

COLORADO DEPARTMENT OF TRANSPORTATION STAFF BRIDGE BRIDGE DESIGN MANUAL	Subsection: 19.1 Effective: August 1, 2002 Supersedes: April 10, 2000
MINIMUM PROJECT REQUIREMENTS FOR MAJOR STRUCTURES	

The following presents the minimum requirements for CDOT projects which include major structures (as defined in section 19.1.8 below). This is a summary. More detailed information can be found in the standards referenced herein and other CDOT documents addressing design and construction. This summary identifies the structural staff, submittals, design and construction specifications, and project processes required for major structures.

These requirements provide for the following primary objectives when the project includes major structures.

- The minimum requirements for major structures will be similar for all projects; in-house, consultant, developer, and design-build.
- A thorough preliminary design process is required to identify the general structural solutions and the appropriate project design criteria needed to meet the Department's needs, and to help reduce costly delays and revisions during final design and construction.
- Structure final plans and specifications shall have a thorough independent quality control check by the structural design team.
- Whether or not to conduct quality assurance reviews of consultant structure design work after the FIR will be at the discretion of the Resident Engineer. Department final design reviews may be added to the contract for consultant design and design-build projects, but are not listed in this document as minimum requirements.
- Design and as-constructed documentation on major structures will be prepared and submitted to Staff Bridge for the Department's structural archives.

As pertaining to structures, any conflicts between this summary, the standards referenced herein, or any other CDOT document shall be resolved by the Staff Bridge Engineer or his designee.

Establishing CDOT's structural design policy and allowing variances to the policy is the responsibility of the Staff Bridge Engineer. It is also the responsibility of the Staff Bridge Engineer to ensure the Department's policy on major structures is clearly communicated, readily referenced, and benefits the mission of the Department. Recommendations for improvement in this regard should be communicated to either the Staff Bridge Engineer, his staff, or the Chief Engineer.

19.1.1 GENERAL PROJECT REQUIREMENTS FOR MAJOR STRUCTURES

19.1.1A STANDARDS

All major structures shall be designed and constructed in accordance with the Department's structural standards as defined in section 19.1.6 of this document.

19.1.1B PROJECT STRUCTURAL ENGINEER

On projects with major structures, the design team shall include a Project Structural Engineer (see definitions). This engineer will be in responsible charge of the structural design activities and will seal the contract plans and specifications pertaining to the major structures. The Project Structural

Engineer may be either a consultant or CDOT employee. Note, in order to accomplish the independent design check discussed under 19.1.4, Final Design, the project team will also need to include, at least, a second structural engineer. This second engineer does not need to be a member of the Project Structural Engineer's staff.

19.1.1C STRUCTURAL REVIEWER

On consultant design projects the design team shall include a licensed CDOT engineer with sufficient structural experience to act as the Structural Reviewer. Thorough and detailed reviews of the preliminary design submittals (as a minimum, structure selection reports and FIR plans as described below) are required. After the FIR, holding structure status meetings is the minimum requirement. Quality control is the responsibility of the Consultant Project Structural Engineer; consequently, whether or not the Structural Reviewer will conduct a quality assurance plans review after the FIR will be left to the discretion of the Resident Engineer.

19.1.1D STRUCTURE STATUS MEETINGS

On consultant projects the Consultant Project Structural Engineer shall meet periodically with the CDOT Structural Reviewer to discuss the design work. Typically, these structure review meetings shall be held no less than once every two months and no more than once every two weeks. They may be held in conjunction with the general project progress meetings. Attendance by the Resident Engineer and, as appropriate, other members of the design team (e.g., geology and hydraulics) is encouraged. Holding structure status meetings for in-house design projects is also encouraged.

19.1.1E EXCEPTIONS

Major structures for which the Department's M & S Standards are used (e.g., concrete box culverts and sign bridges) are excluded from the section 19.1.4 final design requirements given below. Sign bridges, cantilevers and butterflies extending over traffic are major structures but are excluded from the preliminary design sections 19.1.3.A through 19.1.3.D below as minimum requirements

The requirements in this document apply to design-build projects except the FOR activities in section 19.1.4C, and the quantity calculations under 19.1.4E.4, will not apply to the Contractor's design work.

The requirements in this document apply to developer projects (see definitions) constructed within CDOT right-of-way except for the scoping requirements in 19.1.2, and the preliminary design activities related to determining minimum construction costs (section 19.1.3B.8 primarily). FIR and FOR level submittals are generally expected, but whether or not to hold formal meetings will be at the discretion of the Resident Engineer. Field packages and construction engineering assistance (Sections 19.1.4E.4, 19.1.5A, and 19.1.5B) are not CDOT requirements if the Developer performs the construction engineering.

