

DESIGN GUIDE AL #1

BRIDGES FOR LIVESTOCK AND AGRICULTURAL EQUIPMENT

CONSTRUCTION DETAILS AND
SPECIFICATIONS



Alabama

(adopted from Maryland NRCS)

May 2012

TABLE OF CONTENTS

SECTION	PAGES
I. General Information	1
General	1
Design	1
Site Selection	2
Procedure	2
Materials	3
Decking Options	4
Decision Recording	4
Figure 1. Standard AASHTO Truck Loads	5
II. Sample Operation and Maintenance Plan	6
III. Construction Specifications	7
IV. Beam Tables	
Table 1. Livestock Use Only (AL-ENG-578-001) and Livestock and Farm Equipment (AL-ENG-578-002)	10
Table 2. Livestock and Vehicular Loads (AL-ENG-578-003)	12
V. Construction Drawings for Agricultural Bridges	
Details:	
AL-ENG-578-001 Timber Bridge for Livestock Use Only (TB-1)	15
AL-ENG-578-002 Timber Bridge for Livestock and Farm Equipment (TB-2)	16
AL-ENG-578-003 Timber Bridge for Livestock and Vehicular Loads (TB-3)	17
VI. Construction Details for Agricultural Bridge Components	
Details:	
AL-ENG-578-004 Plate and Curb Attachment (TB-2D)	18
AL-ENG-578-005 Lateral Bracing and Bearing Pad (TB-3D)	19
AL-ENG-578-006 Alternate Detail for Bearing Pad and Lateral Bracing (TB-4D)	20
AL-ENG-578-007 Nail Laminated Deck (TB-5D)	21
AL-ENG-578-008 C-Clip (TB-6D)	22
AL-ENG-578-009 Details For Prestressed Concrete Bridge (PCB-1)	23
AL-ENG-578-010 Details for Prestressed Concrete Bridge (Safety Fence) (PCB-2)	24
AL-ENG-578-011 Prestressed Concrete Bridge – Sequence of Construction (PCB-3)	25

SECTION I – GENERAL INFORMATION

GENERAL

This design guide is a technical resource prepared by the Maryland NRCS Engineering staff, adopted for use in Alabama, and is intended for use by the NRCS in Alabama and its partners. The bridge designs contained in this design guide are offered as an alternative to other types of stream crossing such as fords and culverts. These prequalified designs are to be used as part of a site-specific design. Construction drawings for bridges of various uses and sizes are included, as well as other appropriate construction details and specifications. The bridge designs contained in this design guide are for on farm use only.

Section II contains a general operation and maintenance plan for the bridges.

Section III contains the construction specifications to be used as part of the site-specific design. These construction specifications are to be used for all bridge designs facilities. Add site specific construction specifications as needed.

Section IV contains the beam selection tables to be used for the different uses as shown in the design guide.

Section V contains the appropriate construction drawings for the agricultural bridges.

Section VI contains construction details for the agricultural bridge components.

To aid in the design process, the drawings, design guide text and specifications are available on the Alabama Home Page. No changes are allowed on these details without prior approval from the NRCS engineering staff.

DESIGN

Loading:

Several different design loads were chosen for varying situations. For livestock and tractor loads, 100 psf (unfactored) and 5000 lbs. per wheel (unfactored) respectively were utilized in the design of the beams. This information was taken from Midwest Plan Service, Structure and Environment Handbook, 11th Edition 1983 page 102.1. Tandem wheel tractors and tandem axle trucks are not covered in this design guide.

In addition to the above designs, loadings for vehicle types 4 ton GVW, H10, H20 and 40 ton GVW have been included. See figure 1 for gross vehicle weights (GVW) and load distributions. These loadings will cover such vehicles as lime and grain trucks.

Design Procedures:

The design of the steel beams follows the procedures of the Manual of Steel Construction; Load & Resistance Factor Design 1st edition. Load factors of 1.2 and 1.6 were used for dead load and live load factoring, respectively. The bridge is designed assuming one vehicle, moving at low speeds, is on the bridge or fully loaded with livestock whichever yields the greatest load for the scenarios given.

The design of the wooden deck follows the procedures of the Timber Bridges; Design, Construction, Inspection, and Maintenance, U.S. Forest Service, June 1990. Load factors of 1.2 and 1.6 were used for dead load and live load factoring, respectively. The bridge deck is not designed to carry the vehicular loads. The beam carries the load of the vehicle. The dimensioning of the bridge has been designed so that the wheels pass directly over the beam. It is important that the appropriate bridge design be chosen for the equipment being used. The wooden deck is designed to carry full livestock loads. Bridges [AL-ENG-578-001](#) and [AL-ENG-578-003](#) require a

wooden deck with a minimum width of 8 inches while bridge [AL-ENG-578-002](#) requires a wooden deck with a minimum width of 10 inches. In all cases, wider lumber may be used.

SITE SELECTION

To help reduce costs, the bridges have been designed without headwalls. Bearing pads are used for supporting the bridge beams. The intent of the bearing pad is to extend the bridge beams beyond the top of bank and back onto stable ground surrounding the stream channel. The soil where the bearing pad sits requires a minimum soil bearing capacity of 2000 psf. When using the 24-inch wide pad option with an H20 truck loading, the minimum soil bearing capacity required is 2600 psf. Usually inorganic soils having a stiff or compact consistency will meet the minimum requirement for bearing capacity. Organic soils and inorganic soils having a soft or loose consistency may require construction measures such as removal and replacement of the soil or extending the bearing pads to a soil layer having adequate bearing capacity. See Department of the Navy Design Manual, NAVFAC DM-7, March 1971, Table 11-1 for typical bearing capacity values of various soils. In order for the bearing pads to function properly, several things must be considered when siting the bridge location. The stream channel must be stable. If the stream channel is degrading or has active bank erosion, actions must be taken to eliminate these problems first. Natural stability techniques should be utilized when possible.

Two different bearing pad options are given. Option #1 ([AL-ENG-578-005](#)) shows a 4-foot wide bearing pad. The streamside face of the bearing pad must be located a minimum distance of a 1.5:1 (from top of pad to stream bottom) horizontal projection from the toe of streambank. This is a minimum projection. In areas where the stream bank slope is flatter than 1.5:1, increase the horizontal projection to that of the streambank slope. This is to avoid obstructing the stream channel.

