Michigan DOT: Design Challenges of Dearborn to Ypsilanti Double Track Project

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ABSTRACT

With grant funds from the FRA, the State of Michigan has purchased 135 miles of existing railroad right of way from Norfolk Southern to develop high speed rail service between Detroit and Chicago. The design team prepared engineering plans to rehabilitate a ten-mile double track segment and install a new 9-mile second track on an historic two track corridor. The improvements will facilitate joint passenger and freight operations and allow Class 6 (110 MPH) passenger service. The 19-mile project between Dearborn and Ypsilanti incorporates high speed crossovers and turnouts, track geometric modifications, grading and drainage improvements, a new signal system, grade crossing safety enhancements, and clearance accommodations for the proposed Dearborn Intermodal Station curved platforms.

The project is subject to challenging NEPA constraints, requiring minimal excavation, no work outside of the existing railroad right-of-way, no major bridge work and no grade crossing closures. The horizontal alignment of the new second track was designed to allow increased track center spacing, while tying in to the existing centers established at TPG bridges and control points. The existing mainline track alignment “kinks”
periodically throughout the 15-mile “tangent” segment creating a difficult alignment 
design for the new track. Vertically, the new track must tie-in with existing elevations at 
bridges and grade crossings while minimizing excavation in the areas between them. 
At the station site, level boarding platform issues were analyzed. The paper will discuss 
the design challenges and solutions, providing guidance for similar projects throughout 
the country.

INTRODUCTION

The State of Michigan is actively engaged in continuing its long history of promoting and 
providing passenger rail service to its citizens as well as working to develop new 
services that enhance mobility within the state and region. As a benefactor to recent 
federal grants supporting intercity passenger rail projects, the Michigan Department of 
Transportation (MDOT) has secured funding for several projects dedicated to the 
State’s passenger rail program. This report covers some of these projects and details 
some of the topics that will be of interest to the rail design and construction community.

PROJECT CONTEXT

Michigan Passenger Rail Services

At this time, two intercity passenger services are located within the state of Michigan. 
The heaviest traveled route is the Amtrak service providing three round trips per day 
between Chicago and Detroit/Pontiac, known as the Wolverine Service. The second 
route, which MDOT supports with state funds, provides one round trip between Chicago 
and Grand Rapids via Battle Creek, known as The Bluewater. Michigan is also in the 
planning stages for implementation of commuter rail service along an east-west corridor 
between Detroit and Ann Arbor, and a north-south corridor between Howell and Ann 
Arbor. Michigan is also a key member of the Midwest Regional Rail Initiative, a 
cooperative committee of DOT representatives from nine states working to develop a 
high-speed rail network in the Midwest.

MDOT ARRA Grants

MDOT is actively engaged in both maintaining and upgrading the segment of track 
between Dearborn and Kalamazoo on the Chicago-Detroit/Pontiac Corridor to support 
both existing intercity and future accelerated intercity passenger rail services. In 
support of these efforts, the Federal Railroad Administration (FRA) and MDOT have 
entered into two separate Cooperative Grant Agreements. The first grant, the Corridor 
Acquisition and Improvements Grant, is for MDOT to acquire railroad right-of-way from 
Norfolk Southern Railway (NS) (specifically the property located between MP 7.6 at 
Townline to MP 119.6 at CP Baron (112.00 miles) and between MP 121.39 at Gord to 
MP 145.60 in Kalamazoo (24.21 miles)), complete certain improvements to the Line and 
hire professional services to assist in closing the acquisition and managing the 
improvements on the Line. The second, the Service Development Program Grant, is for 
MDOT to conduct track rehabilitation and signal improvements on the Line to allow for 
increases in passenger speeds up to 110 mph.
MDOT Purchase of NSRR ROW

The 135-mile section of track between Dearborn and Kalamazoo that had been owned by NS is currently used by both the Wolverine and Blue Water service. Because of a decline in freight business along the Line, NS determined that it could no longer justify maintaining track standards to allow for passenger trains to operate at 79 mph, asserting that its existing freight business only requires track be maintained for freight train operations at 25 mph. In 2009, NS informed Amtrak that effective March 2010, track would be maintained no higher than Class 2 (25 mph freight, 30 mph passenger) unless an alternate agreement was reached.

