INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Design Memorandum No. 09-14
Technical Advisory

May 18, 2009

TO: **All Design, Operations, and District Personnel, and Consultants**

FROM: ***/s/ Anthony L. Uremovich***
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Production Management Division

SUBJECT: **Three or Four-Sided Drainage Structure**

ADDS: ***Indiana Design Manual*** **Section 31-4.05**

EFFECTIVE: **September 10, 2009, Letting**

A. Precast-Concrete Box Culvert

A precast-concrete box culvert may be recommended by the Hydraulics Team. The maximum span for a box culvert is 12'-0" (3.65 m). The recommended layout method for a box culvert is to extend it to the point where the roadway sideslope intercepts the stream flowline. The sideslope at the end of a box culvert should be protected with guardrail or be located beyond the clear zone.

B. Precast-Concrete Oversize Box or Three-Sided Structure

A precast-concrete oversize box structure may be recommended by the Hydraulics Team. A box structure is considered oversize if its clear-span length is more than 12'-0" (3.65 m), but not more than 20'-0" (6.1 m). Product information is available from local suppliers.

The hydraulic recommendations letter will indicate if a three-sided structure with a base slab is an acceptable alternate to an oversize box structure. The designer should consult with the

Hydraulics Team for guidance as to whether the two structure types are interchangeable for the specific site. A cost comparison should be used in making the final structure selection.

If the distance between the top of the structure and the top of the pavement section, is less than 2 ft (600 mm) as measured at the edge of travel lane, all top slab reinforcement in a box structure, or all reinforcement in a three-sided structure, should be epoxy coated. A note should be placed in the Structure Data Table's comments column indicating this.

An oversize box culvert should be laid out so that the total structure length is a multiple of the box-segment length for the given box size. It is not necessary to add a tolerance for the joints between segments in determining the total structure length. The available segment weights (masses) and lengths are shown in Figure 09-14A.

RISE	4 ft		5 ft		6 ft		7 ft		8 ft	
SPAN	Wt., T / ft	Lgth., ft	Wt., T / ft	Lgth., ft	Wt., T / ft	Lgth., ft	Wt., T / ft	Lgth., ft	Wt., T / ft	Lgth., ft
14 ft	3.15	6	3.30	6	3.45	6	3.60	6	3.75	5
16 ft	3.45	6	3.60	6	3.75	5	3.90	5	4.05	5
18 ft	3.75	5	3.90	5	4.05	5	4.20	5	4.35	5
20 ft	4.05	5	4.20	5	4.35	5	4.50	4	4.65	4

OVERSIZE-BOX-CULVERT SEGMENTS WEIGHT AND LENGTH
English Units

RISE	1.22 m		1.52 m		1.83 m		2.30 m		2.44 m	
SPAN	Mass, Mg/m	Lgth., m	Mass, Mg/m	Lgth., m	Mass, Mg/m	Lgth., m	Mass, Mg/m	Lgth., m	Mass, Mg/m	Lgth., m
4.27 m	9.38	1.83	9.82	1.83	11.61	1.83	10.71	1.83	12.50	1.83
4.88 m	10.27	1.83	10.27	1.83	12.05	1.52	11.16	1.52	12.95	1.52
5.49 m	11.16	1.52	10.71	1.52	12.50	1.52	11.61	1.52	13.39	1.52
6.10 m	12.05	1.52	11.16	1.52	12.95	1.52	12.05	1.52	13.84	1.22

OVERSIZE-BOX-CULVERT SEGMENTS MASS AND LENGTH
Metric Units

Figure 09-14A

C. Wingwalls and Headwalls for Precast-Concrete Structure

Wingwalls and headwalls for a precast-concrete structure will be required. Such wingwalls and headwalls may be precast or cast in place.

The information to be shown on the plans is as follows:

1. a plan view showing the total length of the structure, skew angle, distance from roadway centerline to each end of structure, and the flare angle of all wingwalls;

2. an elevation view of the end of the structure including wingwalls and headwall. The span and rise of the structure should be dimensioned. The heights of the headwalls should be shown;

3. wingwalls labeled A through D with a table showing all dimensions and elevations for each wingwall;

4. a table summarizing the wingwall areas required;

5. a conceptual drawing showing a typical section through each wingwall that shows the approximate footing configuration. Footing dimensions should not be shown. The contractor is responsible for the footing design; and

6. the allowable soil bearing pressure. A table should be included on the plans listing the soil parameters for wingwall design as follows:

    a. angle of friction between wingwall footing and foundation soil, δ;
    b. angle of internal friction of the foundation soil, φ;
    c. ultimate cohesion of foundation soil, C; and
    d. ultimate adhesion between foundation soil and concrete, C_A.

    These soil parameters will be provided in the geotechnical report for the structure. If the geotechnical report is lacking this information, it should be requested from the Production Management Division's Office of Geotechnical Services.

The headwalls' quantities will be included in the structure quantities.

If a project has at least one precast-concrete box structure, and at least one precast-concrete three-sided drainage structure, each with wingwalls, the wingwalls' quantities for both types of structures may be combined.

D. Plans Details, and Design Computations and Shop Drawings

Only the conceptual layout for a precast-concrete 3-sided or 4-sided structure, or precast wingwalls and headwalls, should be shown on the plans. Once the work is under contract, the fabricator will design and detail the structure. For each 3-sided structure, or for a 4-sided structure of greater than 12'-0" (3.65 m) span, the fabricator will provide design computations and shop drawings which are to be checked by, and are subject to the approval of, the designer.

The contractor may choose to substitute a three-sided structure as a cost-reduction incentive. Details for a hydraulically-equivalent three-sided structure should not be shown on the plans.

E. Pay Items

The new pay items are as follows:

714-09726, Headwall
714-08514, Wingwall

The pay unit for these is square foot (square meter).

For the structure box sections and structure-extension box sections pay items listed in 2010 INDOT *Standard Specifications* Section 714.10, the size increments are as follows.

1. Structure of 12'-0" (3.65 m) Span or Less. Span and rise range from a minimum of 3 ft through a maximum of 12 ft, in 1-ft increments. The rise must be less than or equal to the span.

2. Oversize Structure. Span is 14, 16, 18, or 20 ft. Rise is 4, 5, 6, 7, or 8 ft.

Metric-units span and rise should be rounded to the nearer 0.01 m.

Once the span and rise are known, contact the Contract Administration Division's Document Control Team for a pay-item code number.

F. Recurring Special Provisions

Recurring Special Provisions 714-R-437 regarding box structures, 723-R-282 regarding three-sided structures, and 735-R-468 regarding wingwalls and headwalls, have been incorporated into the INDOT *Standard Specifications*. The provisions should not be called for in specific contracts.

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