In areas where it is impractical or impossible to meet the conditions for option #1 shown above, Option #2 ([AL-ENG-578-006](#)) is an alternative. The bearing pad is designed as bulk footing. The depth of the bearing pad is increased to extend into the bank until the 1.5:1 horizontal protection can be achieved. The bearing pad shall have a minimum depth of 2 feet and a maximum depth of 6 feet. In areas where the streambank height is less than 6 feet, consider extending the pad to the elevation of the stream bottom or below.

The beams are to be attached to the bearing pads by using anchor bolts. Two anchor bolts are required for each beam end. The anchor bolts shall consist of A36 steel; have a minimum diameter of 1/2 inches and a length of 6 inches. Cast the anchor bolts 4 inches into the concrete and set adjacent to the beam flange, one on each side. Place oversized washers or 1/4-inch steel plates over the beam flange and onto the anchor bolt. Nuts shall be snugged by hand so as to not over tighten. As an alternative to the anchor bolts, #4 steel rebar (8 inches long) may be used by setting the rebar into the concrete (minimum 4 inches) adjacent to the beam flange. Once the beams have been set, the rebar is then bent to overlap the flange of the beam to hold them in place. A tight fit is not required, only overlapping.

PROCEDURE

Determine the appropriate use for the bridge. Will it involve livestock, equipment, or both? What size and type of equipment will be used? Choose a bridge location; consider planned usage, livestock patterns, stability of the stream channel, and planned changes being made to the system. Choose a location where the bridge can be constructed straight across the stream channel and not on a skew. Constructing the bridge on a skew will increase costs and complicate construction. If the stream channel is not stable, measures will be needed to stabilize the channel. Riprap slope protection may be needed along the bank, under the bridge. If the stream channel is degrading, stabilization of the channel is critical. It is not enough to look only at the site when

determining if channel degradation is occurring. The stream channel downstream of the bridge must be reviewed for active head cutting.

In most cases the elevation of the bottom of the beams will coincide with the top of bank elevation. In certain situations it may be advisable to elevate the bottom of the bridge above the top of bank elevation. Narrow valleys having little or no floodplain and/or steep gradients that would result in high flood flow velocities will impose added lateral stress to the bridge structure. Elevating the bridge above anticipated flood levels or to a height that would decrease the frequency of submergence will minimize stresses from flood flows.

Survey the site. Take cross-sections as needed of the stream channel. Extend the cross-sections a minimum of 25 feet from the top of bank. Take a profile of the stream channel and extend the profile a minimum of 100 feet upstream and 100 feet downstream of the proposed crossing location.

Determine the location and type of bearing pads using the criteria shown in the Site Selection section. Once the bearing pad location is set, the length of beam can be determined. The beam selection tables are based on the clear span of the beam for the different options shown. The clear span is the distance between the stream side faces of the bearing pads. The clear span shown in the tables is the maximum for that given beam. For example, if the design requires a beam with a clear span of 22 feet, use a beam selected from the 25-foot section of the table.

The beam sizes are given in W-shape designation. A beam designated as W12x26 is a wide (W) flange beam, with an approximate height of 12 inches and weighs 26 lbs./foot. Five different beam options are given for each loading scenario. In general, for the choices given, the most efficient beam size will be the one with the largest height. These have greater strength and less deflection than others in the group. In some situations, beams that are shorter in height may be needed. Deflection, when the beam is loaded, is also shown in the tables. This is provided to give the user information on how the beam will perform. Beams with larger deflections will apply greater stresses on the wood plate and deck. This may require more frequent need to replace the material. When selecting a beam, consider the efficiency of the beam and the expected deflection that will occur when loaded.

Construction details and specifications are provided. These are to be used as part of a site-specific design. There will be no changes in the drawings or specifications without approval from the NRCS engineer.

MATERIALS

Steel beams, plates, angles and braces shall consist of ASTM A36 steel with minimum yield strength of 36 KSI. A minimum of one coat of primer is required on all steel.

Wood for decking and plates shall be Southern Yellow Pine No. 2 rough sawn, Mixed Oak visually graded No. 2 rough sawn, or better. Preservative treatment meeting American Wood-Preserver's Association (AWPA) use category UC3B or better is **required** when using the Southern Yellow Pine, any other softwood, or when using the nail laminated deck option.

Preservative treatment of Mixed Oak is required meeting American Wood-Preserver's Association (AWPA) use category UC3B or higher. Other hardwoods may require treatment and will be evaluated on a case-by-case basis. Preservative treat hardwood lumber using preservatives containing Copper Naphthenate (minimum 8% active ingredient) applied in the field by brush, spray or dipping. Copper Naphthenate generally comes in a green or brown color and will discolor the wood. An applicator license is not required for this product. The product is to be applied and maintained in accordance with manufacturer recommendations. When field applying Copper Naphthenate apply the first coat before the lumber has been installed on the beams.

Apply the second coat, after the lumber is installed, to all exposed surfaces. Other types and methods of preservative treatment can also be considered.

With either option, the landowner must be in agreement to maintain, inspect and replace any damaged or rotting lumber as needed. This must be covered in the operation and maintenance plan.

DECKING OPTIONS

Three different deck options are included within the design guide. The first option uses standard rough sawn planking with widths of 8 inches or 10 inches, width dependent on bridge type, and a depth of 3 inches.

The second option uses a nail laminated deck of treated 2-inch by 4-inch lumber. This option has increased strength over the first option and should be considered when the use of the bridge is for livestock. Unlike the first option where the load of the animal is supported by individual boards, the load on the nail laminated deck is supported over many boards and reduces the chance of an animal stepping through a damaged piece of lumber.

Since 1985, a number of agricultural bridges, using a prestressed concrete deck with a cast in place concrete wearing surface, have been constructed. The actual design of the deck is performed by a concrete products company. These decks can support an HS-20 loading, as well as livestock up to a maximum deck length of 27 feet. A case-by-case design is required for each site. Concrete product companies will perform the design for the prestressed concrete deck, provide structural computations, and work with the field office to develop shop drawings for the prestressed concrete deck. A site specific design is required for the bridge.

DECISION RECORDING

There are many design options available that will affect the design, construction and operation and maintenance of the bridge. Recording of decisions and events is an important part of the design process. It is important that all decisions are recorded in the Conservation Assistance Notes and the Operation and Maintenance Plan and construction plans are carefully reviewed with the landowner.

