ATTACHMENT 58 – ANSWERS TO STANDARD SET OF QUESTIONS BY THE PENNSYLVANIA DOT

(41 pages)

Pennsylvania DOT

May 28, 2008

Italics represent the responses by the Pennsylvania DOT.

1. What was your procedure in reviewing consultant engineering bridge plans in the early 1960's?

In the 1960's, the review of all bridge projects was performed in the Central Office, including shop drawings. The central bridge staff was comprised of approximately 80 bridge staff members with 70 engineers. There were 5 specialized sections.

- *Prestressed Concrete*
- *Steel Design*
- *Type Size and Location Review*
- *Foundation Review*
- *Plans Specifications and Estimate Review*

Central Office reviewed the calculations and drawings for bridge projects prepared by the consultants.

PennDOT was developing software in the late 60s for the analysis and design of prestressed beams, abutment design and box culvert design to aid in bridge design.

In the 60's PennDOT had standards for prestressed design and for steel design. The reviews performed verified the designs met our standards and specifications.

What is your procedure in reviewing consultant engineering bridge plans today?

Today, bridge plans are reviewed by the District bridge unit and many times by the Central Office bridge staff for larger more complex structures. For reviews by PennDOT Central Office bridge staff, a review engineer is assigned to perform the reviews for a particular District. Thus the review engineer must be familiar with the design of all components of a bridge, the design requirements for steel or prestressed concrete beams, substructure and foundation design.

The bridge plans and calculations are reviewed for thoroughness and accuracy, conformance to accepted engineering standards, that the calculations and drawings are properly initialed off and sealed. The plans are reviewed for constructability, consistency between the design plans and design calculations, verification that the proper version of the computer program is used and the proper input to the various computer programs used to design/analyze the bridge. In addition, designs are accepted for review with the appropriate completed QA forms.

2. How do you ensure the QA/QC process of a consultant engineering firm is adequate? In the early 1960's and today?

Today, consultants prepare a written QA/QC process that is submitted to the Department and reviewed by the Department as a requirement for becoming a business partner. The QA/QC procedures outline the corporate QA/QC philosophy for the consultant engineering firm. In addition, consultants prepare a project specific QA/QC procedure. Typically this project specific QA/QC procedure is reviewed by the Department's Project Manager and is discussed at the kickoff meeting. As the project advances through the design phase, if issues of quality are identified, the corrective actions of the QA/QC procedures are invoked.

Note: Attached are the QA/QC requirements in PennDOT Publication 442.

What procedures are in-place to ensure that the consultant does not submit an inadequate design?

An inadequate design can be prevented from occurring throughout the entire project life. This is ensured by the selection of the right consultant for the project, and by the reviews performed at various stages of design and through construction. Preliminary structural member sizes are verified at the Type, Size and Location (TS&L) phase of the project. Final structural members sizes are checked at the 90% plan submission and final plan submission. Similarly, foundation capacities are checked at the foundation submission stage and at the 90% and final plan submissions.

At the District level, the designs are reviewed by the bridge units and also the construction units and maintenance units. The Central Office also reviews large complex structures.

PennDOT has developed tools that aid in the design process including a comprehensive design manual, design and construction standard drawings, quality assurance forms and software. PennDOT has an extensive suite of bridge design/analysis software that is continuously updated and thoroughly tested thus if used properly will provide a level of consistency and quality to the designs.

Another step in achieving a quality bridge design is PennDOT requires the completion of QA forms which are included in our Design Manual Part 4, Appendix A. The forms are intended to ensure key design requirements are met, such as requiring the designer state the maximum factored resistance and maximum factored moment in a beam per Form D-509 (Attached).

3. What does the Pennsylvania DOT consider a red-flag item when reviewing consultant engineering bridge plans?

When reviewing consultant engineering plans, the following extensive but not comprehensive list of items are considered not acceptable:

- *Design criteria not as per current PennDOT Design Publications*
- *Inappropriate key design assumptions*
- *Plan details not as per current PennDOT Standard details*
- *Violates a well known/frequently used/commonly known portion of the design or construction specifications or standards – AASHTO LRFD Bridge Design Standards DM-4, PennDOT's BD or BC Standards*
- *Errors (mathematical, drafting, missing information, etc)*
- *Items not meeting our policies, specifications and/or standards without explanation/justification*
- *Violates an engineering principal of a design, construction, or materials nature (foundation placed on an inconsistent foundation, aluminum placed in contact with concrete)*
- *Use of engineering programs not tested and accepted by PennDOT*
- *Plan specified materials not as per current PennDOT bulletin*
- *Differences in material strengths used in design than as specified on the bridge plans or specifications*
- *Improper use of a computer program or improper input for typical design/analysis*
- *Incomplete verification of assumptions used in design (spreadsheets, etc.)*
- *Warning/error messages in computer output that's not explained*
- *Inadequate Reinforcement Details – inadequate lap lengths or development lengths, reinforcing pattern that does not provide a direct transfer of tensile stresses, unique reinforcing patterns*
- *Non-standard structural details or materials*
- *Design does not have adequate structural strength*
- *An element of the bridge/structure has a size or design which does not make practical sense (fixed pier smaller than expansion piers)*
- *Discrepancies between submission letters, plans, calculations, and/or QA Forms*
- *Design is not constructible or material availability is questionable*
- *Stability of structural members during construction, i.e., structural steel plate girders with inadequate flange width*
- *Transportation of material to job site, hauling of beams*

What follow-up action is taken to address the red-flag item?

- *Design computations and/or plan details are returned to design/consultant with written explanation as to why criteria/specifications are not acceptable. Included in the comments will be guidance as to how to proceed in design using current accepted PennDOT design criteria or material specifications. Items are noted on comment sheet for the consultant to respond and/or justify.*

- *Designer made to revise bridge design and drawings prior to letting project out for bid. Otherwise, an addendum is issued with the revised bridge plan sheets.*
- *Strike-off Letter used to alert all bridge designers to clarify unclear Design Manual sections to prevent encountered problems from occurring in future bridge designs problem.*
- *Follow-up by verifying that the comments were addressed or adequate explanation was provided before recommending approval.*
- *More stringent enforcement of prime consultant responsibility/accountability for subconsultant work.*
- *Documentation of the QA/QC process of consultants has been requested.*

Describe the level of detail the Pennsylvania DOT uses in reviewing consultant engineering bridge plans?

Quality Assurance (QA) engineer performs a check of design methodology and plan specifications. A QA engineer would typically provide an in-depth detailed review of design procedures, plan development and details for critical design aspects and/or unique features depending upon the structure type, complexity and unusual nature.

Level of detail depends on whether a red flag item is found. The more red flags, the closer the review. Also somewhat dependant on the size of the structure. Larger structures require more time as they are usually high volume structures and have more substructure units that can have special details.

The reviews focus on:

- *Evaluation of computer programs (if other than programs accepted by the Department) are made and the program results are verified if necessary*
- *Review for compliance with Department criteria and standards*
- *Review for constructibility and cost-effectiveness when design is prepared by a consultant retained by the Department*
- *Check of design calculations such as computer program input values*
- *Check of plans to ensure that design information is adequately and correctly shown*

More detailed review for complicated structures or if needed based on problems found during a review.

4. Does the Pennsylvania DOT review consultant engineering bridge plans concurrently with the FHWA Division Office?

PennDOT performs design reviews for all bridge plans. FHWA performs design plan reviews for the major and complex bridges. For projects that the plans will be reviewed by PennDOT and FHWA, the reviews are performed concurrently in most instances.

Does the Pennsylvania DOT review the consultant plans with the expectation that FHWA will be performing a similar type of review?

PennDOT performs a thorough and complete design plan review irrespective of the type of review performed by FHWA. We do welcome the reviews performed by FHWA as they provide an insight from experiences on a national level/perspective.

5. What are the qualifications of the Pennsylvania DOT personnel who conduct the review of consultant engineering bridge plans?

PennDOT has developed Standard Operating Procedures for Structure Design. These SOPs were issued by policy letter 430-02-02.

PennDOT bridge personnel who perform the reviews of bridge plans have a four year degree in engineering and many are Professional Engineers. PennDOT has many training courses for bridge design and inspection, and encourages the bridge staff to take these courses. Also, several NHI courses are conducted each year.

