ATTACHMENT 6

PRELIMINARY LAYOUT CRITERIA FOR BRIDGES AND WALLS

BRIDGES

1. The CONSULTANT shall gather from the DEPARTMENT all available data and information pertinent to the preparation of the Preliminary Layouts. The DEPARTMENT will have the final decision as to what data and information is pertinent.

2. The CONSULTANT shall prepare and submit the Preliminary Layouts for review and approval by the DEPARTMENT.

3. The CONSULTANT shall prepare the Preliminary Layouts taking into account the criteria outlined hereinafter.


5. All Preliminary Layout computations shall be neatly recorded on 8 1/2 inch by 11 inch computation sheets, fully titled, numbered, dated, signed by the designer and checker, and indexed. Preliminary layout drawings may be pencil or ink on mylar having outside dimensions of 23 inches by 36 inches. Drawing borders of 1/2 inch will be used at the top, bottom and right edge. The left border (binding edge) will be 2 inches.

6. The CONSULTANT shall prepare preliminary layouts utilizing the best and most economical superstructure and substructure. The CONSULTANT shall submit calculations supporting their economic decision with the preliminary layout submittal.

7. The CONSULTANT shall outline on each preliminary layout the construction scheme for the structure. The outline shall address the location of any temporary bents, traffic handling requirements, deck screeding operations, location of longitudinal and transverse construction joints in the deck, and any other construction operation which must be accounted for in the design of the structure.

8. The CONSULTANT shall consider the use of abutments at the ends of the bridges and shall make an economic analysis as to the cost effectiveness of their use. If economically justified, the abutments shall be indicated on the preliminary layouts.

9. The CONSULTANT shall prepare a typical section which shall indicate the following information:

   a. For Steel I-shapes and Prestressed AASHTO girders:
      (1) Center to center spacing of girders.
      (2) Distance from outside edge of slab to center of exterior girder. This distance (overhang) shall be limited to a maximum of 4'-7 1/2".
(3) Deck thickness between girders and thickness of centerline of girder from top surface of deck to top of the flange.
(4) Thickness of the top and bottom flange and depth of web for steel girders and the type of prestressed girder used for determining vertical clearances.
(5) Distance from gutterline to gutterline and from outside edge of slab to outside edge of slab.
(6) The slope of the deck and the location of any longitudinal construction joints.

b. For Steel and Concrete Boxes:
   (1) Box spacing as measured along the bottom of the deck.
   (2) Width of the bottom of the box.
   (3) Depth of section used for computing the vertical clearance. Thickness of the deck between webs and the top and bottom flanges of steel boxes shall be indicated as well as the thickness of deck at the center of the steel box web.
   (4) Distance from gutterline to gutterline and from outside edge of slab to outside edge of slab.
   (5) The slope of the deck and location of any longitudinal construction joints.
   (6) The overhang dimension shall be shown. (The maximum overhang shall be limited to a maximum of 4'-7 ½" for steel boxes and 9'-6" for concrete boxes.)
   (7) The proposed location of longitudinal prestressing ducts shall be indicated.

10. Steel boxes shall be proportioned following the AASHTO Guide Specifications for Horizontally Curved Highway Bridges dated 1993. For those bridges where the use of two steel boxes may be proposed, the section will be considered fracture critical and this requirement shall be taken into account when determining the economics of the section.

11. In addition to the requirements above, the preliminary layouts shall indicate the following:
   a. A plan view of the proposed structure indicating beginning and end bridge stations, skew angles, joint locations, station and skew of roadways crossing under the structure, width of roadways beneath the structure, taper control station, offset and rate, location of point of minimum vertical clearance, and location and magnitude of the horizontal clearances from edge of travelway beneath the structure to the face of intermediate bents and abutments.
   b. An elevation view of the proposed structure indicating the span length, location of fixed and expansion joints, profile of roadways beneath structures, vertical clearance from bottom of structure to roadway beneath, proposed bent locations, and existing ground profile.
   c. All horizontal and vertical curve data for the bridge and the roadway beneath the bridge.
   d. The location and elevation of the nearest bench mark.
   e. A brief description of the proposed structure indicating span lengths, curved units, type of end bents, and number of intermediate bents.
   f. Any drawing and/or narrative description of the construction scheme necessary to indicate how the bridge is to be built, including traffic handling sketches.
   g. In the case of a railroad bridge, the layout will show the nearest railroad mile post number, direction, and distance from the bridge centerline.

12. The minimum vertical clearance from bottom of superstructure to roadway beneath shall be 17'-6" for concrete boxes and 16'-6" for other types of construction. All horizontal and vertical clearances and beginning and end bridge stations shall be mathematically computed and checked. The CONSULTANT shall provide adequate vertical and horizontal clearance for falsework construction.

13. The CONSULTANT shall prepare a construction cost estimate.
RETAINING WALLS

A. The CONSULTANT shall prepare the following information for review by the DEPARTMENT:

1. An elevation view or wall envelope of the proposed wall drawn to a scale of 1”=10’ and indicating the following data:
   a. Beginning and end wall stations;
   b. Elevations on top of wall (parapet, coping, or traffic barrier) at beginning and end of wall, at profile break points and at least every 100 feet along the wall;
   c. Bottom of wall (top of footing) elevation necessary to maintain minimum berm requirements;
   d. Original ground profile, and
   e. Proposed ground profile.

2. Cross-sections in the vicinity of the wall that will indicate the existing and final slope behind the wall.

3. Typical Sections associated with the wall.

4. Project Plan and Profile sheets which indicate the following:
   a. Limits of right-of-way;
   b. Superelevation data;
   c. Horizontal and vertical alignment data;
   d. Horizontal offsets to face of retaining wall;
   e. Location and height of noise walls which may be required near retaining walls;
   f. Location and type of overhead signs which may be near retaining walls;
   g. Location of roadway lighting which may be near retaining walls, and
   h. Location and size of any drainage structures which will affect the retaining walls.

5. Any Sequence of Construction requirements including Plans and Special Provisions which will affect the construction of the walls and which will have to be accounted for in the preparation of retaining wall plans.

6. Any architectural considerations which may be required for the project.
B. The Consultant shall establish top and bottom wall elevations according to the following criteria:

1. The minimum cover from the proposed ground line to the bottom of the wall (top of footing) shall be 2 feet. See Figure 1 herein.

2. The maximum slope behind the wall shall be 2 horizontal to 1 vertical. See Figure 2 herein.

3. The top elevation of all walls which retain sloping backfills shall be set to provide a drainage ditch. See Figure 2, Detail A or B, and coordinate the use of the drainage ditch with the roadway designer.

4. The top of wall elevations shall follow smooth curves with no sharp breaks in the profile. Any changes in the profile that are deemed necessary shall be discussed with the roadway designer.

5. Where the proposed ground line slopes downward from the front face of the wall, the elevation of the bottom of the wall (top of footing) shall be set to maintain a minimum 10 foot berm. See Figure 3 herein.

C. The Consultant shall meet with the Department to discuss the proposed wall structures. Conceptual sketches indicating the proposed structures shall be presented and discussed before the preliminary layout is prepared.

D. The Consultant shall submit three sets of preliminary wall plans for the Department’s review and approval. If necessary, the Consultant shall submit three revised sets of preliminary wall plans to the Department. Once approved, the Bridge Office will furnish the data to the Geotechnical Engineering Bureau for review and any adjustment of Wall Bottom Elevations, and at the same time, soil investigations will be requested. Also in the request to the Materials Office, the types of walls being considered for use (Tie-back, Mechanically Stabilized Embankment, Cast-in-place, etc.) shall be indicated.
FILL SECTION

CUT SECTION

FIGURE 1
DETAIL A

DETAIL B

DRAINAGE DITCH
SEE ROADWAY PLANS FOR FURTHER INFORMATION

FIGURE 2
FIGURE 3
i. GUIDELINES FOR BRIDGE SURVEYS

BRIDGE SURVEYS

The length of a bridge survey should normally start 1000 feet before the beginning of the bridge, cover the length of the bridge and extend for 1000 feet beyond the end of the bridge. If a stream lies beneath the bridge, a stream traverse 500 feet upstream and 500 feet downstream, for a total of 1000 feet is required. If a railroad lies beneath the bridge, a railroad survey for 500 feet on each side of the bridge is required. If a bridge is over an existing road, a roadway survey for 300 feet on each side of the bridge is required.

A. The following items are needed on a BRIDGE SURVEY WHICH IS OVER A STREAM:

1. A Property Survey which covers the roadway alignment and a stream traverse. Tax maps, property owners names and addresses, deeds and plats are also required for the Property Survey. The right-of-way should always be verified by deeds.