H20 HAS GROSS VEHICLE WEIGHT OF 40,000 LBS (20 TON)
H10 HAS GROSS VEHICLE WEIGHT OF 20,000 LBS (10 TON)
GROSS VEHICLE WEIGHT (GVW) IS THE TOTAL MAXIMUM WEIGHT
OF THE VEHICLE LOADED

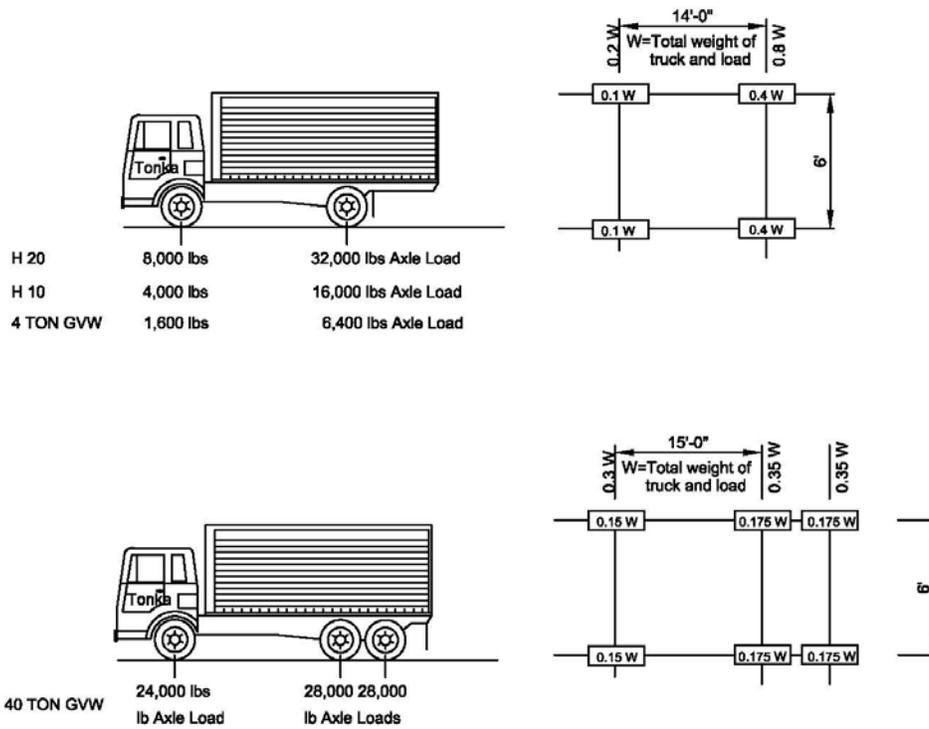


FIGURE 1

 <p>NRCS Natural Resources Conservation Service United States Department of Agriculture</p>	H 10 AND H 20 TRUCKS STANDARD AASHTO TRUCK LOADS 4 TON GVW TRUCK LOAD 40 TON GVW TRUCK LOAD	Designed _____ Date _____	File Name TB/PCB Figure 1
		Drawn _____	Drawing Name
		Checked _____	00/00/00 00:00
		Approved _____	Sheet of

SECTION II – OPERATION AND MAINTENANCE PLAN

AGRICULTURAL BRIDGE AND STREAM CROSSING

Definition

A stabilized area to provide access across a stream for livestock or farm machinery.

Purpose

To provide a controlled crossing for livestock along with access for farm equipment. To control bank erosion, reduce sediment, and enhance water quality.

Operation and Maintenance

This bridge is designed for livestock use and a maximum vehicular load of 10 ton gross vehicle weight. Vehicular traffic should travel over the bridge so that the wheels are placed directly over the bridge beams.

Inspect the bridge at least twice annually. Replace timber decking, curbs and plates that are damaged or rotting immediately. Tighten hardware that has come loose or replaced if necessary. Paint steel beams, braces and other metal components as needed to prevent rust. Replace damaged hardware.

Inspect stream channel under and around the bridge, at least twice annually and after major storms, for obstructions. Remove any blockages of trash, sediment, or debris that could affect flow.

The use of fencing on the bridge, unless otherwise shown on the plans, is at the discretion of the landowner.

The use of wood preservative on the deck and other wooden components is recommended. The use, type and frequency of application are at the discretion of the landowner. Apply wood preservative treatments in accordance with the treatments' labeled directions.

If erosion is occurring around the support pads or footings or around riprap on the stream banks, contact the NRCS Field Office.

If beams have become damaged or show noticeable signs of bending, discontinue use and contact the NRCS Field Office.

If you have any questions or need assistance, call your NRCS Field office at _____.

I have reviewed and understand the operation and maintenance plan contained herein.

_____	_____	_____	_____
Landowner/Operator	Date	NRCS Representative	Date

SECTION III – CONSTRUCTION SPECIFICATIONS

BRIDGES FOR LIVESTOCK AND AGRICULTURAL EQUIPMENT

1. All materials and construction shall be in accordance with applicable NRCS standards and construction specifications.
2. Any changes in the plans or specifications must be approved by the engineer prior to construction. Changes are to be reviewed by the landowner for concurrence.
3. Concrete shall have Type IA cement, compressive strength of 4,000 psi, and have 5% air entrainment.
4. Reinforcing steel shall conform to ASTM specification A 615, Grade 60 steel. All reinforcing material shall be free of dirt, rust, scale, oil, paint or other coatings. The steel shall be accurately placed into position and securely restrained prior to placement of concrete. Reinforcement steel shall have a minimum of 3 inches of concrete cover. Overlap all reinforcement steel splices a minimum of 18 inches. Welded wire fabric shall conform to ASTM specification A 185. Overlap splices a minimum of 6 inches. The welding of reinforcing steel is not permitted.
5. Concrete forms shall have sufficient strength and rigidity to hold the concrete to withstand the necessary pressure, tamping and vibration without deflection from the prescribed lines. They shall be mortar-tight and constructed so that they can be removed without hammering or prying against the concrete. The inside of form shall be oiled with a non-staining mineral oil or thoroughly wetted before concrete is placed. Forms may be removed 24 hours after the placement of concrete.
6. Metal ties or anchorages shall be full dimension. Wall tie ends must be broken off and patched with a concrete epoxy or polymer cement. Patching is required on all sides of the concrete structures.
7. Concrete shall be delivered to the site and discharged completely into the forms within 90 minutes after the introduction of cement to the aggregates. This time shall be reduced to 45 minutes when the atmospheric temperature is over 90⁰ F. Set retarding admixtures may be used to increase mixing time and shall conform to ASTM specification C 494 Types A, B, D, F, or G.
8. All concrete for abutments shall be consolidated with internal type mechanical vibrators or by rodding. Concrete shall be placed in horizontal lifts not greater than 2 feet. Concrete shall not have a vertical drop greater than 5 feet. Vibration shall be supplemented by spading and hand tamping as needed.
9. Concrete shall not be placed when the daily minimum atmospheric temperature is less than 40⁰F unless facilities are provided to prevent the concrete from freezing. The concrete shall be kept at or above 40⁰F for a minimum of 7 days or the concrete shall be kept at or above 55⁰F for a minimum of 3 days. The use of accelerators or antifreeze compounds will not be allowed. The concrete shall be maintained at temperature below 90⁰F during mixing, conveying and placement.
10. Protect exposed surfaces of concrete from the direct rays of the sun for at least the first 3 days. Keep all concrete continuously moist for at least 7 days after being placed.