19.1.2 PROJECT SCOPING FOR MAJOR STRUCTURES**19.1.2A SCOPING**

The Program Engineer and Resident Engineer will determine when to involve structural engineering staff in the project scoping. To prevent later changes to the project scope, the Department's structural employees should be involved in any scoping involving major structures. When the project involves existing structures, the information available from Staff Bridge on these structures shall be utilized.

On consultant projects, the contract Scope of Work shall be reviewed by CDOT's Structural Reviewer and the Consultant's Project Structural Engineer prior to signing the consultant's contract. The structure activities in the Scope of Work shall be consistent with the requirements outlined in this document.

19.1.2B SCHEDULE AND WORKHOUR ESTIMATES

When preparing schedules and workhour estimates, the Resident Engineer shall obtain estimates for the major structure activities from the Project Structural Engineer on in-house jobs, or the Structural Reviewer on consultant jobs. The Resident Engineer will establish the final schedule and work hours, however this decision is not to be made independent of information received from the CDOT structural team member. Early in the project, if the CDOT Project Structural Engineer or Structural Reviewer is not known, then an employee who may potentially act in this capacity for the project will be assigned to prepare the estimates.

19.1.2C PROJECT SURVEY REQUEST

The Project Structural Engineer should participate in developing the project survey request to determine if any project specific modifications to the basic information required by the Department's Survey Manual are necessary.

19.1.3 MAJOR STRUCTURE PRELIMINARY DESIGN

The preliminary design for major structures shall be conducted as outlined below to ensure the Department obtains a structure layout and type selection which achieves the project's objectives and minimizes revisions during the final design and construction phases. The structure selection report presents the results of the preliminary design process. The report shall document, justify and explain the Project Structural Engineers' structure layout and type selection.

All of the following topics should be considered for design-build projects, but the preliminary design shall be developed only to the extent necessary to define the Department's minimum project requirements for the structures and establish probable construction costs.

The Project Structural Engineer will be responsible for conducting the following activities.

19.1.3A STRUCTURE DATA COLLECTION

1. *Obtain the structure site data:* The following data, as applicable, shall be collected (see Procedural Directive 1905.1): Typical roadway section; roadway plan and profile sheets showing all alignment data, topography, utilities,

preliminary drainage plan, and right-of-way restrictions; preliminary hydraulics information; preliminary geology information; environmental constraints; lighting requirements; guardrail types; conceptual recommendations for structure type; and architectural recommendations.

2. *Obtain data on existing structures:* When applicable, collect items such as existing plans, inspection reports, structure ratings, foundation information, and shop drawings. A field investigation of existing structures will be made, with notification of the Resident Engineer.

19.1.3B STRUCTURE LAYOUT AND TYPE STUDY

1. *Review the structure site data* to determine the requirements that will control the structure size, layout, type, and rehabilitation alternatives. On a continuing basis provide data and recommendations to other members of the design team (e.g., roadway, hydraulics, survey) to help finalize the structure site data.

2. *Determine the structure layout alternatives.* Determine the structure length, width, and span configurations that satisfy all horizontal and vertical clearance criteria. Working with the roadway designer, determine the necessary length of walls, and the top and bottom of wall profiles.

3. *Determine the rehabilitation alternatives.* Continued use of all or parts of existing structures shall be considered as applicable. The structural and functional adequacy of existing structures shall be investigated and reported on. Determine the modifications and rehabilitation necessary to use all or parts of existing structures and the associated costs.

4. *Determine the structure type alternatives.* Consider precast and cast-in-place concrete and steel superstructures and determine the spans and depths for each. For walls, determine the feasible wall types as discussed in CDOT Bridge Design Manual Section 5.

5. *Determine the foundation alternatives.* Consider piles, drilled shafts, spread footings, and mechanically stabilized earth foundations based on geology information from existing structures and early estimates from the project geologist. To obtain supporting information, initiate the foundation investigation as early as possible during the preliminary design phase.

6. *Develop the staged construction phasing plan,* as necessary for traffic control and detours, in conjunction with the parties performing the roadway design and traffic control plan. The impact of staged construction on the structure alternatives shall be considered and reported on.

7. *Compute preliminary quantities and preliminary cost* estimates as necessary to evaluate and compare the structure layout, type, and rehabilitation alternatives. Do not use square foot or relative cost estimates to select the final structure layout and type; i.e., compute the bid item quantities for the substructures and superstructures for each alternative in accordance with Subsections 18.2 and 18.3 and determine the cost for each of them in accordance with the requirements in Subsection 18.1. Square foot and relative cost estimates are to be used for conceptual design work only.