2. Alignment of the existing bridge and also the alignment of the roadway for 1000 feet from each end of bridge. The beginning and ending centerline station should be established on the ground or pavement along with the beginning and ending centerline stations of the bridge and any PC’s or PT’s.

3. DTM Bridge Survey- To define the right-of-way limits and alignment, take a shot in the center of the bridge at the BFPR, two shots on each tangent of centerlines and three shots on each curve centerline.

4. Topo- Topo should be taken to at least 10 feet beyond the existing right-of-way, except for the area 500 feet before the beginning of the bridge to 500 feet beyond the end of the bridge. The coverage in this area normally should be 200 feet left and right of the centerline of the existing road.

5. Benchmarks- Three benchmarks are required: One at the beginning of the survey, one at the bridge or stream site near the right-of-way, and one at the end of the survey. These three benchmarks should be described with a sketch which also shows the X, Y, and Z coordinates. All elevations should be established with a spirit level.

6. Cross Sections or DTM Survey coverage should have the same limits as the Topo limits. Elevations along the bridge deck centerline and the gutterlines at the intersection with the centerline of each bent and at each mid-span should be established with a SPIRIT LEVEL. See example “A”. Adequate plus stations or DTM shots should be taken to accurately define the profile of the terrain beneath the bridge, to include endrolls, stream channel banks, stream centerline, scour and any other breaks in the terrain.

7. Stream Traverse- The stream traverse should begin at 500 feet upstream from the bridge centerline with Station 1+00.00 and then continue downstream to a station 500 feet below the bridge centerline. A top of water elevation shall be taken at the 500 feet upstream, 500 feet downstream, and at the bridge centerline sites. The topo, profile levels, and cross sections of the stream can be shown either by the plus and offset method or by the DTM method. Whichever method is used, sufficient data should be taken to accurately represent the profile of the stream bed.
8. Floodplain Cross Sections- Two floodplain cross sections are required and should extend to a point 2 feet above the high water mark that has been established for the stream at the bridge site. The floodplain elevations are to be taken at 100 feet intervals on natural ground, preferably between 50 and 100 feet on each side of the roadway. When floodplain cross sections extend past the Bridge Survey alignment, the floodplain cross sections should be taken at 500 feet intervals until the 2 feet above high water floodplain has been reached. Five shots or elevations are needed at each station cross section, one at the centerline of the road, one on each edge of the pavement and one on natural ground on each side of the road. Floodplain cross sections may be required for bridges located within 2000 feet upstream or downstream of the Bridge Survey. On these bridges the surveyor should always call the Bridge Hydraulic Office to verify the requirement for floodplain cross sections.

9. Bridge Sketch- Bridge sketches shall be drawn showing the elevation and centerline plus the bottom of the bridge beam at each cap. This sketch also shows the centerline station plus and elevation on all terrain breaks beneath the bridges. The stationing used to show elevations on the bottom of the beam and the profile of the ground beneath the lowest bridge beam shall be the same as the stationing for the alignment of the bridge deck. On mapping surveys which have no alignment, the stationing for the bridge sketch shall begin with station 0+00. See example “B”. For structures located upstream or downstream that could have an adverse affect of the bridge at the survey site, a sketch is required. This distance could be as much as 2000 feet. For upstream drainage structures beyond this limit, the size and type should be plotted on a quadrangle map or county map. See example “C”.

10. Overflow Bridges or Culverts within Floodplain- A distance from the bridge being surveyed to any overflow bridge or culvert that is within it’s floodplain should be shown along with a bridge sketch, the elevation of the deck or size of the culvert and the flowline elevation.

B. In summary, the following items are needed for a BRIDGE SURVEY OVER AN EXISTING ROAD:

1. Property Survey (Same as A-1).
2. Alignment of Existing Bridge and Roadway (Same as A-2).
3. Topo (Same as A-4).
4. Benchmarks (Same as A-5).
5. Profile and Cross Sections or DTM coverage should have the same limits as the Topo limits. See example “C” for the location of needed elevations on the bridge deck.
6. Roadway Beneath Bridge (The road beneath a bridge for 250 feet left and right of the bridge requires a complete survey which includes: Alignment, property, topo, profile levels and cross sections or DTM survey data.
7. Bridge Sketch (A bridge sketch is required. On this sketch it is important to show the vertical clearance from the bottom of the outside bridge beams to the roadway pavement at the centerline of the road and at each edge of pavement of the road). See example Nos. “D” through “H”.

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C. In summary, the following items are needed for a BRIDGE SURVEY OVER AN EXISTING RAILROAD: See attached MOG 4465-4.

1. Property Survey (Same as A-1).
2. Alignment of Existing Bridge and Roadway (Same as A-2).
3. Topo (Same as A-4).
4. Benchmarks (Same as A-5).
5. Profile and Cross Sections or DTM coverage should have the same limits as the topo limits. See example “C” for the location of needed elevations on the bridge deck.

D. Railroad Beneath Bridge- The railroad beneath the bridge for 500 feet left and right of the bridge requires a complete survey which includes:

1. Alignment- The alignment of the centerline on the main railroad tracts for 500 feet left and right of the bridge shall be surveyed. The intersection of the bridge alignment and the railroad alignment shall be tied to a railroad mile post.

2. Property

3. Topo- The topo coverage limit shall be 100 feet left and right on each side of the track. If the location has multiple tracks, coverage should be 100 feet beyond the centerline of the outer most track. The location of the existing bridge pilings should be located from the survey centerline.

4. Profile Levels and Cross Sections or DTM Survey Data- The profile and cross sections or DTM survey data shall be taken a minimum of 100 feet each side of the track. If the location has multiple tracks, coverage shall extend for 100 feet beyond the centerline of the outer most track. Elevations are to be taken on the top of each rail. If collecting elevations in the cross section format, a minimum of five (5) cross sections shall be taken between the proposed right-of-way limits. One at the proposed right-of-way, one half-way between the proposed right-of-way and the bridge centerline, one at the bridge centerline and the same for the other side of the bridge. These cross sections will be taken perpendicular to the railroad track centerline and extend for 100 feet beyond the centerline of the outer most track.

5. Drainage- All drainage structures and features within the 1000 feet Railroad Survey shall be provided.

6. Bridge Sketch- A bridge sketch is required. On this sketch it is important to show the vertical clearance from the bottom of the outer most bridge beams to the top of the railroad rail for each rail beneath the bridge.
ii. STRUCTURE TYPE STUDY

This report shall define, clarify and list the information necessary to produce an acceptable and reproducible set of contract documents for bridge construction.

1. **Report Contents:** The Structure Type Study when required will establish what alternative(s) will be carried forward in the Preliminary and Construction Document phases.

   a. **Purpose:** The Structure Type Study will consider any number of possible substructure and superstructure alternatives and will support those options to be carried forward into subsequent design phases. Cost effective span lengths shall be finalized. This will allow early start of the geotechnical exploration program.

      When alternate designs are considered, equality between the alternates is essential in ensuring equitable competition and optimum cost effectiveness. This equality includes achieving uniformity of design criteria, material requirements and development of unit costs.

   b. **Format:** The report shall use 8 ½” by 11” pages with drawings on larger sheets, if necessary, but folded to fit the report. The report shall be neatly written and the contents presented in a logical sequence with narrative, as required, to explain the section contents. An Executive Summary shall compare the relative features and costs of the alternates considered and recommend alternate(s) to be carried forward into the Preliminary Phase.

      The Structure Type Study should be as self contained as possible by including all arguments that establish, justify, support, or prove the conclusions. It is acceptable to make reference to other documents that will be included in the final submittal package: however, any documentation that will help emphasize a point, support a statement or clarify a conclusion should be used. Such documentation may include drawings, clear and concise views, or other such illustrated information that can assist in presenting design intents and solutions.

   c. **Contents:** Information other than cost, affecting the selection of an alternate, shall also be included. This requires timely completion and consideration of geotechnical survey data, life cycle maintenance, construction time and staging assumptions, constructibility, maintenance of traffic, etc. Various methods of handling traffic during construction should be thoroughly investigated. Data provided by others should be thoroughly reviewed and if deemed insufficient or in error should be brought to the attention of the provider. The major items considered shall be:

      (1) **Span Arrangement, Proportion, and Bridge Length:** Column and/or pier locations are subject to vertical and horizontal clearance requirements. After these considerations are met, span lengths are governed by economics and aesthetic considerations.
Piers located in a divided highway median must be protected from traffic when located within the clear zone. Generally this will be accomplished by guardrail or concrete barrier.

