



Preparing Quantity Calculations

General Information

Quantity calculation sheets are required for all contract items. This includes “Fixed Final Pay Quantity” items, “Lump Sum” items and “Unit Price” items. Quantity calculation sheets are also required for Contract Change Orders which increase or decrease the quantity of a contract item.

In general, pay quantities for all Structure items are calculated and checked by Structure field personnel assigned to the project. However, if it is agreeable with the Resident Engineer, District personnel may be used to assist in preparing or checking quantity calculations. On jobs, where no other personnel are available to check quantity calculations, arrangements should be made with the Bridge Construction Engineer to have the quantities checked by personnel assigned to other jobs in the vicinity.

All quantity calculation sheets must show the name of the person making the original computation and the name of the checker. Initials are not sufficient.

When calculating quantities, keep in mind that all computations must be checked, and quite often the checker will be less experienced and less familiar with the particular details of construction than the person making the original calculations. In addition, quantity calculation sheets are part of the contract payment records, and as such, are subject to audit both during and subsequent to completion of the project.

To facilitate checking and auditing, and to simplify original calculations, keep the following suggestions in mind:

1. All calculations should be legible and not crowded on the sheet.
2. Before starting the calculations for any item, a thorough study of the contract specifications should be made to prevent misinterpretation of the units involved.
3. Before starting complicated items, it may be advisable to prepare a detailed outline to ensure a logical sequence of computing the individual units.
4. Quantity calculations for complex features should be augmented by frequent sketches.
5. All sheets should be referenced to the plan sheet number, field book, detail sheet, etc., on which the calculations are based.
6. On any sheets on which dimensions are different from the original plans, include an appropriate reference to explain the change. Notations such as As-Built, Field Measured, See CCO No. 6, etc., will suffice.
7. When the same type of computation must be repeated a great many times, it will facilitate both computing and checking if a tabular form is used.

Auditing procedures require project identification on each quantity calculation sheet. Use the job identification stamp where possible. On contracts with two or more structures, the calculations for each structure should be further identified in some way, such as bridge name or number.

Electronic Computer Service

Most quantity calculations have electronic computer applications, and computer service is available to field personnel.

Individual code numbers and instruction sheets are available through the District Offices for those field personnel who wish to take advantage of the computer service.

Input sheets should be checked before submission. When the machine tabulation sheets are received, another check should be made to see that all calculations have been made.

If the computer service is used, prepare a summary of the quantities so calculated and make a suitable reference to the data processing sheets.

Unit Price Item Calculations

Payment for "Unit Price" items may be based on a "field measurement", a scale weight or a calculated quantity. The following information is presented to aid the Structure Representative in making quantity calculations, and to maintain uniformity.

Earthwork - If calculations are required for excavation, backfill, pervious material, etc., use *Quantity Calculation Sheet*, Form HC-52, or the computer Six Factor Computation Form HCS-289. The average end area method may be used for irregular sections. The accuracy of calculations would normally be 0.1 cubic yard. When original ground elevations must be determined and used, and elevation to the nearest 0.1 foot is generally adequate.

Piling - Pile quantities are to be calculated on Form DC-SC78 (Rev 8/81) *Pile Quantity and Driving Record (Driven Piles)* or DC-SC78A (8/81) *Pile Quantity and Drilling Record (CIDH Piles)*. See Section 3 and 130 of *Bridge Construction Records and Procedures* for instructions. The accuracy of calculations for piling would normally be 0.1 lineal foot.

Concrete - When concrete calculations are required, use *Quantity Calculation Sheet*, Form HC-52, or the Six Factor Computation Form HCS-289 for the calculations. When applicable, the prismoidal formula may be used and *Rise Over Chord* tables may be used for segments of circles. Do not use calculus. Deduct all chamfers over 2 inches and all openings over 2 inches except weep holes, deck drains, and similar small openings. Do not deduct for the volume occupied by reinforcing steel, embedded structural steel, or for the volume of expansion joint filler, rubber waterstops, etc. The accuracy of calculations for concrete quantities would normally be 0.01 cubic yard.