The decision by NS to reduce the level of maintenance on the Line not only threatened the viability of existing intercity passenger service it also threatened the viability of future higher speed intercity passenger service in the Chicago-Detroit/Pontiac corridor that, as part of the Chicago Hub, is a federally designated high speed rail (HSR) corridor. In response, the State of Michigan has taken action to acquire the 135-mile section of track owned by Norfolk Southern between Dearborn and Kalamazoo, stabilize the track, make improvements to the track and upgrade the track and signal system to allow for passenger train operation at speeds up to 110 mph. The acquisition was completed in December of 2012.

Amtrak Partnership

The purchase of the NS-owned segment of the Chicago-Detroit/Pontiac corridor set the stages for a unique partnership with Amtrak. Directly to the west of the NS territory lies a section of track between Porter, IN and Kalamazoo, MI owned and dispatched by Amtrak. The State of Michigan has contracted with Amtrak to maintain its newly acquired right-of-way and to provide dispatching services in its territory. Amtrak will continue to operate its current services as well as provide the operations for new accelerated high speed services in the future.

PRIIA Equipment

Michigan is a member of a four state partnership with Illinois, California and Missouri, working cooperatively to procure new intercity passenger rail equipment and locomotives. The coach cars will follow PRIIA specification No. 305-001.

PROJECT DESIGN CHALLENGES
Dearborn-Ypsilanti Rail Design

Project Overview
With funding from the Corridor Acquisition and Improvement Grant, MDOT negotiated with NS to purchase the right-of-way between Dearborn and Kalamazoo with the sale becoming final on Dec 7, 2012. As a contingency to the sale, NS required the reconstruction of 9 miles of former second main track between Dearborn and Wayne,
MI (CP Mort to CP Wayne) to facilitate freight movements in and out of Wayne Yard – one of the primary rail shipping facilities utilized by Ford Motors – as well as allow passenger trains to travel through the vicinity at maximum speeds of 110 MPH. The existing track structure through the area employs timber ties, hard rock ballast and 127 lb continuous welded rail, installed in 1988. Historically, the Michigan Central employed a two track mainline between the Detroit-Windsor tunnel and a point west of Ann Arbor. The north side mainline (ML1) was removed in the vicinity of Dearborn as freight and passenger traffic diminished. Two tracks (Mainlines #1 and #2) exist to the west of CP Wayne to CP Ypsi at MP 28.2.

The negotiated project also included the rehabilitation of 20 at-grade crossings, the construction of two additional universal crossovers on either end of the yard and other minor civil improvements in the vicinity. The new track will be installed to the north of the existing single mainline track (ML2).

Existing Data Collection

Lidar Survey An aerial survey was conducted in 2009 by NS that covers the territory between Kalamazoo and Dearborn. The survey utilized light detection and ranging (LIDAR) technology to gather X,Y,Z point data for use in PTC implementation. This data was acquired by MDOT and used for creating a base map and digital terrain model from which the project design is based. The LIDAR survey was supplemented by conventional ground survey at grade crossing locations where the data collection swath was not wide enough to aid in the design process. A comparison between the LIDAR data and the conventional survey data yields good correspondence.

Geotechnical A Ground Penetrating Radar (GPR) analysis was performed along both tracks and along the existing roadbed in the proposed second track area. The GPR analysis found no indications of subgrade failure or deformation, but did find multiple locations with fouled ballast and high moisture including all of the grade crossings. The report suggests ballast cleaning and drainage improvements at these locations. The report also suggests installing a minimum 10-inch ballast depth and 6-inch subballast depth below the new tracks.

To supplement the GPR analysis, borings were drilled at locations within the proposed second track roadbed. The geotechnical report and borings found loose to very loose subsurface soils with low unconfined compressive strength, and areas with excessive fines that may not allow proper drainage. The report recommends undercutting 2-3 ft. at locations with excessive fines, and replacing with compacted engineered fill. The report also recommends the use of geogrid to reinforce newly placed ballast, as well as geotextile fabric to promote lateral drainage and reduce upward movement of fines.