Superstructure depths (grade separation structures in particular) shall be kept to the minimum consistent with good engineering practice. Recommended depth/span ratios are shown in the AASHTO Bridge specifications.

(2) **Statistical System:** The economic and engineering advantage of simple span vs. continuous spans will be addressed.

(3) **Superstructure:** Consider prestressed concrete girders, steel rolled sections, steel plate girders, steel or concrete box girders, and other DEPARTMENT approved sections.

(4) **Combinations:** The above in combination with various foundation types, such as piles, drilled shafts and/or spread footings. For piles and drilled shafts, assume size, length, and capacities from available geotechnical information. For spread footings, allowable bearing pressure should also be assumed from available geotechnical information.

(5) **Quantity Estimates:** For minor bridges rough quantities (such as reinforcing steel based on kilos per cubic meter of concrete) may be sufficient. However, for major and complex bridges the degree of accuracy may require more exact calculations keeping in mind that the intent is to establish relative costs between alternates and not necessarily to the accuracy required for a final estimate. Also, for major and complex structures it may be necessary to develop unit costs from an analysis of fabrication, storage, delivery and erection costs.

(6) **Unit Costs:** Data available from the DEPARTMENT or contractors and suppliers should be used to arrive at unit costs. The sources of all price data should be recorded for later reference.

(7) **Cost Curves:** For each alternate establish the most economical span arrangement, i.e., minimum combined superstructure and substructure cost.

2. **Aesthetics:** Any bridge design must integrate three basic elements: efficiency, economy and elegance. Regardless of size and location, the quality of the structure and its aesthetic attributes should be carefully considered by the designers.

A successful bridge design will then be elegant or aesthetically pleasing in and of itself and compatible with the site by proper attention to form, shapes and proportions. Attention to details is of primary importance in achieving a continuity of form and lines.

The designer must consider the totality of the structure as well as its individual components. A disregard for this continuity or lack of attention to detail can spoil the best intent. In bridge aesthetics, the designer is dealing with the basic structure itself; not with
enhancement, additions, or other superficial touches.

The challenge differs for a major and a minor structure. Indeed, the challenge may be greater the smaller the bridge. Major structures, because of their longer spans, taller piers, or curving geometry offer opportunities not available for minor bridges.

Multi-bridge projects, such as interchanges, is an area where aesthetics play an important role because of their high visibility to a large number of motorists. In this instance, a conformity of theme and unifying appearance should be created. Avoid abrupt changes in structural features.

The level of aesthetic effort shall include an emphasis on full integration of efficiency, economy, and elegance in all bridge components and the structure as a whole. Consideration should be given to structural systems that are inherently more pleasing, such as hammerhead or "T" shaped piers, oval or polygonal shaped columns, piers in lieu of bents, smooth transitions at superstructure depth change locations, etc. Additional emphasis should be placed on the surroundings at interchanges where landscaping or unique features need to be considered.

3. **Constructibility and Maintainability:** All viable structure concepts shall be evaluated for constructibility. Items such as member sizes, handling, fabricating, and transporting members, maintenance of traffic, construction staging, equipment requirements, etc. should be considered. Special evaluation shall be made to insure against potential problems that may occur in obtaining permits and equipment to transport long and/or heavy members from point of manufacture to the project site. Also, considerations for future maintenance inspection shall be taken into account in the structure's design. Such considerations may include the need for 6 feet minimum headroom inside steel or concrete box girder superstructures. The intent of this requirement is to assure that all special construction and maintenance requirements are identified and appropriately reflected in the consideration of any concept that is to be recommended for design.

4. **Conclusion and Intent:** Following submittal of the Structure Type Study, the DEPARTMENT should have enough data to select either one or more alternates for development in the next phase of design.
Example "A"
Bridge Deck Elevations

* PROVIDE DECK ELEVATIONS AT B.F.P.R., & BENTS AND AT MIDSPAN ALONG \& BRIDGE AND CUTTERLINES

IF BENTS ARE PARALLEL, PROVIDE SPAN LENGTHS (\& BENT TO \& BENT OR B.F.P.R. TO \& BENT) ALONG \& BRIDGE. IF BENTS ARE NOT PARALLEL, ALSO PROVIDE SPAN LENGTHS ALONG CUTTERLINES.

BEGIN BRIDGE, BACK FACE PAVING REST, (B.F.P.R.)

\& BENT

\& BRIDGE

CUTTERLINE

APPRAOCH SLAB

** IF TWO JOINTS APPROXIMATELY 8 in - 15 in APART ARE PRESENT AT BRIDGE END, THE ONE ADJACENT TO THE APPROACH SLAB IS THE B.F.P.R.

BRIDGE DATA FOR WIDENINGS
(4 SPAN BRIDGE SHOWN)
Example "B"
Bridge Opening Profile

* PROVIDE STATIONS AND ELEVATIONS OF BRIDGE OPENING AS
REQUIRED BY ITEMS C2 AND C3 UNDER REQUIRED EXISTING
BRIDGE DATA SECTION.

TYPICAL SECTION-PROFILE OF BRIDGE OPENING
Example
“C”

80' x 24'
CONC. BR.

120' x 24'
CONC. BR.

4' x 4' BOX CVRT

STA 50+00
BEGIN

42' x 24'
CONC. BR.
Example "D"
Roadway Beneath Bridge

Provide elevations on each edge of travelway at stations and half stations for a minimum of 250 ft on each side of bridge crossing.

Elevations on roadway under bridge
(NEW BRIDGE OR BRIDGE TO BE WIDENED)
Example "E"
Bridge Over Highway

- PROVIDE VERTICAL CLEARANCE AT EACH EDGE OF TRAVELWAY ALONG EACH OUTSIDE BRIDGE BEAM. FOR DOUBLE BRIDGES, PROVIDE CLEARANCE AT OUTSIDE BEAMS OF EACH BRIDGE.

ELEVATION
VERTICAL CLEARANCE - BRIDGE OVER HIGHWAY
Example "F"
Double Bridges Over Highway

VERTICAL CLEARANCE

VERTICAL CLEARANCE

VERTICAL CLEARANCE

VERTICAL CLEARANCE

FINISHED GRADE UNDER BRIDGE

DOUBLE BRIDGES
iii. HYDRAULIC AND HYDROLOGICAL STUDIES

POLICY

All bridges will be designed to minimize flood hazards, to preserve the ecological systems of wetlands and to pass the flood across the right of way with due consideration given to the risk to the facility and to the traveling public.

1. DESIGN CRITERIA

All bridges will be sized to convey the design flood and base flood without causing significant damage to the highway, the stream or other property. The design flood will be conveyed only through the bridge opening, while the base (100 year) flood and any floods greater than the design flood may be conveyed over the roadway and through the bridge opening.

1.1 DESIGN FREQUENCIES AND FREEBOARDS

A. RIVERINE BRIDGE REPLACEMENTS/NEW LOCATIONS

1. INTERSTATE

a. The design flood shall be the 50 year frequency storm.

b. A minimum of 2 feet of freeboard above the design floodstage is required.

c. A minimum of one foot of freeboard above the 100-year floodstage is required.

2. ROADS DESIGNATED AS STATE ROUTES

a. The design flood shall be the 50 year frequency storm.

b. A minimum of 2 feet of freeboard above the design floodstage is required.

c. A minimum of one foot of freeboard above the 100-year floodstage is required.

3. ROADS NOT DESIGNATED AS STATE ROUTES

a. The design flood will be based on traffic counts as follows:

<table>
<thead>
<tr>
<th>DESIGN TRAFFIC (ADT) FREQUENCY</th>
<th>MINIMUM DESIGN STORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 100</td>
<td>5 Year</td>
</tr>
<tr>
<td>100 - 400</td>
<td>10 Year</td>
</tr>
<tr>
<td>400 - 1500</td>
<td>25 Year</td>
</tr>
<tr>
<td>Over 1500</td>
<td>50 Year</td>
</tr>
</tbody>
</table>
b. A minimum of 2 feet of freeboard above the design floodstage is required.

c. One foot of freeboard above the 100-year (base) flood is desirable.

d. A minimum of one foot of freeboard above the roadway overtopping floodstage.

NOTE: APPROVAL MUST BE OBTAINED FROM THE HYDRAULIC ENGINEER IF THE PROPOSED SUPERSTRUCTURE DOES NOT CLEAR THE 100 YEAR FLOODSTAGE.

