## Common Errors Seen in Plan Review

Melissa Effinger, P.E. – Michael Baker Intl. Rebecca Camarata, P.E. – INDOT

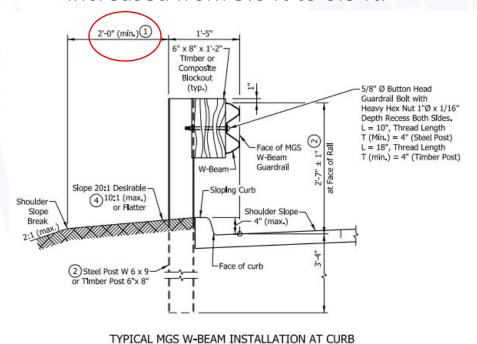


- Guardrail
- ADA Curb Ramp Plan Details
- Intersection Sight Distance
- Maintenance of Traffic
- Submissions



### MGS Guardrail

- Not providing the desirable 2 ft distance (at 10:1 max slope) behind MGS Guardrail. This distance is desirable, but narrowing the distance behind the guardrail should not be done without a good reason (i.e., environmental impacts). Cost savings alone is not a good reason.
- Also, if the 2 ft distance is not provided, then the working width (allowable deflection distance) is increased from 5.0 ft to 6.5 ft.

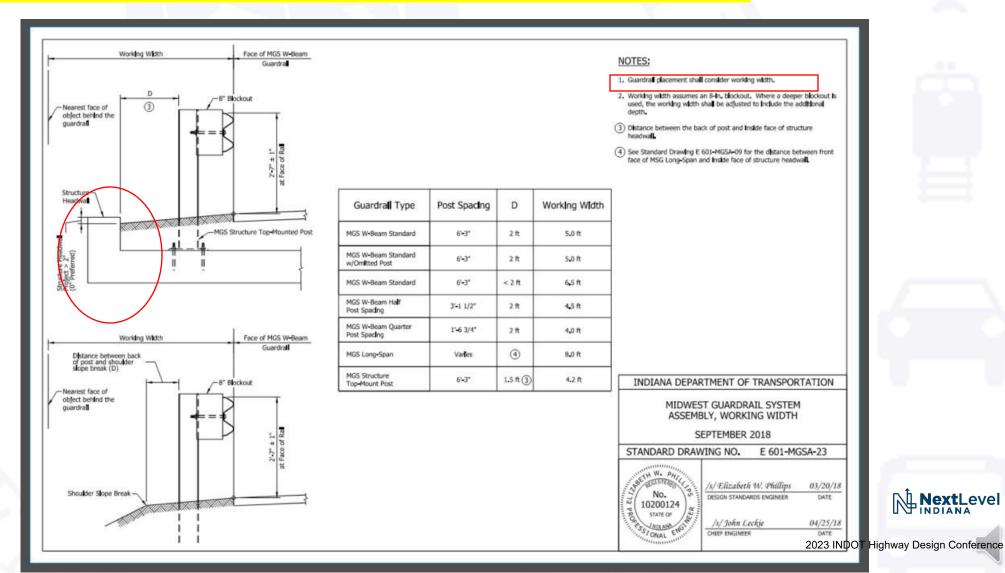


Guardrail Type	Post Spacing	D	Working Width	
MGS W-Beam Standard	6'-3"	2 ft	5.0 ft	
MGS W-Beam Standard w/Omitted Post	6'-3"	2 ft	5.0 ft	
MGS W-Beam Standard	6'-3"	< 2 ft	6.5 ft	
MGS W-Beam Half Post Spacing	3'-1 1/2"	2 ft	4.5 ft	
MGS W-Beam Quarter Post Spacing	1'-6 3/4"	2 ft	4.0 ft	
MGS Long-Span	Varies	4	8.0 ft	
MGS Structure Top-Mount Post	6'-3"	1.5 ft ③	4.2 ft	



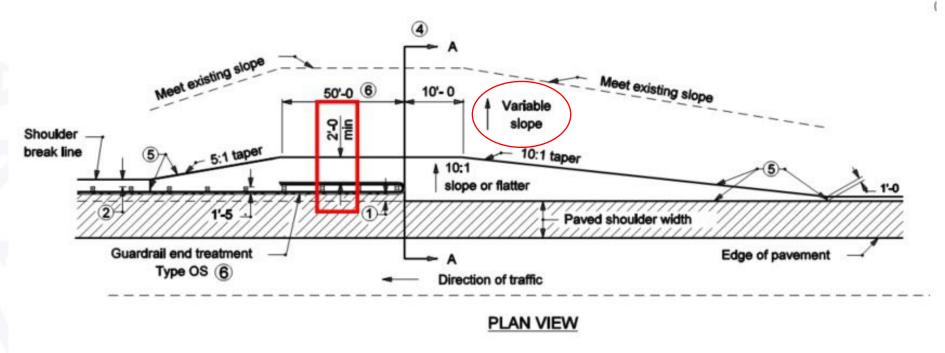
Not providing sufficient deflection distance between to a fixed object.

No obstructions greater than 2 in. in height are allowed within the working width distance.



NextLevel INDIANA

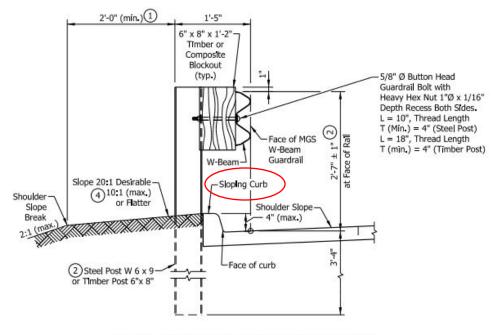
- Grading for Guardrail End Treatment
  - Not providing the required grading behind a GRET OS.
  - The minimum 2 ft distance at 10:1 or flatter slope is required, not desirable
  - The allowable variable slopes beyond this distance are shown on Std. Dwg. 601-GRET-08 and 09



GRADING DETAIL FOR GUARDRAIL END TREATMENT TYPE OS



- MGS Guardrail
  - Specifying barrier curb with guardrail or placing curb (of any kind) in front of the face of guardrail.
  - Refer to Design Memos 17-10 and 17-17. IDM Ch. 49 has not yet been updated