6. What is the percentage of bridge design work that is done in-house versus the percentage that is done by consultant engineering firms?

As PennDOT is a decentralized organization, the percentage of design work done in-house varies by the District. In the rural Districts, more work is done in-house than by consultant and conversely in the urban Districts more work is performed by consultants than the in-house staff. However, for the complex and/or major bridges, the design would be performed by an engineering consultant. Statewide approximately 60% of bridge designs for new bridges, rehabilitation and replacements are developed by consultants. In the urban districts, this percentage is between 90%-100%. However, for preservation and maintenance projects, nearly 100% of the designed is developed by in-house staff.

7. Describe the structure of the Pennsylvania DOT? Is the bridge office centrally organized?

PennDOT is decentralized with the Central Office providing policy development, quality assurance, technical assistance and project oversight, review and approvals.

How many district bridge offices are located in the state?

PennDOT has 11 District offices located throughout the Commonwealth.

Are consultant engineering bridge plans reviewed at the central office or district bridge office?

The review responsibility is described in Design Manual Part 4, PP 1.9 Bridge Submissions Design Phase, specifically Table 1.9-1, 1.9-2 and 1.9-3. The more complex projects are

reviewed by District staff as well as Central Office staff. For certain projects, the District may also hire an engineering firm to assist with the review. The reviews will be completed in accordance with DM4 PP 1.3.4.

OA-501 12-67

COMMONWEALTH OF PENNSYLVANIA
Department of Highways
Harrisburg
March 28, 1969
4/11/69 HG

SUBJECT: Design Manual, Part 4, Structures

TO: ENGINEERING DISTRICTS
CONSULTING ENGINEERS

FROM: B. F. Kotalik, Chief Bridge Engineer

[redacted]

Attached is a copy of the forthcoming Design Manual, Part 4, Structures for your information. The use of the Design Manual is permitted in design and preparation of structure plans, whose type, size and location has already been approved. The use of the Manual is mandatory in the design of those structures whose type, size and location approval is given after April 15,1969.

430/BFK/KRP/db

Attachment

cc:

W. S. Lawrence, Assistant Chief Engineer--Bureau of Design

4/11/69 #4

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF HIGHWAYS

DESIGN MANUAL

PART 4

STRUCTURES

PROCEDURES - DESIGN - PLANS PRESENTATION

CHAPTER 2

PRELIMINARY PLANS FOR HIGHWAY STRUCTURES

SUBMISSION OF PRELIMINARY BRIDGE PLANS

Preliminary Type, Size and Location (T. S. & L.) approval shall be obtained for all structures.

Test Borings for structures shall be undertaken after a tentative T. S. & L. Approval has been received. Major structures, arches, or questionable areas should be investigated as to foundation material before T. S. & L.

All submissions for approval shall be made to the Chief Bridge Engineer by the District Engineer. The letter of transmittal shall include the District's specific recommendations and comments.

The following information shall be required when requesting type, size and location approval:

(1) Route and Section Number, Index Map and Stations of Work limits.

(2) Program under which project will be financed (Federal Aid classification, 100% state, Department Force or special program) and the State Project Number including the Allotment Code.

(3) Designer (Consultant, Division of Bridge Engineering, or District Office).

(4) List of proposed structures by station and identity.

(5) Expanded traffic and class of highways on Relevent Roads.

(6) Date of line and grade approval and design speed.

(7) Prints showing approved typical sections; also roadway type approval when available.

of design live loading and steel, and allowable stresses for various structural members shall be submitted with T. S. & L. submission.

(14) Statement concerning mining in the area and previous foundation problems, if any.

(15) Pedestrian count and information concerning possible future development which might warrant need for sidewalks on all bridge plans which will be under Public Utility Commission jurisdiction.

Items 1 thru 9 shall be submitted in duplicate at the start of the project with the first structure submitted for T. S. & L. approval, and need not be submitted with subsequent type, size and location submission. Items 10 thru 15 shall be submitted in duplicate with each structure where applicable.

Submission for type, size and location approval shall consist of two prints each of the preliminary bridge plan (dated), roadway plan and profile drawings for both main routes and crossing, roadway and railroad right-of-way, and stream cross section augmented by the information listed above, Items 1 thru 15.

Preliminary plans shall show plan and profile of bridge showing proposed type of superstructure and substructure, location of expansion and fixed ends and section thru approach pavement, curb, or sidewalk, and shoulders including guard rail and controlling horizontal and vertical clearances and a cost estimate preferably including quantities and unit costs. Contours or existing ground along centerline of structure, finished elevations at abutments and piers shall also be indicated.

CHAPTER 3

FINAL PLANS FOR HIGHWAY STRUCTURES

PRESENTATION OF FINAL PLANS

(A) The County name shall be placed in the title block of each drawing sheet. Under County name, the Project Route (L.R. Number and Section Number), Station and type of structure shall be shown, as practical. Consultant's name, Pennsylvania P.E. Seal, signature and date shall be placed at the left side of the title block only on the first sheet of design drawings. For details see Page 4.3.60.

(B) Design drawings for Highway Structures shall be prepared on Tracing Cloth furnished by the Department. Drawings shall be so planned that all details will fall within the prescribed border lines.

When preparing design drawings, every effort shall be made to draw the plans, sections, elevations and details accurately to scale. Generally the scales should be large enough to show clearly all dimensions and details necessary for construction of the structure. Preferably, plans, sections and elevations should be drawn to a scale not less than $\frac{1}{4}$ inch per foot, and details to a scale not less than 3/8 inch per foot.

All lines on the drawing shall be dense in opacity and of sufficient width so as to have some residual density when reduced 50% photographically. Minimum size for lettering, symbols, and characters shall be size #5 on the standard lettering guide. Upper case size #4 lettering will be accepted. All characters shall be open, bold, uniform, and formed with a dense but not wide line. Space between the letters shall be one-half the width of the widest letter, and space between the lines of lettering shall be one-half the height of the tallest letter.

(G) If, because of lack of space on a particular sheet, it is necessary to place a view or a section on another sheet, both sheets should be clearly cross-referenced.

(H) When misinterpretation is possible, the limits of pay items shall be clearly indicated on the corresponding details of structure.

(I) Abbreviation of words shall generally be avoided, and those abbreviations which are not in common use shall be explained.

(J) The following essential information shall be shown on the first sheet (or in the case of large structures on subsequent sheets) designated as "General Plan".

(1) Plan View: Outer limits of substructure and superstructure, length of spans along centerline of roadway, skew angle(s), stations and grade elevations at intersections of profile grade with bearing centerlines at abutments and piers, stations at end and beginning of approach pavements, location of points of minimum vertical clearances, scuppers and test borings, minimum horizontal clearances between underpassing highways and railroad tracks and faces of adjacent parts of substructure, and normal horizontal clearances between faces of substructures for drainage structures.

(2) Elevation View: Rate and direction of roadway grade, spacing of railing posts and lighting poles, finished ground line and approximate original ground line along construction centerline of bridge, bottom of footing elevations, piles if used, and required and provided minimum vertical clearances with elevations at both points of clearances.

(3) Typical normal section (s) of superstructure: Roadway width between curbs or sidewalks, over-all dimensions out-to-out of outside faces or parapets, water tables and cross slopes of roadway.

(2) Reinforcement bars shall not be provided with hooks unless otherwise specified or required by design.

(3) Unless otherwise specified, reinforcement bars smaller than #4 size, and larger than #11 size should not be used. Bundling of bars will be considered.

(4) Bar marks should be simple and instructive as to location and shall not indicate size and/or length which would complicate possible revisions of reinforcement bars.

(5) It is desirable that the numerals of bar marks follow as close as possible the order of placing the bars in each construction part of structure.

(6) Bar Schedule shall be arranged in a tabular form for each part of structure (Abutment #1, Pier #1, Pier #2, Deck Slab, etc.) indicating the bar mark, size, length and type (straight or bent) of each bar. The bending diagram shall be shown near the bar schedule.

(7) In general, the following key letters are recommended:

In stem of abutment, wings and retaining walls . . . . . W

In Piers . . . . . P

In Deck Slab . . . . . S

In Stems of T-beams . . . . . B

In Curbs and Parapets C

In Footings (Including Dowels) . . . . . F

(8) For small or simple structures, one key letter with different numerals for various types of bars may be used, except that the key letter "F" should be used for bars in footings.