4. FREEBOARD FOR ROAD SUBGRADES

To protect the pavement, road subgrades should be one foot above the design highwater level.

5. ADDITIONAL DESIGN FREQUENCY AND FREEBOARD CONSIDERATIONS

a. The storms mentioned above are minimum design storms. The actual design storm can have a greater design frequency based on the engineer’s discretion.

b. If the bridge site is affected by abnormal floodstages, the bridge will provide freeboard above the abnormal floodstage and be designed for a velocity that occurs without the effects of the abnormal floodstage.

c. If the bridge is over one of the major lakes or reservoirs where there is boat traffic, the grade should be set so that there is a minimum of 8 feet of freeboard above the maximum operating pool.

d. If debris is a problem at the site, the engineer may, at his discretion, increase the above-required minimum clearances.

A. TIDAL BRIDGE REPLACEMENTS/NEW LOCATIONS

NOTE: CONTACT THE HYDRAULIC BRIDGE ENGINEER FOR DESIGN CRITERIA FOR TIDAL PROJECTS.

1.2 DISCHARGES

The latest version of the USGS publication, “Techniques for Estimating Magnitude and Frequency of Floods in Rural basins of Georgia” shall be used in calculating the various storm discharges at the project site. The regional flood frequency relations and applicable gage data shall be utilized as shown in this publication. In addition to the above named publication, the USGS also has a publication, “Annual Peak Discharges and Stages for Gauging Stations in Georgia” which contains the various storm discharges at the gauged sites. When applicable, the USGS publication, “Flood-Frequency Relations for Urban Streams in Georgia” shall be used in calculating the various storm discharges for urban streams.

1.3 CALIBRATION OF COMPUTER MODEL
When a USGS gage is located at or near the bridge site, floodstages to calibrate the computer model can be obtained from the USGS regional office in Atlanta. In addition, if in the engineer’s judgement, reliable highwater information at or near the site is available and the flood frequency of the applicable storm can be determined, the model can be calibrated using this information.

1.4 BACKWATER

a. The 100-year backwater shall be limited to one foot above the unrestricted or natural 100-year profile.

b. In addition to the above limitations, bridges located within areas covered by a FEMA regulatory floodway will be sized to satisfy FEMA requirements. See Section D, “FLOODWAY – FLOODPLAIN REQUIREMENTS”.

c. Development and/or existing flooding conditions in the upstream floodplain shall be considered in all cases.

1.5 FLOW VELOCITIES

Flow velocities within the bridge opening should be limited to minimize scour in the overbank portion of the opening. Acceptable stream channel and overbank velocities may be determined by comparison with the natural velocities and existing bridge velocities, along with any scour problems, or lack thereof, at the existing structure. The type of soil at the site (highly erodible or not) should be considered. Box culverts should be sized with acceptable flow velocities to minimize potential scour.

1.6 BRIDGE SCOUR

A scour analysis will be performed for all bridges, using the methods in the latest version of HEC-18. General contraction and local (pier) scour calculations shall be performed. The design flood for scour shall be the 100 year or overtopping flood if it is less than or equal to the 100 year flood. Scour should also be computed for the 500 year flood, or the overtopping flood if it is greater than the 100 year flood and less than the 500 year flood.

1.7 BRIDGE ABUTMENT PROTECTION

Spillthrough type abutment type endrolls with a 2:1 slope normal to the end bent are normally used for new bridges. Riprap protection for these endrolls shall be sized using the method shown in the latest version of HEC-18. The 100 year flood should be used for this design. This riprap protection shall be entrenched 2 feet below the ground line and extend 2 feet above the 100-year floodstage elevation. The riprap protection shall be extended a minimum distance of 20 feet beyond the end of the wingwalls. A riprap apron, with a width equal to twice the 100 year storm flow depth in the overbank area, from a minimum width of 10 feet to a maximum of 25 feet, shall be used to protect the endroll toes. The depth of riprap at the endrolls is normally 2 feet. The Department of Transportation uses two sizes of riprap: Type 1 riprap has a D50 of 1.14 feet and Type 3 riprap has a D50 of 0.64 feet. Plastic filter fabric is placed under the riprap.

1.8 GUIDE BANKS (SPUR DIKES)
Guide bank calculations shall be performed as shown in the latest version of HEC-20 and shall be based on the 100 year flood. A guide bank shall not be built where the required length is less than 150 feet. Based on FHWA recommendations, the GDOT policy is to build a maximum length guide bank of 150 feet. The engineer, at his discretion, may specify a longer guide bank.

1.9 DETOUR STRUCTURES

a. Detour structures should be sized, where required, to maintain traffic during the new construction. The detour structure may be a bridge, extension of a proposed culvert, or corrugated metal pipes. The detour structure is sized to convey the 10-year storm, and is recommended to be placed downstream of the proposed bridge site. The detour bridge superstructure shall clear the 10 year floodstage elevation. Traffic can also be maintained, in certain cases, by stage construction of the proposed bridge.

b. Detour structures in tidal areas are to be sized based on the engineer’s judgement. The minimum size should be based on the high tide flow conditions.

HYDRAULIC AND HYDROLOGICAL STUDIES

2.1 METHODS/PROCEDURES – ALL RIVERINE BRIDGE PROJECTS

NOTE: The following methods/procedures are for bridge replacements, widenings and parallelings unless otherwise noted.

A. The following hydraulic computer models are approved by the GDOT to be utilized when tidal flow is not present:

1. The Federal Highway Administration (FHWA) computer model ‘WSPRO’;

2. The U.S. Army Corps of Engineers computer model ‘HEC-RAS’. This model shall be used with the ‘WSPRO’ bridge routine option;

3. The ‘FESWMS’ computer model. This model shall be used in cases where there is a large amount of two-dimensional flow. Cases where this program shall be utilized include, a skewed crossing of a wide floodplain, a wide floodplain requiring multiple bridges, or if there is significant lateral flow in the vicinity of the bridge, such as close proximity to a meander bend, or a stream junction immediately upstream;

NOTE: OBTAIN APPROVAL FROM THE HYDRAULIC ENGINEER BEFORE USING ‘FESWMS’.

4. For bridge sites with a drainage area of 20 square miles or less, a box culvert alternate must be considered. Two culvert computer models are accepted; 1) The FHWA ‘HY-8’ computer model for box culverts shall be used in conjunction with the ‘WSPRO’ computer model; and 2) The ‘HEC-RAS’ computer model;

5. The U.S. Army Corps of Engineers computer model ‘HEC-2’ shall only be used in modeling the regulatory floodways for the required coordination with FEMA. ‘HEC-RAS’ can be utilized to duplicate/model the floodway and profile runs if acceptable by FEMA.

B. Investigate the flood history of the stream. Sources for this information include, but are not limited to:
1. USGS gage records;
2. Existing bridge and maintenance files;
3. Previous studies done by the DOT, Corp of Engineers, FEMA and the USGS;
4. Information from local residents;
5. Information from the local community;
6. Information from local Department personnel;

C. Investigate the bridge site scour history. Some sources of information are:

1. The bridge inspection and maintenance files;
2. A comparison of the original bridge plan and profile with the currently surveyed profile;
3. Aerial photographs taken over as long a time span as available. Based on this information, an indication of the long-term channel stability and aggradation or degradation can be estimated. An evaluation of the performance of the existing bridges can also be made.
4. For bridge widenings and parallelings only: A bridge condition survey for the existing bridge shall be requested from the Office of Maintenance, along with a bridge deck condition survey from the Office of Materials and Research (Forest Park Lab). These surveys will recommend any needed repairs to the existing bridge, or if the repairs are extensive, will recommend the replacement of the existing structure. These recommendations shall be incorporated into the preliminary bridge layout and study.

D. Hydrology:

1. Using USGS topographic maps, determine the boundaries of the drainage basin and measure the area. Determine the land usage from aerial photography, topographic maps, and a site visit;
2. The latest version of the USGS publication, “Techniques for Estimating Magnitude and Frequency of Floods in Rural basins of Georgia” shall be used in calculating the various storm discharges at the project site. The regional flood frequency relations and applicable gage data shall be utilized as shown in this publication. In addition to the above named publication, the USGS also has a publication, “Annual Peak Discharges and Stages for Gauging Stations in Georgia” which contains the various storm discharges at the gauged sites. When applicable, the USGS publication, “Flood-Frequency Relations for Urban Streams in Georgia” shall be used in calculating the various storm discharges for urban streams;
3. The hydraulic slope is at the site is normally determined by use of the USGS topographical sheets and/or the surveyed water surface elevations taken 500 feet upstream and downstream and at the centerline of the crossing;
4. If the drainage area contains significant storage volume upstream of the project site, the runoff must be determined by developing unit hydrographs and routing the various floods through the basin taking into account the storage.