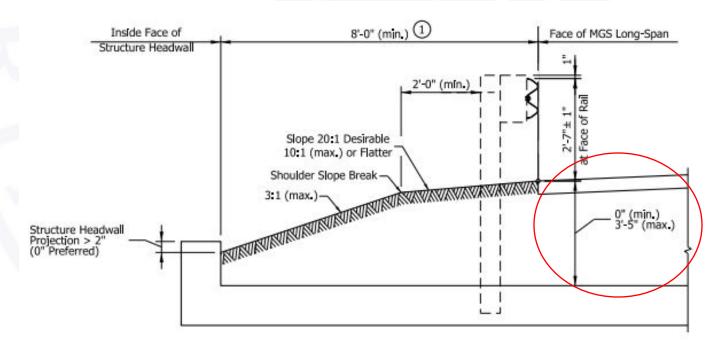
TYPICAL MGS W-BEAM INSTALLATION AT CURB





### Guardrail

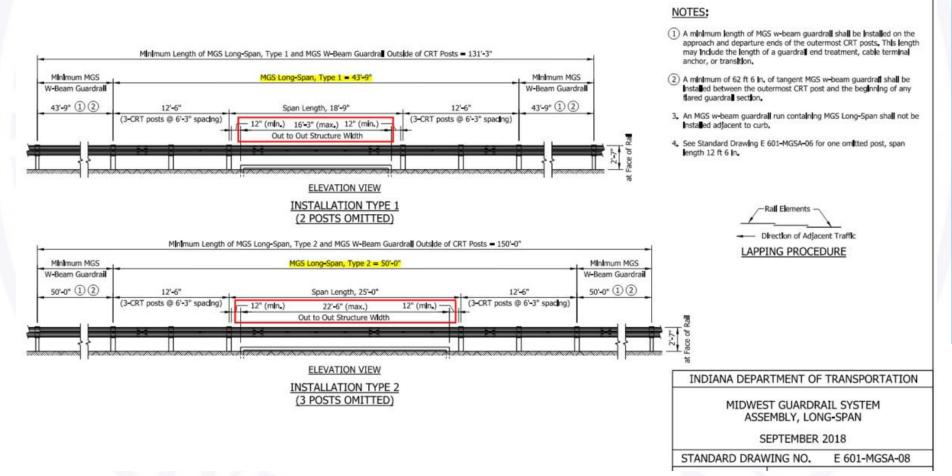
- Placing standard MGS Guardrail over a culvert without sufficient cover for the 3'-4" post lengths.
  - Options
    - Omit one post (max. out to out structure width is 16'-3")
    - Use long span section (max. out to out structure width is 22'-6")
    - Specify top-mounted posts



 Don't forget to check working width for any of these options.



- MGS Guardrail over low fill structures
  - Placing an MGS Long Span section without sufficient lateral clearance between the posts and structure.



- Follow guidance on maximum out to out structure width. Don't forget to account for a skew.
- If a structure's out to out width exceeds 22'-6", then Top-Mounted Posts can be used. See 601-MGSA-10



- Curved W-Beam Guardrail Connector and Terminal Systems
  - Incorrect layout for Curved W-Beam Guardrail and Connector Systems
  - An MGS height transition is required when connecting MGS Guardrail to either of the Wbeam curved sections MGS curved sections are under development (national effort, every DOT is looking at it).
  - The connector system is specified at a public road approach, the terminal system is generally specified at a driveway approach, but can be specified at a low volume public road approach with approval.
  - Ensure hatched area shown on the Std. Dwg. 601-CWGS-02 is free of fixed objects.
  - A W-beam connector system can be connected directly to an end treatment, but a height transition is needed when specifying the taller GRET OS. The MGS height transition can replace the min 25' of guardrail shown on Std. Dwg. E 601-CWGS-01.
  - Refer to Design Memos 17-10 and 17-17. IDM Ch. 49 has not yet been updated. Refer to Std. Dwg. E 601-CSGS-01 thru 06. Read the fine print!



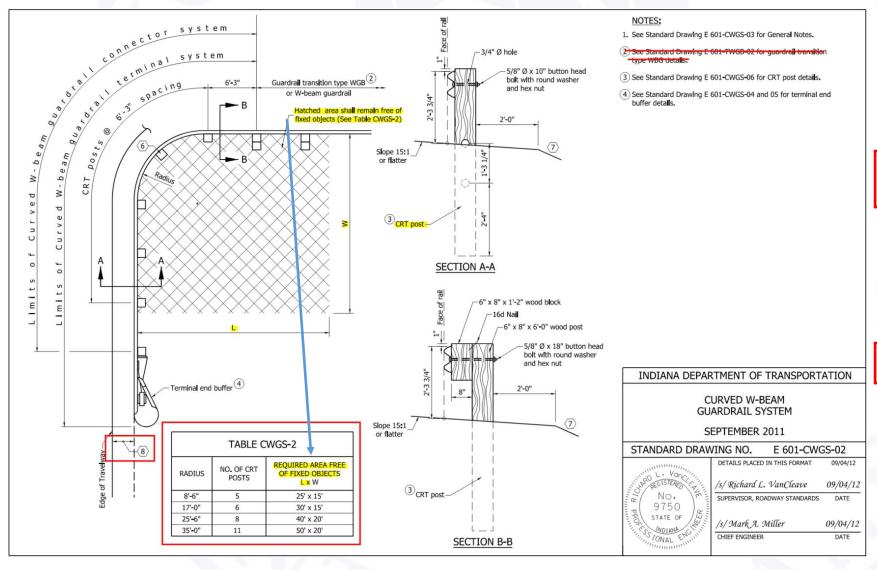
• Compatibility for Guardrail Systems

#### 2. Ensure compatibility among guardrail systems.

27 ¾" Height NCHRP 350	31" Height (601-MGSA) MASH	Notes
W-beam Guardrail	MGS W-beam Guardrail	These are standard longitudinal runs of guardrail
	MGS W-beam Guardrail, Omitted Post	Omitting post acceptable only in longitudinal runs, not acceptable in other systems
Guardrail Transition, TGB	Guardrail Transition, MGS	Transition to concrete bridge railing transition
Nested Guardrail	Long Span Guardrail (type)	Over culvert
Connector System  Terminal System		Use with MGS W-beam requires an MGS Height Transition
	MGS Structure Top-Mounted Posts	Flat top or Box Culvert only