Concrete shall not be exposed to freezing during the curing period. Curing compounds may be used.

11. Defective concrete, honeycombed areas, and voids left by the removal of tie rods shall be repaired immediately after the removal of forms. All voids shall be reamed and completely filled with a quickset, non-shrink hydraulic cement.
12. Abutments may be backfilled after 7 days of the placement of concrete.
13. Compaction around structures shall be accomplished by placing fill in maximum 4-inch lifts and compacting by means of hand tampers or other manually directed compaction equipment.
14. Wood shall be Southern Yellow Pine No. 2 or Mixed Oak visually graded No. 2 or better, rough sawn to the nominal dimensions shown on the plan. There shall be no changes in sizes without prior approval from the engineer.

Southern yellow pine, all other softwoods, and the nail laminated deck option require a preservative treatment meeting American Wood-Preserver's Association (AWPA) use category UC3B or better.

Preservative treatment of Mixed Oak is required. Other hardwoods may require treatment and will be evaluated on a case by case basis. Preservative treat hardwood lumber using preservatives containing Copper Naphthenate (minimum 8% active ingredient) applied in the field by brush, spray or dipping. Apply the first coat before the lumber has been installed on the beams. Apply the second coat, after the lumber is installed, to all exposed surfaces. Equivalent treatment types and methods may also be used.

15. Steel beams, plates, angles and braces shall be to the dimensions shown on the plan and consist of ASTM specification A-36 steel with minimum yield strength of 36 KSI. All steel shall have a minimum of one coat of primer.
16. All bolts, lags, anchor bolts etc. shall have properly sized washers. Size bolts, nuts, washers and other hardware as shown on the plans. Fasteners (bolts) shall conform to ASTM specification A 307 (grade A) and nuts ASTM specification A 567. All fasteners shall be zinc coated (galvanized) meeting ASTM specification A 153.
17. All fasteners in contact with treated wood shall be either hot-dipped galvanized per ASTM A153 or stainless steel, Type 304 or 316. All connectors in contact with treated wood shall be either hot-dipped galvanized per ASTM A653 or stainless steel, Type 304 or 316.
18. The NRCS makes no representation as to the existence or nonexistence of any utilities at the construction site. Shown on these construction drawings are those utilities, which have been identified. It is the responsibility of the landowners or operators and contractors to assure themselves that no hazard exists or damage will occur to utilities. Alabama One Call should be contacted at **1-800-292-8525**.

SECTION IV - BEAM SELECTION FOR TIMBER BRIDGE

TABLE 1. Livestock Use Only (AL-ENG-578-001) and Livestock and Farm Equipment (AL-ENG-578-002)

Note: Truck loadings shown above are single axle only. Tractor loading is single axle and single wheel only.

20 FT. MAXIMUM CLEAR SPAN							
LIVESTOCK OR 4 TON VEHICLE AL-ENG-578-001 Beam Spacing 2 feet		LIVESTOCK OR 10 TON TRACTOR AL-ENG-578-002 Beam Spacing 3 feet		LIVESTOCK, 10 TON TRACTOR, OR H10 LOADING AL-ENG-578-002 Beam Spacing 3 feet		LIVESTOCK, 10 TON TRACTOR, OR H20 LOADING AL-ENG-578-002 Beam Spacing 3 feet	
Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection
W6 x 12	2.2 Inches	W6 x 25	2.2 Inches	W10 x 22	1.5 Inches	W12 x 35	1.2 Inches
W6 x 15	1.7 Inches	W8 x 21	1.5 Inches	W10 x 26	1.2 Inches	W12 x 40	1.1 Inches
W8 x 10	1.6 Inches	W12 x 14	1.3 Inches	W12 x 22	1.1 Inches	W14 x 34	1.0 Inch
W8 x 13	1.2 Inches	W12 x 16	1.1 Inches	W12 x 26	1.0 Inch	W14 x 38	0.9 Inches
W10 x 12	1.0 Inch	W12 x 19	1.0 Inch	W14 x 22	1.0 Inch	W16 x 31	0.9 Inches

25 FT. MAXIMUM CLEAR SPAN							
LIVESTOCK OR 4 TON VEHICLE AL-ENG-578-001 Beam Spacing 2 feet		LIVESTOCK OR 10 TON TRACTOR AL-ENG-578-002 Beam Spacing 3 feet		LIVESTOCK, 10 TON TRACTOR, OR H10 LOADING AL-ENG-578-002 Beam Spacing 3 feet		LIVESTOCK, 10 TON TRACTOR, OR H20 LOADING AL-ENG-578-002 Beam Spacing 3 feet	
Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection
W6 X 16	3.8 Inches	W8 x 24	2.8 Inches	W10 x 30	2.0 Inches	W14 x 43	1.5 Inches
W8 x 15	2.5 Inches	W10 X 22	1.9 Inches	W12 x 26	1.7 Inches	W16 x 36	1.4 Inches
W8 x 18	2.0 Inches	W12 x 19	1.8 Inches	W12 x 30	1.5 Inches	W16 x 40	1.3 Inches
W10 x 12	2.3 Inches	W12 x 22	1.5 Inches	W14 x 22	1.8 Inches	W18 x 35	1.3 Inches
W10 x 15	1.8 Inches	M14 x 18	1.5 Inches	W14 x 26	1.4 Inches	W18 x 40	1.1 Inches