Design Challenges

Categorical Exclusion One of the primary challenges faced during the project design was the environmental constraints. The track and roadway construction work will be performed under a Categorical Exclusion issued by the FRA. Key requirements of the CE include:
- Restoration of the second main track on the existing ballast bed
- No right of way or utility impacts
- No culvert extensions
- No bulk transport of hazardous materials
- Limited quantities of contaminated material encountered or generated during construction. Disposal at a licensed facility is required.
- No anticipated excavation or earth disturbance
- No wetlands impact

The CE effectively requires the design to minimize any excavation work and constrains both the horizontal and vertical geometry of the new track.

**Horizontal Constraints - Track Center Spacing** As mentioned previously, the proposed north mainline track (ML1) construction is actually the re-installation of a former second main of a double main track built decades before modern construction equipment was available. The existing double track (located between CP Wayne and CP Ypsi) has an average track center spacing of 13.25 ft. The newly constructed ML1 must tie into existing tracks at CP Mort (MP 9.3) and CP Wayne (MP 18.1) as well as fit within the concrete ballast retainers at undergrade bridges. No new bridge construction or rehabilitation is proposed in this project. Within the proposed double track territory there are 8 undergrade bridges, 5 of which are found within the eastern-most 2 miles.

The horizontal alignment in this track segment is primarily tangent, with three horizontal curves. A closer look at the tangent track (utilizing LIDAR survey data, discussed in a separate section) finds that the alignment “kinks” to the south periodically creating bearing changes throughout the corridor. It is assumed that “line of sight” surveying techniques were used to lay out the original corridor. Within the 6 miles of continuous “tangent” track, the kinking effect results in approximately 36 ft. of offset from a true bearing.

This creates a difficult design constraint. Modern track geometry design and construction, especially in higher train speed applications, should employ design software and construction equipment that sets a constant bearing for tangent track. In this corridor, a constant bearing for ML1 would result in extreme variations in track center spacing.

**Vertical Constraints** The existing elevations at the grade crossings and bridges will not be raised more than 2 inches in order to minimize additional dead load at bridges, and reduce impact to roadway vertical geometry at grade crossings. The LiDAR survey data shows that the track tends to sag in an undulating fashion between grade crossings, railroad bridges and other locations where track elevation has been maintained through time.

Between the crossings and bridges, the TRE between the two mainlines does not have to match; however there is a limit to the elevation difference. ML1 cannot be installed at an elevation that will result in the ballast shoulder encroaching on the ML2 track.
structure. Therefore, the vertical geometry must contain curvature that approximately matches top of rail elevation (TRE) at the fixed points and minimizes track elevation differential in the sagged roadbed between them, all while limiting excavation as discussed in the Categorical Exclusion Constraints.

Financial/Budgetary Construction of the track, grade crossing and signal work in the Dearborn-Ypsilanti segment was estimated at $29.87 million in the Grant /Cooperative Agreement.

Design Solutions

Horizontal Geometry As discussed previously, the horizontal geometry and track center spacing is constrained by track tie-in locations (CP Mort, CP Wayne, bridges with ballast curbs), bearing changes, and by the construction limits allowed by the Categorical Exclusion. During the design phase the primary objectives were to design an alignment capable of allowing 110 MPH passenger train speeds, maintain consistent track center spacing from ML2, and allow for the construction of a new track with ample room for worker safety. A 15 ft. offset was desired by Amtrak to allow safer conditions for roadway workers; however 14 ft. was the minimum acceptable offset.

The first solution the design staff attempted was a proposed alignment with a consistent track offset from the existing ML2 track throughout the project length. In order to achieve this several ballasted deck through-plate girder (TPG) bridge superstructures would have to be shifted to the north. The design team discovered that this option would be feasible due to the available bearing surface on each bridge’s abutment backwalls; however the idea was eventually abandoned because the funds required to accomplish the solution were not available in the budget. Leaving the TPG bridges in place results in several “choke points” where the proposed track centers spacing must be reduced to meet historical values. Structural evaluation of the bridge structures was not performed during the project design phase. Prior inspections by Amtrak staff resulted in no immediate need for structure improvements, and MDOT has hired a consultant to perform more detailed condition assessments of all the structures in the corridor; which may result in improvements to be performed during future regular maintenance activities.