DESIGN COMPUTATIONS

(A) Original design computations shall be made in such a way to produce clear and legible copies, and must be arranged so that a checker may easily follow the subject and procedures of the design-analysis. Each sheet of design computations shall be thoroughly checked and initialed by the designer and the checker.

(B) Design computations are not required for any portion of a structure for which the information is taken verbatim from a Standard; e.g., A Standard may be used if the corresponding dimensions and design data of the structure being designed are identical to those shown on the Standard.

(C) In general, the design computations shall consist of these items: Geometry calculations, structural analysis, quantity computations and necessary sketches.

Each phase of computations should include a table showing the summary of results, e.g., with "Structural Analysis" it shall indicate the actual and allowable stresses for various loading groups.

Trial or preliminary design or analysis may be included in the computations.

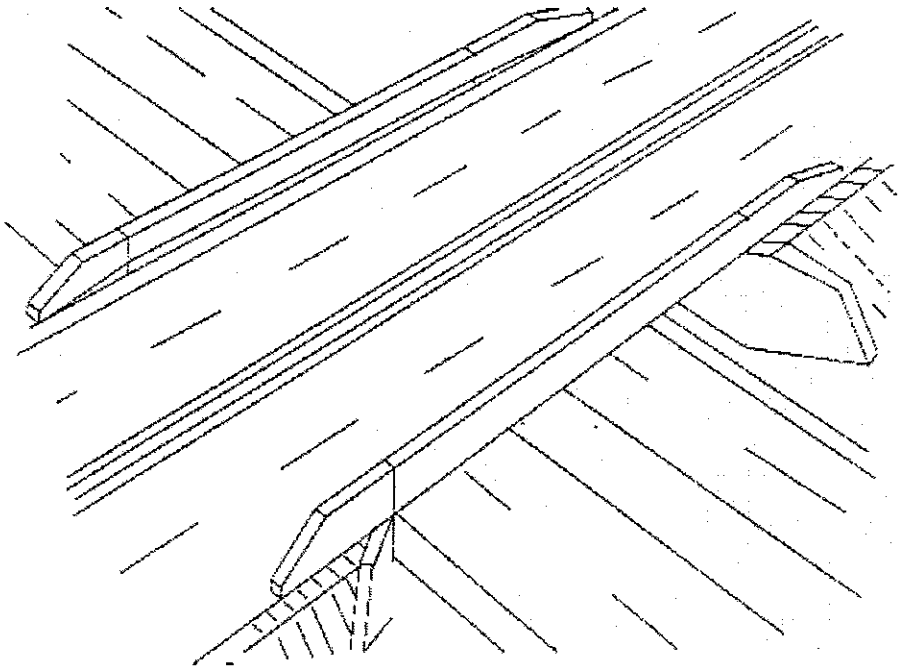
When computations are made by electronic computer, the input and output listings, with explanations of terms, must accompany the design computations.

When methods or formulae which are not in general use are employed, the source shall be given.

(D) Title sheet of original design computations, and the sticker on the binder, shall show the name of County, Project Route (L.R. Number and

DESIGN MANUAL
PART 4

Volume 1 of 2 Volumes



STRUCTURES

PROCEDURES – DESIGN – PLANS PRESENTATION
PDT – PUB No. 15M

SEPTEMBER 2007 EDITION
(Dual Unit)

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION

PENNDOT

(d) Tests for steel to establish chemical composition, yield and ultimate strengths, as well as Charpy tests

(e) Fatigue damage analysis with possible strain gaging if decision on rehabilitation vs. replacement is involved

(f) Rating analysis

(g) Constructibility review by an independent consultant for all new major, unusual and complex bridge rehabilitation projects.

1.3.3 Selection of Design Methodology

The Department shall specify the design method (line girder method, two-dimensional grid analysis, or three-dimensional finite element design) to be used for the project.

For straight girder bridges with skews greater than 70°, a line girder method (with distribution factors as given in A4.6.2.2 and D4.6.2.2) shall be used (see PP3.2.2 for the Department's definition of skew angle).

1.3.4 Bridge Design Review by Consultants

The consultants may be asked to perform one of the following two different levels of review:

(a) Level 1 review (see PP1.3.4.1 for additional details) is applicable mostly to contractor-designed alternates and design-build projects of a complex nature or to those which incorporate "leading edge" technology. Such designs will often be beyond the scope of the criteria covered by the Design Manual and the Department's standards. The review consultants will be required to make a detailed review of the design to ensure that the Contractor's conceptual design approved by the Department is correctly developed and presented by the Contractor. This level of review will also be applicable to "leading edge" designs prepared by other consultants retained by the Department, where an independent review by another consultant would be in the best interest of the Department.

Figure 1 or Figure 2 shall be used for stamping the first sheet of the bridge plans reviewed by the review consultants.

(b) Level 2 review (see PP1.3.4.1 for additional details) is applicable to routine types of structures designed in conformance with Department criteria and standards. Review shall be limited to ensuring general conformance with the Department's design criteria and standards.

Figure 3 or Figure 4 shall be used for stamping the first sheet of the bridge plans reviewed by the review consultants.

The depth of review required of the review consultant shall be described in detail in the Engineering Agreement. When the level of review cannot be clearly determined for contractor-designed alternates and design-build projects, one of the two levels shall be assumed on the basis of the complexity of the as-designed bridge. The level of review will be changed, depending upon the alternate design proposed by the low bidder, either by the District Bridge Engineer or the Chief Bridge Engineer, according to approval responsibility. (Note that if a contractor-designed alternate or a design-build project converts a routine type of structure to a "leading edge" type, the Chief Bridge Engineer becomes responsible for approval.) Since most of the review work assigned to consultants is based upon a specific rate of pay, only the total cost of review would change, depending upon the level of review. When the level of review cannot be readily determined, the cost for both levels may be sought during the agreement stage.

Review may be assigned to consultants when work loads are such that review cannot be done in-house. Most consultant review assignments will be made for the review of contractor-designed alternates and design-build projects, but there may also be some assignments for the review of designs prepared by other consultants during the design phase.

Alternate Design

S x x x x A PE Seal

Reviewed by:

Review Consultant's Name,
Signature and Date

The design review is a detailed review for compliance with the contract documents and for proper development and presentation of the Contractor's conceptual design approved by the Department. It is not intended to relieve the Contractor of full responsibility for accuracy and completeness of the plans or for complete compliance with the contract documents.

Figure 1.3.4-1 Level 1 Review - Applicable to Complex and "Leading-Edge" Contractor-Designed Alternates and Design-Build Projects

Design reviewed by: PE Seal

Review Consultant's Name,
Signature and Date

The design review is a detailed review for proper development and presentation of the concepts in the type, size and location plans approved by the Department. It is not intended to relieve the designer of full responsibility for the proper development and presentation of the design and for the accuracy and completeness of the plans.

Figure 1.3.4-2 Level 1 Review - Applicable to Complex and "Leading-Edge" Designs Prepared by Other Consultants Retained by the Department

Alternate Design

S x x x x A PE Seal

Reviewed by:

Review Consultant's Name,
Signature and Date

The design review is for general conformance with the contract documents and the Department's design and construction criteria and standards. It is not intended to relieve the Contractor of full responsibility for the accuracy and completeness of the plans or for complete compliance with the contract documents.

Figure 1.3.4-3 Level 2 Review - Applicable to Non-complex Contractor-Designed Alternates and Design-Build Projects Designed in Accordance with the Department's Criteria and Standards

Design reviewed by: PE Seal

Review Consultant's Name,
Signature and Date

The design review is for general conformance with the Department's design and construction criteria and standards and is not intended to relieve the designer of full responsibility for the accuracy and completeness of the plans.

Figure 1.3.4-4 Level 2 Review - Applicable to Non-complex Structures Designed by Other Consultants in Accordance with the Department's Criteria and Standards

1.3.4.1 REVIEW LEVELS

(a) Level 1 - Detailed review shall consist of the following, as applicable, and additional requirements which may be unique to a particular bridge:

(1) Evaluation of design methods and design assumptions.