### Curved Guardrail Connector and Terminal Systems

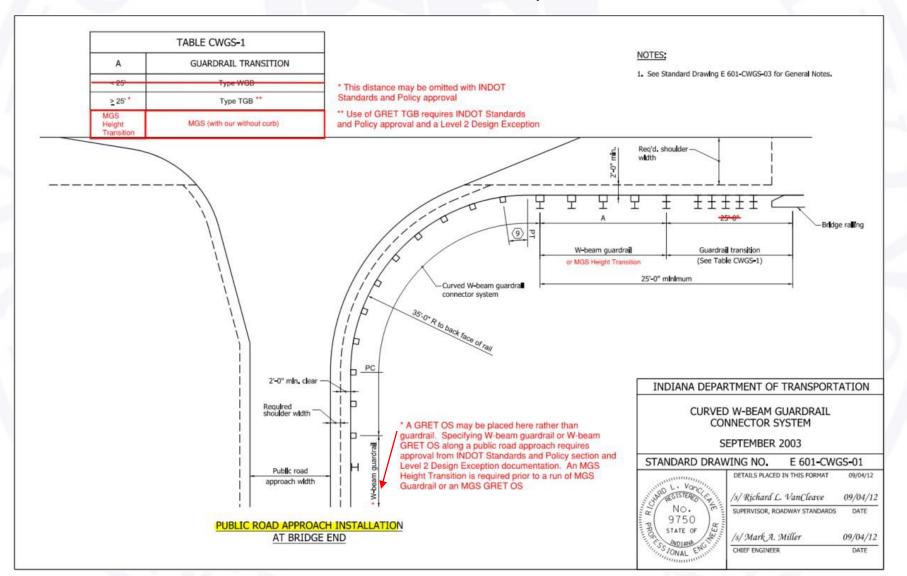


#### **GENERAL NOTES**

- This drawing shall be used in conjunction with Standard Drawings E 601-CWGS-01 through -06, and E 601-CWGT-01 and -02 where a curved W-beam guardrail system is specified.
- The type of curved W-beam guardrall system to be used shall be as shown on the plans in accordance with Table CWGS-3.
- Except where otherwise shown, all hardware and installation shall be the same as for the guardrail specified for the adjacent run.
- 4. A curved W-beam guardrail terminal system shall be used to terminate a run of guardrail only at a driveway. For a public road approach, a curved W-beam guardrail connector system shall be used.
- 5. A maximum of two guardrall panels may be omitted from the curved W-beam guardrall terminal system only where the bridge railing falls outside of the clear zone and the plans specifically state that panels are to be omitted. See Table CWGS-03 for the number of guardrail panels to be removed for each type of curved W-beam guardrall system.
- 6 For the 8'-6" radius curved W-beam guardrail terminal system, guardrail shall not be bolted to this post.
- The embankment slope behind the curved W-beam guardrail system shall be 2:1 or flatter.
- 8 A minimum 4 ft width shoulder shall be used with a 15 ft minimum drive radius.
- (9) This dimension shall be 5 ft for the 35 ft radius curved W-beam guardrall connector system.

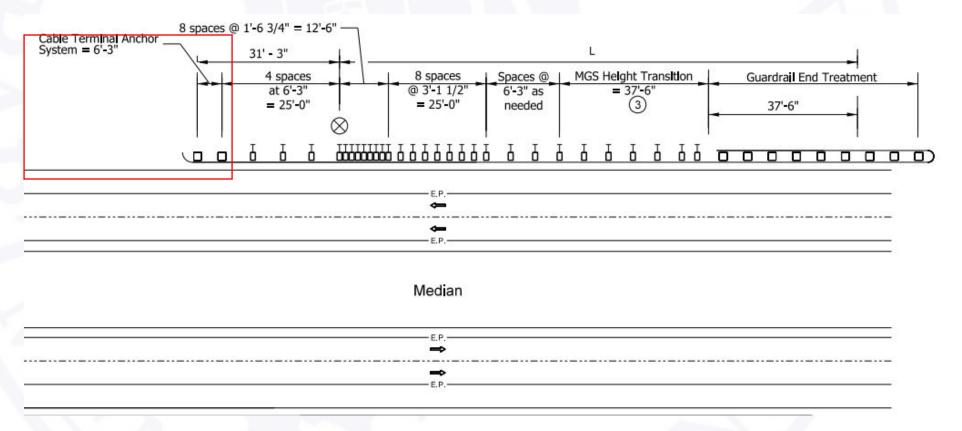


Curved W-Beam Guardrail Connector System



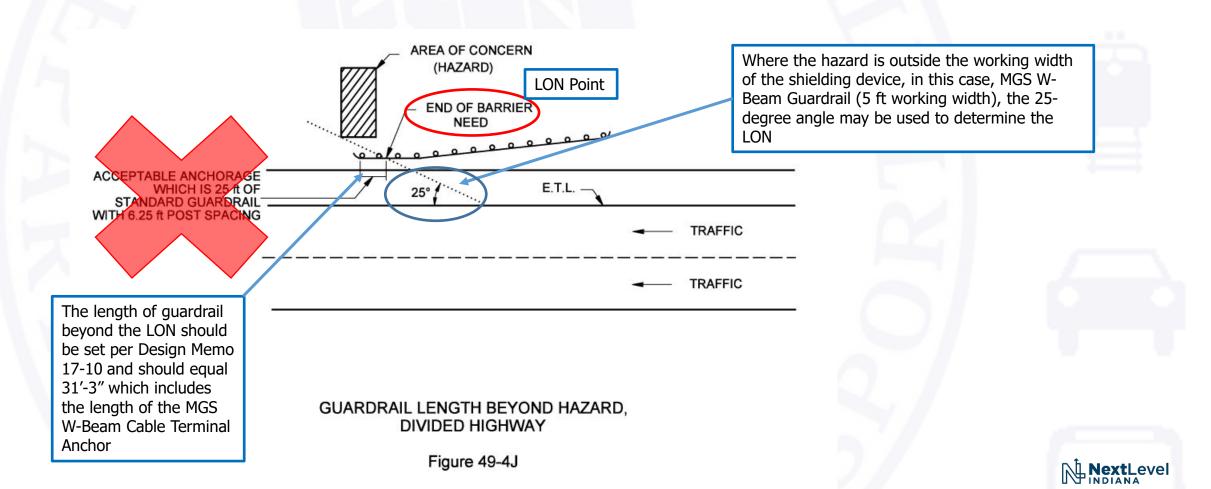


- Guardrail on Divided Highways
  - Not providing an MGS Cable Terminal Anchor at the outgoing end of MGS Guardrail on a divided highway application.

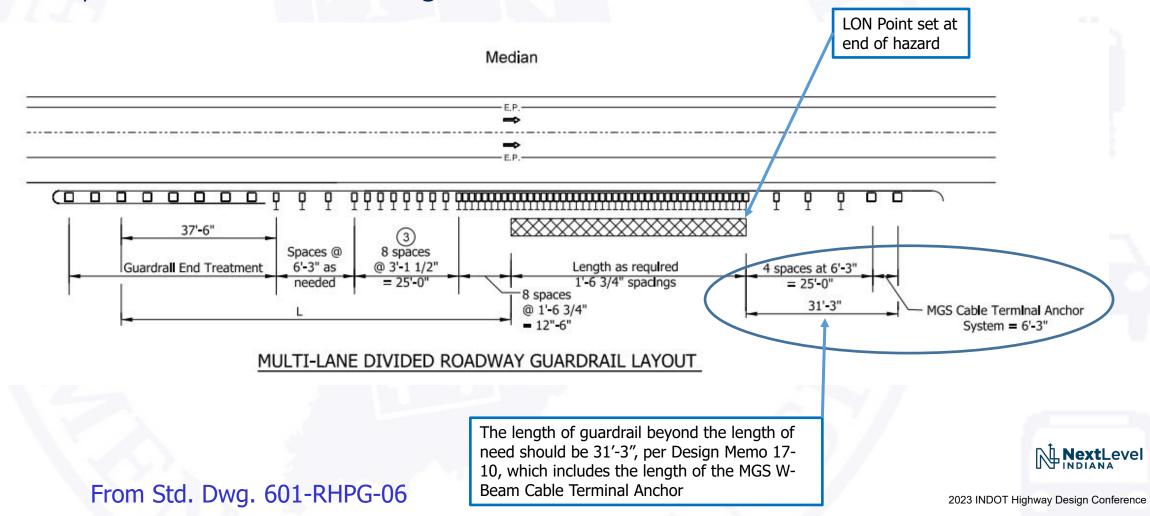




• Length of Need (LON) Calculation beyond Hazard Outside of the Working Width



- LON Calculation beyond Hazard at or Inside of the Working Width
  - Use layout with Standard Drawing series 601-RHPG