Another critical challenge to the horizontal design is the intermittent bearing changes occurring over the length of the project. The design solution implemented during the project design was to create an alignment for the new track with constant bearing sections for the maximum length possible while maintaining no less than existing track center spacing (13.25’) at the “choke points” and no more than a 15 ft. track center. This approach served to minimize the number of “kinks” that would be required to stay parallel with existing ML2. In order to accomplish this, the bearing angle at each TPG bridge location was determined and held constant to a distance approximately 100 feet out from the edge of the ballast retainers. Between “choke point” locations, a single point of inflection (PI) was established where a small deflection curve was designed to allow the track to change bearings.
The small deflection curvature at these points was designed similarly to the “angle point” criteria established in Amtrak Spec. No. 63, paragraph 4.10 as shown below (1).

### 4.10. Angle Points

4.10.1. **Definition**: Angle points are the points where two elements of an alignment (tangents, spirals, curves, and turnouts) intersect each other as opposed to becoming co-linear.

4.10.2. Angle points must never be used if a turnout, curve, or a spiral is involved.

4.10.3. Angle points between two tangents must not be used unless the use of a properly-designed curve is impossible.

4.10.4. The angle between two tangents at an angle point must not exceed the values in the following table:

<table>
<thead>
<tr>
<th>Angle Points between Tangents</th>
<th>Track Class</th>
<th>Max. Speed</th>
<th>Maximum Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>15</td>
<td>0°-30'-00&quot;</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>30</td>
<td>0°-20'-00&quot;</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>60</td>
<td>0°-11'-00&quot;</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>80</td>
<td>0°-7'-00&quot;</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>90</td>
<td>0°-5'-30&quot;</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>110</td>
<td>0°-4'-00&quot;</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>125</td>
<td>0°-3'-00&quot;</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>160</td>
<td>0°-2'-00&quot;</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>200</td>
<td>0°-1'-30&quot;</td>
</tr>
</tbody>
</table>

4.10.5. Successive angle points must be separated by the greater of 100 feet and 6 V where V is the maximum authorized speed [mph].

The proposed “curve design” for small deflection curves is similar and effectively allows the track contractor to accomplish the required deflection change over nominal 100 ft curved elements. Our design strategy assigned superelevation and spiral length as follows:

- Where \( E(e) < 0.25 \) inches \( E(a)=0 \) \( L(s)=0 \)
- Where \( 0.25 \leq E(e) < 0.50 \) in. \( E(a)=0.25 \) \( L(s)=0 \), runoff super in curve
- Where \( 0.50 \leq E(e) < 0.75 \) inches \( E(a)=0.50 \) \( L(s)=0 \), runoff super in curve
- Where \( E(e) \geq 0.75 \) inches \( E(a)=0.50 \) \( L(s)=\text{AREMA Formula} \)
Where conventional railroad curves are employed in the existing alignment, our design employs curve parameters for curvature, superelevation and spiral length as defined in AREMA Manual for Railway Engineering (2) and Amtrak Spec 63 (1).

**Vertical Alignment** Several challenges faced the design team in regards to vertical geometry design of the new ML1 track. MDOT intends to minimize track elevation change at the grade crossing locations to minimize roadway profile changes. In addition, the existing ballasted deck bridges would require a structural evaluation with major track elevation change, which would add ballast and dead load to the structures. Crossings and bridges occur at an average of every 0.5 miles in the proposed double track segment. MDOT also intends to minimize earth excavation where possible (between each crossing and bridge).

Another challenge for the vertical alignment is the presence of underground utilities. An existing underground fiber optic backbone cable owned by CenturyLink is buried directly below the proposed second track alignment at an unknown depth. Excavation for the new track roadbed may damage the fiber without proper precautions. MDOT is working to resolve this issue with Century Link.

As discussed in a previous section, by evaluation of the LIDAR data and through field verification it was discovered that the track elevation sags between roadway at-grade crossings and railroad bridges because these locations. To meet the requirements of the project, the vertical alignment for the new track was designed to match the existing ML2 TRE at the grade crossings and bridges, but was allowed to vary from the ML2 TRE between the crossings and bridges. However the TRE differential could not be greater than 12 inches. With a track center spacing less than 15 ft. too much elevation differential would result in ballast shoulder encroachment. Vertical curve geometry follows Amtrak Spec 63 requirements.