(2) Evaluation of computer program used in design (or check of design using a different computer program acceptable to the Department).

(3) Check of manual calculations.

(4) Check of construction methods, including applicable safety regulations, when required, to ensure that the intent of the design can be realized.

(5) Check of erection stresses, where applicable.

(6) Check of plans to ensure that design information is adequately and correctly presented.

(7) Check of construction dimensions is not required, except as in (6) above unless specified in the engineering agreement.

(8) Quantity check is not required.

(9) Constructibility check is not required for contractor-designed alternates and Design-Build projects, except as noted in (4) above.

(10) Constructibility check is required for review of design prepared by the consultants retained by the Department.

(11) Review for cost-effectiveness when design is prepared by another consultant retained by the Department.

(12) Review for compliance with Department criteria and standards, as applicable.

(b) Level 2 Review for conformance to Department criteria and standards shall consist of the following, as applicable, and additional requirements which may be unique to a particular bridge:

(1) Review for compliance with Department criteria and standards.

(2) Review for constructibility and cost-effectiveness when design is prepared by a consultant retained by the Department.

(3) Check of design calculations only when required (will depend on quality of design, history of design consultant, etc.).

(4) Check of plans to ensure that design information is adequately and correctly shown.

(5) Check of construction dimensions and quantities are not required unless specified in the engineering agreement.

1.4 COMPUTER PROGRAMS

1.4.1 Modification, Acquisition, or Development of Programs

The software outlined in PP1.4.2 and PP1.4.7 shall be used for all PennDOT projects. If software for a particular application is not available from the Department, the designer may use other commercially available software with the approval of the Department. The designer is fully responsible for the entire design and analysis, regardless of the software used.

2. The additional dead load shall not be applied to structures under fill.

3. Metal deck forms with blocked out valleys are commercially available and may be specified when economical for rehabilitation projects or when dead load is a control. Removable forms may also be specified for each case.

4. The note shall be shown on the drawing when retarder admixture is necessary in the concrete deck slab for conditions other than temperature control (mostly in skewed continuous structures).

5. The note shall appear on the plans for repairing, rehabilitating, widening, or extending the existing structures.

6. The design details/splices shall be coordinated with PP1.13, "Hauling Restrictions and Permits", and the standard note adjusted accordingly. If needed, the special provisions shall be expanded or adjusted by the designer. Optional field splice details should not be shown, but the note shall be shown on the drawing for beams or girders between 21 300 mm {70 ft.} and the limiting lengths specified in PP1.13.2.

7. The design details/splices shall be coordinated with PP1.13 and the standard note adjusted accordingly. If needed, the special provisions shall be expanded or adjusted by the designer. For beams or girders exceeding the lengths specified in PP1.13.2, field splice details shall be shown, and the note shall appear on the plans.

8. The note shall appear on the drawing when corrosion inhibiting admixture is to be specified for the project with the approval of the Chief Bridge Engineer. Indicate the time to corrosion.

1.7.11 Timber Notes

At the completion of preservative treatment, clean the treated material by a post-treatment steaming specified for the individual type of material or species. (Use this note for wooden bridges.)

1.7.12 Mechanically Stabilized Earth Walls

I hereby certify that all design assumptions have been validated either through construction details or notes on these drawings or through the contract plans and special provisions. (Show this note above the P.E. seal on structure plan.)

1.8 DESIGN COMPUTATIONS

1.8.1 General Requirements

(a) Original design computations shall be made in such a way that they can be microfilmed and will produce clear and legible copies. The minimum font size shall be 10 pt. Computations shall be arranged so that a Reviewer may easily follow the subject and procedures of the design analysis. Each sheet of design computations shall be thoroughly checked and initialed by the designer and the checker. An index sheet shall be provided for easy reference. The computations shall be of good contrast and shall be only on one side of 297 mm x 210 mm (Metric Size A4) or 8 ½" x 11" (U.S. Customary Letter Size) sheets for ease of microfilming. An exception to the minimum font size may be approved by the District on a case-by-case basis if space is limited and all caps are used. For these limited cases, a minimum 8.5 pt size in a font such as ARIAL may be considered.

(b) Design computations are not required for any portion of a structure for which the information is taken verbatim from an applicable current Department standard. In such cases, the standard shall be referenced in the calculations.

(c) In general, the design computations shall consist of these items: geometry calculations, structural analysis, quantity computations and necessary sketches.

Each phase of computer-generated computations should include a table showing the summary of results unless the critical items are obvious, e.g., for "Structural Analysis" the table showing the summary of results shall indicate the actual and allowable stresses for various loading groups.

Preliminary computations are not required, but may be included in the computations if identified and separated from the

final design computations.

When methods or formulas which are not in general use are employed, the source shall be given, including title and edition of the book, name of author(s), publisher and page numbers.

(d) Title sheet and cover of original design computations shall show the name of county, project route (S. R. number and section number), station of structure and S-number of the drawings, and be signed and sealed by the responsible engineers. Each sheet of calculations shall be dated by designer and checker.

(e) Original design computations shall be bound in hard covers that completely enclose the parts of the fasteners used. Bindings with exposed fasteners shall not be used. Upon final acceptance of the drawings, the original design computations shall be submitted to the District Office as a permanent record.

1.8.1.1 POLICY FOR DESIGNER'S RESPONSIBILITY FOR CONSTRUCTIBILITY

CASE A: Construction Methods and/or Sequences Specified by the Designer in the Contract Documents

When the design model assumes that the design loads will be applied in a certain sequence or under certain conditions, the designer must provide enough information in the contract documents (including plans) to ensure that construction sequence and/or methods will be consistent with the design assumption. In such cases, the designer is fully responsible and accountable for constructibility due to all temporary and cumulative design loads which eventually become part of the final design loads.

CASE B: Designs Based on New Design Methods which May Affect the Constructibility of a Common Bridge by Decreasing the Size of its Members. Optimized Designs are also Included in Case B.

The Designer is responsible for providing an appropriate notice in the contract documents (including plans) if typical construction methods used successfully in the past will not be permitted because of higher temporary construction stresses that may occur due to design dead loads and/or construction loads. As an alternative, the designer may design for a typical construction method which has been used successfully in the past, if it is economical to do so, and indicate the assumed construction method in the contract documents. The reason for assigning this responsibility to the designer is that the designer is in a better position to be aware of the affect that changes in design specifications and design methods will have on constructibility than would be the Contractor.

Although this policy assigns responsibility to the designer for Case B, the degree of accountability will vary with the circumstances as follows:

(1) If new design specifications or design methods implemented by the Department contain guidelines and/or commentaries which identify potential problems in constructibility, the designer will be held accountable if constructibility problems occur because of a failure to introduce constructibility guidelines in the design.

(2) The absence of constructibility guidelines or commentaries in new design specifications will not relieve the designer of responsibility for addressing constructibility. Accountability, should problems occur, will depend on whether the designer made a reasonable effort to address constructibility. An example of a reasonable effort in this case would be a request for approval of constructibility criteria during design, preferably at TS&L stage.

For contractor-designed alternates and Design-Build projects, the Contractor is completely responsible and accountable for constructibility.

Even with reasonable efforts, some constructibility problems may still occur because of the current state-of-the-art. In such cases, the Department, in the past, has been quite liberal in assuming some degree of accountability and will continue to do so.
The Designer's responsibility for constructibility must be considered in the technical scope of work in consultant engineering proposals.

For bridges under construction, the revised design specifications can often be met by modifying the size and sequence of the deck pours.

1.9.3 Type, Size and Location (TS&L)

1.9.3.1 GENERAL

The investigation of a proposed structure shall be sufficiently intense to discriminatingly select and justify type, size and location on the basis of the information available from the various phases of study outlined in Design Manual, Part 1, including any foundation information obtained. Preliminary cost comparisons shall be made to support TS&L recommendations.

The District Bridge Engineer or his representative shall attend the Design Field View for all bridge projects to provide input in finalizing location, horizontal and vertical alignment for the project, taking into account site specific conditions, such as slide or scour potential. Whenever an existing foundation is to be reused and new loads are to be applied, the existing foundations must be re-evaluated to assure adequate foundation carrying capacity.