8. *Evaluate the structure alternatives.* Establish the criteria for evaluating and comparing the structure alternatives that encompass all aspects of the project's objectives. Elements typically considered include safety,

construction cost, constructability, life cycle costs (durability), environmental considerations, aesthetics, in service maintenance and inspection, and the ability to rehabilitate, widen and replace the new structure. Based on this criteria, select the optimum structure layout, type, and rehabilitation alternatives, as applicable, for recommendation. In the case of design-build, select the set of suitable structure alternatives.

9. *Prepare preliminary general layout* for the recommended structure. Prepare the structure layout in accordance with the CDOT Bridge Detailing Manual. Obtain a structure number from Staff Bridge to show on the layout. Special detail drawings shall accompany the general layout where appropriate. Perform the independent design check of the general layout.

19.1.3C STRUCTURE SELECTION REPORT

Prepare a structure selection report to document, and obtain approval for, the structure preliminary design. By means of the structure general layout with supporting drawings, tables, and discussion, provide for the following as applicable:

1. Summarize the structure site data used to select and lay out the structure. Include the following:

- Project site plan
- Roadway vertical and horizontal alignments and cross sections at the structure.
- Existing structure data, including sufficiency rating and, for HBRRP (the FHWA highway bridge replacement and rehabilitation program) projects, whether or not the structure is on the Federal Select List.
- Construction phasing.
- Utilities on, below, and adjacent to the structure.
- Hydraulics: Channel size and skew, thalweg elevation, design year frequency, minimum low girder elevation, design year and 500 year high water elevations, estimated design year and 500 year scour profiles, and channel scour protection.
- Environmental constraints.
- Preliminary geology information for structure foundations.
- Architectural requirements.

2. Report on the structure layout and type selection process. Include the following:

- Discuss the structure layout, type, and rehabilitation alternatives considered.
- Define the criteria used to evaluate the structure alternatives and how the recommended structure was selected.
- Identify any deviations from the Department's structural standards as defined in section 19.1.6 of this document.
- Provide a detailed preliminary cost estimate and general layout of the recommended structure, or, for design-build, set of suitable structures.

3. *Submit the report for review and comment* by the project design team to obtain acceptance of the recommended structure type and its layout. Allow at least two weeks for review. A copy of the structure selection report shall be submitted to the Staff Bridge Preconstruction Engineer, and on Federal Aid projects and projects on the National Highway system, to the FHWA Division Bridge Engineer. The associated general layout, with the revisions resulting

from the review, will be included in the FIR plans. The work schedule shall be planned accordingly.

19.1.3D FOUNDATION INVESTIGATION REQUEST

Initiate the foundation investigation as early in the preliminary design phase as practical. On plan sheets showing the project control line, as well as any utilities, identify the test holes needed with stations and coordinates and submit them to the project geologist. The available general layout information for the new structure shall be included in the investigation request.

19.1.3E FIR

On obtaining initial approval for the structure type selection and layout, the Project Structural Engineer shall submit the general layout for inclusion in the FIR plans. After the FIR the general layout shall be revised as needed. Final approval from the Resident Engineer of the revised general layout shall be obtained before proceeding with final design.

19.1.4 MAJOR STRUCTURE FINAL DESIGN

The Project Structural Engineer will be responsible for conducting the following activities after the FIR.

19.1.4A STRUCTURAL DESIGN AND PREPARATION OF PLANS AND SPECIFICATIONS

1. Perform the structural analysis and design. Document the work with design notes, detail notes and computer output. The Engineer is responsible for the meaning and applicability of all computer generated information.

2. Update the general layout, as necessary, as final design information is received from the other disciplines. Keep the design team apprised of any changes. Obtain the final geology and hydraulics reports early in the design process.

3. Prepare all detail drawings in accordance with the CDOT Bridge Detailing Manual and Bridge Design Manual. Obtain the current standard worksheets and specifications from Staff Bridge.

4. Prepare the special provisions applicable to the project. The Project Structural Engineer shall provide the special provisions applicable to the major structures.

5. Compute the quantities and complete the summary of quantities.

19.1.4B INDEPENDENT DESIGN, DETAIL, AND QUANTITY CHECK

1. Perform independent design and detail checks (see definitions) of the plans and special provisions. The Engineer is responsible for the meaning and applicability of all computer generated information.

2. Revise all plan sheets, special provisions and design notes to correct any deficiencies found in the design and detail checks.