**Track Structure** Recent high speed passenger projects are using either concrete or timber tie track construction. Rail weights vary from 115 lb to 141 lb. For the second track installation between CP Mort and CP Wayne, the design team looked at the feasibility of employing Amtrak track design standards for concrete tie track with 136 lb continuous welded rail and a roadbed section in accordance with Amtrak standard roadway sections. To install a track to these specifications, the total minimum structure depth required is 48.5 inches (7” rail, 9.5” tie, 14” ballast, 8” subballast).
This roadbed section resulted in over 40,000 CY of earth excavation. As discussed previously, a primary goal for the project is to minimize the amount of excavation while providing a suitable and properly draining granular layer for the new track. Considering the significant depth of the existing granular layer in the ML1 roadbed and the stable condition of the subgrade, a revised track structure was considered.

Timber ties rather than concrete, reduces the depth by 2.5 inches. The GPR report recommendation of a 10-inch minimum ballast depth was employed along with a layer of geogrid to increase interaction between the ballast and existing material. The placement of a new subballast layer was removed due to the presence of 3-5 feet of granular material in the former roadbed. These changes reduced the total structure depth to approximately 24 inches.

The reduction in track structure depth lowered the earthwork quantity to approximately 17,000 CY of cut.

With the onset of passenger train speeds up to 110 MPH, NS and Amtrak requested a roadbed design that provides suitable access along the tracks and a place for roadway workers to retreat to as trains pass. The design team considered a series of options to provide a roadbed shoulder to the north of the new ML1 track, including a 3 ft. walkway, and a 10 ft. access road. The 10 ft. access road was the ideal solution because maintenance vehicles would have easier access to the tracks, and the earthwork resulting from the new track structure installation could be balanced by grading the excavated material to the north as the roadbed shoulder.

Analysis of roadbed shoulder alternatives showed that a shoulder greater than 3 ft. would result in construction outside of the existing edge of ballast which would violate the CE. The CE would also be violated in that the track construction will require excavation into the existing roadbed. In late 2012, the requirements for projects under Categorical Exclusion were made more lenient. This project decided to move forward with a roadbed shoulder width of 10 ft. except where major constraints precluded that width, such as limited right-of-way, high embankment or longitudinal ditches. The minimum roadbed shoulder used is 3 ft.
**Track Design Summary** The challenges and solutions discussed herein led the design team to produce their design following these criteria:

- The new track centerline shall be located a minimum of 14.0 ft. from the existing adjacent track centerline, except where constrained by existing bridges or endpoint conditions (“choke points”). Existing bridge superstructures will not be shifted.
- New track shall employ timber ties and provide a minimum 10-inch ballast section including a geogrid. No subballast layer shall be required. No geotextile fabric will be used, except at grade crossing locations.
- Minimize excavation, so as to spoil in situ material within the right of way without disturbing wetlands.
- The track section shall be laid on the existing surface with minimal surface preparation, except as necessary to eliminate ruts and to feather into crossings so as to minimize elevation changes.
- A 10 ft. access road/shoulder shall be constructed except at locations where sufficient elevation change exists, or other limitations preclude a greater shoulder width. The minimum shoulder width shall be 3 ft.
- Curve horizontal and vertical geometry is designed in accordance with Amtrak Specification No. 63 (See Exhibit E in Appendix) and AREMA guidelines for passenger rail. Horizontal curvature shall employ spirals to optimize passenger comfort during travel through curves. The track superelevation shall be limited to a maximum of 6 inches. Maximum passenger design speed shall be 110 mph, while freight shall be 60 mph. Maximum passenger unbalance shall not exceed 4 inches.
- Bridge deck and road crossing top of rail elevation increase of no more than 2.0 inches.
- General elevation difference between proposed mainline 1 top of rail and existing mainline 2 top of rail shall not exceed 14.0 inches. The 14-inch value assumes that the existing track will be surfaced to provide a general 2.0 inch lift and that the permissible elevation difference between adjacent tracks at 14 ft. track centers is 12.0 inches.
- The elevation difference between adjacent tracks will be 0 inches at crossover and station locations.
- At crossovers and turnouts, a 12-inch ballast layer, 6-inch compacted subballast layer, and geogrid shall be installed. A 3-foot subballast shoulder shall be provided where feasible.
- The permissible elevation difference in superelevated curves will be evaluated to ensure that ballast at normal 2:1 slopes does not spill onto adjacent track ballast shoulder.
Dearborn-Ypsilanti Grade Crossing Design

Project Overview
As part of the Dearborn-Ypsilanti Second Track Project, 20 at-grade crossings will be reconstructed to provide concrete crossing panels, better drainage, better ride-ability for motorists, and improved crossing warning systems that comply with faster train speeds.