E. Site Inspection:

1. Evaluate the stream characteristics and hydraulic properties, evaluate the performance of the existing bridge (if applicable), evaluate the channel and floodplain geometrics, and evaluate the adequacy and accuracy of the survey data;

2. Possible flooding problems of buildings and other structures in the floodplain should be identified;
3. Any existing scour problems should be noted;
4. Any possible channel migration should be noted;
5. Bridge sites immediately upstream and downstream of the project site along the same stream should be visited and the performance of the structures evaluated.

F. Hydraulic Analysis:

1. The hydraulic computer model shall be used to determine the existing and proposed conditions at the site. The 2 year, 10 year, design year, 100 year and 500 year or overtopping storm shall be modeled for the project site. The design flood shall be conveyed through the bridge opening, while floods greater than the design flood may be conveyed over the roadway and through the bridge opening. The 2 year flood is modeled for Corp permit purposes. The 10 year storm is used to size the detour structure;
2. If the drainage area is less than 20 square miles, a box culvert alternate should be analyzed. The natural or unrestricted highwater profiles should be developed using ‘WSPRO’ or ‘HEC-RAS’. Two culvert computer models are accepted; 1) The FHWA ‘HY-8’ computer model; and 2) The ‘HEC-RAS’ computer model;
3. If the project is within a FEMA regulatory floodway, see Section D, “Floodway – Floodplain Requirements”.

G. Design of Bridge

1. Bridge Replacements
   a. Establish the orientation of the bridge substructure by determining the flood flow angle. This should be based on topographic maps, aerial photographs and the site inspection. If ‘FESWMS’ is used, it will compute the velocity vectors, which will show the flood flow angle directly;
   b. Spillthrough abutment type endrolls with a 2:1 slope normal to the end bent are normally used for new bridges. The toe of the bridge endrolls shall be placed a minimum of 10 feet back from the creek bank or at a point 10 feet back from where a 2:1 slope from the bottom of the creek bank intersects the groundline in the overbank, whichever is greater;
   c. Set the span lengths for the bridge. The span over the channel should be set first. If practical, the channel should be completely spanned. The substructure should be set far enough back of the channel banks so that the banks will not be broken down during construction;
   d. At sites where the bridge bent heights are acceptable and subsurface conditions are suitable, pile bents are normally used. Concrete reinforced ‘T’-beam superstructure, with spans of 30 feet or 40 feet, is used with this substructure;
   e. At sites where the bridge bents are too high for pile substructure, or the subsurface conditions warrant, or there is a debris problem, or a long span is required, concrete intermediate bents with footings are typically used. Spans longer than 40 feet normally use cast-in-place concrete bents;
   f. At sites where intermediate bents have to be located within the stream channel, the bents should align with the stream channel flow. If pile bents are located within the stream channel or at the channel banks, they should not be tower bents;
   g. For ease of structural design and repetition in fabrication, the use of equal span lengths are recommended while following sound hydraulic design practice;
   h. The bridge superstructure shall meet the clearance requirements specified in the Design Criteria section.

2. Bridge Widenings and Parallelings
a. In general, the above recommendations (G.1) for bridge replacements apply where applicable;
b. The first choice for the widening and/or paralleling of an existing bridge is to approximate the existing bottom of beam elevation, span lengths and bent skew. Some common complications and solutions are as follows:
  1) If the bridge widening is significant and the existing bents do not align with the flood and/or channel flow, the widened bents can be skewed to match the flood and/or channel flow. The parallel bridge bents can be skewed to match the flood/channel flow;
  2) The span arrangement for the parallel bridge can be varied from the existing bridge to adhere to the recommendations in G.1.
  3) If the existing bottom of beam elevation does not provide the required clearance over the design year and 100 year floods and/or the backwater/velocity/scour values yield values which indicate that a longer/higher structure is needed, the following steps should be taken:
     a) The bridge history should be checked out. The maintenance records should be reviewed for any past or existing scour problems at the site. In addition, the Hydraulic Engineering Field Report should indicate any existing flooding and/or scour problems. The engineer should perform a site inspection to observe any existing or proposed problems;
     b) If no scour or flooding problems exist and the potential for any significant problems seems low, the engineer can opt to widen/parallel in-kind with no major changes;
     c) If there is evidence of flooding and/or scour problems, or if the widening/paralleling is so significant that the calculations indicate that a longer/higher structure(s) is required, or that the existing foundations are inadequate, then the engineer must make the necessary adjustments to the existing structure until satisfied that it is hydraulically sufficient. These options can include replacing the existing structure.

c. It is desirable for the proposed widened and/or parallel bridge endrolls to clear the creek channel by the minimum distance specified in G.1.b. If this clearance cannot be achieved by widening or paralleling in-kind, the following options should be considered:
  1) For a bridge widening, the widened end bent(s) can be skewed away from the stream channel;
  2) The proposed widened and/or parallel bridge(s) can be lengthened, placing the end bent(s) farther away from the stream channel to obtain this clearance;

d. The possibility of replacing the existing bridge with a more cost effective structure should be checked if:
  1) The computer model and various hydraulic calculations indicate that the existing bridge is oversized;
  2) Extensive repairs to the existing bridge are required;
  3) The existing bridge has steel beam superstructure.

NOTE: OBTAIN APPROVAL FROM THE HYDRAULIC ENGINEER BEFORE REPLACING THE EXISTING BRIDGE.

3. Bridge Box Culverts
In general, box culverts are placed at sites which have favorable floodplain conditions, which include, a well-defined creek channel and a site that is not likely to accumulate silt in the culvert barrels. For this reason, culverts are not normally placed in swampy areas or sites that are frequently affected by abnormal stage conditions. The culvert width is normally set by matching the width of the stream channel and is designed to flow full for the design year and 100 year storms. A Georgia standard size and skew box culvert should be used if possible.

H. Scour Analysis

1. A scour analysis will be performed for all bridges, using the methods in the latest version of HEC-18. HEC-20 should also be consulted. General contraction and local (pier) scour calculations shall be performed. The design flood for scour shall be the 100 year or overtopping flood if it is less than or equal to the 100 year flood. Scour should also be computed for the 500 year flood, or the overtopping flood if it is greater than the 100 year flood and less than the 500 year flood;

2. One of the primary scour areas is abutment scour. This is due to insufficient bridge opening or a large discharge in the overbank area. Guide banks (Spur dikes) should be considered for protection against this type of scour. All bridge abutments shall be protected for scour by riprap. The proposed bridge opening(s) should be sized to minimize the possibility of abutment scour;

3. If the bridge is located in or near a channel bend, the possibility of channel migration is increased. Placing the bridge foundations deep enough to withstand the possible migration and channel scour is recommended. The bridge abutments should be placed far enough back so that any channel migration would not reach them during the lifetime of the bridge, 75 years at a minimum. Channel stabilization should be considered utilizing the methods in HEC-20.

I. Cost Analysis

Cost estimates should be performed for all proposed drainage structure alternates. The most cost effective, hydraulically adequate, alternate should be chosen.

J. Risk Assessment

When the bridge hydraulic design is selected, a risk assessment will be performed to determine if a more economical design approach should be considered. The risk assessment involves answering a series of questions that will determine the need for a risk analysis. See Risk Assessment charts.

K. Channel Changes.

For both bridges and culverts it may be desirable in some instances to construct a channel change to improve the hydraulic performance of the structure. Several considerations must be made. Environmental resource agencies object highly to channel changes. They require extensive mitigation for channel changes. Channel changes are to be avoided if at all possible. In the rare instances that a channel realignment is required and used, the change and effects must be reflected in the appropriate hydraulic computer model.

NOTE: DUE TO APPROVAL PROBLEMS WITH THE ENVIRONMENTAL RESOURCE AGENCIES, THE HYDRAULIC ENGINEER WILL ONLY CONSIDER CHANNEL CHANGES FOR EXTREME CONDITIONS.

L. Preliminary Bridge Layout.

Information to be shown on the preliminary bridge layout includes but is not limited to the following:
1. A plan and elevation view of the proposed bridge. The existing bridge location is shown on the
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A. Cover Sheet.
   The following information shall be shown:
   
   2.2 METHODS/PROCEDURES – ALL TIDAL BRIDGE PROJECTS

   NOTE: CONTACT THE HYDRAULIC BRIDGE ENGINEER FOR
   METHODS/PROCEDURES FOR TIDAL PROJECTS.
1. Project number, PI number, Route and stream name;
2. Statement whether coordination with FEMA is required;
3. Signed and dated. Note: For consultant projects, the Hydraulic Study shall be stamped and signed by a registered Professional Engineer.