• Guardrail – Most Common Error

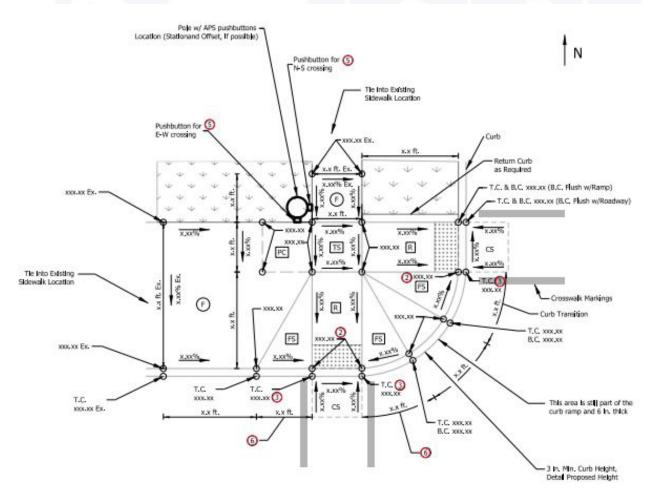
 Specifying W-beam guardrail, nested guardrail, or any non-standard application without INDOT Standards & Policy Section approval AND a Level 2 Design Exception



- ADA Curb Ramp Plan Details See Design Memo 18-26
  - Not labeling curb ramp type
  - Not labeling both top and bottom of curb elevations at ramp opening (TC/BC)
  - Turning Space (TS) not labeled
  - Clear Space (CS) not labeled
  - Not providing notes for push button adjustments (or no adjustment required)
  - Errors calculating ramp slopes



ADA Curb Ramp Plan Details – See Design Memo 18-26



#### LEGEND:

Buffer or Other Non-Walkable Surface

Ramp

Detectable Warning Surface

Turning Space

Clear Space

Pedestrian Clear Space (1)

Flared Side

Sidewalk

Proposed Slopes or Existing Slopes

Proposed Elevations or Existing Elevations

Length and Widths of all Elements and other lenghts and widths for constructability. (All may not be shown on this detail)

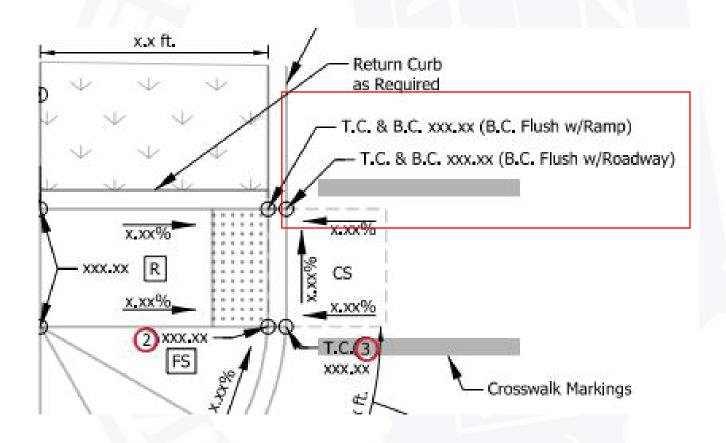
Existing Slope or Elevation

Top of Curb T.C.

B.C. Bottom of Curb



ADA Curb Ramp Plan Details – See Design Memo 18-26

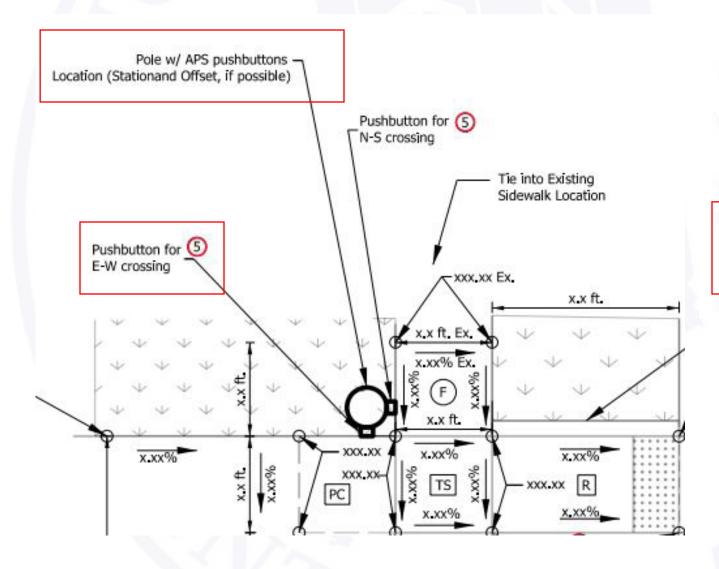


#### NOTES:

- Required where the pedestrian clear space does not overlap a turning space, level ramp, or a well defined and level sidewalk.
- (2) Elevation to be flush with ramp.
- (3) Elevation to be flush with roadway.
- 4) The curb ramp should be labeled to include the curb ramp type.
- 5 Pushbutton note should call for crossing direction and any adjustments to mounting height and side reach. If an extension is required for side reach the length should be noted. If no adjustments are required for mounting height or side reach, this should also be included in the note.
- (6) Dimension the length of the curb transition, in addition to all other lengths.



ADA Curb Ramp Plan Details – See Design Memo 18-26

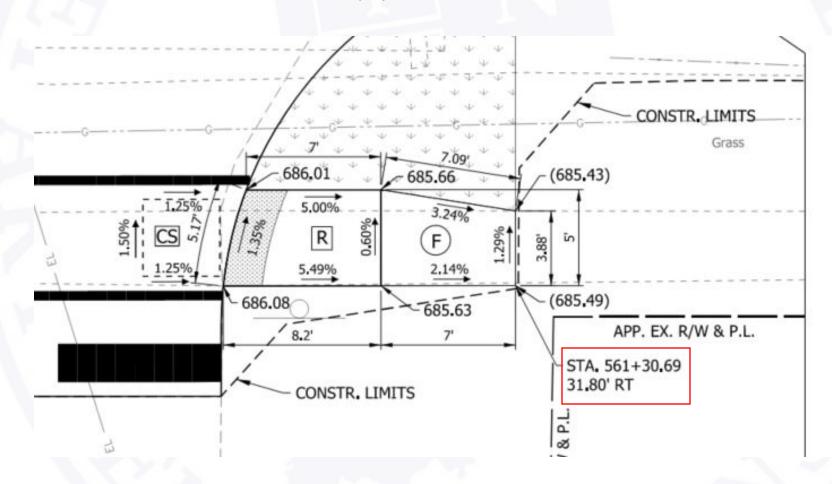


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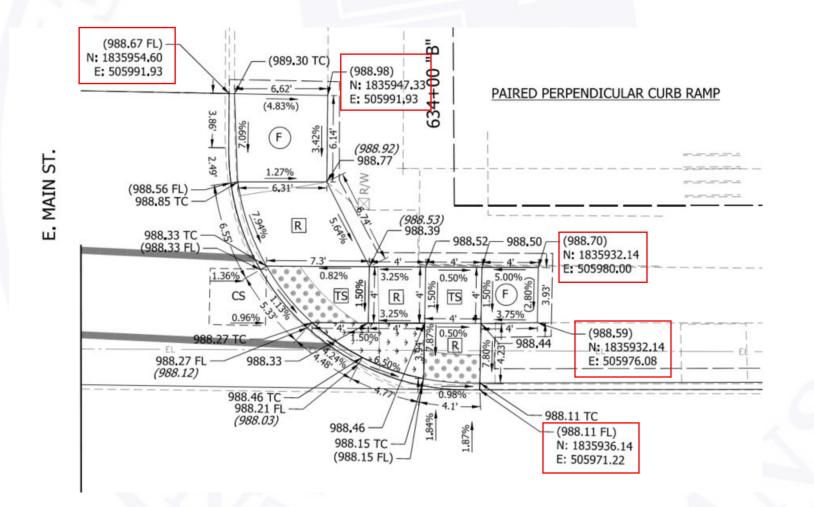


