

# Illinois Department of Transportation

2300 South Dirksen Parkway / Springfield, Illinois / 62764

April 14, 2003

## Precast Concrete Box Culvert Shop Drawings

County Engineers/Superintendent of Highways  
Municipal Engineers/Director of Public Works  
Consulting Engineers

#03-05

The Bureau of Bridges and Structures (BBS) issued an All District Engineers Memorandum (copy attached) on March 1, 2002 pertaining to the review and approval of shop drawings for precast concrete box culverts. This circular letter provides guidance in applying the information contained in that memorandum to local agency projects.

The memorandum states: "Effective with the June 14, 2002 letting, the department is implementing a new policy for shop drawings of Precast Concrete Box Culverts. Shop drawing approval by the department will no longer be required for precast concrete box culverts which comply with (1) the IDOT Specifications, (2) the applicable requirements of the AASHTO Specifications and (3) the specific producer's QC/QA plan approved by the department.

To accomplish this agenda, the designer will be required to clearly indicate the design fill height for every precast and cast-in-place culvert, including extensions, in the contract plans. To determine the design fill height, the maximum and minimum fill heights between the extreme edges of the shoulders shall be calculated."

### SYNOPSIS OF BBS MEMORANDUM

1. The "No BBS Review/Approval" policy is only applicable to **standard** precast culvert sizes – "standard" culvert sizes considered to be those contained in AASHTO M 273 and M 259 (both English) and also in accordance with Section 540 of the department's Standard Specifications.
2. The design fill height, span x rise, proper AASHTO designation (and whether interstate loading is required) must be clearly shown on the design plans. The producer will be required to mark this information on the precast concrete box.

3. The producer is also **required** to provide the producer mark, AASHTO/ASTM designation, date of manufacture, and the span, rise, and design cover per Bureau of Materials and Physical Research (BMPR) Policy Memorandum 02-02 for the Quality Control/Quality Assurance Program for Precast Concrete Products. This memorandum may be found at <http://www.dot.state.il.us/materials/02-02qcqa.pdf>.
4. For **non-standard** precast culvert designs, the BBS will still review and approve precast concrete box culvert shop drawings. Alternatively, shop drawings with the seal, signature, and structural certification of an Illinois Licensed Structural Engineer may be accepted.

### **GENERAL – ALL DESIGNS**

For local agency projects, it is recommended, for all designs, that the designer clearly indicate in the contract plans the design fill height, the span x rise, and the proper AASHTO designation for every precast and cast-in-place culvert, including extensions and end sections, as described in the BBS' memorandum of March 1, 2002. It is also recommended that the construction documents specify that the culverts be in accordance with BMPR Policy Memorandum 02-02 for the Quality Control/Quality Assurance Program for Precast Concrete Products.

Note that shop drawings are still required for all precast concrete box culvert projects (including standard and non-standard box sections, manholes, junction chambers, extensions and end sections). For all non-standard precast culvert sizes, the review of the BBS, or a structural engineer's seal, signature and certification, are required for approval; non-standard designs shall not be approved based solely on a shop drawing review and approval without prior design certification.

A number of options are available to local agencies for the review and approval of shop drawings, for both non-standard and standard designs, for precast concrete box culverts.

### **NON-STANDARD DESIGNS**

For precast concrete box culverts following the procedures contained in the March 1, 2002 BBS memorandum, shop drawings may be submitted for review and approval to the BBS through the District Bureau of Local Roads and Streets.

**Submittal Procedure.** The precast producer should submit shop drawings to the contractor, who is to then forward the shop drawings to the local agency/owner for their review and approval. If found acceptable, the shop drawings should be submitted to the IDOT District Office for forwarding to the BBS, to the attention of the Structural Services Engineer. Accompanying the shop drawings should be appropriate design plan sheets that indicate the design fill height, span x rise, proper AASHTO designation, etc. as indicated in the BBS' memorandum of March 1, 2002. The shop drawings should be no larger than 11"x17". The number of sets submitted should provide for one record set each to be retained by the BBS and the IDOT District office.

The shop drawings may be accepted by the local agency based on the seal and structural certification of an Illinois Licensed Structural Engineer. This would expedite the approval process, and a special provision specifying this requirement would need to be contained in the project specifications.