TS&L for any structure supported on proprietary walls shall not be approved unless adequate foundation information including scour evaluation (if applicable) is available or foundation investigation is completed and recommendations are available.

Type of substructure will be approved during foundation approval.

Formal TS&L approval is required for in-house designed BRADD projects.

Submit the TS&L Report and Structure Geotechnical Foundation Report for Retaining Walls, and Sound Barrier Walls concurrently.

1.9.3.2 RESPONSIBILITY

Refer to Tables PP1.9-1 and PP1.9-3 for the review and approval responsibility for TS&L. For new bridge designs having a deck joint at a substructure unit, the TS&L must be submitted to BQAD for approval.

1.9.3.2.1 Responsibility of District

The designer shall submit two sets of TS&L plans and related information (see PP1.9.3.3) to the pertinent District for approval when the District is responsible for TS&L approval.

The District shall send to the BQAD an informational copy of the final TS&L approval letter, with road plans, applicable Q/A forms and preliminary bridge plans showing core boring layout.

1.9.3.2.2 Responsibility of BQAD

The District Executive shall submit to BQAD, for approval, two sets of TS&L plans and related information (see PP1.9.2.2) for approval when BQAD is responsible for TS&L Approval.

If the District desires to revise a Consultant's submission, the revision shall be marked on the plans in red and forwarded to BQAD with an explanation where necessary.

BQAD will review the submission and will approve it if it is found satisfactory and after obtaining necessary FHWA approval. Submission of revised preliminary plans will be requested, if necessary.

1.9.3.3 SUBMISSION REQUIREMENT

TS&L Submission requirements are divided into two categories, Standard and Streamlined. Standard TS&L submissions are required on all projects unless a Streamlined TS&L submission is agreed upon by the District, BQAD and FHWA (if applicable).

1.9.3.3.1 Standard TS&L

The following information shall be included for TS&L submission:

(a) TS&L submission letter

The letter of transmittal shall include the following:

(1) Location - Over or under S. R. or local road, segment, offset, and station (and/or stream name, railroad name, or road name)

(2) Type of superstructure recommended - Girder size and spacing and deck overhang dimensions

1. Indicate the type of superstructure coating system for steel girders (i.e. Painting, Galvanizing, Metallizing or None [for weathering steel bridges]).

(3) Span C/C bearing and/or C/C piers

(4) Roadway width Out-to-out, curb-to-curb and sidewalk width where applicable

(5) Skew angle or range of skew angles and direction (left or right)

(6) Vertical and horizontal clearance: Minimum required, actual provided

(7) Type of substructure recommended

(8) Location, type and movement classification of proposed deck joints

(9) Bearing type and location (defer designation of bearing fixity in multi-pier structures until final design)

(10) Deck and off structure drainage

(11) Design methodology to be used for superstructure design

(b) TS&L plans

The following information shall be shown on TS&L plans:

(1) Plan view, including controlling clearances, span length, skew, existing contours and finished contours (excluding BRADD plans), scupper locations, and end structure drainage, where required

(2) Elevation view showing controlling clearances, span length, existing and finished ground line, continuity, fix-expansion support condition, type and movement classification of expansion dams, and type of bearings

(3) Cross-section showing out-to-out (O/O) dimension, traffic lanes, shoulder widths, beam type, size and spacing, overhangs, cross slope, superelevation, minimum slab thickness, type of traffic or pedestrian barrier, and thickness of wearing surfaces

(4) Typical sections showing limits of individual construction stages where staging is required for construction of the bridge. Locations of longitudinal joints in the deck, locations and the type of temporary barrier, and traffic lane locations and widths shall be shown.

(5) Elevation view of pier(s) showing proposed configuration

(6) Deck protective system (for rehabilitation projects only)

(7) Loading, design and analysis method; non-standard details

(8) Core boring layout

(9) Hydraulic information including design flood data, flood of record and date, slope protection, where required, and preliminary scour information

(10) Horizontal and vertical curve data for all roadways shown

(11) For retaining walls, the length and height for each segment (Note that the TS&L for walls will not be approved until foundation recommendation is provided.)

(12) Bridge-mounted lighting poles, sound barriers and signs, if required.

(c) Report on alternate studies and justification for the recommended bridge types

(1) Cost comparison for all types considered during type, size and location study. (The cost estimate shall be arranged so as to indicate total cost per substructure unit and major portion of superstructure, e.g., rolled beam span, plate girder span.)

(2) Justification for recommended alternate

(3) Address the need to account for future widening and future redecking requirements into the recommended bridge

(4) Design Requirements for Contractor-Designed Alternate Structures and Design-Build Projects.
- Permissible changes to the bridge geometrics (span, bridge width, abutments, and piers) and vertical and horizontal alignment.
- Permissible Material Types (e.g., weathering steel, proprietary walls, etc.).
- Permissible Number of Deck Joints (typically, this will be the number of deck expansion joints provided in the as-designed structure; however, this limitation should not be so restrictive that it eliminates the use of individual superstructure material types for the alternate).
- Future Redecking Requirements (as applicable)
  - Maximum Number of Permissible Construction Stages.
  - Number of Required Lanes.
  - Minimum Lane Width(s).
  - Lane Location Limitations (if any).
  - Need to Maintain Pedestrian Traffic.
  - Minimum Number of Beams.
  - Design requirements for the individual stages.
- Future Widening Requirements (as applicable).
- Environmental Requirements Related to the Structure (as specified in the environmental clearance document - EIS, EA, CEE, or EER).
- Other.

(d) Soil reconnaissance and foundation exploration plans

Submission requirements are discussed in PP6.3.1.

(e) Additional information to be supplied by the designer

(1) Route and section number, index map and segment/offset of limits

(2) Program under which project will be financed (Federal-aid classifications, 100% State-funded, Department Force, or special program) and the State project number including the allotment code

(3) Name of designer (Consultant or District Office)

(4) List of proposed structures by station and type

(5) Design traffic data including current and projected ADTT and class of highways on relevant roads

(6) Date of line and grade approval and design speed

(7) Statement on balance of earthwork for project

(8) Statement whether project is designed for free or controlled access

(9) Prints or roadway plans showing approved typical sections; also pavement-type approval when available

(10) Copy of waterway approval (from Department of Environmental Protection) and results of acidity tests of water and soil, if applicable

(11) Copy of the minutes of the Design Field View approval as defined in Design Manual, Part 1, Chapter 2, and available road plans.

(12) For rehabilitation projects, the following information shall be provided:

1. Age of existing structure, present and cumulative ADTT, portion to be replaced, type of steel-for-steel bridges, date of last inspection, type of diaphragm connections, i.e., welded or riveted, type and location of deterioration, deck drainage, expansion dam type, barrier type, and other pertinent items.

2. Live load ratings of the bridge at present and after rehabilitation.

3. Fatigue-prone details, such as out-of-plane bending problem areas, cover-plated beams, remaining fatigue life with and without retrofit, fatigue problems observed during inspection, recommended retrofit for existing fatigue-prone details, and other pertinent items.

4. Proposed scope of work.

(13) For structures involving railroads, the following information shall be provided:

1. Completed Form 4279 "Railroad Crossing Data for Bridge Engineer", as well as railroad right-of-way cross-sections, 152 000 mm {500 ft.} each side of proposed structure, degree of track curvature and rate of superelevation, if applicable.

2. Existing railroad drainage facilities and conditions in the vicinity of the structure site shall be investigated and described.

3. For situations in which railroads are overpassed by a highway structure, the procedures to determine track clearances are discussed in Design Manual, Part 1, Chapter 5, "Clearance of Track where Railroads are Overpassed by a Highway Structure", and in D2.3.3.4.

4. All contacts with the railroad companies shall be through the District Executive unless authorization is given to consultants, in which case copies of all correspondence and memoranda of meetings shall accompany submission of plans to the District.

5. A copy of the railroad company's letter of approval of acceptance regarding horizontal and vertical clearances, type of design live loading, type of steel and allowable stresses for various structural members shall be submitted with TS&L submission, as well as a request for temporary support for railroad tracks, if needed.

(14) Copies of all available structure foundation exploration from Design Manual, Part 1, Chapters 3 and 4. (Provide a statement concerning mining in the area and any previous foundation problems, if any.)