 ADA Curb Ramp Plan Details – Don't forgot to locate the curb ramp with station/offsets or N/E at key points





 ADA Curb Ramp Plan Details – Don't forgot to locate the curb ramp with station/offsets or N/E at key points





- Intersection Sight Distance
- Maintenance of Traffic
- Submissions



## Intersection Sight Distance – Common Errors

- Common errors found during plan review
  - Eye locations placed incorrectly
  - Profile under sight lines not included
  - ISD not being checked where required
  - Sight lines noted as meeting ISD when it is restricted



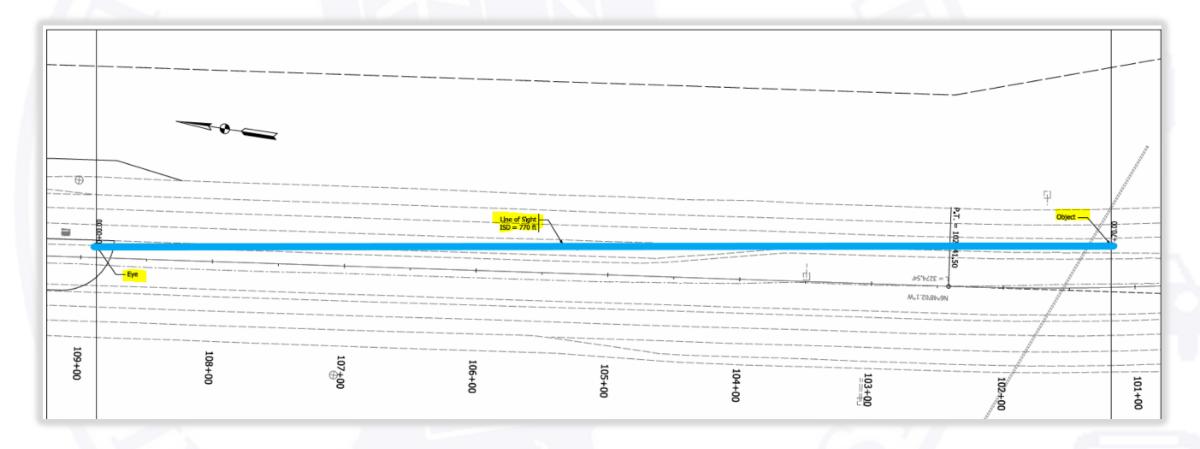
## Intersection Sight Distance – Eye Location

- Intersection sight distance should provide "sufficient sight distance for a driver to perceive potential conflicts and to perform the actions needed to negotiate the intersection safely." (IDM 46-10.0 Intersection Sight Distance)
- Height of Eye
  - Passenger Car Driver = 3.5 ft.
  - Single Unit or Combination Truck = 7.6 ft.
- Height of Object
  - Passenger Car Driver = 3.5 ft.
  - Single Unit or Combination Truck = 3.5 ft.
- Horizontal Eye Location
  - New or Reconstruction = 18 ft. behind the edge of travel lane
  - 3R project = 14.5 ft. behind the edge of travel lane
  - Turning Roadway See IDM Figure 46-10E
  - Drives = 10 ft. behind the edge of travel lane



# Intersection Sight Distance – Eye Location

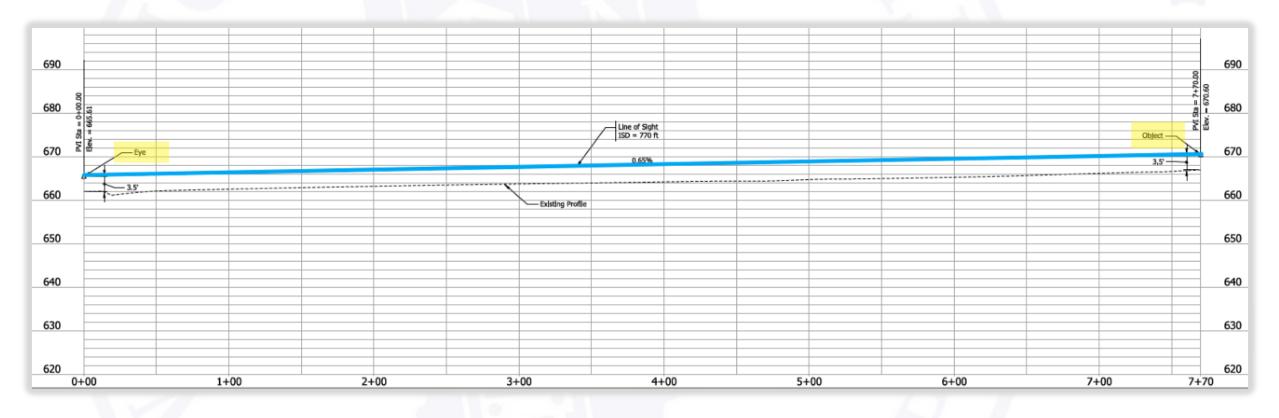
Horizontal Line of Sight





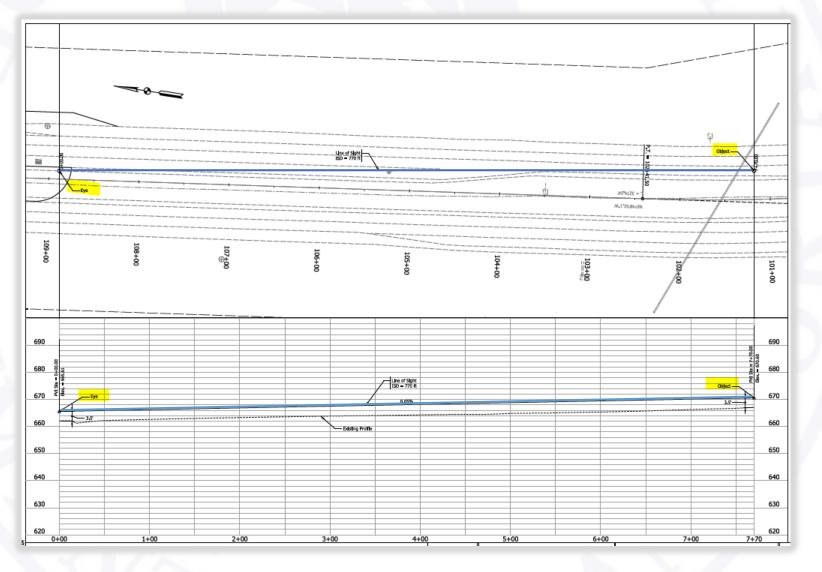
# Intersection Sight Distance – Profile Under Sight Lines