30 FT. MAXIMUM CLEAR SPAN							
LIVESTOCK OR 4 TON VEHICLE AL-ENG-578-001 Beam Spacing 2 feet		LIVESTOCK OR 10 TON TRACTOR AL-ENG-578-002 Beam Spacing 3 feet		LIVESTOCK, 10 TON TRACTOR, OR H10 LOADING AL-ENG-578-002 Beam Spacing 3 feet		LIVESTOCK, 10 TON TRACTOR, OR H20 LOADING AL-ENG-578-002 Beam Spacing 3 feet	
Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection
W10 x 19	3.2 Inches	W10 x 30	2.4 Inches	W10 x 39	2.7 Inches	W12 x 53	2.6 Inches
W10 x 22	2.6 Inches	W12 x 22	2.6 Inches	W12 x 30	2.4 Inches	W14 x 48	2.3 Inches
W12 x 16	2.9 Inches	W12 x 26	2.0 Inches	W14 x 26	2.3 Inches	W14 x 53	2.1 Inches
W12 x 19	2.3 Inches	W14 x 22	2.0 Inches	W14 x 30	1.9 Inches	W16 x 45	1.9 Inches
W14 x 22	1.5 Inches	W14 x 26	1.6 Inches	W16 x 26	1.9 Inches	W18 x 40	1.9 Inches

SECTION IV - BEAM SELECTION FOR TIMBER BRIDGE (con't)

TABLE 1. Livestock Use Only (AL-ENG-578-001) and Livestock and Farm Equipment (AL-ENG-578-002) (con't)							
Note: Truck loadings shown above are single axle only. Tractor loading is single axle and single wheel only.							
35 FT. MAXIMUM CLEAR SPAN							
LIVESTOCK OR 4 TON VEHICLE AL-ENG-578-001 Beam Spacing 2 feet		LIVESTOCK OR 10 TON TRACTOR AL-ENG-578-002 Beam Spacing 3 feet		LIVESTOCK, 10 TON TRACTOR, OR H10 LOADING AL-ENG-578-002 Beam Spacing 3 feet		LIVESTOCK, 10 TON TRACTOR, OR H20 LOADING AL-ENG-578-002 Beam Spacing 3 feet	
Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection
W10 x 22	4.1 Inches	W12 x 30	3.2 Inches	W12 x 35	4.4 Inches	W12 x 65	3.6 Inches
W12 x 19	3.8 Inches	W12 x 35	2.7 Inches	W12 x 40	3.4 Inches	W14 x 61	3.0 Inches
W12 x 22	3.2 Inches	W14 x 26	3.1 Inches	W14 x 34	3.1 Inches	W16 x 57	2.6 Inches
M14 x 18	3.3 Inches	W14 x 30	2.6 Inches	W14 x 38	2.7 Inches	W18 x 50	2.4 Inches
W14 x 22	2.5 Inches	W16 x 26	2.6 Inches	W16 x 31	2.8 Inches	W21 x 44	2.3 Inches

40 FT. MAXIMUM CLEAR SPAN							
LIVESTOCK OR 4 TON VEHICLE AL-ENG-578-001 Beam Spacing 2 feet		LIVESTOCK OR 10 TON TRACTOR AL-ENG-578-002 Beam Spacing 3 feet		LIVESTOCK, 10 TON TRACTOR, OR H10 LOADING AL-ENG-578-002 Beam Spacing 3 feet		LIVESTOCK, 10 TON TRACTOR, OR H20 LOADING AL-ENG-578-002 Beam Spacing 3 feet	
Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection
W10 x 49	3.5 Inches	W10 x 60	3.7 Inches	W12 x 50	3.9 Inches	W18 x 60	2.9 Inches
W12 x 35	3.4 Inches	W12 x 45	3.6 Inches	W14 x 43	3.6 Inches	W18 x 65	2.7 Inches
W14 x 26	3.9 Inches	W14 x 34	3.7 Inches	W16 x 36	3.4 Inches	W21 x 50	2.9 Inches
W14 x 30	3.3 Inches	W16 x 31	3.4 Inches	W18 x 35	3.0 Inches	W21 x 57	2.5 Inches
W16 x 26	3.2 Inches	W18 x 35	2.5 Inches	W21 x 44	1.8 Inches	W24 x 55	2.2 Inches

SECTION IV - BEAM SELECTION FOR TIMBER BRIDGE (con't)

TABLE 2. Livestock and Vehicular Loads (AL-ENG-578-003).

20 FT. MAXIMUM CLEAR SPAN					
LIVESTOCK, 10 TON TRACTOR, OR H10 LOADING AL-ENG-578-003		LIVESTOCK, 10 TON TRACTOR, OR H20 LOADING AL-ENG-578-003		LIVESTOCK, 10 TON TRACTOR, OR 40 TON GVW LOADING AL-ENG-578-003	
Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection
W6 x 25	2.2 Inches	W10 x 22	1.4 Inches	W12 x 26	1.2 Inches
W8 x 21	1.5 Inches	W12 x 19	1.2 Inches	W12 x 30	1.0 Inches
W12 x 14	1.3 Inches	W12 x 22	1.0 Inches	W14 x 26	1.0 Inches
W12 x 16	1.1 Inches	W14 x 18	1.1 Inches	W14 x 30	0.8 Inches
W12 x 19	1.0 Inch	W14 x 22	0.8 Inches	W16 x 26	0.8 Inches

25 FT. MAXIMUM CLEAR SPAN					
LIVESTOCK, 10 TON TRACTOR, OR H10 LOADING AL-ENG-578-003		LIVESTOCK, 10 TON TRACTOR, OR H20 LOADING AL-ENG-578-003		LIVESTOCK, 10 TON TRACTOR, OR 40 TON GVW LOADING AL-ENG-578-003	
Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection
W10 x 19	2.1 Inches	W10 x 30	2.0 Inches	W14 x 30	1.7 Inches
W12 x 16	1.9 Inches	W12 x 26	1.7 Inches	W14 x 34	1.5 Inches
W12 x 19	1.5 Inches	W12 x 30	1.5 Inches	W16 x 31	1.3 Inches
M14 x 18	1.4 Inches	W14 x 22	1.8 Inches	W16 x 36	1.1 Inches
W14 x 22	1 Inch	W14 x 26	1.4 Inches	W18 x 35	1.0 Inches