Design Challenges
The primary challenge faced with the crossing design was the determination of design criteria for roadway profile across the tracks. The crossings are all locally owned roads with low to moderate ADT values. Some of the crossings have become “humped” over time due to ongoing railroad maintenance activities which have raised the track elevation over time. The design team researched several studies on humped crossings and found that there is no clear design standard for profile design at railroad-roadway crossings. MDOT has published criteria for new construction at major arterial highway crossings, but that did not apply to this project. AREMA Guidance suggests a preferred 3 inch in 30 ft. maximum elevation change, but notes that this is not always achievable. Following the AREMA design guidance at the humped crossings would have resulted in additional roadway construction outside of the railroad right-of-way that was never programmed for with grant funds.

Design Solutions
Rather than follow the general guidance that was not specific to this project, the design team settled on a practical solution that accounted for the most likely hazard to occur at humped crossings – low clearance truck hang-ups. In order to ensure each crossing provided mitigation for the potential for low clearance trucks from getting stuck at the roadway-railway interface, a “lowboy” clearance template was developed. The template used an MDOT standard WB-62 trailer clearance envelope and added an additional safety factor. The resultant template, which employed a 4-inch vertical clearance at a 36 ft. wheelbase, was tested using CADD software at each crossing. This template provided the most conservative vertical clearance template of any relevant design vehicle. Car-carrier trucks were also analyzed, but did not result in lower clearances than the modified WB-62.

The following design criteria were established as a result of the lowboy analysis:
- The TRE elevation for both tracks will be set to an equal elevation to provide a flat surface through the crossing.
- The flat surface will be extended beyond the outer rails approximately 5 feet.
- The roadway profile will then extend downward at a maximum 3% grade, and tie in with the existing pavement within the railroad right-of-way where possible.

At crossings where vertical profile adjustments are necessary the design team employed MDOT’s local road project criteria which have been adopted by the Federal Highway Association (FHWA). The design criteria are typically applicable to roadway Rehabilitation, R, R (3R) projects within the state. The criteria allows design variances
Dearborn Station Platform Design

Project Overview
The City of Dearborn is constructing a new passenger intermodal facility approximately two miles west of the existing Amtrak station. The facility includes two-500 ft by 12 ft side platforms located on each side of the double track rail corridor. An overhead pedestrian walkway, providing a clearance to the top of rail in excess of 22 ft 6 in will connect the platforms. The passenger platforms will be constructed at an elevation of 15 in above top of the grade rail at 5 ft 6 in from the track centerlines. The station is currently under construction and is funded with an ARRA grant that requires completion of the work by August 22, 2013.

Design Challenges
Curved Platform
The first challenge for this project is the fact that the platforms will be located entirely within the length of a 1-degree spiraled curve; part of the platform is located in the circular curve, and part within the eastern spiral. The curves for each track are designed for 79 mph passenger operations. Superelevation is limited to a practical value for adjacent passenger platforms. Track superelevation will range from 0.3 in at the east end of the platform to 1.0 in at the west end of the platform. Amtrak and NS design standards require an additional 1.5 inch of clearance to the platform edge for every 1 degree of curvature. Therefore the platforms will be constructed at 15.0 inches above the grade rail at a distance not less than 5 ft 6 in from the track centerline. Grade rail is the low rail. Therefore, the north side platform will be constructed approximately 15 inches above the adjacent rail at the east end and 14 inches above the adjacent rail at the west end due to the superelevation. The south side platform will be constructed at a constant 15 inches above the adjacent rail.