Vertical Line of Sight



## Intersection Sight Distance

• Diagram showing the eye location and the sight line/proposed ground profile





## Intersection Sight Distance – When to Check

- When to check ISD
  - Public Road Approaches
  - Frontage Roads
  - Driveways
  - Turning Roadways
  - Left Turn from Divided Highway Medians
  - Unprotected Left Turns (IDM 46-10.04 Left Turn From the Major Road)
    - "Each location along the major road where a vehicle is permitted to turn left across opposing traffic, including an intersection or drive,"
  - Right Turn on Red at Signalized Intersections (IDM 46-10.05 Signal Controlled Intersection)
    - Also includes left turns from one-way street to another one-way street
    - If criterion are not met, consideration should be given to prohibiting turns on red, which will require an Official Action
  - Maintenance of Traffic



## Intersection Sight Distance - Restrictions

- What if there is a restriction that prevents ISD from meeting recommended values?
  - "The additional costs and impacts of removing sight obstructions are often justified. If
    it is impractical to remove an obstruction blocking the sight distance, the designer
    should consider providing traffic-control devices or applications (e.g., warning signs,
    traffic signals, or turn lanes) which may not otherwise be warranted." (IDM 46-10.0
    Intersection Sight Distance)
  - Restrictions may include:
    - Bridge Railing
    - Guardrail
    - Structures
    - Landscaping/Vegetation (single tree versus row of trees)
    - Alignment of the Major Road
    - Right-of-Way Limits
    - On-street Parking
    - All of the above, during MOT



# Intersection Sight Distance - Documentation

- What if there is a restriction that prevents ISD from meeting recommended values?
  - ISD is a Level 2 Design Criteria (IDM 40-8.02(02) Hierarchy of Design Criteria)
  - If ISD cannot be met, documentation should include the following:
    - design speed
    - summarization of accident data for the most recent available 3-year period
    - evaluation of the accident data which is related to intersection sight distance
    - approximate cost of to be in accordance with the intersection sight distance requirements
    - \*If an LPA project, written concurrence from the local elected official should be included in the project file.



## Maintenance of Traffic – Common Errors

- Design Speed for MOT not provided on MOT sheets
- Lane tapers not based on posted speed limit (min)
- Lane shift tapers and lane reductions within the same location
- Lane Tapers not being offset
- Missing MOT Details and Draft TMP at STG1 for Significant WZ projects
- Elevation differences and drainage issues between MOT phases not being considered



## Maintenance of Traffic – Design Speed

- "The Construction Zone Design Speed is to be shown on the MOT plan sheets for each phase of construction." (IDM 503-3.04(01) Construction Zone Design Speed)
  - Selection of the Construction Zone Design Speed should consider:
    - "Drivers will reduce their speeds only if they clearly perceive a need to do so." (IMUTCD, 6c.01.2)
    - Reduced speed limits should be used only in the specific portion of the TTC zone where conditions or restrictive features are present. However, frequent changes in the speed limit should be avoided. A TTC plan should be designed so that vehicles can travel through the TTC zone with a speed limit reduction of no more than 10 mph.
    - A reduction of more than 10 mph in the speed limit should be used only when required by restrictive features in the TTC zone. Where restrictive features justify a speed reduction of more than 10 mph, additional driver notification should be provided. The speed limit should be stepped down in advance of the location requiring the lowest speed, and additional TTC warning devices should be used.
    - Reduced speed zoning (lowering the regulatory speed limit) should be avoided as much as practical because drivers will reduce their speeds only if they clearly perceive a need to do so.



## Maintenance of Traffic – Design Speed

- Selection of the Construction Zone Design Speed should consider:
  - The permanent posted speed limit **prior** to construction; not the reduced speed shown on worksite speed limit sign assemblies.
  - Desirable to match or exceed current posted speed limit
    - Per the IMUTCD, the construction zone design speed should desirably match or exceed the current posted speed limit but in any case should not be more than 10 mph lower than this posted speed limit."
    - IDM 503-3.04(01), notes that, "If the operating speed (85th percentile) is significantly higher than the current posted speed limit, a higher construction-zone design speed should be considered."
    - Additional guidance to use 10 mph above the posted speed limit was provided for areas with high ADT or significant truck traffic (DM No. 21-05)

On roads with high ADT, or significant truck traffic, longer tapers should be considered. It is advisable in those situations to consider taper lengths that correspond with a speed that is 10 mph greater than the normal posted speed of the highway. This is particularly important when configuring the first taper into a work zone where large trucks require greater distances to adjust their speed and maneuver safely. An



## Maintenance of Traffic – Lane Tapers

- Lane Tapers Guidance
  - Reviewers are seeing many lane tapers (merging and shifting) being based on design speeds that are lower than the existing posted speed limit
  - Per Design Memo No. 21-05,

#### **Work Zone Safety Mitigation Measures**

#### Lane Tapers

The most important element in the transition area is the taper that provides channelization. Please reference IDM Figure 503-7D and 503-7E for the types of lane tapers. An inadequate taper produces undesirable traffic operations, which could lead to crashes within the work area. A merging taper is used on multilane roadways when the number of traffic lanes is reduced. The length of the merging taper must be long enough for vehicles traveling side-by-side to adjust their speeds and merge into a single lane before the end of the transition. Please reference INDOT Standard Drawing 801-TCDV-03; this table provides minimum taper lengths based on speed and either the width of the lane or the shift. The minimum speed that is used to determine the taper length should match the posted speed limit of the road in advance of the construction zone. This speed is the normal posted speed limit of the road, and not the work zone design speed.



## Maintenance of Traffic – Lane Tapers

- Lane Tapers Guidance
  - Per Design Memo No. 22-06,
    - 1. The standard initial merge taper length entering the work zone for all interstate and freeway projects will be based on 70 mph speed regardless of the permanently posted speed limit. This change recognizes that in urban areas operating speeds significantly exceed the posted speed limit on a regular basis. Subsequent merges throughout the work zone will also be based on 70 mph speeds unless a variation is deemed appropriate by engineering judgment- prevailing operating speeds at the location should be considered and documented with through a level 2 design exception. Following the same reasoning, interstate and freeway shift taper lengths for a full 12 ft shift should be 420 ft. (801-TCDV-03)
  - For all **interstate and freeway** projects, the standard initial merge taper, subsequent merges, and shifts should be designed for 70 mph regardless of the permanently posted speed limit

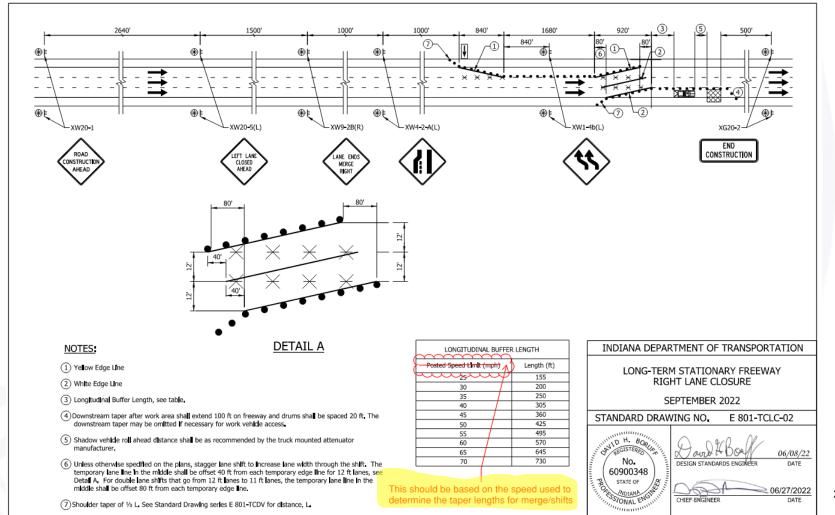
(\*Buffer lengths should also be determined based upon the speed used to determine the merging/shifting tapers)

