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# MEMORANDUM

**To:** **Rachel Korkos , Sr. Project Manager ACE**

**From:** **Keith Gillfillan, Sr. Project Manager M&N**

**Date:** **November 28, 2017**

**Subject:** **Maple Avenue Ped. OH Structure Alt.- Constructability Considerations / Alternative Recommendation**

**M&N Job No.:9003-02**

The purpose of this memorandum is to provide additional information regarding the potential operational impacts the Union Pacific Railroad (UPPR) freight trains and Metrolink commuter passenger trains will have when constructing the Maple Ave. Pedestrian Overhead (Ped. OH) structure. This memorandum also addresses the construction restrictions due to train operations.

The Maple Ave. at-grade crossing is located at milepost 8.00 of the UPRR Los Angeles subdivision. There are two (2) mainline tracks in this portion of the subdivision. Current train traffic is approximately 32 freight trains per day and 12 passenger trains per day.

The Ped OH will be constructed over the entire width of the railroad right-of-way as a single span structure regardless of the alternative selected. This information is being provided to assist ACE in reaching a final decision on the preferred Pedestrian Overhead structure to construct for the Maple Avenue crossing.

In addition to the following text, the attached Exhibit “A” presents additional information for each alternative regarding cost, construction sequencing duration etc.

As shown in Exhibit “A”, the following four (4) alternatives are being considered for the Maple Ave. Ped OH structure:

Alt. #1 - Pre-cast/Pre-Stressed Box Girder (Tub)

Alt. #2 - Pre-cast/Pre-Stressed Three Box Girders (Beams)

Alt. #3 – Cast-in-Place / Pre-Stressed Box Girder (False Work Required)

Alt. #4 – Steel Truss Structure

Based upon the understanding that the UPRR has a strong preference to NOT allow structures that require falsework, Moffatt & Nichol’s (M&N) Type Selection Report submitted during Phase 1 of the project recommended a Pre-cast / Pre-Stressed Structure (Alt. #1 / Alt. #2) as the preferred alternative. While the UPRR concurred with this alternative, in their comment response to the report they stated being receptive to a Cast-in-Place (Alt. #3) structure which requires false work therefore, M&N has continued to consider both alternatives during the Preliminary Engineering phase. As M&N advanced the Pre-cast / Pre-Stressed Structure (Alt. #1/Alt. #2) to a higher level of analysis and design, the constructability, site constraints and railroad operations posed constraints that warranted consideration and re-evaluation of the other alternatives. The following summarizes the impacts of rail operations, constructability and presents a final recommendation.

## I. Restrictions Working within RR ROW – Form B vs Work Windows:

Regardless of the alternative selected, construction workers and equipment will be required to work on the elevated structure once it is in place over the active railroad. In the case of the pre-cast structure (Alt. #1 & Alt. #2), workers will need to construct / install the top slab, parapet walls and fencing after the structure is lifted into place. The cast-in-place alternative (Alt. #3) will require workers and equipment to be on the elevated falsework for the longest duration to build the structure commencing with installing the false work form work to completing the finished structure. The steel truss structure (Alt. #4) may present the shortest duration workers and equipment will be on the elevated structure to install lighting, aesthetic and miscellaneous features after it is lifted into place.

It is our experience that workers (and/or equipment) are required to stand down / clear the RR ROW when a train travels through the project area, regardless if they are on the ground or up on the structure. This is required to comply with Railway Workers Protection and UPRR Safety requirements and will be subject to the direction of the RR Employee-in-Charge (EIC) at the site. The EIC makes the decision whether workers/equipment are in the foul zone or have the potential to foul the track. If the workers are up on the structure, a place (or places) of safe refuge will have to be provided at that level for workers to move out of the foul zone.

Form B: Work can be performed under the supervision and 'control' of the EIC, and workers and equipment must be in the clear before a train passes through the designated work area.

Work Windows: Work can be performed within a designated work area for a specific approved number of hours (as agreed upon in advance) with no trains going through the work area during that time.

Both Form B and Work Windows require early negotiations and approvals in writing from UPRR and Metrolink, well in advance before any work may begin.

Due to the rail and operational constraints stated below (very limited hours during typical construction hours under Form B), it's our opinion that Work Windows in lieu of Form B will be the most efficient and effective way for workers to perform their duties regardless of the Alternative selected.

## II. Rail Operational Impacts / Constraints:

Train counts were recorded on August 22, 23 and 24, 2017 and the data is on file and available if desired. Based on these counts, the current average daily train traffic at the Maple Ave. at-grade crossing are:

Freight Trains = 32 / day
Passenger Trains (Metrolink) = 12 / day (9 operate Mon. thru Fri. 5:30 am to 7:00 pm)
Passenger Train (Amtrak) = 1 / day per Amtrak website (operates Mon. thru Fri.)

