Checking Standards and Procedures

3.1 Purpose

To assure a clear, complete, and accurate set of structure plans.

3.2 Responsibility

The responsibility for compiling a set of plans lies with the Project Structural Engineer; however, each individual checker shall be responsible for the work assigned.

3.3 Procedures

Detail checking shall take place upon the completion of the necessary structural details. Details with which the checker agrees shall be crossed through with a yellow pencil or marker. Corrections or suggestions shall be made neatly with a red pencil or pen. All checking shall be done using prints of the latest design and details.

Design and constructability checking shall be performed as defined in the Design Manual.

3.4 Detail Check

The detail check shall be made independently based on the plan set by someone who is adequately experienced with the CDOT Bridge Detail Manual requirements and, preferably, unfamiliar with the project. All items in the plan set are to be checked in accordance with this manual, including:

A) Geometry Program
   1) Input of the geometry program from the roadway sheets (horizontal and vertical alignment, roadway cross slopes).
   2) Input of the geometry program for the structure layout (bent lines, girder lines, layout lines, skew, etc.).
   3) Key points (away from the control line) by hand calculations of output.

B) Details – Verify the following:
   1) Dimensions, stations, and elevations taken from geometry output
   2) Hand calculated dimensions, stations, and elevations
   3) Adequate room for placement of reinforcing, expansion joints, embedments, bearing devices, etc.
   4) Reinforcing placements, lengths, sizes, shapes, etc.
   5) Sufficient information to construct the structure

6) Bridge Working Drawings (structural worksheets) are revised to match project specifics
7) M & S Standards references
8) General considerations: foot and inch marks, arrowheads, required notes, spelling, dimensions add up, etc.
9) Section letter, detail number, sheet references

See other chapters of this manual for specific items to check for each sheet.

3.5   Quantity Check

The quantity check shall be made independently based on the plan set, preferably by someone unfamiliar with the project. Typically, the detailer performs one set of the quantity calculations as defined in the Design Manual. During the process of calculating quantities, it is not unusual to find that additional information or clarification is needed. If sufficient information is not on the plans to complete the quantity, the plan set shall be marked up for the proposed revisions. Once the quantity calculations are completed, the two sets of quantities shall be compared and any differences resolved. During this resolution process, it is determined which is the record quantity set.

During this comparison, the following items shall be considered:

o   Both sets of quantities shall be within 1% of each other, per the following formula:

$$\% \, Difference = \frac{Record \, Set - \ Check \, Set}{Record \, Set} \, \%$$

o   Excavation and backfill quantities may be within 10% difference.

o   Quantities shall be checked for each structure or structure component for the Summary of Quantities sheet.

o   Preliminary quantities based on volume (Lb/CY) or area (Lb/SF) or percentages shall never be used for final quantities.

o   Areas and volumes may be measured from CAD program for only one of the calculation sets. The other set must use information found on the plan set.

  o   Quantities from the two independent sets shall not be averaged.

  o   Eight digit cost code item shall be used in tabulations.

o A summary showing percentage differences shall be included in the calculations.

Differences shall be resolved and totals from the record set shall be shown in the plans (see examples in Chapter 5). Quantity differences between the two independent sets that cannot be resolved shall be referred to the Engineer of Record for resolution.