• Additional guidance will be provided in Design Memo 23-04



### Maintenance of Traffic – Lane Tapers / Reductions

• Standard Drawing Series E-801-TCLC has been updated to provide additional guidance for MOT (Design Memo 22-06)





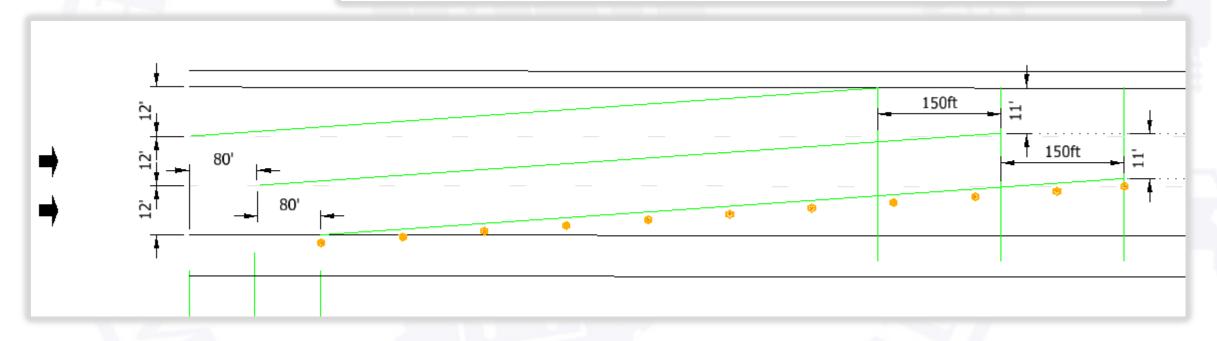
2023 INDOT Highway Design Conference

# Maintenance of Traffic – Lane Tapers / Reductions

• Standard Drawing Series E-801-TCLC has been updated to provide additional

guidance for MOT

(6) Unless otherwise specified on the plans, stagger lane shift to increase lane width through the shift. The temporary lane line in the middle shall be offset 40 ft from each temporary edge line for 12 ft lanes, see Detail A. For double lane shifts that go from 12 ft lanes to 11 ft lanes, the temporary lane line in the middle shall be offset 80 ft from each temporary edge line.





### Maintenance of Traffic – STG1 Requirements

 Current guidance states that for Significant Projects the following should be submitted at STG1 & STG2

- 6. <u>Traffic-Maintenance Details</u>. The conceptual traffic-maintenance strategy and phasing should be detailed.
- Draft TMP Report for Significant Projects. The following documents should be included in the draft TMP Report unless it is not required. Where a document is not required, reasoning should be noted.
  - a. TMP Team. The designer should provide a list of the TMP Team members and contact information, including all stakeholders, see Section 503-2.04.
  - b. TMP meeting minutes or other correspondence,
  - c. Determination of Significant Work Zone Impacts, see 503-2.02,
  - d. Approved Traffic Control Strategy memo, see Section 503-2.05(02),
  - e. Draft IHCP exception request, where required, see Section 503-3.02,
- Proposed guidance will state that the IHCP policy should be reviewed at STG1 to determine if an exception will be needed



# Maintenance of Traffic – Elevation and Drainage

- Elevation differences between MOT phases
  - Is there enough horizontal space for a drum / TTB as well as an elevation transition?
  - Do you need sheet piling to hold back fill?
  - Is there horizontal working width for construction equipment?
  - Typical sections for MOT phases will help to identify these issues. Include Typical sections in your MOT details.
- Drainage issues between MOT phases not being considered
  - Where will be the water go during each phase? Are you trapping water with crossover pavement? Do you need drainage pipes?
  - Consider how to drain the water from your project during each phase of MOT



#### Submissions – Common Errors

- STG2 Plans for Publication not submitted
- Plans for Traffic review not submitted
- Interstate Highway Congestion Policy (IHCP) Exception not submitted at appropriate time
- Preliminary Geometric Review for Reduced Conflict Intersections not submitted prior to STG1



- Design Memo No. 22-1 announced the revision of Indiana Design Manual sections in chapter 14 to add a requirement for STG2 Plans for Publication to be submitted for all STG2 submittals on or after January 6, 2022.
- STG2 PUB plans are available via Eighteen Month Letting List Search at: <a href="https://www.in.gov/indot/doing-business-with-indot/contractorsconstruction/general-information/">https://www.in.gov/indot/doing-business-with-indot/contractorsconstruction/general-information/</a>
- The following documents will be published for public viewing if submitted at STG2:

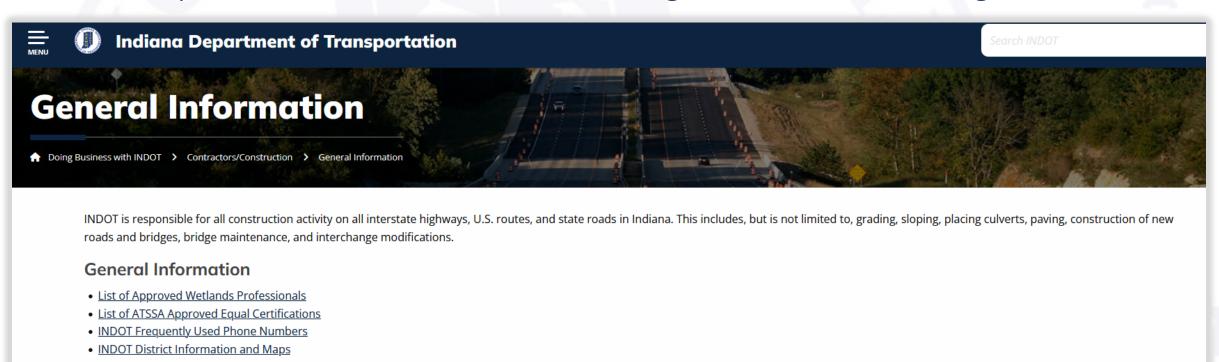
STG2 PlansXsect**Pub** [Des] for [Bridge or Roadway] Services STG2 Plans**Pub** [Des] for [Bridge or Roadway] Services STG2 UnqSplProv [Des] for [Bridge or Roadway] Services\* STG2 QtyCalcs [Des] for [Bridge or Roadway] Services