Considering a typical construction day of 7:00 am to 3:30 pm and using the count data collected in August 2017 the trains operating during the typical construction hours yields:

Freight Trains = 11 trains during typical construction work hours
Passenger Trains = 4 trains during typical construction work hours
Total Trains = 15 trains during typical construction work hours

Assume an average loss of production – 15 minutes per train (includes stand down / resume work times)

Estimated loss of productive work time = 15 trains x 15 min = 225 min. = **3.75 hrs. / day**

When considering the **typical construction work day is 7:00 am to 3:30 pm the productive work period is reduced to approx. 4.25 hrs.**

Based upon the above, **work on any of the Alternatives after they are lifted into place or false work installed will have to be done during non-typical work hours, including night hours in order to achieve any type of productive work.** The Steel Truss Structure alternative (Alt. #4) may be the exception due to the minimal amount of work required to finish compared to other alternatives once it is lifted into place.

## III. Crane Lifting Operations and False Work Construction:

Alt. #1 and Alt. #2 are very heavy structures and will require sizable cranes to lift the structures into place.

- **Alt. #1 - Pre-cast/Pre-Stressed Box Girder (Tub)** weighs approx. 145 tons and will require 2 – 300 ton cranes to make the lift.

  Cranes would likely set up on Maple Ave. with one crane set up on either side of the railroad R/W to make the lift. The box may be constructed onsite at the ATC school site or could be delivered via permit vehicle and lifted directly from the truck and either swung or crawled into final position before setting the beam. This option will require a minimum of a 50' x 250' working area or two 25'x 250' working areas to assemble the cranes. Crane assembly time is expected to be 1-2 weeks. A rail closure window will be required for the following operations:

  - Walking cranes into position – 1 hr.
  - Setting up rigging / girder delivery – 2-3 hrs.
    - Delivery of the girder will need to be meticulously scheduled to occur within this window
  - Lifting and setting the girder - 3-4 hrs.
  - Walking cranes back to staging area – 1 hr.

  Total work window time = 7 to 8 hrs.

  It may be possible to use 1 crane for the lift, but could require lift capacities in the 500 ton to 600-ton range to make the lift with the required offsets. A single crane of this capacity would be very large and will be more difficult to mobilize, set up and walk into position, compared to two – 300 ton cranes.

- **Alt. #2 - Pre-cast/Pre-Stressed Three Box Girders (Beams)** weighs approx. 45 tons for each beam and may require only a single – 300-ton crane to make the lift.

  Similar to Alt. #1 the beams could be constructed onsite or delivered via permit vehicle and lifted directly from the truck and either swung or crawled into final position. The work area to assemble the crane would be similar as Alt. #1 (min. 25' x 250') and the expected assembly time would be 1 to 2 weeks. A rail closure window will be required for the following operations:

  - Walking crane into position – 1 hr.
  - Setting up rigging – 1 hr.
    - Delivery of the girders will need to be meticulously scheduled or staged nearby to occur within this window
  - (3x) Rigging, lifting and setting the girder - 1-2 hrs. per lift
  - Walking cranes back to staging area – 1 hr.

  Total work window time = 4 to 5 hrs. per lift, or 7-8 hrs. for all 3 lifts.

- **Alt. #3 – Cast-in-Place / Pre-Stressed Box Girder (False Work Required)**

  Anticipated time to construct falsework includes 1-3 weeks to construct falsework towers and a 2-4 hr. window to install falsework across the tracks. A rail work window will be required to place the horizontal falsework across the tracks. As indicated above due to train traffic volumes, installation of forms, reinforcing bars, and other fixtures will need to be performed during non-typical work hours, including "night work". Typical concrete pours can be achieved at a rate of 100cy per hour. The main span requires approximately 75 cy of concrete divided into 2-3 pours of about a 1 hr. each. A smaller crane (<100 ton) can be mobilized for this task.

  Total work window to install falsework towers & overhead falsework = approx. 1 to 3 weeks.

- **Alt. #4 - Steel Truss Structure**

  This alternative will require a single 300-ton crane. Crane would likely set up on Maple Ave. The preassembled steel bridges could be delivered to a nearby staging area, assembled, and then shipped to the site via permit truck. Crane could lift the assembled bridge directly from the truck and either swung or crawled into final position. This alternative will require a minimum of a 25' x 250' working area to assemble the crane. Crane assembly time is expected to be 1-2 weeks. A rail closure window will be required for the following operations:

  - Walking crane into position – 1 hr.
  - Setting up rigging – 1 hr.
  - Lifting and setting the girder - 1 hr. per lift
  - Walking cranes back to staging area – 1 hr.

  This alternative has an advantage of requiring minimal additional work within the railroad R/W once the bridge is in place. Such additional work may consist of installing lighting, aesthetic

treatments and miscellaneous features. Maintenance painting will be required to extend the life of the structure and is recommended every 15-20 years.