(15) Pedestrian count and information concerning possible future development which might warrant need for sidewalks and/or pedestrian protective fence.

(16) Address problem areas so that there are no surprises at the final plan submission (kink in girders rather than curved girders, etc.). If problems or questions arise after approval is given, they should be brought to the attention of the Department.

(17) Address safety areas which are structure related and were noted at the Design Field View.

(f) Completed applicable Q/A Forms D-501, D-502, D-503 and/or D-504 (refer to Appendix A).

1.9.3.3.2 Streamlined TS&L

A Streamlined Submission, as a result of a Bridge Pro-Team meeting, shall include the information outlined in PP1.9.3.3.1(a) with signature blocks, (b) and (f).

The submission shall also include meeting minutes from the Pro-Team Bridge Scoping capturing all alternates discussed with reasoning behind decisions to pursue or exclude. All involved parties including the appropriate reviewing authorities, not just meeting attendees, should review and approve the minutes. The minutes should be made available to consultants for review during agreement advertisement for projects where consultants are used for design.

1.9.4 Foundations

1.9.4.1 GENERAL

The foundation exploration and report preparation shall be done as outlined in Chapter 6, and outlined herein.

Submit the TS&L Report and Structure Geotechnical Foundation Report for Retaining Walls, and Sound Barrier Walls concurrently.

1.9.4.2 RESPONSIBILITY

Refer to Table PP1.9-2 for the review and approval responsibility for foundations.

1.9.4.2.1 Responsibility of District

The foundation approval may be granted by the District Bridge Engineer or designee: However, input from the District Geotechnical Engineer should be considered. The District may consult BQAD and the Geotechnical Engineers and Geotechnical Engineering Section of the Materials and Testing Division about unusual cases.

The designer shall submit two sets of foundation plans to the District for approval.

1.9.4.2.2 Responsibility of BQAD

The designer shall submit to the District three sets of foundation plans for PENNDOT oversight projects and four sets for Federal oversight projects.

The District Bridge Engineer and the District Soils Engineer shall review the submission. The District Executive shall forward the submission to BQAD with the District's recommendation. The District shall submit to BQAD one set of the foundation submission for BQAD approval responsibility and two sets for FHWA approval responsibility projects.

If the District desires to revise the Consultant's recommendations, the revision shall be marked on the plans in red, with an explanation where necessary.

BQAD will review the submission and, after obtaining necessary FHWA approval, will approve it if it is found satisfactory. Submission of revised plans will be requested if necessary. The Soils and Geotechnical Engineering Section of the Materials and Testing Division may be consulted about unusual or complex foundations.

1.9.4.3 SUBMISSION REQUIREMENT

Foundation Submission requirements are divided into two categories, Standard and Streamlined. Standard Foundation submissions are required on all projects unless a Streamlined Submission is agreed upon by the District, BQAD and FHWA (if applicable).

1.9.4.3.2 Streamlined Foundation

A Streamlined Submission, as a result of a Bridge Pro-Team meeting, shall include the information outlined in PP1.9.4.3.1(a), (b), (c) and (d). PP1.9.4.3.1(c) references additional requirements in PP6.3.4.2.8. PP6.3.4.2.8(a), (b), and (d)(2) need not be furnished if borings are provided. PP6.3.4.2.8(d)(5) may be omitted if discussed in the Pro-Team meeting and documented in Pro-Team minutes

The submission shall also include a Foundation approval letter with signature blocks, to the District, listing items from DM4 PP 1.9.4.3(a) and meeting minutes capturing all alternates discussed with reasoning behind decisions to pursue or exclude. All involved parties including the appropriate reviewing authorities, not just meeting attendees, should review and approve the minutes. The minutes should be made available to consultants for review during agreement advertisement for projects where consultants are used for design.

1.9.4.4 SPECIAL CONSIDERATIONS

Based upon past experience, the following list of precautionary items is provided:

(a) Foundation in limestone/dolomite area shall be evaluated conservatively, i.e., use a smaller resistance per pile, provide grouting if necessary, etc. History of sinkhole activity must be checked.

(b) Piles or other deep foundations shall be recommended for substructure units in flood plain unless the footing will be supported on bedrock. Exceptions must be evaluated with extreme caution.

(c) Interference of inclined piles of the same and adjoining substructure units must be checked.

(d) For structure widening, watch for undercutting of existing foundation. Foundation column alternates may be considered. Similarly, foundation adjoining operating railroad or other property must be evaluated for the use of foundations column, caissons, etc., to eliminate cost of sheet piling or other similar costly measures.

(e) Foundations for non-flexible walls or substructure units must be set below the frost depth.

(f) Pile overdrive requirements may be needed for Conemaugh (clay stone and clay shale), decomposed mica schist and similar formations, if load test history indicates such a need.

1.9.4.5 FOUNDATION APPROVAL

The following items shall be included, as a minimum, in the foundation approval letter:

(a) All data outlined in PP1.9.4.3(a).

(b) Reasons for lower than normal allowable foundation pressures, pile loads, etc.

(c) Specific pile-driving method.

(d) Precautionary notes (for example, "Note that piles will terminate on limestone bedrock and considerable variation in the pile tip elevations may result").

(e) A note to the effect that a copy of the foundation approval letter is to be given to the field office for the Inspector's guidance during construction.

1.9.5 Final Review of Plans

1.9.5.1 RESPONSIBILITY

Refer to Tables PP1.9-1 and PP1.9-3 for review and approval responsibility for final plans.

The review of the final plans shall be conducted by either the District or BQAD, whichever has the final plan approval responsibility.

1.9.5.2 SUBMISSIONS

Two sets of prints of final plans, special provisions and Quality Assurance forms shall be submitted for review and approval to the District Executive for the bridge types for which the District is responsible. Three sets of prints (five sets for major, unusual, or complex bridges) of final plans, and special provisions and Quality Assurance Forms shall be submitted to the District for the bridge types for which the Chief Bridge Engineer has the responsibility for approval. The District shall submit two sets (four sets for major, unusual, or complex bridges) to BQAD for review and comments. If the District desires to revise the Consultant's submission, the revision shall be marked on the prints in red prior to being forwarded to BQAD. BQAD will send a set (three sets for major, unusual, or complex bridges) to FHWA for its review and comments when applicable.

For FAST and special projects, partial submissions, such as superstructure or substructure, may be made for early input and comments so that major items are resolved before plans are finalized.

The Quality Assurance forms submitted shall be all the required applicable formed in accordance with Appendix A. A copy of all calculations pages required by the form shall also be attached to each form. Additional calculations may be required upon request of the reviewing office.

1.9.5.2.1 Plan Review by Consulting Engineers

The District shall provide one set of review plans, special provisions, and design computations and the required applicable Quality Assurance forms in accordance with Appendix A to the review consulting engineer. Direct communication and correspondence between the design and review consultants shall be permitted, provided that copies of correspondence are forwarded to both the District and BQAD. Any deviation from standard design practices, design criteria and standards shall be approved by the Chief Bridge Engineer prior to its acceptance by the review engineer.

1.9.5.3 CHECKLIST OF MINIMUM ITEMS

In addition to the items included in PP1.6, the following list of minimum items is provided for uniformity and as a reminder:

(a) All pertinent items included in TS&L and Foundation submissions. The sheet or sheets of plotted core borings shall be the last sheet or sheets in the set of structure plans.

(b) Applicable general notes, quantities in the prescribed format (See Standard Construction Items Catalogue for appropriate unit measures), including utility installation items and alternate bid items, table of deck elevations, etc. All bridges shall have alternate bid item unless prior approval for one design is secured at the TS&L stage.

(c) All new bridges and new bridge superstructures (for rehabilitation projects) shall be bid lump sum. However, items below footings shall be bid on a unit price basis, except test piles, which will be a lump sum item. In addition, where quantities can be well defined, items may be bid lump sum. In case of conflict, the Chief Bridge Engineer shall be contacted.

(d) All design computations shall be submitted at this stage, and shall be completely checked with an index.

(e) All drawings shall be thoroughly checked for correctness and accuracy and shall be initialed by the designer and checker.

(f) Bridge type, size, location and foundation details shall match approvals.