18 Month Letting Reports

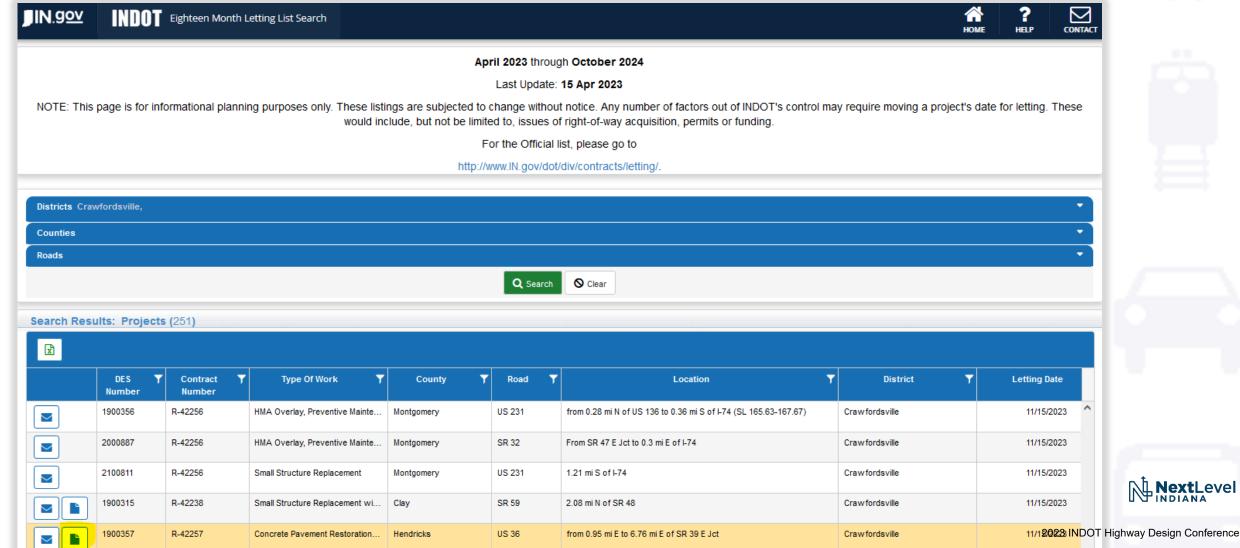
• 18 Month Letting List Search | List Report

• STG2 PUB plans will then be available via Eighteen Month Letting List Search at:



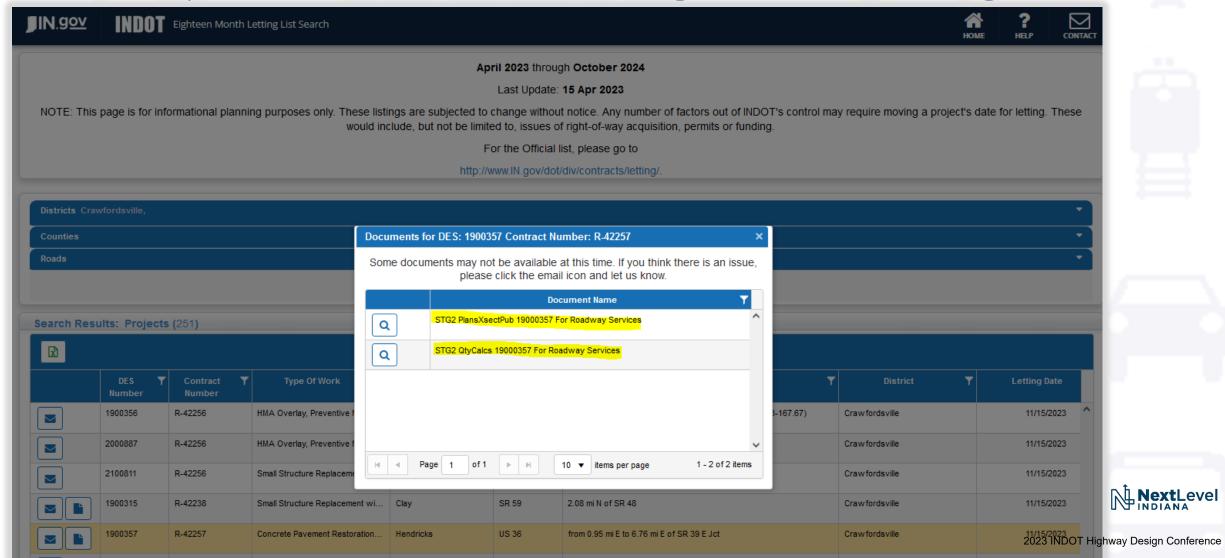


• STG2 PUB plans will then be available via Eighteen Month Letting List Search at:





• STG2 PUB plans will then be available via Eighteen Month Letting List Search at:



### Submissions – Plans for Traffic Review

- "If the project includes traffic signal(s), signing, or lighting details a separate set of plans should be submitted into ERMS for traffic review in accordance with Section 14-1.02(09)." (IDM Sections 14-2.01(03), 14-2.01(07), 14-2.01(12), 14-2.03(01), 14-2.03(10), 14-2.04(02), 14-2.04(06), 14-2.04(09), 14-2.05(01), 14-2.05(03), 14-2.05(05))
- This guidance applies to all stage submittals, whether Bridge or Road contracts.
- File naming format should be as follows:

TRAF Plans XXXXXXX for Traffic Services STGX



### Submissions – IHCP Exception

- IHCP Policy Statement, "It is the policy of the Indiana Department of Transportation (INDOT) to limit operations which reduce the number of lanes, reduce the width of lanes, or may otherwise cause congestion to occur on an interstate route." (Interstate Highways Congestion Policy 2017)
- IHCP Exception Requests are applicable to all construction or maintenance activities that "require closure of or restrictions to one or more lanes on an Interstate highway" (IDM 503-3.02 Interstate Highways Congestion Policy)
- Current guidance: Draft IHCP Exception Requests should be submitted at STG1 and STG2 as part of the Draft TMP for projects deemed Significant when needed (IDM 14-2.01(07).14e Stage 2 Review Submission)
- IHCP Exception Requests "made during design should be submitted as soon as possible, but no later than three months prior to Final Tracings submittal". (IDM 503-3.02 Interstate Highways Congestion Policy)



## Submissions – IHCP Exception

- Chapter 503 Maintenance of Traffic is being revised. Design Memo 23-04 will be providing revised guidance on the timeframe for submittal and review of IHCP exception requests. This guidance is currently at FHWA for signatures and is expected to be published very soon.
- Proposed guidance:
  - IHCP should be reviewed at STG1 to determine if an exception is needed. Designers should consider the setup and removal of MOT phases including initial placement of pavement markings, removal of temporary markings, and placement of permanent markings.
  - Draft MOT plans and draft IHCP exception request submitted at STG2
  - Final MOT plan and APPROVED IHCP Exception Request by STG3



## Submissions – Preliminary Geometric Review

- Preliminary Geometric Review Submissions PRIOR to STG1
  - Reduced Conflict Intersections (RCI) should be submitted for geometric review prior to STG1 for project including:

Roundabout (RAB)	Median U-Turn	Displaced Left Turn
Green "T"	Jug Handle	Quadrant Roadway (QRI)
Grade Separation	Offset "T"	Others?

- Traffic Engineering would like to be notified of all RCI projects during preliminary engineering and prior to STG1 so that they can review and identify any high-level traffic related layout concerns.
- This direction has not been incorporated into policy yet.
  - Chapter 14 revisions will include requirement for all RCI's to have a Geometric Review prior to STG1.
  - Chapter 46 rewrite is underway and RCI info will be included with drawings.



#### Common Errors Seen in Plan Review

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