Reinforcing Steel - Form HCS 144, *Reinforcing Steel* may be used for determining reinforcing steel quantities. This form may be used either for hand extensions or computer computation. Instructions for computer application are given in Section 110,

Volume II of the *Bridge Construction Records and Procedures*. As the form is primarily for use by the Office of Structures Design, adaptations must be made when using it for field quantity calculations. When the form is used for field quantity calculations, be sure to show the project identification, bridge name and number, name of person making calculations and name of person checking calculations. Note that Form HCS-144 does not provide space for either No. 14 or No. 18 bars. It is therefore necessary to list these bars in one of the other columns. When this is done, cross out the size printed at top of column and the weight at bottom of column and enter the correct size and weight. The accuracy of calculations for bar reinforcing steel is 1.0 pound.

Structural Steel - When structural steel quantity calculations are required, use *Quantity Calculation Sheet*, Form HC-52 or the computer Six Factor Computation Form HCS- 289 for the calculations. Tabular weights, as given in the AISC Handbook, may be used in making calculations of weights of rolled shapes and structural plates. Additional details, concerning measurements for structural steel quantities, are given in Section 55 of the Standard Specifications. The accuracy of structural steel quantity calculations would normally be 1.0 pound.

Miscellaneous Metal - The pay quantity for miscellaneous metal is determined by scale weights. Quantity calculations, therefore, consist of a listing of scale weights for various components. These calculations can be shown on *Quantity Calculation Sheet*, Form HC-52. The accuracy of miscellaneous metal quantity calculations would normally be 1.0 pound.

Miscellaneous Items - Items such as railings, pipe, conduit, waterstop, joint seal, etc., are paid for by the lineal foot and are usually "field measured". Calculations for these types of items generally consist of a listing of the field measurements which can be made on Form HC-52, *Quantity Calculation Sheet*. The accuracy of quantity calculations for these type items would generally be 0.1 foot. Items such as Protective Cover, Membrane Waterproofing, Texture Panels, Chipped Surfacing, Contrast Treatment, etc., are paid for by the square yard. Quantities may be "field measured" or calculated. In either case, Form HC-52 may be used for the calculations. Accuracy of calculations is generally the nearest 0.1 square yard.

Fixed Final Pay Quantity and Lump Sum Item Calculations

Lump sum items (such as Removing Bridge or Prestressing Cast-in-Place Concrete) require only one quantity sheet per item. Since these will be summary sheets, list only one item per sheet. Show the item number, the name of the item, and the pay unit, such as "One Lump Sum."

Items having fixed final pay quantities, such as "Structure Concrete (Bridge)", or "Bar Reinforcing Steel (Bridge)", also require only one final quantity sheet per item, on which should be shown the item number, the name of the item and the final pay quantity shown on the plans. However, if authorized changes increase or decrease a fixed final pay quantity, calculation sheets must be prepared to substantiate the increase or decrease. The item summary sheet would list these quantities in addition to the fixed final pay quantity shown on the plans. Form HC-52 may be used for these calculation sheets.

No measurements, calculations, weight slips, etc., are required for the permanent record for “Lump Sum” items, nor for fixed “Final Pay Quantity” items.

Contract Change Order Calculations

Quantity calculations for Contract Change Orders require the same procedures and degree of accuracy as those calculated for other similar contract items. Additional copies of the calculations shall be made if requested by the Resident Engineer. The number of copies would be as requested. One or more sheets are to be made up for each item affected by the change order. Do not show more than one item on a sheet.

Totals shown on a contract change order quantity sheet should be the net increase or decrease due to the change. This figure can then be used in the “body” of the Contract Change Order. If a change is one that requires revised plan sheets, Structures Design will generally furnish revised quantities, along with the revised plan sheets.