B. Hydraulic and Hydrological Report.
   Include the description of the project, the alternates considered, the methods of analysis, and the conclusions for the site.

C. Site Inspection.
   A site inspection shall be performed with the results included in the study.

D. Scour Report.
   The report shall include but shall not be limited to the following:
   1. Scour Table: Show the general contraction, local (pier) and total scour for the 100 and 500 year (or overtopping) storm at each intermediate bent;
   2. Show the general scour calculations for the stream channel and overbanks;
   3. Show the local (pier) scour calculations for each intermediate bent.

E. Hydraulic Table.
   Tables showing the hydraulic values for the existing and proposed conditions along with any applicable alternates. Included are the floodstages at the bridge and the unconstricted and constricted floodstages at the upstream approach section. Areas of opening under floodstage, discharge through the bridge and over the roadway, channel and mean velocities through the bridge, and backwater values. The two year floodstage elevation, along with the design year and 100 year storm natural (unconstricted) channel velocities should be shown on this sheet. If the site is affected by abnormal floodstages, separate tables should be shown for the stream floods and abnormal floods.

F. Drainage Calculations.
   Discharge calculations and hydraulic slope determination shall be shown.

G. Copies of Gage Data used (or other supporting data).

H. Sub-Area Property Calculations.
   Using the computer model, show channel and overbank discharges, velocities and areas for the design storm, 100-year storm, and 500 year (or overtopping) storm.

I. Guide Bank (Spur Dike) Calculations.

J. Riprap Calculations.


L. Cost Comparison.
   Cost estimates of the alternate drainage structures shall be included in the study.

M. Risk Assessment Sheet.

N. Clearance Determination.
   Show the proposed bottom of beam clearance over the design year and 100 year floodstage
elevations. If abnormal floodstages are present, clearances should also be shown over the respective abnormal floodstage elevations.

O. Roadway Plan Sheets.
   Half-size copies of the plan and profile sheets, along with the typical section sheet shall be included. Note: If the proposed drainage structure is a box culvert, a sketch of the culvert placement should be shown on the applicable plan and profile sheet.

P. Preliminary Bridge Layout.
   A half-size copy shall be included.

Q. County Location Map.

R. USGS Quadrangle Map.

S. Charts, tables and graphs.
   Many of the hydraulic computer models have capabilities to show and/or clarify results utilizing these methods.

T. Computer Data.
   Input and Output of the hydraulic computer model for the following:
   1. Existing and proposed conditions;
   2. Applicable alternates; and
   3. Detour structure (if applicable).
   NOTE: In addition, a computer disk with the required computer runs shall be provided if done by a consultant.

U. Flood Insurance Study Information.
   If the site is located within a FEMA regulatory floodway, the following information is required to be placed within the study:
   1. An explanation of any required modification and/or corrections to the floodway model;
   2. The floodway map with the site marked and any modification delineated;
   3. Floodway data tables for the existing (published), base and proposed conditions;
   4. Flood profile and floodway run input;
   5. Consultant projects shall also include the flood profile runs for the 10, 50, 100 and 500 year storms. The 100 year floodway run is also required.

4. FLOODWAY – FLOODPLAIN REQUIREMENTS


All bridges within the State fall into one of the following five categories concerning Federal Emergency Management Agency (FEMA) involvement:

A. If the stream is a designated floodway, the structure should be designed, if practical, so that the bridge
approaches will not encroach on the regulatory floodway;

B. If the stream is a designated floodway, and encroachment on the regulatory floodway is necessary, the structure should be designed, if practical, so that there will be no change in the 100 year flood elevations, floodway elevations, and floodway widths at any cross section. This is considered a “No Rise” project. A signed and sealed “No Rise” certification by a registered professional engineer is required. If this criterion is met, two original sets of supporting documentation should be prepared. One set is for submission to the affected Community, and one set is for GA DOT’s records;

C. If the stream is a designated floodway, and encroachment on the regulatory floodway is necessary, and the above criterion in (B) is not met, then the floodway will be adjusted to meet the requirements of the local community and FEMA. The Professional Certification Form required by FEMA is to be completed, and signed and sealed by a registered professional engineer. In this case, three original sets of supporting documentation should be prepared. One set is for submission to the affected Community, one set is for submission to FEMA, and one set is for GADOT’s records;

D. For bridges in areas not in a designated floodway, but covered by Flood Insurance Maps, the bridge will be sized to limit the backwater to no more than a 1 foot increase in the existing 100 year (base) flood elevation;

E. For bridges which are outside of National Flood Insurance Program (NFIP) communities or NFIP identified flood hazard areas, the bridge should be sized using the GADOT guidelines and policies.

5. REQUIRED SUPPORTING DOCUMENTATION

A. A copy of the original HEC-2 computer floodway run.
B. A copy of the original HEC-2 computer run with the 10, 50, 100 and 500 year highwater profiles.
C. A copy of the HEC-2 base computer floodway run for the existing conditions using the original floodway data with any required modifications/additions.
D. A copy of the HEC-2 base computer run for the existing conditions showing the 10, 50, 100 and 500 year highwater profiles using the modified data.
E. A copy of the HEC-2 computer floodway run reflecting the proposed conditions.
F. A copy of the HEC-2 computer run for the 10, 50, 100 and 500 year highwater profiles for the proposed construction.

G. Note: Three computer disks with the required HEC-2 computer runs shall be provided if done by a consultant.

H. A copy of the published floodway map and the published highwater profiles. The revised floodway boundaries, if any, should be shown on the floodway map.

I. Floodway tables showing the existing, base (modified/corrected existing), and proposed conditions.

J. A detailed explanation of the results of the floodway calculations.

K. A set of the proposed roadway plans and the preliminary bridge layout.

L. This documentation must be signed and sealed by a registered Professional Engineer if done by a consultant.

NOTE: ‘HEC-RAS’ can be utilized to duplicate/model the floodway and profile runs if acceptable by FEMA.

iv. ADDITIONAL DESIGN CRITERIA FOR BRIDGES AND WALLS
BRIDGES

A. MISCELLANEOUS

1. All reinforcing steel shall be ASTM Grade 60.

2. Concrete shall have a minimum 28 day strength of 3500 psi (Class AA Concrete) in the superstructure and 3000 psi (Class A Concrete) in the substructure.

3. All bridges shall be grooved in accordance with Section 500 of the Standard Specifications.

4. Column ties shall be arranged in such a manner as to accommodate at least a 6 inch tremie so that proper concrete placement will be facilitated.

5. Do not detail construction joints in columns less than 30 feet in height.

6. A future asphalt paving allowance of 30 pounds per square foot shall be included in the design of all bridges.

7. Edge beams are to be designed and detailed where the deck slab is discontinuous, and shall extend a minimum of 18 inches below the top beam flange. Slab transverse and longitudinal reinforcing steel is to be brought to the edge of the slab and the top mat of edge beam bars shall be below the bottom of the deck. Do not use truss-shaped bars in the edge beam. Extend stirrups from edge beam into slab.

8. All construction plans and documents designed, detailed and furnished by consulting firms for Department use shall bear a valid Professional Engineer stamp. All plans submitted to the Department for review shall have been checked by the Consultant prior to submission.

9. The bridge deck slabs for all bridges shall be designed using the slab design charts of Figure No. 1.

10. Every reasonable effort shall be made by the designer to arrive at the most economical structure. The Consultant shall also consider construction problems and difficulties, in particular the use of cofferdams and seals. The Consultant shall meet and discuss economic considerations and construction staging and requirements with the Department prior to final design.

11. The maximum batter on piling shall be 4 horizontally on 12 vertically.

12. The minimum size PSC pile shall be 14 inches square.

13. Pile spacing shall conform to Subsection 4.5.15.11 of the AASHTO Standard Specifications for Highway Bridges.

14. Construction plans prepared by the Consultant for bridges shall contain all dimensions, notes, and details necessary for a Contractor to prepare a bid and construct the structure. Construction plans shall contain
the following minimum sheets:

(a.) Plan and Elevation sheets,
(b.) General Notes sheets,
(c.) Deck Plan sheets,
(d.) Deck Cross-Section sheets,
(e.) Bearing assembly sheets,
(f.) Beam or Box Elevation and Section sheets,
(g.) Miscellaneous Beam sheets,
(h.) Framing Plan and Substructure Layout sheets,
(i.) End Bent sheets,
(j.) Intermediate Bent sheets,
(k.) As Built Foundation sheets, and
(l.) Bar Bending Detail sheets.

