QUANTITIES

**General**
The quantities of the various materials involved in the construction of a project are needed for determining the estimated cost of the project and for establishing a base for the contractor’s bid and payment.

Upon completion of structural design and detailing of plans, the quantities of materials in the construction of the project shall be computed. Quantities are to be computed and checked independently. Final quantities to be listed in the Special Provisions and Bid Proposal sheet are to be calculated to have an accuracy of +/- 1 percent.

Method of measurement for the various materials shall be in accordance with the ITD *Standard Specifications for Highway Construction*, current edition, and Supplemental Specifications.

**Section 210 – Structure Excavation and Compacting Backfill**
Structure Excavation, Schedule No. 1, shall include excavation for bridges, box and stiffleg culverts, and Structure Excavation, Schedule No. 2, shall include excavation for all other structures.

Structure excavation will be measured by the cubic yard of material in its original position, using the average end area method. The volume of material actually removed shall be measured within a prism with limiting planes as follows:

1. **Conduit and Structural Plate Pipe**:
   - As shown on the plans.

2. **Other Structures**:
   a. The bottom of the foundation.
   b. The vertical planes 2 ft. outside of and parallel to the outside lines of the structure, in the case of bents with individual column footings, the entire bent shall be considered as one structure.
   c. With upper limits as follows:
      1. In embankment sections, the existing ground surface as cross sectioned.
      2. In roadway cut sections or channel changes, the planes of the roadway cut or channel change as excavated.

Compacting backfill will be measured by the cubic yard of backfill material placed. The volume will be determined as follows:

1. **Conduit**:
   - As shown on the plans.

2. **Other Structures**:
   a. Below the original ground surface: A volume equal to the volume of structure excavation less the volume of the permanent structure including opening, contained within the limits of measurement for structure excavation.
   b. Above the original ground surface: The volume contained between the outside walls of the structure and vertical planes 4 ft. outside thereof; the original ground surface; and a horizontal plane 1 ft. above the top of the structure or of the subgrade, whichever is the lesser.
   c. Volumes of backfill placed through water around abutments, wing walls and piers, will not be included in the measurement of quantities for compacting backfill.
STRUCTURE IN EMBANKMENT

Ground surface at time of structure excavation

EXCAVATION

2'-0"

Structure
Excavation

Structure
Backfill

SUBGRADE

Finished slope

BACKFILL

2'-0"

2'-0"
STRUCTURE IN NATURAL GROUND

EXCAVATION

Natural ground

Structure Excavation

Structure

Backfill

Finished slope

Subgrade

Natural ground

BACKFILL

2'-0"  2'-0"

4'-0"

2'-0"  2'-0"
STRUCTURE ABOVE NATURAL GROUND

Construct embankment 1'-0" above footing elevation prior to structure excavation.

EXCAVATION

Roadway
Embankment

Structure
Excavation

Structure
Backfill

BACKFILL

Subgrade

Natural ground
Section 510 - Concrete Overlays

DECKS WITH 2½” COVER ON THE TOP LAYER OF EPOXY REINFORCEMENT
Mean removal depth is 2” with a nominal 1.5” of silica fume concrete.

DECKS WITH LESS THAN 2½” COVER ON THE TOP LAYER OF PLAIN REINFORCEMENT
The new concrete overlay shall provide 2½” of cover for the top layer of reinforcement and shall have a minimum thickness of 1.5”.
The new deck thickness is determined by subtracting the existing top rebar cover from 2.5” and adding the result to the thickness of the existing deck.

REMOVAL DEPTH
Ce = existing cover
Te = existing deck thickness
Dm = mean removal depth
S = ½ the maximum aggregate size

ITD Construction Specifications | Maximum Aggregate Size
--------------------------------|------------------
Up to 1967                     | 2”               
Between 1967 & 1976            | 1.5”             
1976 & after                   | 1”               

Tn = new deck thickness = Te + (2.5 - Ce)
Te - (Dm - S) = Tn - 1.5 \(\equiv\) Dm = S + Ce - 1.0

On the contract plan details, show Dm, S, Ce, Te, & Tn values.

CONCRETE OVERLAY QUANTITY
Use Dmax to calculate the concrete overlay quantity. This will provide a pay item cost that should reduce cost over-runs during construction.

\[
\begin{align*}
D_{\text{min}} &= D_m - S \\
D_{\text{max}} &= D_m + S
\end{align*}
\]

EXAMPLE
Te = 6”
Ce = 1.25”
Dm = 6 + (2.5 - 1.25) = 7.25”
1957 ITD Construction Specifications = 2” max aggregate
S = 2”/2 = 1”
Dm = Te - Tn + 1.5 + S = 6 - 7.25 + 1.5 + 1 = 1.25”

\[
\begin{align*}
D_{\text{min}} &= D_m - S = 1.25 - 1 = 0.25” \\
D_{\text{max}} &= D_m + S = 1.25 + 1 = 2.25”
\end{align*}
\]

Concrete overlay quantity
Deck Thickness after Removal \(T_r = T_e - D_{\text{max}} = 6 - 2.25 = 3.75”\)
Overlay thickness = \(T_n - T_r = 7.25 - 3.75 = 3.5”\)

Section 551 – Polyester Polymer Concrete Overlay

PPC overlays are ¾” thick. The quantity should be computed using ¾” thickness to allow for surface texture variation.
**Precision of Units**

The precision of the units to be shown on the Cost Estimate is shown in the following table.

<table>
<thead>
<tr>
<th>SECTION</th>
<th>DESCRIPTION</th>
<th>UNIT PRECISION</th>
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<tbody>
<tr>
<td>205</td>
<td>Granular Borrow</td>
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<tr>
<td>210</td>
<td>Structure Excavation Sch. No. 1</td>
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<tr>
<td></td>
<td>Compacting Backfill</td>
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<tr>
<td>502</td>
<td>Concrete – All classes</td>
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<tr>
<td></td>
<td>Prestressed Girders</td>
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<td></td>
<td>Concrete Parapet</td>
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<td></td>
<td>Approach Slab</td>
<td>0.1 SY</td>
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<tr>
<td>503</td>
<td>Prestressed Slabs, T-beams, Box Beams</td>
<td>0.1 LF</td>
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<tr>
<td>504</td>
<td>Metal Reinforcement</td>
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<td>505</td>
<td>Structural Steel</td>
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<td>Railing</td>
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<tr>
<td>507</td>
<td>Furnish &amp; Drive Piling, Test Piling</td>
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<td>511</td>
<td>Concrete Waterproofing System</td>
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<td>Pre-drilling for Piles</td>
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<td>551</td>
<td>PPC Overlay – Prepare &amp; Place</td>
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<td>PPC Overlay – Furnish Material</td>
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<td>Epoxy Overlay</td>
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<td>Expansion Joints</td>
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<td>Elastomeric Concrete Header</td>
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<td>Remove Expansion Joint</td>
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**Reference:** Contract Administration Manual and Standard Specifications for Highway Construction
Revisions:
Nov 2019  Moved Article A5.7 Concrete Overlay quantity calculations to this article under Section 510.
          Added instructions for Concrete Overlay on decks with epoxy reinforcement.
          Added quantity calculation instructions for PPC overlays, Section 551.
          Revised Precision of Units Table for 2018 Specification pay items.