Suggested certification statement:

“I certify that to the best of my knowledge, information and belief, that this precast box culvert design is structurally adequate for the design fill height, span x rise, and AASHTO designation shown on the plans. The design is an economical one for the style of structure and complies with requirements of the current ‘AASHTO Standard Specifications for Highway Bridges’.”

### **STANDARD DESIGNS**

**Submittal Procedure.** The producer should submit shop drawings to the contractor, who is to then forward the shop drawings to the local agency/owner for their review and approval.

1. The local agency may, at their discretion, accept the producer’s shop drawings by following the procedures in the BBS’ memorandum of March 1, 2002 along with specifying that the culverts must be in accordance with BMPR Policy Memorandum 02-02.
2. The local agency may approve the shop drawings by use of an Illinois Licensed Structural Engineer or an Illinois Licensed Professional Engineer, either under their employment or that of a qualified consulting engineer.
3. The local agency may require, by special provision, that the shop drawings provided by the contractor/producer be approved by an Illinois Licensed Structural Engineer or an Illinois Licensed Professional Engineer.

The local agency may choose to specify that the producer provides a certification statement. In this case, the following is suggested:

“I certify that the details shown in the precast concrete box culvert shop drawings for this project comply with the current applicable AASHTO design specifications and contract requirements. The shop drawings will satisfy the reinforcement and dimensional requirements of the contract.

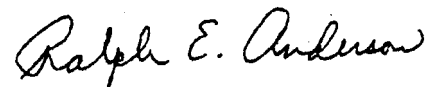
Signature: \_\_\_\_\_ License No. \_\_\_\_\_  
Date: \_\_\_\_\_

Printed Name: \_\_\_\_\_ Company: \_\_\_\_\_”

Local agencies should review the March 1, 2002 BBS' All District Engineers Memorandum to determine if they wish to utilize other criteria described in the memorandum. In addition to the above recommendations, the memorandum describes exceptions that the local agency may wish to consider as a means of accepting precast concrete box culvert shop drawings.

Questions in regard to the applicability of the procedures for the review and approval of shop drawings for precast concrete box culverts may be directed to Jim Klein at (217) 782-5928.

Sincerely,

A handwritten signature in cursive script that reads "Ralph E. Anderson".

Ralph E. Anderson  
Engineer of Bridges and Structures

JKK/TP/TP



# Illinois Department of Transportation

## Memorandum

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To: ALL DISTRICT ENGINEERS  
From: Ralph E. Anderson *Ralph E. Anderson*  
Subject: Precast Concrete Box Culvert Shop Drawings  
Date: March 1, 2002

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Effective with the June 14, 2002 letting, the Department is implementing a new policy for shop drawings of Precast Concrete Box Culverts. Shop drawing approval by the Department will no longer be required for precast concrete box culverts which comply with (1) the IDOT Specifications, (2) the applicable requirements of the AASHTO Specifications and (3) the specific producer's QC/QA plan approved by the Department.

To accomplish this agenda, the designer will be required to clearly indicate the design fill height for every precast and cast-in-place culvert, including extensions, in the contract plans. To determine the design fill height, the maximum and minimum fill heights between the extreme edges of the shoulders shall be calculated. If the minimum fill height is less than 2' (0.6 m), the design fill height shall be designated as "< 2' " which corresponds to an AASHTO designation of M 273. If the minimum fill height is greater than or equal to 2' (0.6 m) but less than 3' (0.9 m), the design fill height shall be designated as 2' (0.6 m), which corresponds to an AASHTO designation of M 259. If the minimum fill height is greater than or equal to 3' (0.9 m) but less than 4' (1.2 m), the design fill height shall be designated as 3' (0.9 m), which corresponds to an AASHTO designation of M 259. If the minimum fill height is 4' (1.2 m) or greater, the design fill height shall be designated as the maximum fill height calculated between the edges of shoulders. The AASHTO designation for this case would also be M 259. Please refer to the Box Culvert Design Criteria charts (included herein) for a summary.

The design fill height shall be applicable to the entire culvert, including culvert extensions, even if the sections are beyond the edge of shoulder. Precast end sections connecting directly to precast box sections shall also conform to the same specification, as its adjacent box section. This will assure uniform wall and slab thicknesses between units and provide for a proper overlap connection. If a precast end section is not connected directly to a precast concrete box section, i.e. a cast-in-place collar or closure piece is used between the sections, the end section must provide the minimum reinforcement as shown on the contract plans.