Total work window time = 4 hrs.

**Construction Durations:**

- **Construction duration** for each alternative is as follows:

| Alternative | Construction Duration (in-place) |
|---|---|
| Alt. #1 - Pre-cast/Pre-Stressed Box Girder (Tub) | 4 to 5 weeks |
| Alt. #2 - Pre-cast/Pre-Stressed 3Box Girders (Beams) | 3 to 4 weeks |
| Alt. #3 – Cast-in-Place / Pre-Stressed Box Girder | 10 to 12 weeks |
| Alt. #4 – Steel Truss Structure | 3 to 4 weeks |

- **Other time line considerations:**
  - UPRR Lift plan approval – Alt. #1, #2, #3 & #4 — 2 to 3 months

## IV. Construction and Other Cost Considerations:

- **Construction cost** for each alternative is as follows:

| Alternative | Construction Cost |
|---|---|
| Alt. #1 - Pre-cast/Pre-Stressed Box Girder (Tub) | $ 340,000.00 |
| Alt. #2 - Pre-cast/Pre-Stressed Three Box Girders (Beams) | $ 340,000.00 |
| Alt. #3 – Cast-in-Place / Pre-Stressed Box Girder (False Work Required) | $ 230,000.00 |
| Alt. #4 – Steel Truss Structure | $ 275,000.00 |

- **Other Cost Considerations**
  - Temporary Construction Easement (TCE) – Alt. #1, #2 & #4 will require obtaining a TCE from the ATC school property to construct and / or assemble the tub, beams or steel truss before lifting into place.
  - Alt. # 1, #2 & # 4 will require cost for lifting / placement of the respective structure.
  - Alt. #1 - Pre-cast/Pre-Stressed Box Girder (Tub) – 10’-0” width exceeds the manufacturers standard maximum form width of 8’-6” and therefore will require a custom form which will add cost.
  - Alt. #1, #2 & #4 – it may be desired to incorporate aesthetic treatment which will add additional cost.

## V. Discontinued / Recommended Alternative:

- **Discontinued Alternatives**:

  Alt. #1 - Pre-cast/Pre-Stressed Box Girder (Tub)

  Alt. #2 - Pre-cast/Pre-Stressed Three Box Girders (Beams)

It is recommended the above alternatives be discontinued for further consideration for the following reasons:

- Both of the above alternatives will require special equipment (heavy duty cranes) for lifting and installing the respective structures while working in a very constrained work space adding risk and uncertainty to the project.
- Using the ATC school site to build and assemble the structure before lifting into place will restrict construction of the south leg (circular portion) of the ped. ramp until after the structure is in place.
- Using the ATC school site for building and assembly may cause damage and repair to the school parking and paving & etc. when transporting the structure to the lift area causing additional / unforeseen cost and potential claims.
- Approval of a lift plan from the UPRR could be a lengthy process and take schedule control out of the hands of the contractor and present potential delay claims.
- A significant amount of work during non-typical work hours or night work is not desirable due to the proximity of residential homes.
- Graffiti on the structure will be a concern.
- Both alternatives are the highest cost compared to the other alternates.

➢ **Preferred / Recommended Alternatives**

Alt. #3 – Cast-in-Place / Pre-Stressed Box Girder

Alt. #4 – Steel Truss Structure

The above alternatives are a virtual tie for the preferred / recommended alternative, assuming the use of false work is allowed.

Alt. #3 provides:

- A common more standard approach, resulting in better cost-effective bids from contractors.
- Construction flexibility in building the entire Pedestrian facility. The north leg (ramp) and south leg (circular portion) of the pedestrian ramp can be constructed concurrent with the overhead structure in the UPRR ROW.
- A significant amount of work during non-typical work hours or night work which is not desirable due to the proximity of residential homes.
- Better seismic performance than Alt. # & Alt. # 2.
- Lower concrete compressive strength.

Alt. #4 provides:

- No falsework required.
- Easy and quick installation - Shortest assembly and installation duration of all alternatives considered.

- Reduced amount of non-typical construction hours or night work hours, as compared to the other alternatives.
- Lightest alternative which will reduce seismic forces.
- Reduced opportunity for graffiti.
- Opportunity to incorporate aesthetics – fits with the ATC mascot – "The Iron Horse"
- Best cost control from assembly through installation.

**M&N Final Recommendation – Alt. #4 – Steel Truss Structure**

This recommendation is primarily based upon:

- ✓ Ease of construction and installation
- ✓ Opportunity for reduced graffiti and incorporation of cost effective aesthetic treatment which are important to ACE and the City.
- ✓ Reduced amount of non-typical construction hours or night work hours, as compared to the other alternatives.
- ✓ Minimal impacts to train operations