Level Boarding
The second design challenge deals with the issue of level boarding at the station. Throughout the state of Michigan and the Midwest states, current Amtrak platforms are located at 8 inches above top of rail elevation (TRE), and require the use of wheel chair lifts to allow ADA passengers to board. At the new Dearborn platform, the design decision for the platform height became a lengthy negotiation between many parties due to contemporary accessibility regulations that came into conflict with freight car clearance requirements. Due to the fact that PRIIA bi-level train cars will be used for passenger rail service in this corridor, the level boarding height will be 15 inches above TRE at a distance 5 ft 6 in from track centerline. This dimension conflicts with NS clearance requirements which state a minimum clearance of 8 ft 6 in at 15 inches above TRE. NS stated that only dimensional loads need a clearance up to 8 ft 6 in; however the railroad does not want to preclude the ability to run such loads through the corridor.
During negotiations, Amtrak and state pushed for returning to the 8 in above TRE platform height that exists throughout the Midwest. This solution was denied when the FRA mandated that level boarding must be implemented at newly constructed platforms on property not owned by freight railroads. Because the corridor will remain a shared-use corridor, and NS would not approve the property sale without the ability to move dimensional loads the only feasible solution was to design a “movable” platform edge.

A movable platform edge solution requires that the platform edge be moved back approximately 3 ft or be lowered approximately 7 inches to provide standard clearance. To accomplish this there are three critical measurements between the rail centerline and the platform edge that have been accepted by all parties:

- In the normal platform position, the movable platform segment will be in the down or horizontal position. The platform edge will be positioned so as to provide a minimum horizontal clearance of 5 ft 6 in from the track centerline at 15 in above the grade rail.
- In the retracted position, the movable platform segment will be rotated away from the track centerline, such that the bottom surface of the movable platform segment provides a minimum horizontal clearance of 8 ft 7.5 in from the track centerline.  
- When the movable platform segment is rotated away from the track centerline, the fixed platform base will remain in position, so as to provide a minimum horizontal clearance to the track centerline of 5 ft 6 in at a maximum elevation of 8 in above the grade rail.

It is anticipated that the platform edge in the normal position will be positioned so as to achieve the minimum horizontal clearance value within permissible construction tolerances. Such positioning is necessary to allow reliable bridge plate deployment by the new PRIIA passenger equipment and to provide reasonable platform edge to bottom step horizontal gap dimensions for legacy equipment. As of the time of this writing, the actual details of platform construction and achieving the required clearance have not been resolved.

**Construction Staging**

The third design challenge at the platform location will be the construction staging. Construction of the north side platform in advance of the ML1 track in the vicinity of Dearborn will make the track work more difficult, although not impossible. The current plan is to advance the rail construction in the vicinity of the platform, so that the track is constructed before the platform.

**CONCLUSION**

As one of the states leading the country in developing higher speed intercity passenger rail, Michigan has encountered numerous challenges that will aid in the development of rail design and construction policies that may be in effect long after these projects are completed. The state has worked tirelessly to generate creative, practical and cost-
effective solutions to these challenges, and they remain committed to working cooperatively with USDOT, Amtrak, and freight railroads to accomplish their goal to enhance mobility in the state and region.

MDOT has recently procured many of the track components needed to rehabilitate the corridor under the Service Development Program ARRA Grant (ties, rail, tie plates, spikes, etc.) and intends to begin track and signal construction work in August of 2013. The Dearborn-Ypsilanti Second Track and Grade Crossing Improvement Projects are slated to begin in the spring of 2014 following FRA approval of Preliminary Engineering and Final Design deliverables.

REFERENCES


Michigan DOT: Design Challenges of Dearborn to Ypsilanti Double Track Project
**Introduction**

**Project Context**

- **Existing Passenger Rail Services in Michigan**
  - Wolverine Service (Chicago-Detroit/Pontiac)
  - Blue Water Service (Chicago-Port Huron)
  - Pere Marquette Service (Chicago-Grand Rapids)

**Project Context**

- **Amtrak Services in Michigan**

**Project Context**

- **Ongoing Rail Projects in Michigan**
  - MDOT ARRA Grants
    - Corridor Acquisition and Improvements Grant
    - MDOT purchase NSRR right-of-way
    - Dearborn-Ypsilanti Double Track and Grade Crossing Projects
  - Service Development Program Grant
    - Tier 1 EIS
    - Dearborn-Kalamazoo Track and Signal Stabilization
    - Stations
    - New Dearborn Intermodal Station
    - New Troy/Birmingham Station
    - Battle Creek Renovation