(g) Foundation bearing pressures, axial and lateral pile/caisson loads, and the horizontal force for checking against sliding shall be shown for the controlling condition for each substructure unit. Indicate the controlling limit state, whether maximum values control, whether temporary or final conditions control, and the factored force effects (i.e., factored bearing pressure, factored pile axial load) and resistance values associated with the controlling conditions. A summary of soil/rock properties at each layer used for design shall also be shown, including, as applicable, undrained shear strength, mass unit density, saturated unit density, cohesion, effective friction angle, and empirical rock bearing capacity.

EXAMPLE:

Factored Pile Axial Load	=	_____	kip (Strength 1)*
Factored Pile Axial Resistance	=	_____	kip (Strength 1)*
Factored Pile Lateral Load	=	_____	kip (Strength 1)*
Factored Pile Lateral Resistance	=	_____	kip (Strength 1)*

*Show actual controlling limit state.

(h) If a construction item is not a standard item covered by Publication 408, a special provision shall be prepared and submitted. Construction item terminology shall match the construction item catalog.

(i) Utility occupancy data, transportability of prefabricated structure components, inclusion of special provisions for hauling permit and review of routes for accessibility shall be provided.

(j) Moment and shear envelopes, section properties for composite designs, prestressed notes, details for live load continuity for prestressed beams including continuity diaphragms, additional deck steel in negative moment area, dowel details, no keying of continuity diaphragms, deck pouring sequence, camber diagrams, etc. shall be shown in drawings.

(k) Bearing type and size shall be provided. The tolerance values used for the bearing pad design shall be shown on the construction plans. Provisions for future superstructure jacking shall be considered. The construction plans should clearly indicate where and when jacking is required, and provisions for jacking points must be included in the design and detailing of the superstructure and substructure. The jacking forces should also be specified.

(l) When consecutively fixed piers are utilized in a design, instructions for jacking the required deflection into the piers for proper positioning of the bearings under the beams shall be shown on the drawings. A table of dimensions shall be included showing the relative distance that each pier must be moved for each 5° C {10° F} temperature variation from the mid-range of the anticipated temperature extremes.

The theoretical fixed point on the bridge, based on the relative stiffness and heights of the piers that are fixed, shall also be shown on the drawings.

(m) Details for expansion dams, manufacturing and installation, shall match the standards unless approved by the Chief Bridge Engineer.

(n) Prestressed adjacent box beams: Bearing area should follow the deck cross slope; however, possibility of beam twisting should be watched by comparing seat cross slope at each end of the beam. Longitudinal slope should match the combination of grade and camber.

Prestressed spread box beams: Bearing area can be level transversely. Longitudinal slope should match the combination of grade and camber. Beveled sole plate shall be provided when longitudinal slope of the beam seat exceeds 4%, and the beam seat shall be level in the longitudinal direction. Special care shall be exercised when the bearings are parallel to a substructure unit with sharp skew; in such instances bevel shall be in two directions.

For both prestressed adjacent and spread box beams, D14.7.6.3 provides bearing area and sole plate requirements. For box beams having a transverse beam seat slope, s_t, exceeding 5% and placed on neoprene bearing pads thicker than 90 mm {3.5 in.}, provide a note on the design drawings requiring the contractor to provide temporary lateral support to the beam during construction until the end diaphragms are cast and the shear blocks or dowel bars are installed per D14.7.6.3.8d1.2P

If an exception has been given for the deck slab overhang, include a note on the plans per D9.7.1.5.1P.

(o) Steel structures: Deck pouring sequence (watch for lateral support for compression flange); fracture control plan; Charpy V-notch requirements; identification of tension flange; diaphragm connections to girders (watch for fatigue details); no out-of-plane bending details; end rotation on skewed bridges (compensate in expansion dam movement classification unless deck block-out detail is used for the dam); direction of deck placement (skewed placement) to eliminate corner

uplift; camber diagram (including differential camber between fascia and interior girders), appropriate overhang notes (see D6.10.3.2.4.2P and D9.7.1.5.1P), note per D14.7.6.3.5 if a lift-off condition is expected when beam is initially set on bearing pad, weld joint symbols, etc.

(p) Prefabricated walls: Typical foundation detail, conceptual drawing with all needed locations, dimensions and elevations, allowable foundation pressure with settlement control plan, if any, construction procedure, where required, barrier connection details, general notes, temporary shoring, where required, drainage details, abutment details, if applicable, concrete wall abutting details, and other site-specific requirements.

(q) Wall design: Clarify the use of wet or dry soil condition for wall design at the very first submission. Also, clarify how the designer validated assumptions on the construction or contract plans.

(r) Completed applicable Q/A Forms D-506 through D-518 (refer to Appendix A).

1.9.6 Final Plans

1.9.6.1 RESPONSIBILITY

Refer to Tables PP1.9-1 and PP1.9-3 for final plans.

1.9.6.1.1 Responsibility of District Bridge Engineer

The District may consult BQAD about unusual cases. When Federal funds are used in any phase of a project, PENNDOT oversight project procedure shall be followed.

Bridge-mounted sound barrier plans shall be approved for structural adequacy only.

1.9.6.1.2 Responsibility of BQAD

The District Executive shall submit the tracings, special provisions, one set of prints and the review prints with BQAD's comments to BQAD for approval of the bridge plans.

BQAD will review and approve the plans (tracings) and Special Provisions after satisfactory resolution of all comments, and will send prints of the approved plans, if necessary, or when requested by the District for preparing PS&E submission.

Bridge-mounted noise barrier plans shall be approved for structural adequacy only.

1.9.6.2 PLAN PRESENTATION

See PP1.6, "Plan Presentation". If the plans are prepared by a consulting engineer, the first sheet shall be signed and stamped by a Professional Engineer registered in Pennsylvania.

For design review performed by consultants, see PP1.3.4, which provides additional requirements.

All comments from the review of the final plans (PP1.9.5) shall be addressed before the final plans are approved.

1.9.6.3 SIGNING OF BRIDGE PLANS

The first sheet shall be dated and signed by the Chief Bridge Engineer or the District Bridge Engineer, depending on whose office has signature authority. All other sheets, except core boring sheets, shall be dated only. The core boring sheets shall neither be signed nor dated, except as indicated in PP1.9.4.3(b)(5).

The following procedure shall be followed for the approval of structure plans for local projects:

1. Federally-Funded Local Projects:

   The structure plans shall be processed using appropriate (PENNDOT oversight or Federal oversight) procedures. The District Bridge Engineer should sign the first sheet of the structure plans and indicate the approval date on the remaining sheets.

2. State-Funded Local Projects:

   The structure plans shall be processed as specified in Appendix A, Publication 9. The District Bridge Engineer should

QUALITY ASSURANCE FORM FOR PRESTRESSED CONCRETE BRIDGE DESIGN

Designer: _____ Date: _____
(DESIGN OFFICE & NAME OF DESIGNER)

System of Units ☐ Metric ☐ U. S. Customary

1. PROJECT INFORMATION

County: _____ S.R.: _____ Sec.: _____ Over: _____
(STREAM, RAILROAD, OR ROAD)

S-No.:_____ Design ADT: _____ ADTT: _____ Year: _____

2. SUPERSTRUCTURE

No. of spans: _____; Span length(s): _____; Max. Skew: _____

Type and Size of Beams: _____

Any deviations from T.S.&L. and Foundation approvals? Yes ☐ No ☐

If yes, indicate reasons _____

List restrictions on Alternate Design, if any: _____

_____

If multi-span, is it a jointless design? Yes ☐ No ☐ N/A ☐

If no, indicate reasons: _____

LL Distribution: PennDOT Approximate ☐ Finite Element ☐ Other ☐

Strands: Size _____

1860 MPa{270ksi} Low Lax _____; Stress Rel _____; Straight _____; Draped _____

Debonded in lieu of draping _____; % Debonded _____

Max. Unfact. Pos. Moment _____ kN≅m {kip≅ft} (Calc. Page _____)

Location _____

Max. Unfact. Neg. Moment (Slab @ Cont.) _____ kN≅m {kip≅ft} (Calc. Page _____)

Location _____

QUALITY ASSURANCE FORM FOR PRESTRESSED CONCRETE BRIDGE DESIGN

Designer: _____ Date: _____
(DESIGN OFFICE & NAME OF DESIGNER)

System of Units ☐ Metric ☐ U. S. Customary

Final Tensile Stresses in Precomp. Tensile Zone:

PHL-93 (actual) = _____ MPa {ksi} (Calc. Page _____)

Resistance = _____ MPa {ksi} (Calc. Page _____)

Maximum Prestressing Force _____ kN {kips}; Eccentricity _____ mm {in.}

For Critical Section*: Maximum Factored Flexural Resistance (M_r) _____ kN≅m {kip≅ft};

Maximum Factored Moment (M_u) _____ kN≅m {kip≅ft}

*Based on controlling vehicle, either PHL-93 or P-92.