3. Perform an independent check of quantities and revise the summary of quantities as necessary.

19.1.4C FOR

Complete structural plans and special provisions shall be submitted for inclusion in the FOR plan set. The Project Structural Engineer shall review the FOR plans to verify design information received from the other disciplines, and attend the FOR to obtain review comments on the structural design. After the FOR the plans and specifications shall be revised as needed and submitted for inclusion in the final plan set.

19.1.4D BRIDGE RATING AND FIELD PACKAGES

Prepare the rating packages in accordance with the CDOT Bridge Rating Manual. Prepare the structure field packages in accordance with the CDOT Bridge Detailing Manual.

19.1.4E FINAL DESIGN SUBMITTAL

When the final plans and specifications are submitted to the Resident Engineer, the Project Structural Engineer shall submit to the Staff Bridge records unit an independent set of the following for each major structure. A copy of the Field Package should be submitted directly to the Resident Engineer by the Project Structural Engineer.

1. A final submittal letter certifying that the structural plans and specifications have been prepared in accordance with the current design standards of the Colorado Department of Transportation.
2. The complete set of final design notes for each bridge, overhead sign structure and retaining wall (including output from computer programs). These notes shall include revisions reconciling any differences between the original design, the independent design check and any design changes resulting from subsequent reviews.
3. The complete set of final independent design check notes for each bridge, overhead sign structure and retaining wall.
4. A Field Package for each bridge: The final set of the final quantity calculations as described in the CDOT Bridge Detailing Manual, and a copy of the geology report. When the project involves the replacement, widening, or rehabilitation of an existing structure, the as-constructed plans of the existing structure shall be included in the field package. The set of quantity calculations is not required for the Contractor design work on design-build projects.
5. A Rating Package for each bridge: Rating summary sheet for girders and deck, rating information and hand calculation sheets, rating computer output, and electronic copy of rating input file. Refer to the Bridge Rating Manual for a description of these items.

19.1.5 MAJOR STRUCTURE CONSTRUCTION**19.1.5A ASSISTING THE PROJECT ENGINEER**

The Project Structural Engineer shall be available to the construction Project Engineer for assistance in interpreting the structure plans and specifications, and for resolving construction problems related to the structure. Any changes

or additions to the structure, as defined in the contract documents, shall be communicated to the Project Structural Engineer.

19.1.5B OUTSIDE INQUIRIES

After project advertisement, any inquiries from contractors, suppliers or the media regarding the structural plans and specifications shall be responded to through the Project Engineer unless approval is obtained from the Project Engineer to do otherwise. This applies to all CDOT employees and any consultants that were part of the design process.

19.1.5C CONTRACTOR DRAWING SUBMITTALS

The Project Structural Engineer for a given structure shall review any shop drawings submitted for that structure. This includes Contractor designed modifications or alternates to the structure. At the Project Engineer's request, the Project Structural Engineer will assist in interpreting Contractor working drawing submittals. Staff Bridge shall receive a copy of all contractor drawing submittals for archiving.

19.1.5D AS CONSTRUCTED PLANS

The Project Engineer shall document the final dimensions and details of the completed structure on the original plan sheets and submit them to Staff Bridge for archiving.

19.1.6 STANDARDS FOR THE DESIGN AND CONSTRUCTION OF STRUCTURES

This is not a list of general references, but a list of required references which establish CDOT's structural design and construction requirements. Other standards are applicable as referenced by the following publications (e.g., CDOT M&S standards, CDOT Survey Manual, AREA specifications, AWS and CRSI publications, and software applications).

19.1.6A CDOT STANDARDS PUBLISHED BY STAFF BRIDGE

- * CDOT Bridge Design Manual
- * CDOT Bridge Detailing Manual
- * CDOT Bridge Rating Manual
- * Staff Bridge Technical Memorandums
- * Staff Bridge Project Special Provisions
- * CDOT Staff Bridge Worksheets (standard drawings)

19.1.6B CDOT STANDARDS PUBLISHED OUTSIDE OF STAFF BRIDGE

- * CDOT Standard Specifications for Road and Bridge Construction
- * CDOT Supplemental Standard Specifications for Construction
- * CDOT Standard Special Provisions
- * CDOT Design Manual
- * CDOT Construction Manual

19.1.6C STANDARDS PUBLISHED OUTSIDE OF CDOT

- * AASHTO LRFD Bridge Design Specifications
- * AASHTO Standard Specifications for Highway Bridges
- * AASHTO Guide Specifications for Design of Pedestrian Bridges
- * AASHTO Guide Specifications for Horizontally Curved Highway Bridges