- **Other Projects**
  - Jackson Amtrak station renovation
  - Detroit-Ann Arbor Commuter Rail
  - Ann Arbor Station
  - WALLY Commuter Rail
**Project Context**

- MDOT purchase of NSRR ROW
  - Kalamazoo to Dearborn
  - Freight agreements

- Track and Signal Stabilization
  - New ITCS Signal System
  - Class 6 track at both ends
  - Tie program
  - Rail replacement in curves
  - Grade Crossing Renewal

- Partnerships
  - Amtrak
    - Service Operator
    - Maintenance Contractor for state owned rail property
  - PRIIA Equipment
    - Multi-state agreement for equipment procurement

**Dearborn-Ypsilanti Double Track Project**

- Overview
  - 9 miles of “new” second mainline track construction
  - 2 new Universal Crossovers
  - Reconfigure access to Willow Run Yard
  - Coordination with Dearborn Intermodal Station Platform
  - Renewal of 20 Grade Crossings

**MDOT-Norfolk Southern Track Arrangement Agreement**
Dearborn-Ypsilanti Double Track Project

MDOT-Norfolk Southern Track Arrangement Agreement

Existing Data Collection - GPR performed by sub, Hyground Engineering

Elevation of Top of Subgrade

Existing Data Collection - LIDAR

Existing Data Collection - LIDAR
Dearborn-Ypsilanti Double Track Project

Design Challenges

- Categorical Exclusion (pending revisions)
  - No excavation
  - No work outside existing ballast edge
  - No work outside right-of-way
  - No major bridge or culvert modifications
  - No bulk transport of hazardous materials
  - CE regulations relaxed in December 2012

Horizontal Constraints

- Minimum 14 ft. track center spacing for track worker safety
- Maximum 15 ft. track center spacing in order to tie-in at bridges and project endpoints
- Existing “kinked” alignment
- “Choke Points”: Ballasted deck through-plate girder bridges; High embankment
- Angle point design

Horizontal Constraints - Kinked Alignment
Dearborn-Ypsilanti Double Track Project

Design Challenges
- Vertical Constraints
  - Track elevation maintained at grade-crossings and bridges within 2 inches
  - Track elevation sags between fixed points
  - Second track elevation differential from existing track limited

Horizontal and Vertical Alignment Restrictions

Design Solutions
- Horizontal Geometry
  - “Choke Point” Design
  - Angle Point Design

Vertical Alignment
  - Maximum 2” track raise at crossings and bridges
  - Maximum 12” elevation differential between new track and existing track
  - Minimize excavation between “fixed points”

Earthwork Balance
  - Reusing excess excavation as fill for roadbed shoulder, access road/walkway

Design Solutions - Track Structure

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Dearborn-Ypsilanti Grade Crossings Project

Overview
- 20 Crossings - 13 within new track construction segment
- Minimize work beyond railroad right-of-way
- Remove entire existing crossing
- Improve drainage
- Precast Concrete panel installation

Roadway Vertical Profile at Humped Crossings - AREMA/AASHTO Design

- Design Solution
  - 0% grade to a minimum 5 ft. beyond gage rail
  - Maximum 3% downslope
  - MDOT 3R vertical profile criteria for crest curvature if needed
  - Lowboy template check
Dearborn Intermodal Station Project

- New Intermodal Passenger Station
- Shared Passenger and Freight
- Entrance to The Henry Ford Museum Campus
- Two Side Platforms and Overhead Pedestrian Walkway
- Double Track on 1 Degree Curve
- 15 Inch ATR at 5 ft 6 in from Track CL
- North Side Movable Platform Edge to Allow Dimensional Moves

Dearborn Intermodal Station Platform Project

- Design Challenges
  - Curved Track and Platform
  - Level Boarding

Dearborn Intermodal Station Platform Project

- Design Challenges
  - Level Boarding
Dearborn Intermodal Station Platform Project

- Design Challenges
- Construction Staging

Conclusion