Structural Engineering Guidance No. 14-01

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SUBJECT: NEW BRIDGE APPROACH SLABS (BAS) IMPLEMENTATION

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EPG Status: To Be Submitted

Std. Drawing Status: Incorporated

Effective Date: January 2015

Expiration/Duration: When Incorporated into EPG

Background and Purpose:

Two new bridge approach slab classes are being introduced for incorporation which is the result of research performed by the University of Missouri-Kansas City and the University of Missouri-Rolla with technical assistance from MoDOT. Its purpose was to search, analyze and design new bridge approach slabs that would reduce construction costs and maintain current approach slab performance. The two new bridge approach slab classes purposely and conveniently follow MoDOT’s current practice of having two different types of approach slabs for the two different road classes(1). For further reading, the research is broken up into two major project reports, one which explored approach slab alternatives and one that reports on field-tested performances of specific project-implemented recommended slab alternatives. The reports are stored electronically at MoDOT’s Innovation Library website:

*Bridge Approach Slabs for Missouri DOT Looking at Alternative and Cost Efficient Approaches*, 2011

<http://library.modot.mo.gov/RDT/reports/TRyy0915/or11009.pdf>

*Bridge Approach Slabs for Missouri DOT: Field Evaluation of Alternative and Cost Efficient Bridge Approach Slabs*, 2013

<http://library.modot.mo.gov/RDT/reports/TRyy1121/cmr13-010_Final.pdf>

(1)After re-examining how bridge approach slabs are designated in the current EPG 503 and its field implementation, it was decided to stay with a system where roadway classification is the main determinant in the type of bridge approach slab utilized but change how the field implements which was discovered has introduced convoluted application and unclear pay practices by not following the EPG. One thing is absolutely clear and that is having both types of bridge approach slabs under the guidance of a single authority has restorative and long lasting stabilizing effects. Therefore, implementation also includes placing the new approach slabs under the responsibility of the Bridge Division for plans and pay items, and that all bridges will formally have an approach slab with the exception that the project core team will be given the authority to change the type of bridge approach slab based on need.

Instructions:

Implement new bridge approach slabs for all new bridge and replacement bridge jobs in accordance with the following guidance and standard drawing guidance. The new bridge approach slabs replace the current (or outgoing) *Bridge Approach Slab* (Bridge) and *Modified Bridge Approach Slab* (Design). Consult districts and Bridge’s Preliminary and Review Section for specific letting opportunities. The earliest available letting date or planned implementation date will be January 2015.

GUIDANCE:

New Standard Bridge Approach Slab (BAS) Classes and Descriptions:

There are two new standard bridge approach slab classes:

* *BAS (Major Road)*
* Replaces current Bridge Approach Slab (Bridge) in function.
* 20 feet in length (Current BAS is 25 feet).
* Material is concrete.
* 30 percent less reinforcement than current BAS.
* Includes sleeper slab.
* Base drainage provisions are same as current BAS.
* *BAS (Minor Road)*
* New BAS (Minor Road) will be the responsibility of Bridge Division. Current MBAS is the responsibility of District Design Divisions.
* Replaces current Modified Bridge Approach Slab (MBAS) (Design) and broadens practicality and efficiency by including optional slabs.
* 20 feet in length (Current MBAS is 25 feet).
* Two material sub-classes are:
* Concrete Approach Slab - Allowed with concrete or asphalt pavement.
* Asphalt Approach Slab (2) - Not allowed with concrete pavement.
* Both sub-classes are contractor options.
* 60 percent less reinforcement in concrete sub-class option than current BAS.
* Does not include sleeper slab; does include an integral heavily reinforced transverse end beam.
* The asphalt bridge approach slab option will more than likely be a continuous run with the asphalt roadway pavement but nevertheless, the first 20 feet from the bridge end is a bridge pay item for accountability purposes.
* Base drainage provisions are same as current MBAS which are same as current BAS.

Effective date on new BAS Standard Drawings is January 2015. Current BAS Standard Drawings will still be available and not archived until after jobs using them have moved through the system.

(2)The concept of a formalized asphalt bridge approach adjacent to the bridge end was created by CM Division and winner of a MoDOT Innovations Award. It expands on the practice of the outgoing practice of running asphalt pavement up to the bridge ends on minor roads with some exceptions. The original concept required granular backfill immediately adjacent to fill face and wings in addition to specification compacted backfill which was eliminated in favor of the current practice of requiring vertical drain tile at the fill face and only specification compacted backfill which is standard for all new bridge designs.