- * AASHTO Manual for Condition Evaluation of Bridges
- * AASHTO Guide Specifications for Design and Construction of Segmental Concrete Bridges
- * AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals
- * AASHTO Guide Specifications for Structural Design of Sound Barriers

19.1.7 MAJOR PROJECT MILESTONES

The following is a list of the major milestones to be used for scheduling the project structural activities for major structures. These are only the major milestones. Other activities and submittals critical to the success of the structural work are not shown; e.g. the submittal of traffic, utility and environmental information to the structural design team. Project start-up activities such as scoping, scheduling and making the survey request are also important to the timely completion of quality structural work, but are not shown below. The hydraulic submittals shown apply to waterway crossings.

Roadway submittal to structure team

Preliminary Hydraulics submittal to structure team

Foundation investigation request by structure team

Submittal of structure selection report

Submittal of structure FIR plans

FIR

Final hydraulics submittal to structure team

Final geology report to structure team

Submittal of structure FOR plans and specifications

FOR

Final structure plans and specifications submittal to the Resident Engineer

Final structure design submittal to Staff Bridge's records unit

Submittal of as-constructed plans to Staff Bridge's records unit

19.1.8 DEFINITIONS

Major Structures: Major structures are bridges and culverts with both a total length greater than 6 m (20'), and retaining walls with both a total length greater than 30 m (100') and a maximum exposed height at any section of over 1.5 m (5'). The length is measured along centerline of roadway for bridges and culverts, and along the top of wall for retaining walls. Overhead sign structures (sign bridges, cantilevers and butterflies extending over traffic) are also major structures. During preliminary design a structure number shall be obtained from Staff Bridge. This number should be used on all subsequent correspondence and plan sheets to identify the structure

Project Structural Engineer: A licensed professional engineer (by the State of Colorado), with structural design experience, acting in responsible charge for the design work of a major structure. Other than the sealing of plans and specifications, the activities described in this document pertaining to the Project Structural Engineer may be executed by his or her designee. The Project Structural Engineer may be a consultant or CDOT employee. There may be more than one Project Structural Engineer on a project as in the case when there is more than one structural design team working on separate major structures, or for design-build where the Contractor will have a Project Structural Engineer for the Contractor's portion of the structural design work.

Structural Reviewer: A CDOT employee with a professional engineer license and structural design experience. This employee will be responsible for the Department's structural design reviews on a consultant project. Although there should be only one Structural Reviewer on a project (to obtain uniformity in directions to consultants or projects with more than one major structure) the activities described in this document pertaining to the Structural Reviewer may be executed by his or her designee.

Project Engineer: As defined in CDOT's Standard Specifications for Road and Bridge Construction, the Chief Engineer's authorized representative who is responsible for the administration of a given construction contract.

Resident Engineer: The CDOT employee who is responsible for the administration of a project. With the Department's re-engineering program, the preconstruction project manager and the construction Project Engineer will either be the Resident Engineer or the Resident Engineer's designee.

Program Engineer: As defined by the Department's re-engineering program, the immediate supervisor of the Resident Engineer.

Independent Check: The verification of the contract documents by a person or party separate from those who prepared the documents. This key quality control requirement involves the complete verification of all design work, details, specifications and quantities to ensure structural integrity, constructability, and that all the standards listed in section 19.1.6 have been satisfied. As such, the independent check results in two sets of complete design and quantity calculations, and a review set of the final plans where all the information has been verified.

Design Review: A quality assurance review of selected portions of the contract documents to verify that the designers' quality control procedures have been implemented. A design review involves little to no calculations and does not ensure that structural members have been sized or detailed sufficiently for structural integrity, constructability, or satisfaction of the standards listed in Section 19.1.6.

Developer Project: A construction project within CDOT right-of-way sponsored and funded by either a private or public entity other than CDOT.

CONTRACTOR DRAWING SUBMITTALS

19.2.1 GENERAL

There are two type of contractor drawing submittals, shop drawings and working drawings. Shop Drawings (6 sets minimum) are submitted for formal review and are returned to the contractor. Working drawings (2 sets minimum) are not formally reviewed nor returned to the contractor. Subsection 105.02 of the CDOT Standard Construction Specifications provides a guide for which type of drawing should be submitted for different structural works, and which drawings should be sealed by the contractor's professional engineer. Designers should thoroughly familiarize themselves with Subsection 105.02 of the Standard Construction Specifications.

The Department must return the shop drawings to the contractor within 4 weeks of the contractor's submittal. Designers must therefore give a high priority to the review, keeping in mind the time necessary for processing and delivery.