Under-reinforced: _____; Over-reinforced: _____

Does Web Thickness meet the I-Beam minimum of 200 mm {8 in.}? Yes ☐ No ☐
(except 455/760, 455/835 and 455/915 beams, which is 155 mm)
{except 18/30, 18/33 and 18/36 beams, which is 6 in.}

Does Top Flange Thickness meet AASHTO Type V/VI Beam (minimum of 125 mm {5 in})? Yes ☐ No ☐

Transverse Tendon Layout as per BD-653M and 654M? Yes ☐ No ☐ N/A ☐

Deck Placement Sequence shown for Cont. Spans show on sheet: _____(including diaphragm area)

If Draped I-Beam Design:

Is extra Shear Steel furnished at drape point? Yes ☐ No ☐

Is Epoxy-Coated Reinforcement provided:

In Non-Composite Adjacent Box Beams with Bituminous Surface? Yes ☐ No ☐

For 2700 mm {9ft.} length at ends of all beams adjacent to joints? Yes ☐ No ☐

Recessed Strand Detail Shown in Plans on Sheet _____

Are Strands Debonded in Bottom Row? Yes ☐ No ☐

For continuous designs: Are shear and moment envelopes or tables shown? Yes ☐ No ☐

Is positive moment reinforcement provided/required? Yes ☐ No ☐

QUALITY ASSURANCE FORM FOR PRESTRESSED CONCRETE BRIDGE DESIGN

Designer: _____ Date: _____
(DESIGN OFFICE & NAME OF DESIGNER)

System of Units ☐ Metric ☐ U. S. Customary

3. SUBSTRUCTURE

Bearing Types:

Expansion: _____ (Calc. Page _____)

Fix: _____ (Calc. Page _____)

Expansion Dam Type: _____

Design Load for Shear Blocks: _____ (Calc. Page _____)

Was Live Load Considered in Design of Backwall as per DM-4? Yes ☐ No ☐ N/A ☐

Are Beam Seats at both substructure units sloped the same for adjacent Box Beams? Yes ☐ No ☐ N/A ☐

(Use camber values for longitudinal slopes)

4. COMMENTS

_____

_____

_____

_____

PUBLICATION NO. 442

PENNSYLVANIA

DEPARTMENT OF TRANSPORTATION

SPECIFICATIONS

FOR

CONSULTANT AGREEMENTS

FOR

PROJECT DEVELOPMENT SERVICES

2.3 Consultant Master Quality Management Plan

The Consultant shall be responsible for providing quality work, services and products to the Department.

The Consultant's Master Quality Management Plan shall provide the Consultant's documented plan to adhere to practices standard to their profession.

As part of the ECMS, the Consultant's is required to submit a Master Quality Management Plan as part of their electronic Annual Qualification Package (AQP). Any electronic AQP that does not include a Master Quality Management Plan will be rejected. The Consultant's Master Quality Management Plan will be considered confidential by the Department due to the operational content of the plan.

The Master Quality Management Plan should demonstrate the Consultant's commitment to ensuring procedures, policies, standards and specifications are followed to deliver quality work, services and products to clients at a fair and reasonable cost and in accord with all terms and conditions accepted by the Consultant. This plan should be concise and applicable to all clients.

The Consultant's Master Quality Management Plan should contain and address the following elements:

A. Policy

The Consultant's executive management shall define and document its policy for ensuring quality. The Consultant shall indicate how the policy is conveyed to all its employees.

B. Organization

The Consultant shall include an organization description that identifies the organization position(s) responsible for ensuring quality throughout the Consultant's organization.

C. Responsibility and Authority

Identify individual(s) in the organization responsible for:

- Overall quality
- Specific project quality
- Ensuring proper corrective actions are taken as required
- Disposition of non-conforming work, services and products

D. Process Controls

Describe in general terms how the project development process will be controlled to achieve the objectives of the project. Identify controls used to ensure all work, services, and products meet project standards and requirements. Identify state-of-the-art equipment to be utilized. Project specific controls will be identified in the project specific quality control plan.

E. Subconsultants

The Consultant shall document procedures to provide subcontracts or purchased services that conform to specific requirements. Define the controls and procedures used to review and monitor the activities and submissions of subconsultants/subcontractors. The level and type of monitoring and control will be dependent upon the type of service and the nature of submissions. Include defined procedures for records and quality audits.

F. Identifying Non-Conforming Work Services and Products

The Consultant shall document procedures to determine conformity of work, services and products to specified requirements. These procedures shall indicate how to identify, document and revise or dispose of the non-conforming work. Procedures for notifying the client and other appropriate agencies or parties shall be included with assurance that non-conforming work, services and products will not be submitted to the client and the client will not be charged for non-conforming work, services and products. The procedures for correcting or changing procedures or activities to prevent future occurrences should be included.

G. Monitoring Schedules/Delivery Dates/Budgets

The Consultant shall describe the procedures and company reports or information that will be used by the Project Manager and management to properly monitor the project and track the status of the following:

- Schedules and deliverables including corrective action to be taken if the fall behind schedule.
- Budgets including corrective action to be taken if the project will not be completed within budget.

H. Agreement Administration

The Consultant management staff shall monitor all terms and conditions of agreements between the Consultant and clients. The Consultant shall establish and define procedures to review and process the following:

- Technical and Price Proposals for Original Agreement.
- Modification to the Technical and Price Proposal applicable to a request for a Supplemental Agreement.
- Modification to the Price Proposal applicable to the transfer of funds.
- Documentation for a time of completion extension.
- Estimating the percent completion and establishing the applicable costs in the preparation of invoices.

I. <u>Procedures For The Following Project Specific Functions Are To Be Addressed</u>

1. Input

The Consultant shall define a framework for compiling, recording and maintaining existing information, data and materials pertinent to successful completion of the project. Relevant criteria including codes and standards will be defined and made available to appropriate staff. Documented procedures for addressing client comments will be established.

2. Output

The Consultant will define procedures and perform reviews to insure completed work, services and products are functional and conform to the standards and requirements of the client and peers. These should include a method for determining that the most recent revisions of the procedures, manuals, standards, etc. are utilized.

3. Changes

The Consultant will define procedures to identify, document, review and discuss, with the appropriate client representative, any deviation from the agreed to work, services and products prior to changes being made.

J. Organizational and Technical Interface

During the course of the project, communication and interface is necessary with various organizations and technical units. The Consultant will define both their approach to these interfaces and their method for documenting and transmitting the results.

K. Quality Control/Quality Assurance Procedures

The Consultant should document their procedures and approaches for QC/QA including but not limited to the following items:

- Cost allocation
- Checking criteria
- Checking calculations
- Computer programs
- Deliverables
- Document Control Logs
- Specifications
- Cost Estimates
- Changes
- Project Schedule
- PS&E package
- Design services during construction

L. Feedback

The Consultant will define procedures for obtaining performance feedback at key project milestone and incorporating this information into their procedures.

M. Internal Quality Auditing

The Consultant shall document procedures for internal quality audits to verify that the Master Quality Control/Quality Assurance Procedures are being followed and the planed results are realized. Consultant staff should perform these audits.

The results of the audits shall be documented and brought to the attention of the responsible personnel in the area audited. Management personnel shall take appropriate timely action to correct deficiencies noted, follow-up and verify effectiveness of the corrective action taken and document these actions.

If the Consultant has a Master or Corporate Quality Management Manual that has been accepted by another State DOT, the Consultant may submit the Manual along with an outline that cross-references the items identified in this directive. If the Consultant has ISO Certification for the areas covered by the Corporate Quality Management Plan, this can be submitted in lieu of the Master Quality Management Plan.