More debatable, the asphalt bridge approach option is called a “slab” because in practice it will perform a similar role as the concrete slab option supported on soil: it is a gross material thickness placed on special drainage features occupying the first 20 feet from the bridge end; behaviorally, it is not a “structural slab” like the concrete slab owing future maintenance to wedging operations. However, both slab options can settle and similarly both may require adding compensatory material either at the bottom of the slab as in mud jacking a concrete slab or at the top of the slab as in wedging an asphalt slab. This entire aside, using similar naming keeps the focus on the function rather than different names adding to confusion.

New Standard Practice for New or Replacement Bridges:

* All new or replacement bridge designs will incorporate a new bridge approach slab class that will follow the roadway classification of the roadway carried on the bridge.
* All new bridge approach slabs for a new bridge on a minor road will allow both material sub-class options.
* All new bridge approach slabs will be 20 feet in length.
* All new bridge approach slabs will be shown on the bridge plans and itemized as a bridge pay item.
* All new or replacement bridge designs will incorporate #5-H bars for approach slab anchorage on the end bent plan sheets and on the bar bill.
* Indicate BAS class on Bridge Memorandum only if it does not match roadway classification. Indicate the status of a Design Exception as in if needed or already approved.
* The pay item for the bridge plans will be as shown on the standard drawings. Preliminary and Review Section will prepare new pay items in the system.

Informing/Coordinating with Districts:

Work with districts on implementation of the new bridge approach slabs; some districts may be aware already.

Districts will no longer need to incorporate a Modified Bridge Approach Slab Special Sheet, Design Special Provision (DSP) or pay item into their documents.

Bridge end drainage should be considered by districts.

Districts must select asphalt mix for BAS (Minor Road) class which should be indicated on the Bridge Memorandum.

Design Exceptions (DE):

Two important guidelines for DEs: (1) most jobs are routine and should use the correlated bridge approach slab class; for most jobs, approach slabs should not be made an issue, and (2) any variance from (1) requires a DE.

* A Design Exception cannot be used to eliminate a bridge approach slab.
* A Design Exception cannot be used to modify the length of a bridge approach slab.
* A Design Exception can be used to change the bridge approach slab class based on project core team consensus. Encouraged substitutions may be solely based on high/low AADT where a BAS (Major Road) is perceived to be a better solution for a minor road bridge with high AADT, or a BAS (Minor Road) is a perceived to be a better solution for a major road bridge with low AADT. Other factors that could be considered are bridge width, length, skew, embankment condition and history, end bent type, flood concerns, deck drainage, bridge end drainage concerns, and “major bridge” status, etc. This is in keeping with current practice where the MBAS is utilized in similar fashion, i.e. AADT has been the critical deciding factor and maybe the only factor.
* A Design Exception is not required to force a BAS (Minor Road) optional slab sub-class.
* A Design Exception for BASs should be initiated by Bridge Division with project core team consensus.
* A Design Exception is not allowed “post-letting”; further, a slab cannot be changed in construction by a change order unless physical ground conditions at site, not known or anticipated beforehand, support the change.

Bridge End Drainage:

Drainage should be considered at all bridge ends; new, replacement, redecking and rehabilitation. Drainage from deck and roadway should be considered. This is the responsibility of district design to show on their plans and project core team consensus is encouraged.

For Major Roads:

* BAS (Major Road) utilizes curbs in conjunction with concrete approach pavement and drain basins.
* Drain basins are required based on need.

For Minor Roads:

* BAS (Minor Road) utilizes curbs in conjunction with drain flumes or extended rock blanket.
* Drain flumes are required based on need.
* Rock blanket extended up to and along BAS (Minor) is included based on need.
* Drain flumes and extended rock blanket are mutually exclusive.

Terminology:

There is some confusion in both the office and field about approaches and naming. In order to increase understanding and awareness, and in order to educate others, the terms are explained here with their associated specification reference section (and Standard Plan), and underlined key components.