19.2.2 REVIEWING SHOP DRAWINGS

Shop drawings are reviewed to evaluate that general compliance with the information given in the plans and specifications has been achieved. The review does not extend to accuracy of dimensions, sequences, procedures of fabrication and construction, nor to safety precautions. The shop drawing review is not a complete check and does not relieve the contractor of the responsibility for the correctness of the shop drawings. The following is a guide for reviewing bridge shop drawings.

1. On the office copy, mark with a red pencil any errors or corrections. Note, only red pencil marks will be copied onto the other copies to be returned to the contractor.

2. The items to be checked are usually as follows. Check them against Contract Plans, Special Provisions, and Standard Specifications. Note, manufacturers' details may vary slightly from contract plan requirements, but must be structurally adequate and reasonable. Engineering judgement is needed.

- a. Material specifications
- b. Size of member and fasteners
- c. Length dimensions if shown on the contract plans
- d. Finish (surface finish, galvanizing, anodizing, painting, etc.)
- e. Weld size and type and welding procedure, if required
- f. Fabrication - reaming, drilling, and assembly procedures
- g. Adequacy of details
- h. Erection procedure when required by contract plans or specifications

Item i through v are specific to post-tensioning shop plans.

- i. Stand or rebar placement, jacking procedure, stress calculations, elongation's, etc., for post-tensioned members
- j. Seating loss
- k. Friction losses
- l. Time-dependent losses
- m. Steel stress plot
- n. Elongation of strands in all tendons (will be compared with the field measurements). In case of curved bridges with different web lengths, separate elongation's for each web shall be calculated where they vary more than 2 percent in exterior webs.

- o. Anchor plate size (if smaller than those called for in plans). Check bearing stress on concrete and flexural stress in plate material. Otherwise data must be (or have been) furnished to substantiate the adequacy of the anchorage's.
- p. Conduit vents at all high and low points in the spans
- q. Adequate room for the system in the concrete members. At least 50 mm (2") clear shall be provided between parallel mild reinforcing steel. The pitch on spirals in the anchorage's shall provide at least 50 mm (2") clear between adjacent bends.
- r. Interference with other reinforcement - special emphasis to be placed on this item if P/T supplier proposes a different number of tendons than shown on the plans.
- s. Offsets, from soffit to bottom of conduits. Watch for sharp curvature of tendons near end anchorage's.
- t. Strand positions in conduit in sag and summit tendon curves.
- u. Stressing sequence.
- v. Geometric details such as size of blockout

3. The following items usually do not need to be checked. However, they should be corrected, if necessary, to be consistent with other corrections.

- a. Quantities in bill of materials
- b. Length dimensions not shown on Contract Plans except for a limited amount of spot checking

4. When finished, mark the office copy with one of the following four categories, in red pencil. If in doubt between "c" and "d", check with your Supervisor. You may suggest an acceptable detail in red and mark the plans under "b", provided the detail is clearly noted: "Suggested Correction-Otherwise Revise and Resubmit".

- a. Approved, no exceptions taken
- b. Approved as noted
- c. Revise as noted Resubmit
- d. Rejected

5. If problems are encountered which may cause a delay in the checking of the shop plans, notify your supervisor and, preferably by e-mail, the Project Engineer.

6. Return 5 sets of reviewed and appropriately marked shop drawings to the Staff Bridge records unit. Alert the Project Engineer if deviations from the Contract Plans are to be allowed.

19.2.3 PARTIAL SHOP DRAWING SUBMITTALS

Unless otherwise directed by project special provisions, packages of drawings less than for a complete bridge will be accepted and dealt with as per the contract requirements of Subsection 105.02 of the CDOT Standard Construction Specifications, and the following.

The Contractor's submittal shall reflect a girder line or lines in total length or in part so long as all attachments or connections to the full or partial girder line or lines are included on the drawings. Thus, packages may be submitted which reflect the total cross-section of a bridge, including diaphragms and connections, but the submittal need not be for the full longitudinal length of the structure. The submittal shall reflect individual girder spans, or in the case of continuous girder lengths, shall reflect units between bearings and splices or between splices.

In an effort to facilitate the construction schedule, lesser submittals such as diaphragms, stiffeners, splice plates, etc., will be reviewed, if desired by the Contractor; however, they will be considered preliminary and will only be

given a cursory review and no approval unless they clearly evidence the design intent. The specifications provide that the Contractor may fabricate such elements; however, prior to approval by the engineer such work is at risk.