An example of a quantity form with quantity checks in Excel is available in ProjectWise under Project Templates (JPC#BRDG_Tabulation of Bridge.xls). The percentage differences are included in the spreadsheet (see Fig. 3.5-1). This Excel file can be copied and used outside of ProjectWise as well.
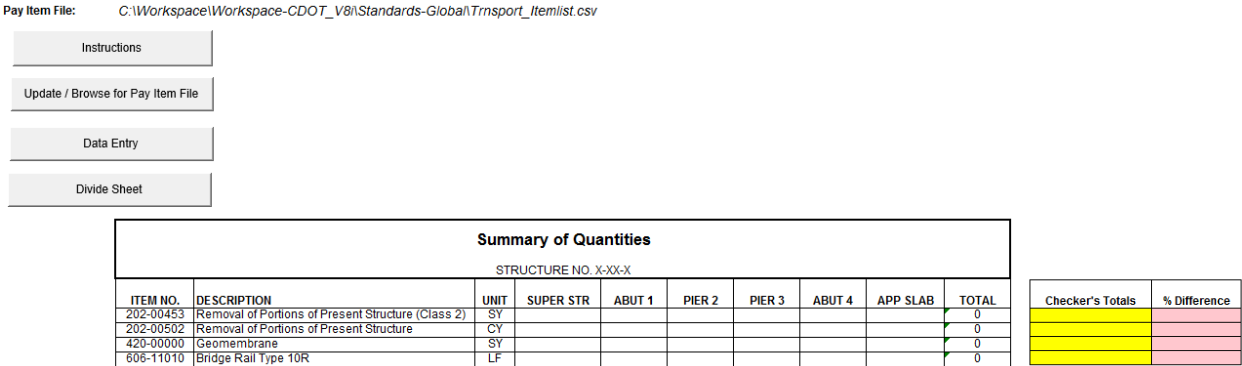

Fig. 3.5-1 Example - Summary of Quantities with Checker's Totals (in Excel)

3.6 Review

When design and detail checks are completed, all changes, including those received from recipients of advanced plans and FOR plans, as applicable, shall be carefully reviewed and combined on one set of prints. This set shall be marked "Final Check Set", and all detail changes shall be made from this set.

3.7 Plan Preparation and Assembly

This is a last quality assurance (QA) that all checks have been done and the plan set is complete and assembled correctly. This should be the responsibility of the Project Structural Engineer or Lead Detailer.

As a minimum, the following items should be checked:

o Plan sheets assembled according to the order shown in Chapter 5 of the Detailing Manual

- o The total number of sheets in the subset is correct on each and every plan sheet

- o The drawing number and title for each sheet matches the number and title shown in the Drawing Index

- o The Final Project Construction Number and Project code are correct on each and every sheet

- o The Border information is correct on each and every plan sheet as shown in Section 1.9

- o All Section letters and Detail numbers are referenced correctly with correct cross reference drawing numbers

- o Summary of Quantities match the record set

3.8   Archiving

All projects, either with a project number or just an in-house repair project, shall be archived in ProjectWise.

The Detailer shall be responsible for archiving all the drawings in the original CADD format, including reference drawings, photos, models and other drawing related data. If InRoads was used, then all InRoads generated files such as surfaces, alignments, templates, etc., shall also be archived.

Both sets of quantity calculations shall also be archived in the original format, along with any materials used in the calculations, e.g. InRoads surfaces, CAD sketches of areas, volume reports, hand calculations, spreadsheets in original format. If hand calculations were performed, they shall be scanned in pdf format and archived.

 "All PDFs with text or numerical data shall be 300 dpi, page aligned, text searchable, compressed and in conformance with ISO PDF/A-1b archival specification. CDOT employees are to refer to LMS My Learning for Smart Scanning training; all others are to contact DOT_Records_Mgmt@state.co.us for training on Smart Scanning and Electronic Signatures."

3.9 Field Information Package

See Bridge Design Manual, Policies and Procedures, Section 4 for information on the Field Information Package.

3.10 Electronic Checking Standards

Currently CDOT does not use an automatic standards checker. This section provides best practices for drawing production to facilitate their common use between detailers as well as future use for the life of a bridge.

1. A sheet model should be used for printing purposes.

2. Use View 1 for plot ready views. Save settings when exiting a file so border view is entirely visible.

3. Border cells should be placed at a 1"=1' scale and reference files scaled to fit into the border.

4. Delete preliminary or extraneous linework from models, e.g. extra profiles, preliminary sections.

5. Bridge linework should be in correct geographic location and rotation.

6. Linework should be centrally located in the file so a fit view shows actually linework instead of dots.

7. Bridge Models should have geographic coordinate system imported from survey files.

8. See Chapter 17, section 17.3 for additional requirements for Inspection Sketches.

Best practices help with batch printing as well such as use View 1 for plot ready views. Some practices were to keep files clean of outdated or not used linework. Standalone files for inspection sketches, i.e. no exterior references.