Where subways, tunnels, or bridges require it, less clearance above ground or rails than required by Table 232-1 may be used locally. The trolley and electrified contact conductor should be graded very gradually from the regular construction down to the reduced elevation.

Exception (5) states: In communities where 16 ft has been established for trolley and electrified railroad contact conductors 0 to 750V to ground, or 18 ft has been established for trolley and electrified railroad contact conductors exceeding 750V, or where local conditions make it impractical to obtain the clearance given in the table, these reduced clearances may be used if carefully maintained.



Nicollet-Central Transit Alternatives

The controlling document for trolley and electrified railroad contact conductors and associated span and messenger wires – 0 to 750V to ground above roads, streets, and other areas subject to oversized truck traffic is the mechanical and electrical component per NESC Appendix A, Table A-1, which must be added to the height of the maximum allowable height of a vehicle (truck). The mechanical component NESC Appendix A, Table A-1 includes the clearances for rigid/non-rigid clearance and grounded, insulated/bare, ungrounded clearance.

In this case, the trolley and electrified railroad contact conductors and associated span and messenger wires are treated the same as an open supply conductor 0 to 750V. The mechanical component per NESC Appendix A, Table A-1 is 2 ft. The electrical component NESC Appendix A, Table A-1 is 0.5 ft. Therefore, the minimum clearance required by the NESC for trolley and electrified railroad contact conductors and associated span and messenger wires with the largest final sag condition - 0 to 750V to ground per NESC Rule 232A, above roads, streets, and other areas subject to oversized truck traffic is 2.5 ft above the height of the maximum allowable vehicle (truck).¹ In other words, with the support bracket holding the wire (say 9") and the required 2.5' of clearance from the OCS wire, the maximum height of a vehicle (truck) that could travel on Central Avenue under the railroad overcrossing will be between 13'-1" and 13'-6". Final clearances will need to be determined during final design and will need to account for the appropriate calculations for the sag of the wire due to expansion at the maximum temperature. The largest final sag condition of the trolley and electrified railroad contact conductors per NESC Rule 232A, calculations are performed for the conductor at 120° F with no wind.

Potential Design Resolutions

There are several options to consider and should be decided when a potential streetcar project advances into design development:

- Restrictions for over-height vehicles – Depending on the final design configuration and the resultant clearances, it may be necessary to restrict vehicular traffic that is higher than 13.1 to 13.5 feet in this segment of Central Avenue (or in the specific streetcar lane).
- Dedicated streetcar-only lane – Removing general traffic from the streetcar lane may be a simple solution which allows for streetcars to pass under the railroad bridge and removes the potential conflict with the OCS wire by segregating general traffic operations from the streetcar infrastructure. Potential traffic capacity concerns and traffic signing/channelization treatments would need to be addressed during the early phases of project implementation.
- Dedicated streetcar-only (single-track) – If maintaining the same capacity for traffic (i.e. the same number of general traffic lanes), it is possible to provide for a single (exclusive) streetcar-only lane under the railroad bridge. This would create a single-track operation which could have some effect on the planned streetcar service by creating a potential operating constraint for streetcars traveling under the bridge. However, this might be mitigated by minimizing the length of the single-track segment, and modeling the streetcar operations to create a schedule so the streetcars traveling in opposite directions do not meet at this point.

¹ Per MnDOT, a permit is required for any vehicle over 13'-6" in height.

- Hybrid streetcar vehicle – Being able to operate a battery-powered (hybrid) vehicle for limited distances is feasible which would eliminate the need for OCS wires. A proposed streetcar could run on wireless operation between stops on either side of the railroad bridge, thereby removing the potential conflict with the OCS wires. However, this option would require that the entire streetcar fleet be composed of hybrid vehicles and add a significant capital cost. Another consideration is that this streetcar vehicle technology is new to the United States; at this time, there are none currently in operation, although there are two U.S. cities that that will use hybrid streetcars. They are Seattle First Hill (in construction) and Dallas Oak Cliff/Union Station (in design).
- Sectionalized OCS wires in vicinity of railroad overpass – It is feasible to create an isolated (sectionalized) segment of the OCS design which energizes the overhead wire only when a streetcar is present in the vicinity of the Central Avenue railroad overpass, and de-energizes the wire once the streetcar has passed under the bridge. This potential solution would significantly reduce the risk of a potential conflict between over-height vehicles contacting the OCS wire and could be used in combination with vehicle restrictions/permitting. To date, there has not been an application such as this for an OCS system. This option would have to be explored further in the early phases of design to determine if it is indeed a practical solution.