The Contractor's submittal of shop drawings is an intermediate step between the design final drawings and specifications and the construction of a project. CDOT Standard Construction Specifications, Section 105, requires the submission of shop drawings. This requirement, therefore, presumes that such drawings are, in fact, necessary for proper execution of the work.

There is no firmly established rule as to what information belongs in the design plans and specifications and what information is to be included in the shop drawings. Typically, the design plans and specifications set forth design criteria and project requirements; whereas, the shop drawings show how the Contractor proposes to implement these criteria and requirements.

Since the project specifications require approval of the shop drawings by the designer, it is important that such drawings be submitted in sufficient details so that the designer may be assured that the drawings will result in a product which is in conformance with the intent of the design.

This Subsection, 19.2.3, is taken directly from a August 1989 memorandum from the Staff Bridge Engineer to the District 6 Construction Engineer regarding the I76-(137) project.

SELECTING BRIDGE FOR REHABILITATION OR REPLACEMENT

To insure that bridge replacement and rehabilitation projects utilizing HBRRP (the FHWA Highway Bridge Replacement and Rehabilitation Program) funds are selected and categorized correctly for the Five Year Plan, the following procedure is established.

1. During development of the Five Year Plan for HBRRP projects, eligible structures will be listed in two categories:
 - (a) Sufficiency rating less than 50.
 - (b) Sufficiency rating greater than 50 and less than 80.
2. When the list of eligible structures is transmitted to the District Engineer the transmittal letter shall define the structures in category (a) as eligible for replacement, and the structures in category (b) as eligible for rehabilitation. The letter shall include instructions that the structures in category (b) can be replaced only if they meet the following conditions, as approved by the FHWA Division Administrator on a case by case basis:
 - 1) Structure type makes rehabilitation impossible, or
 - 2) existing conditions would be sacrificed by rehabilitation, or
 - 3) the cost of rehabilitation would exceed the cost of replacement.
3. The HBRRP funding selections made by the District Engineers shall be sent to the Staff Bridge Branch. Staff Bridge will then review the selections for consistency with the HBRRP program criteria. Staff Bridge will discuss its comments on the Districts' selections with the District Engineers.
4. The final approved list of projects will be forwarded by Staff Bridge to the Division of Transportation Development for inclusion in the Five Year Plan.
5. The District engineers will be advised that if during the development of a rehabilitation project it becomes apparent that a structure's deficiencies cannot reasonably be corrected by rehabilitation, then Staff Bridge shall be consulted. The FHWA will be immediately notified. Together, Staff Bridge and the District Engineer will review the facts and develop supporting documentation for submission to FHWA for approval.

COORDINATION WITH HYDRAULICS DESIGN UNIT

The following procedures were developed in December 1991 by a Staff Bridge and Staff Design joint committee to improve the coordination between bridge and hydraulics designers on projects with major structures.

The bridge design unit leader, bridge designer and hydraulics designer will hold a short meeting after the hydraulics designer has completed a preliminary hydrology and is prepared to make a site review. They will coordinate a time for the bridge and hydraulics designers to visit the site.

Items to be discussed during the site review can include any or all of the following:

- Type of structures that are appropriate and why
- Channel size
- Debris conditions, freeboard
- Possible pier locations
- Skew
- Scour
- Flow orientation
- Any other feature or constraint that appears relevant

A joint memo will be prepared by the hydraulics designer and sent to the project manager relaying the concerns, conclusions or issues that are discussed.