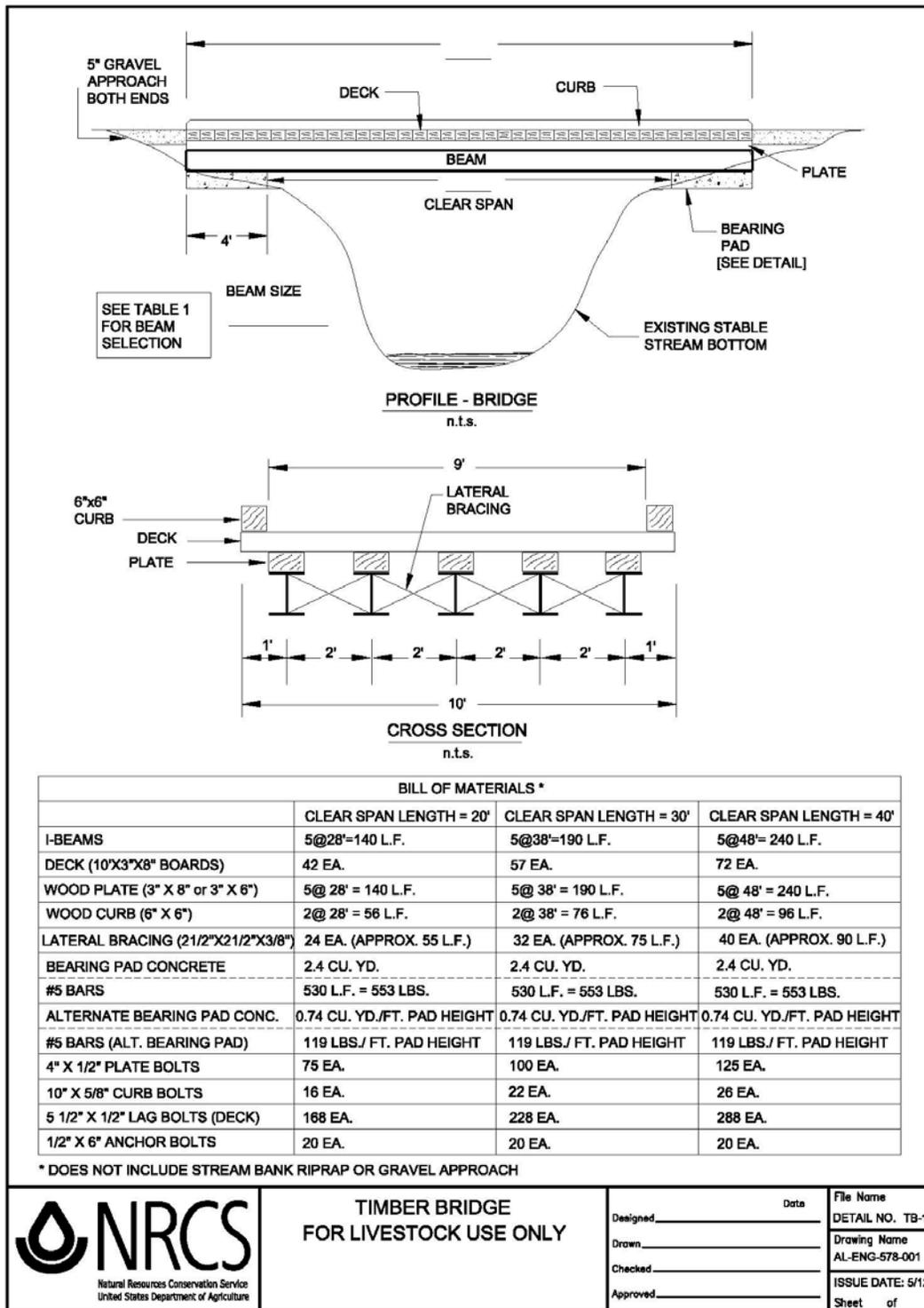
30 FT. MAXIMUM CLEAR SPAN					
LIVESTOCK, 10 TON TRACTOR, OR H10 LOADING AL-ENG-578-003		LIVESTOCK, 10 TON TRACTOR, OR H20 LOADING AL-ENG-578-003		LIVESTOCK, 10 TON TRACTOR, OR 40 TON GVW LOADING AL-ENG-578-003	
Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection
W10 x 30	2.4 Inches	W12 x 30	2.4 Inches	W12 x 45	2.5 Inches
W12 x 22	2.6 Inches	W12 x 35	2.0 Inches	W14 x 38	2.3 Inches
W12 x 26	2.0 Inches	W14 x 26	2.4 Inches	W14 x 43	2.1 Inches
W14 x 22	2.0 Inches	W14 x 30	2.0 Inches	W16 x 36	2.0 Inches
W14 x 26	1.6 Inches	W16 x 26	1.9 Inches	W18 x 35	1.7 Inches

SECTION IV - BEAM SELECTION FOR TIMBER BRIDGE (con't)