* *Bridge Approach Slab* (Sec 503) is to mean a slab, either reinforced concrete or asphalt, on prepared subgrade adjacent to a bridge end. For the concrete bridge approach slabs, they are typically anchored at the bridge end and use a ¾” joint filler expansion end on a sleeper slab or the ground at the other end. For the asphalt bridge approach slab, they are unanchored at the bridge end and are made continuous with the roadway pavement supported on the ground at the other end.
* *Concrete Approach Pavement (CAP)* (Sec 504) is to mean an unreinforced, haunched, concrete roadway pavement on prepared subgrade adjacent to a Bridge Approach Slab (Major) with a ¾” joint filler expansion end on a sleeper slab and a 2” preformed joint filler expansion end on a concrete sill (referred to as an “E” joint because it is shown as a Type E Joint in the Standard Plans).
* *Pavement* is roadway pavement either unreinforced concrete or asphalt adjacent to CAP or BAS (Minor). It may rest on a concrete sill depending on if CAP is used.

Standard Drawing Features for New BASs:

* Standard length changed to 20 feet (was 25 feet).
* Thickness is unchanged from current standard BAS design and remains 12” (Min.).
* 3 underseal access (mudjack) holes changed from 4 holes.
* New shape #5-H bar bridge approach slab anchorage (L Bar). Allows slab “hinging” rather than slab “continuity” at the end of bridge slab if settlement were to occur. (May be underrun in construction)
* End of Slab is identified rather than Fill Face of End Bent.
* Pay item for each BAS class matches class names.
* 90 degree stirrup hook in sleeper slab of BAS (Major Road) changed from 135 degree stirrup hook. Level of need and criticality did not warrant level of detail.
* Removed all references to Grade 40 steel reinforcement.
* Timber header remains for concrete bridge approach slabs at the request of the Resident Engineers.
* All slabs have curbs, concrete or asphalt; curbs are full length of slab for BAS (Major Road) and continuous with concrete approach pavement curbs; curbs are partial length of slab for BAS (Minor Road).
* Asphalt mix callout required on BAS (Minor); work with districts.
* BAS (Major Road) is detailed on one sheet; six sheets total for six foreseeable variances.
* BAS (Minor Road) is detailed on one sheet; one sheet total for most foreseeable variances.

BAS (Minor Road) Pay Item:

This will be a new pay item without a history. The new pay item will represent a cost for material sub-class options, concrete and asphalt. Eventually a history will be developed but indistinguishable in terms of a specific material sub-class option generally upon a quick search. For this reason, cost estimating may be difficult in the beginning and also difficult if a specific sub-class option is forced. For specific jobs, it can be researched with some effort. Consult the Preliminary and Review Section for Guidance.

Bridge Reference Database:

1. This in-house program should be updated to allow for the possibility that a new or rehab bridge can have either bridge approach slab class or that within the BAS (Minor Road) class there can be the possibility of two different material slab sub-classes. The former option of bridge approach slab class can be entered into the program during pre-letting while the latter option can only be known and then entered post-letting which brings up another point.
2. It may be a good idea at this time to have staff review incoming construction as-built plans for indicator boxes that are checked and update the Bridge Reference Database and TMS accordingly.

New Standard Practice for Redecking, Rehabilitation, and New or Replacement Bridge Approach Slab Jobs:

* Use new bridge approach slabs based on roadway classification.
* Determine cause of deterioration or failure of existing approach slab or approach pavement. Is a structural slab required?
* Determine if existing slab has been mudjacked in the past and how much.
* Project core team should agree that BAS is needed or needing to be replaced.
* Design Exceptions:
* Not required if a new BAS is not used.
* Required if changing BAS classes.
* Not required to force a BAS (Minor Road) optional slab sub-class.
* Bridge end drainage should be addressed.
* Work with districts:
* 25 feet is preferred length if replacing a 25-foot bridge approach slab.
* Using same length replacement BAS will cost more but may save time.
* 20 or 25 feet length may be used if adding a new approach slab.
* Using shorter replacement BAS will require more roadway pavement replacement. Savings in BAS cost is partially lost to adding roadway pavement.
* Standard BAS can be lengthened to 25 feet using same reinforcement and performance should be the same.
* Using asphalt behind a bridge introduces drainage issues since asphalt is permeable. For bridges without vertical drains, this could be an issue especially if an asphalt approach slab is replacing a concrete approach or concrete approach slab. Installing vertical drains is expensive but should be considered.

New Prestressed Bridge Approach Slabs (PBAS):

See Structural Engineering Guidance 14-02 for tentative implementation and guidance.

Report Deviations from Guidance:

Deviations or amendments to guidance based on Bridge Memo or Design Layout conferences or discussions with management or districts, or special cases or interpretations should be reported to Development Section or Preliminary and Review Section so that guidance and EPG are updated.

Suggestions and recommendations concerning this guidance or procedure should be directed to the Development Section for review and updating the Engineering Policy Guide.