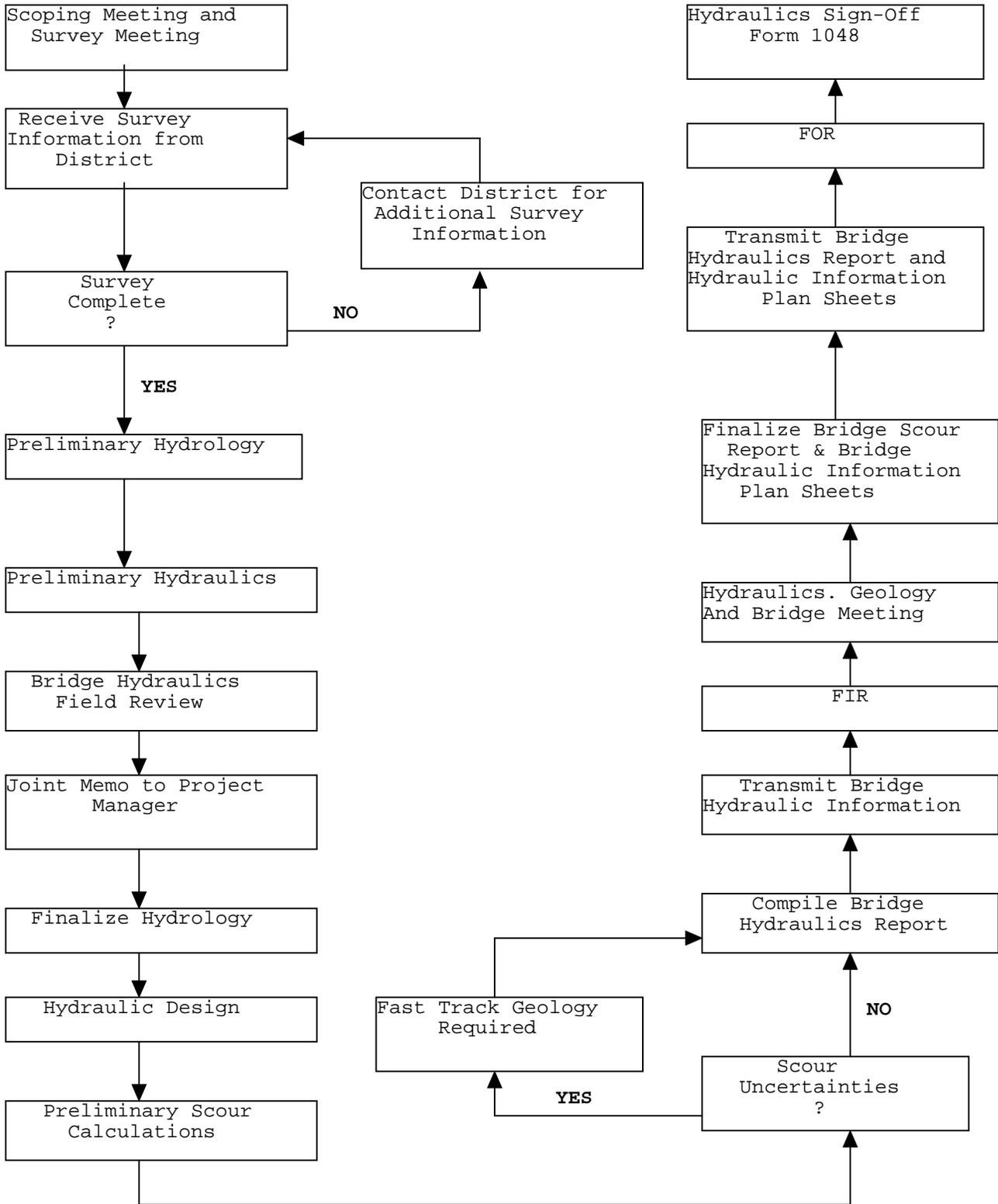
The benefits of a joint site review include early discussion of the site by the two disciplines, deepening knowledge of the other discipline's concerns and presenting a joint discussion to the District roadway designers.

The bridge, hydraulics, and geology engineers should meet to discuss scour. This meeting should be initiated by the geologist soon after the borings are taken and prior to submittal of the foundation report.

This meeting will enhance a multi-discipline approach to scour determination, and accelerate the process of getting the bridge hydraulics report to the bridge designer.

The original, and a copy of, the bridge hydraulics report should be sent to Staff Bridge. The copy shall be addressed to the Staff Bridge Engineer and the Staff Bridge Preconstruction Engineer and the original addressed to the bridge design unit leader.

Attached is a Hydraulics work flow chart for major structures.



COLORADO DEPARTMENT OF TRANSPORTATION STAFF BRIDGE BRIDGE DESIGN MANUAL	Subsection: 19.5 Effective: April 10, 2000 Supersedes: January 1, 1990
OVERLAYS	

When the Region requests an overlay on an existing bridge deck that is to remain in place, the project structural engineer shall do the following:

1. Check the Inventory, Operating and Sufficiency Ratings in the structure folder to see how they will be affected by the proposed overlay.
2. Check the latest bridge inspection report to see that the deck does not exceed 4" of overlay for bridges built prior to January of 2000 and 3" for bridges designed and built thereafter. The 4" thickness is a maximum limit and should be reduced to 3" when it will not cause drainage or grade problems and will not result in an overlay thickness of less than 2" over existing features like asphalt planks and deck joints.
3. Using the criteria in Subsection 2.1, check to see that the overlay will not adversely affect the bridge rail height as measured above the finished roadway surface.

Before any overlay is utilized on an existing bridge deck, a thorough investigation of the condition of the existing deck should be conducted. A cost analysis should be made to arrive at the most cost effective solution whether it be to repair the deck and overlay it, or to replace it.