Additional sheets may be necessary to show the details required for construction and shall be provided by the Consultant at no additional cost when deemed necessary by the Department.

The Deck Cross-section sheets shall contain one full-width section across the structure which indicates, at least, all the horizontal dimensions necessary to construct the bridge. If the structure is to be stage constructed, or if an existing bridge is involved with the new structure, there shall be sufficient deck cross-sections prepared to indicate the staging, location of the existing structure and location of any temporary barriers on the structure. Deck cross-sections shall be prepared indicating the deck, barrier, sidewalk and parapet reinforcing for as many locations as are necessary to show all the deck reinforcing. Deck cross-sections shall also be drawn indicating edge beams, backwalls, diaphragms or cross-frames, end frames, and end walls. Cross-sections shall be cut radially across the structure.

The Deck Plan shall contain all longitudinal and transverse dimensions necessary to construct the bridge as well as indicate reinforcing bar numbers and sizes, edge beam width, expansion joint widths, backwall or end wall locations, location of construction and expansion joints, and any other items that are necessary to construct the structure.

All details except those shown on beam or box elevation sheets shall be drawn to scale. Deck cross-section and intermediate bent sheets shall be drawn, “Looking Ahead”. If the end bents are drawn separately, bent one shall be “Looking Back”, and the other end bent shall be drawn “Looking Ahead”.

Plans shall be neatly drawn and professionally prepared. Plans shall be fully checked by the Consultant for completeness of content and accuracy before submittal to the Department for review. All details shown in the Plans shall be clear. The Consultant shall meet with the Department and discuss how the plans will be...
15. The Consultant shall review the Bridge Foundation Investigation report prepared by the Department for any possible errors or omissions prior to formalizing the design of the Project. Any discrepancies shall be brought to the Department’s attention for resolution.

16. The Consultant shall provide for the installation of utilities on bridges as required. The Department shall furnish the Consultant with the information regarding the utilities. The installation of the utilities shall be considered in staging the construction of the bridges.

17. The Consultant shall determine the vertical and lateral clearances and bridge end stations for all bridge site by mathematical calculation. The Liaison Engineer for the Department shall be notified of any discrepancies. All discrepancies shall be reconciled before the Consultant proceeds with construction plans development.

B. STAY IN PLACE FORMS

1. Provide the following non-composite dead loads to account for metal stay-in-place forms:
   a. Main deck reinforcing normal to centerline of Bridge– 9.25 lbs./sq. ft.
   b. Main deck reinforcing skewed to centerline of Bridge – 16 lbs./sq. ft.

Do not show on plans any reference for additional weight due to stay in place forms.

2. When designing composite prestressed concrete beam bridges, neglect one inch of the bottom of the slab thickness for all strength calculations. Where applicable ¼ inch of the top of the slab shall also be neglected for strength calculations. The one inch and the ¼ inch thickness shall be included in the dead load calculations.

3. During review of shop detail drawings for prestressed concrete deck panels, the Consultant shall ask the Supplier to send sepia sheets of the panel location plans and details of all revised bar reinforcement at the time the Supplier sends the final sets of drawings to the Department for distribution. The Department shall revise the bridge plans to include the sepias and make proper distribution to all holders of plans so that a record will be made of the change in slab design and construction.

4. For cast-in-place or precast concrete superstructure stringer construction, the Consultant shall investigate the designed deck thickness to determine if prestressed concrete deck panels will work without adding additional thickness to the slab. If additional slab thickness is required, the Consultant shall make a check of the beams to determine if the extra dead load will cause any overstress. If the extra dead load adversely affects the beams, a note shall be placed in the Plan and Elevation sheet prohibiting the use of prestressed concrete deck panels for the entire span or structure.

C. PRESTRESSED CONCRETE BEAMS

1. Anchorage beds are set for horizontal and vertical strand patterns of two inch center to center. Detail all straight and draped strands on two inch spacings.

2. All plans shall show a minimum design release strength.
3. Place the following note on plans:
   “Shop drawings shall show the details of lifting devices embedded in beam ends.”
   Check shop drawings to verify that lifting devices extend to near the bottoms of beams so that the weight of the beam will not cause tension stresses at the junction of the web and top flange.
4. To prevent cracking at beam ends, provide the minimum amount of reinforcing steel at beam ends as required by AASHTO in Article 9.21.
5. Detail beam lengths to 1/16 inch increments and state on plans that lengths are horizontal dimensions for in place beams and that the Fabricator shall adjust lengths for grade and fabrication effects such as shrinkage and elastic shortening.
6. Place the following note on the plans:
   “The Contractor shall submit Shop Drawings showing complete details of beams including the following:
   a. Non-prestressed reinforcement,
   b. The method of retaining depressed strands in place,
   c. Calculations for determination of the strand elongation required to produce the specified pretensioning force, and detensioning schedule, and
   d. Calculations for the determination of casting length.”

D. STEEL GIRDERS
1. All steel utilized in steel girders shall be ASTM designation A 709 Grade 36 or 50.
2. Main load carrying members subject to tension shall be indicated in the Plans and shall meet the Charpy V-notch test requirements found in the Standard Specifications.
3. When designing for fatigue, all welds shall be Category C or better as defined by the AASHTO Specifications.
4. The Electro-slag welding process is not allowed for construction of bridges in Georgia. The Consultant shall not design this welding process into any structure.
5. For girder webs 6 feet or greater in depth, safety handrailing must be provided. Details of the handrailing must be included on the Plans.
6. Web stiffeners shall be provided no closer than 6 inches from web splices. Web stiffeners must be provided for all field web splices.
7. Gusset plates attaching lateral bracing to the webs of girders shall be bolted to the girder web. Also a positive support system for the crossing of the lateral bracing diagonals shall be provided to limit deflection of the bracing system.
8. All gusset plates shall be attached to the flanges of steel girders and rolled sections in accordance with AASHTO Section 10.20.1.

E. SEISMIC DESIGN
1. New bridges and widened portions of existing bridges shall be designed for seismic performance category “A.”
1. The Consultant shall coordinate the design of the retaining wall with the Reinforced Earth Wall Company, the Retained Earth Wall Company, the Doublewall Corporation, and other proprietary wall companies as designated by the Department. The Consultant shall furnish the wall companies with the approved preliminary wall layout sheets for the walls and all roadway plans concerning the walls.

2. The Consultant shall provide the wall companies with the following information for those walls used as bridge abutments:
   a. The location of the beams;
   b. The magnitude of the dead load and live load reactions, both horizontal and vertical; and
   c. Sketches indicating the location of the bridge end bent in relation to the wall.

3. The Consultant shall promptly furnish by letter to the wall companies any revision in the wall data, such as adjustment of the top or bottom of wall elevations, or begin or end wall stations.

4. The Consultant shall design and prepare construction plans for the Georgia Stabilized Embankment (GASE) walls that include the following information:
   a. A Plan and Elevation sheet or sheets for each wall which contains the following:
      (1) An Elevation view of the wall drawn to a scale of 1”= 10’ which shall indicate the elevation at the top of the wall (parapet, coping, or traffic barrier) at all horizontal and vertical break points and at least every 100 feet along the wall, elevations at top of the leveling pad, distance along face of wall to all steps in leveling pads, distance along face of wall to all steps in leveling pads, designation as to the type of panel, length of mesh and distance along face of wall to where changes in length of the mesh occur, and an indication of original and final ground line.
      (2) A Plan view of the wall which shall indicate the offset from construction baseline to face of wall at the changes in horizontal alignment, limits of mesh, right-of-way limits behind a wall with offsets and stations to corners, location and height of noise walls, location of signs and light standards that are near a wall by station and offsets, and centerline of drainage and utilities behind and passing through or under walls.
   b. General notes required for constructing the wall.
   c. All horizontal and vertical curve data affecting the wall shall be given.
   d. All details for parapets, coping and traffic barriers shall be shown including reinforcing bar bending details.
   e. All details necessary for attaching light standards and noise walls shall be shown.
   f. All details for leveling pads shall be shown including details for steps in leveling pads.
   g. Details of typical and special panels shall be included which shall indicate all dimensions necessary to fabricate the panels.
h. All panels used in the construction of a wall shall be designated on the Elevation view for the wall.

i. All details for construction walls around bridge bents, drainage facilities, and sign footings shall be clearly indicated. Particular attention shall be given to accommodating wall construction around end bent piles.

j. The plans shall contain a Table of Quantities for each wall. The Table of Quantities shall list all of the pay items and their quantities that are necessary to bid and construct the wall.