In addition to identifying the design fill height on the plans, the designer must also designate in a similar fashion the span and rise of the box culvert opening, the proper AASHTO designation for the precast concrete box culvert, and whether interstate loading is required on the box culvert. Any structure under an interstate route must be designated for interstate loading and designed accordingly. The fabricator will be required to mark this information and more on the precast box culvert according to the revised Policy Memorandum for the Quality Control/Quality Assurance Program for Precast Concrete Products. The resident engineer will know whether a box culvert is suitable for a specific site by comparing the markings on the box culvert with the specific box culvert information on the plans.

**BOX CULVERT DESIGN CRITERIA (English)**

$f_{min} / f_{max}$ (feet)	Design Fill Height (F) (feet)	AASHTO Designation <sup>(1)</sup>
$f_{min} < 2'$	$< 2'$	M 273
$2' \leq f_{min} < 3'$	$2'$	M 259
$3' \leq f_{min} < 4'$	$3'$	M 259
$f_{min} \geq 4'$	$f_{max}$	M 259

$f_{min}$  = The minimum fill height over the culvert between the extreme edges of the shoulder.

$f_{max}$  = The maximum fill height over the culvert between the extreme edges of the shoulder.

F = Design fill height for culvert.

<sup>(1)</sup> Add an "I" following the AASHTO designation for culverts where Interstate loading is applicable. (Ex. M 259 - I)

**BOX CULVERT DESIGN CRITERIA (Metric)**

$f_{min} / f_{max}$ (meter)	Design Fill Height (F) (meter)	AASHTO Designation <sup>(1)</sup>
$f_{min} < 0.6 \text{ m}$	$< 0.6 \text{ m}$	M 273M
$0.6 \text{ m} \leq f_{min} < 0.9 \text{ m}$	$0.6 \text{ m}$	M 259M
$0.9 \text{ m} \leq f_{min} < 1.2 \text{ m}$	$0.9 \text{ m}$	M 259M
$f_{min} \geq 1.2 \text{ m}$	$f_{max}$	M 259M

$f_{min}$  = The minimum fill height over the culvert between the extreme edges of the shoulder.

$f_{max}$  = The maximum fill height over the culvert between the extreme edges of the shoulder.

F = Design fill height for culvert.

<sup>(1)</sup> Add an "I" following the AASHTO designation for culverts where Interstate loading is applicable. (Ex. M 259 - I)

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Section 2.3.3 of the Culvert Manual describes applications where precast concrete box culverts may not be applicable. Plans prepared for cast-in-place culverts which preclude the use of the precast option should contain the note "Precast culvert alternate is not allowed". This note shall be placed next to the culvert on the Plan and Elevation sheet of the Roadway Plans and in the General Notes of the structural plans.

Fabricators are required to prepare shop drawings for all precast box culvert projects (which includes standard box sections, manholes, junction chambers and end sections). The shop drawings shall be available for (1) fabrication, (2) Quality Control personnel, (3) Quality Assurance personnel upon request and (4) provided to the IDOT District Construction office for their as-built records. Fabricators may provide steel reinforcement areas which exceed those shown on the AASHTO Design Table for a specific box culvert span, rise and design fill, provided the steel area does not exceed the largest area shown for all design fills in that same table.

Precast box culvert projects not meeting the IDOT Specifications and the applicable AASHTO Specifications will require shop drawing approval from the Department. Exceptions to these specifications (such as variances in haunch sizes) may be permitted provided they have been previously approved by the Department and included in the QC/QA plan of the fabricator. Shop drawing approval may also be waived for precast box culvert projects, which conform to the design parameters of previously approved shop drawings, by the Department after January 1, 1995.

The fabricator may, at his discretion, provide erection layout shop drawings on certain projects where he believes they are necessary to properly install the box culvert sections. In these cases, the fabricator shall provide the erection layout shop drawings to the contractor and IDOT project personnel prior to the erection of the box culvert sections.

Cast-in-place end sections and special sections detailed on the contract plans are understood to be structurally adequate. However, precast versions of these structural items will be subject to additional stresses due to handling and transportation. Consequently, shop drawings for precast special sections and end sections that were originally designed for cast-in-place concrete are required to be sealed by an Illinois Licensed Structural Engineer to assure the Department that the reinforcement and details have been evaluated to account for handling and transportation stresses. The Department does not require review or approval of these shop drawings however the fabricator must provide a sealed set with delivery of the product to the site in order for the resident engineer to accept the special end sections. These shop drawings shall be incorporated into the District "as built" plans.

