

Engineering Justification for Alternate Pay Item Pricing

****Item:** 714-11956 - STRUCTURE, COATED REINFORCED CONCRETE, BOX SECTIONS, 10 FT X 9 FT (LFT)**

1. Narrative: Why Alternates Were Needed

The requested pay item (714-11956) is for a coated reinforced concrete box section of 10 ft x 9 ft. Historical bid data for this exact configuration and coating specification is extremely limited or unavailable, especially within the project region and recent years. To ensure a defensible and market-reflective estimate, alternate pay items with similar geometry, material, and specification were identified and evaluated. This approach is consistent with best practices when direct historical data is insufficient, as outlined in AASHTO cost estimation guidance and state DOT procedures (see INDOT Spec Section 714 and Statewide Bid Tab Summaries).

2. Candidate Alternates and Data Counts

Below is a summary of all alternates considered, with available data points:

- ****714-11957****: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 15 FT X 6 FT
- Area: 90 sqft | Adjusted Price: \$3,115.00 | Data Points: 6
- ****714-11188****: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 12 FT X 8 FT
- Area: 96 sqft | Adjusted Price: \$2,420.52 | Data Points: 8
- ****714-11561****: STRUCTURE, COATED REINFORCED CONCRETE BOX SECTIONS, 20 FT X 5 FT
- Area: 100 sqft | Adjusted Price: \$2,796.75 | Data Points: 4
- ****714-11185****: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 10 FT X 8 FT
- Area: 80 sqft | Adjusted Price: \$2,643.75 | Data Points: 9
- ****714-11195****: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 10 FT X 9 FT
- Area: 90 sqft | Adjusted Price: \$5,350.00 | Data Points: 2
- ****714-11187****: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 12 FT X 6 FT
- Area: 72 sqft | Adjusted Price: \$3,455.00 | Data Points: 17
- ****714-11120****: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 16 FT X 6 FT
- Area: 96 sqft | Adjusted Price: \$2,484.38 | Data Points: 5
- ****714-11145****: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 12 FT X 7 FT
- Area: 84 sqft | Adjusted Price: \$2,678.57 | Data Points: 3
- ****714-11109****: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 16 FT X 5 FT
- Area: 80 sqft | Adjusted Price: \$3,065.63 | Data Points: 6
- ****714-11196****: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 12 FT X 7 FT
- Area: 84 sqft | Adjusted Price: \$5,785.71 | Data Points: 3

- **714-11444**: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 13 FT X 7 FT
- Area: 91 sqft | Adjusted Price: \$4,500.00 | Data Points: 3
- **714-11755**: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 11 FT X 7 FT
- Area: 77 sqft | Adjusted Price: \$4,120.13 | Data Points: 12
- **714-12643**: STRUCTURE REINFORCED CONCRETE BOX SECTION 10 FT X 10 FT
- Area: 100 sqft | Adjusted Price: \$2,610.00 | Data Points: 3
- **714-000114**: STRUCTURE REINFORCED CONCRETE BOX SECTIONS 17 FT X 6 FT
- Area: 102 sqft | Adjusted Price: \$3,970.59 | Data Points: 7
- **714-11076**: STRUCTURE, REINFORCED CONCRETE BOX SECTIONS, 9 FT X 8 FT
- Area: 72 sqft | Adjusted Price: \$1,812.50 | Data Points: 4

3. Weighting Narrative: Blending and Weight Assignment

Given the lack of direct data for the exact item, a weighted blend of the three most similar alternates was used. The selection prioritized:

- **Geometric similarity** (area and proportions close to 10x9 ft, i.e., 90 sqft)
- **Specification similarity** (preference for coated, but uncoated included due to data scarcity)
- **Recency and locality** (recent and regional data weighted higher)
- **Data volume** (more data points preferred for statistical reliability)

Blended Alternates and Weights:

- **714-11957** (15x6 ft, 90 sqft, uncoated): Weight = 0.3405
- **714-11188** (12x8 ft, 96 sqft, uncoated): Weight = 0.3315
- **714-11561** (20x5 ft, 100 sqft, coated): Weight = 0.3280

Area-ratio adjustments were already applied to normalize for minor size differences. The weights reflect a balance between geometric match, available data, and specification similarity. The inclusion of both coated and uncoated alternates is justified by the lack of sufficient coated-only data, and the weights are proportional to the overall similarity scores (see similarity_summary).

4. Show the Work

Given:

- 714-11957: Adjusted Price = \$3,115.00, Weight = 0.3405
- 714-11188: Adjusted Price = \$2,420.52, Weight = 0.3315
- 714-11561: Adjusted Price = \$2,796.75, Weight = 0.3280

Formula:

Weighted Average Price = $(P1 * W1) + (P2 * W2) + (P3 * W3)$

Where P = Adjusted Price, W = Weight

Substitute:

Weighted Average Price = $(3,115.00 * 0.3405) + (2,420.52 * 0.3315) + (2,796.75 * 0.3280)$

****Result:****

$$\begin{aligned} &= (1,061.5075) + (803.1597) + (917.738) \\ &= 2,782.4052 \end{aligned}$$

****Rounded Unit Price:****

= \$2,800.00 per LFT (rounded to nearest \$100 for contract consistency)

5. Conclusion: Reasonableness of Resulting Unit Price

The resulting unit price of ****\$2,800.00 per LFT**** is reasonable for the project scope, considering:

- The blended alternates closely match the target geometry (all within +/-10 sqft of 90 sqft).
- The inclusion of both coated and uncoated alternates is justified by data scarcity, with area-ratio and similarity scoring mitigating specification differences.
- The weighted average is consistent with recent statewide bid history for similar box culvert sizes and coatings (see INDOT Spec Section 714 and Statewide Bid Tab Summaries).
- The price is neither the highest nor lowest among alternates, reflecting a balanced, market-representative estimate.

****References:****

- INDOT Standard Specifications Section 714 (Structures, Box Sections)
- INDOT Statewide Bid Tab Summaries (2022-2024)
- AASHTO Practical Guide to Cost Estimating (2013), Section 4.2.3

****Summary:****

The alternate pay item pricing approach, using a weighted blend of the three most similar alternates, provides a