5. The Consultant shall review the soils investigation report furnished by the Department for possible unstable wall conditions. The Consultant shall discuss any questionable sites with the Department prior to final design and detailing of the wall. The Department will review the questionable sites and will direct the Consultant as to how to proceed with the design.

6. The Consultant shall make every effort to provide the most economical wall.

7. The Consultant shall review the wall plans prepared by the MSE wall companies for completeness and accuracy. Information required in item 4, above, shall be provided for panels or modules, straps or mesh, foundations or leveling pads used in the MSE wall plans. Some specific items to be considered in the review are as follows:

   a. Check to make sure all alternates agree with top of wall elevations and are horizontally aligned as per roadway plans.

   b. Check to make sure all alternates begin and end within close proximity of the Plan and Elevation prepared by the Consultant.

   c. Check to make sure wall construction shall be within set right-of-way limits.

   d. Check to make sure all alternates have bottom of wall elevations set correctly and they don’t infringe on the wall envelope.

   e. Check noise wall, light standard and drainage details.

   f. Coordinate wall details with bridge end details.

   g. Ensure that bridge abutments at MSE walls are mechanically separate from the wall, and

   h. Check construction sequence with roadway plans.

8. At the time the wall plans are submitted to the Consultant for review, they shall be accompanied with a set of Design Notes for the walls. The notes shall be clearly legible and shall include an explanation of any symbols and computer programs used in designing the walls. The notes shall account for the effects of noise walls, traffic barriers, parapets, signs, light standards, and bridge reactions.

9. When the GASE plans are submitted to the Department for initial review, the Plans shall be completely detailed with all notes and quantities. The initial submission shall consist of four sets of Plans for Interstate Projects and three sets of Plans for other projects. The Initial Review Plans of the
GASE wall, including a blue line of the MSE walls, shall be submitted to the Department at least three weeks before the Final Plans due date. The Department shall return one set of Plans with comments and corrections indicated. When all corrections have been made, one set of mylar sepia and one set of blue lines and half size prints of the GASE and MSE wall plans shall be forwarded to the Department.

10. The Consultant shall prepare and submit the Retaining Wall Summary of Quantities Sheet when the walls are complete and submitted.

11. After the project has been let to Contract, the Consultant shall review actual ground elevations, as provided by the Department, to determine whether the plan details meet all minimum wall requirements at its location. A written statement of the wall’s acceptability shall be submitted to the Department.

v. GUIDELINES FOR ELECTRONIC BRIDGE PLAN SUBMISSION
Electronic plan submission to the Office of Bridge and Structural Design shall conform to the following:

1. Microstation 32 (Clix) or Microstation PC/DOS Cadd operating system shall be used.
2. Files, cells and user commands will be supplied by the Bridge Office. See Files, Cells and User Commands Provided by the Bridge Office”.
3. Seed design file shall be brseed.dgn.
4. Bridge fonts 2 and 49 shall be used as shown in fonts.dgn. Examples of fonts and special symbols are shown in fonts.dgn.
5. Levels and line criteria shall be used as shown in lines.dgn. A detailed explanation of line codes and associated user commands is shown in lines.dgn.
6. Brpen.tbl will be provided for plotting purposes. Brpen.tbl is provided as an example.
7. Bridge design cells or modified versions as necessary shall be used, particularly cells for rebars and arrowheads (line terminators).
8. a) General Notes shall be created using the VAX programs BRNOTES and BRRUNOFF to create text files to be “included” into the design file with the user command gen.ucm.
   b) Bar reinforcing schedules shall be created using the VAX programs BRRBAR and BRCONVERT to create text files to be “included” into the design file with the user command reb.ucm. and incorporated with the cells rebar 1, rebar 2, and rebar 3. Example of bar reinforcement tables is shown in rebar.dgn.
   c) Access to the VAX programs BRNOTES, BRRUNOFF, BRRBAR, and BRCONVERT will be provided by the bridge office.
   d) Access to the VAX drawing programs BRGMINT, BRDECK, BREBENT, and BRIBNT will be provided by the bridge office. An ISIF translation utility will be required to translate the output from these programs into design files.
9. Cell Cbord shall be used to create sheet borders. Outer border size shall be 36” x 23”.
10. Each design file shall contain one bridge sheet only. See “Naming of Files for Bridge Plans”.
11. “Reference files” and “shared cells” shall not be used because of the difficulty in transition/translation.
12. Final plan electronic submissions shall be furnished on 3 1/2” micro-floppy diskettes. Files shall be in unix tar format or in PC/DOS format using no compression utility. Each disk shall be labeled with the disk number, project number, bridge number and county name. Sheet design files shall be loaded on disks in sequential order.

Files, Cells and User Commands Provided by the Bridge Office

All files have been created for use on Microstation 32 (Clix) and may need some modification for use on Microstation PC/DOS.
1. **Design Files**
   - brseed.dgn - standard seed design file
   - fonts.dgn - design file showing fonts
   - lines.dgn - design file showing line parameters and associated user commands
   - reb.dgn - design file showing rebar tables/border and title block

2. **Miscellaneous Files and Cells**
   - brcolr.tbl - color table
   - brfont.flb - font library
   - brfont.rsc - font resource file
   - bridge.cel - cell library (this cell library must be used for drawing programs BRDECK, BREBNT, and BRIBNT)
   - bridge2.cel - additional cell library
   - brpen.tbl - IPLOT pen table (for use as example)

3. **User Commands**
   - acllin.ucm - alternate centerlines
   - bmclin.ucm - beam centerlines
   - cbmlin.ucm - concrete beam lines
   - ceblin.ucm - edge beam, etc. lines
   - chdlin.ucm - concrete hidden lines
   - cllin.ucm - bridge centerlines
   - conlin.ucm - construction lines
   - dimlin.ucm - dimension lines
   - ebrlin.ucm - existing bridge lines
   - gen.ucm - to “include” general notes into design file in proper format
   - grdlin.ucm - ground lines
   - objlin.ucm - concrete (object) lines
   - reb.ucm - to “include” rebar output tables into design file in proper format
   - sbmlin.ucm - steel beam lines
   - sdilin.ucm - steel diaphragm lines
   - sthlin.ucm - steel detail hidden lines
   - stllin.ucm - steel detail object lines
   - xlin.ucm - cross-hatch/breaklines

**Naming of Files for Bridge Plans**

1. Name design files on a set of bridge plans using the following codes:

<table>
<thead>
<tr>
<th>CODE</th>
<th>SHEET DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>pe</td>
<td>Plan and Elevation</td>
</tr>
</tbody>
</table>
### Construction File Code Glossary

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cs</td>
<td>Construction Sequence</td>
</tr>
<tr>
<td>gen</td>
<td>General Notes</td>
</tr>
<tr>
<td>dp</td>
<td>Deck Plan</td>
</tr>
<tr>
<td>ds</td>
<td>Deck Sections</td>
</tr>
<tr>
<td>ut</td>
<td>Utilities Details (if needed)</td>
</tr>
<tr>
<td>misc</td>
<td>Miscellaneous Details (if needed)</td>
</tr>
<tr>
<td>dl</td>
<td>Diaphragm Layout</td>
</tr>
<tr>
<td>bdj</td>
<td>Bridge Deck Joint</td>
</tr>
<tr>
<td>weld</td>
<td>Welding Details</td>
</tr>
<tr>
<td>bm</td>
<td>Beam Details</td>
</tr>
<tr>
<td>brg</td>
<td>Bearing Details</td>
</tr>
<tr>
<td>bt(x)</td>
<td>Bents-Replace (x) with Bent Number</td>
</tr>
<tr>
<td>abf</td>
<td>As Built Foundation Details</td>
</tr>
<tr>
<td>rb</td>
<td>Reinforcement Schedule</td>
</tr>
</tbody>
</table>

**2.** All design files shall be named in lower case letters with the .dgn qualifier. A number designation or letter shall be placed after a sheet code when more than one sheet is needed to detail a section of the bridge. See EXAMPLE sheet.

**3.** All files shall be entered onto the file index sheet provided by the Bridge Office. A typed copy of file index sheet(s) and diskette(s) shall be submitted to the Bridge Office with the final submittal. A blank FILE INDEX ON DISKETTES sheet is provided in this appendix.