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Lateral pipes intersecting with box culverts are very common so recommended detailing practices for these situations are attached. Shop drawings of precast box culverts with lateral pipe connections that meet these details are not required to be submitted for approval. See Section 2.3 of the Culvert Manual for additional guidance on the general design and application of precast concrete box culverts.

Attachment

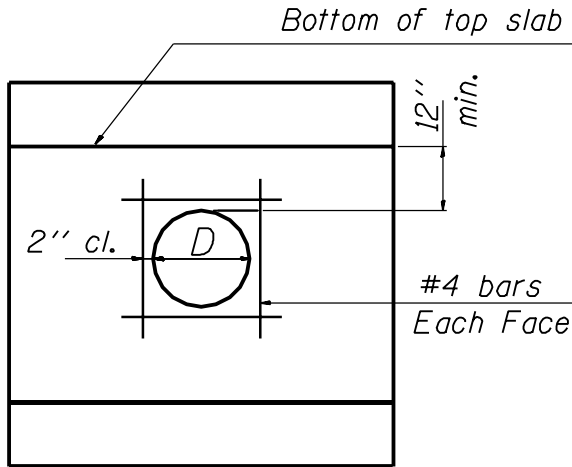
KLR2002.5/bb22294

cc- Gary Gould

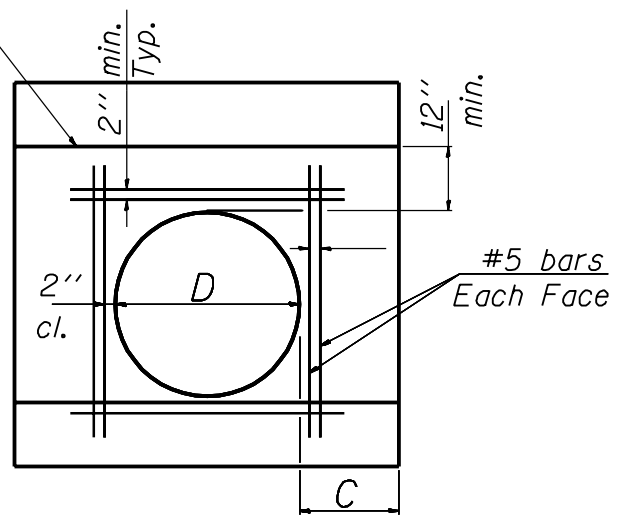
Mike Hine

Darrell McMurray





$$\underline{D \leq 1'-6''}$$



$$\underline{1'-6'' < D \leq 4'-0''}$$

$$C > 2'-6''$$

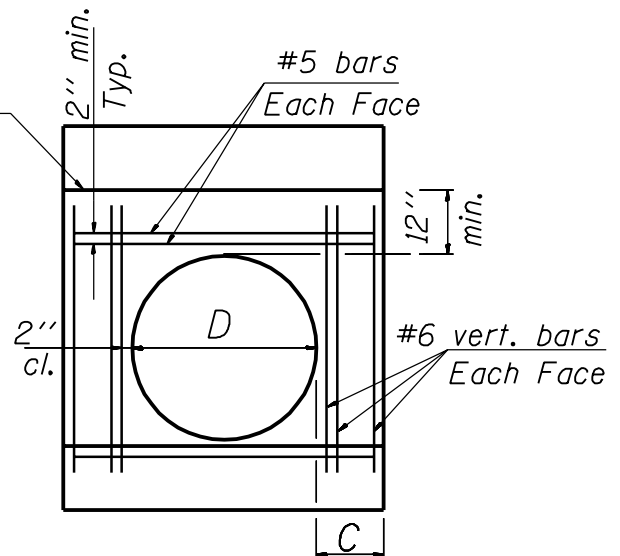
Notes:

$D$  = Diameter of opening  
(Typically OD of pipe plus 1'' to 4'')

Minimum length of reinforcement bars  
around openings =  $D + 1'-4''$

Wall openings beyond these parameters  
shall be submitted for review

These details are not applicable for  
openings in the top slab



$$\underline{1'-6'' < D \leq 4'-0''}$$

$$12'' < C \leq 2'-6''$$

Additional Wall Reinforcement for  
Precast Concrete Box Culverts with Openings