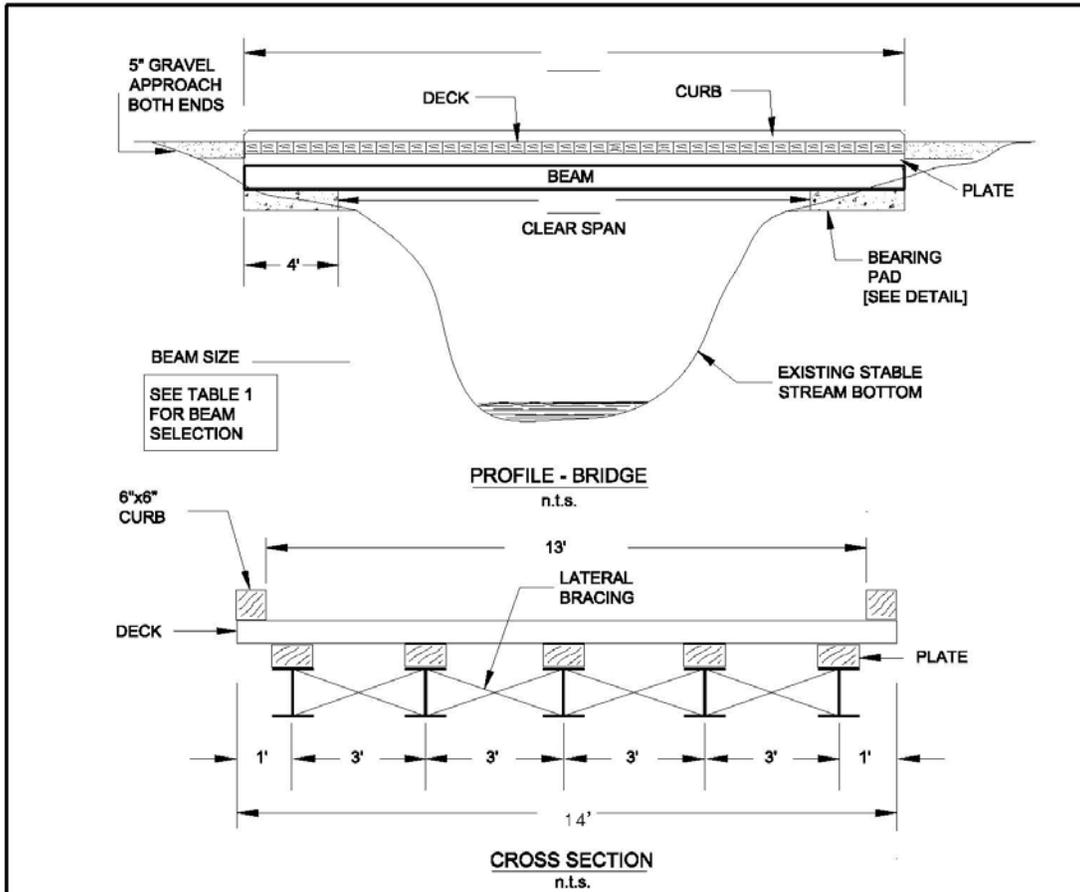
TABLE 2. Livestock and Vehicular Loads (AL-ENG-578-003). (con't)					
35 FT. MAXIMUM CLEAR SPAN					
LIVESTOCK, 10 TON TRACTOR, OR H10 LOADING AL-ENG-578-003		LIVESTOCK, 10 TON TRACTOR, OR H20 LOADING AL-ENG-578-003		LIVESTOCK, 10 TON TRACTOR, OR 40 TON GVW LOADING AL-ENG-578-003	
Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection
W10 x 26	4.2 Inches	W12 x 35	4.4 Inches	W12 x 53	3.5 Inches
W12 x 22	3.8 Inches	W12 x 40	3.4 Inches	W14 x 48	3.1 Inches
W12 x 26	2.9 Inches	W14 x 34	3.1 Inches	W16 x 40	2.9 Inches
W14 x 22	3.0 Inches	W14 x 38	2.7 Inches	W16 x 45	2.6 Inches
W16 x 26	2.0 Inches	W16 x 31	2.8 Inches	W18 x 40	2.5 Inches

40 FT. MAXIMUM CLEAR SPAN					
LIVESTOCK, 10 TON TRACTOR, OR H10 LOADING AL-ENG-578-003		LIVESTOCK, 10 TON TRACTOR, OR H20 LOADING AL-ENG-578-003		LIVESTOCK, 10 TON TRACTOR, OR 40 TON GVW LOADING AL-ENG-578-003	
Beam Size	Deflection	Beam Size	Deflection	Beam Size	Deflection
W10 x 60	3.7 Inches	W12 x 50	4.1 Inches	W12 x 58	4.8 Inches
W12 x 45	3.6 Inches	W14 x 38	4.2 Inches	W14 x 53	4.2 Inches
W14 x 34	3.7 Inches	W16 x 36	3.6 Inches	W16 x 50	3.5 Inches
W16 x 31	3.4 Inches	W16 x 40	3.1 Inches	W18 x 46	3.2 Inches
W18 x 35	2.5 Inches	W18 x 35	3.2 Inches	W21 x 44	2.7 Inches

SECTION V - Construction DRAWINGS for Agricultural Bridges



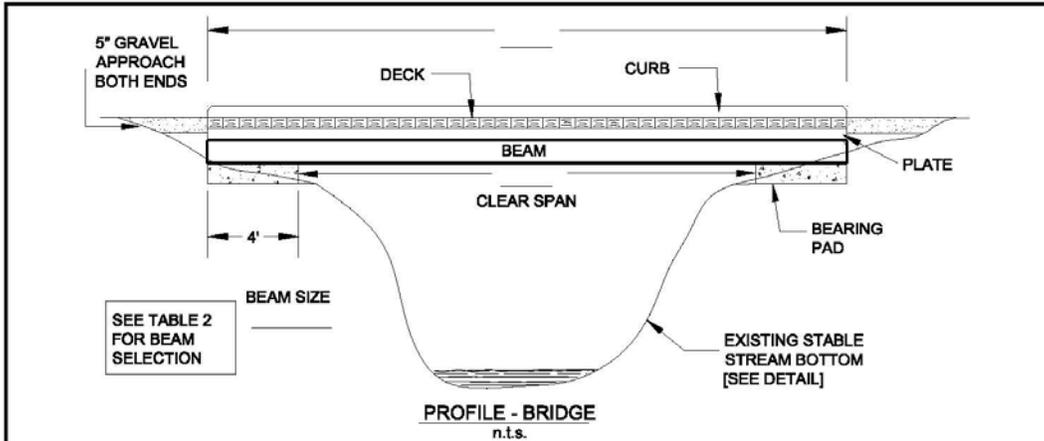
SECTION V - Construction DRAWINGS for Agricultural Bridges (con't)



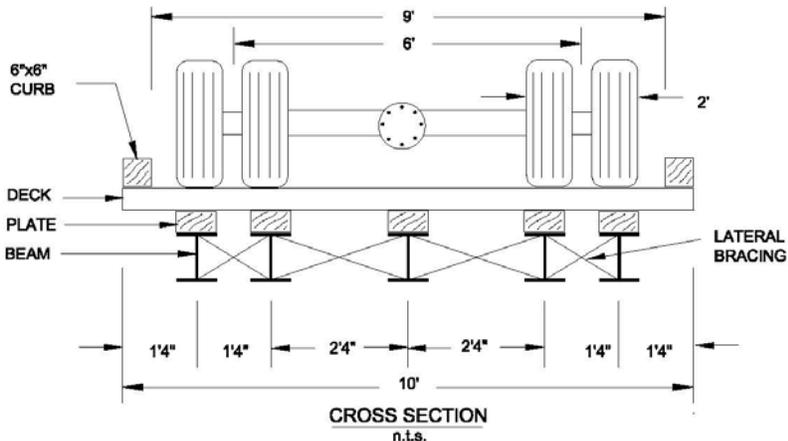
BILL OF MATERIALS			
	CLEAR SPAN LENGTH = 20'	CLEAR SPAN LENGTH = 30'	CLEAR SPAN LENGTH = 40'
I-BEAMS	5@28' = 140 L.F.	5@38' = 190 L.F.	5@48' = 240 L.F.
DECK (14'X3"X10" BOARDS)	33 EA.	45 EA.	57 EA.
WOOD PLATE (3" X 8" or 3" X 6")	5@ 28' = 140 L.F.	5@ 38' = 190 L.F.	5@ 48' = 240 L.F.
WOOD CURB (6" X 6")	2@ 28' = 56 L.F.	2@ 38' = 76 L.F.	2@ 48' = 96 L.F.
LATERAL BRACING (2 1/2"X2 1/2"X3/8")	24 EA. (APPROX. 55 L.F.)	32 EA. (APPROX. 75 L.F.)	40 EA. (APPROX. 90 L.F.)
BEARING PAD CONCRETE	2.8 CU. YD.	2.8 CU. YD.	2.8 CU. YD.
#5 BARS	618 L.F. = 645 LBS.	618 L.F. = 645 LBS.	618 L.F. = 645 LBS.
ALTERNATE BEARING PAD CONC.	1.04 CU. YD./FT. PAD HEIGHT	1.04 CU. YD./FT. PAD HEIGHT	1.04 CU. YD./FT. PAD HEIGHT
#5 BARS (ALT. BEARING PAD)	119 LBS./ FT. PAD HEIGHT	119 LBS./ FT. PAD HEIGHT	119 LBS./ FT. PAD HEIGHT
4" X 1/2" PLATE BOLTS	75 EA.	100 EA.	125 EA.
10" X 5/8" CURB BOLTS	16 EA.	22 EA.	26 EA.
5 1/2" X 1/2" LAG BOLTS (DECK)	132 EA.	180 EA.	228 EA.
1/2" X 6" ANCHOR BOLTS	20 EA.	20 EA.	20 EA.

 <p>Natural Resources Conservation Service United States Department of Agriculture</p>	<p>TIMBER BRIDGE FOR LIVESTOCK AND FARM EQUIPMENT</p>	Date _____ Designed _____ Drawn _____ Checked _____ Approved _____	File Name DETAIL NO. TB-2 Drawing Name AL-ENG-578-002 ISSUE DATE: 5/12 Sheet of _____
---	--	--	--

SECTION V - Construction DRAWINGS for Agricultural Bridges (con't)



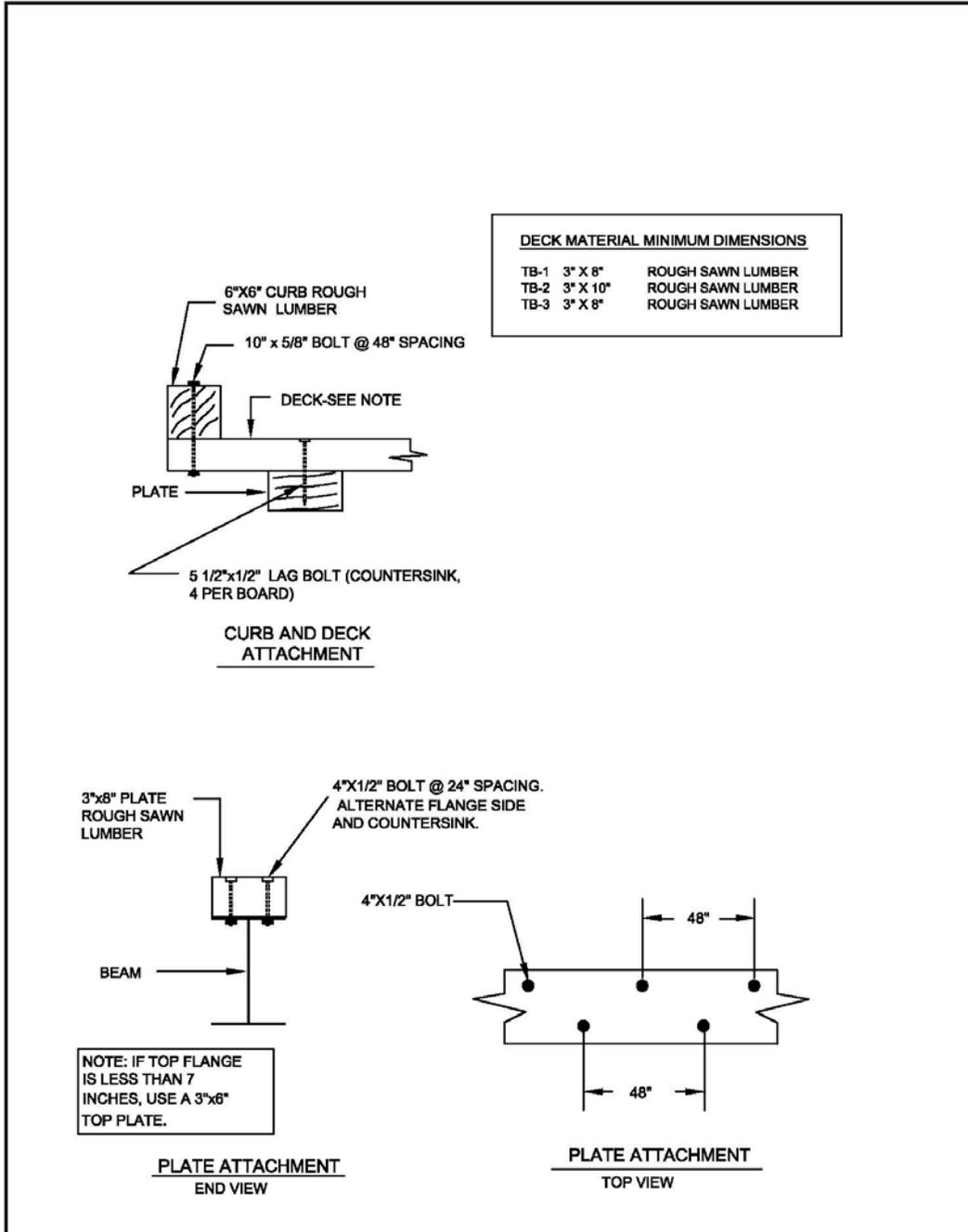
SEE TABLE 2 FOR BEAM SELECTION



	CLEAR SPAN LENGTH = 20'	CLEAR SPAN LENGTH = 30'	CLEAR SPAN LENGTH = 40'
I-BEAMS	5@28'=140 L.F.	5@38'=190 L.F.	5@48'= 240 L.F.
DECK (10'X3"X8" BOARDS)	42 EA.	57 EA.	72 EA.
WOOD PLATE (3" X 8" or 3" X 6")	5@ 28' = 140 L.F.	5@ 38' = 190 L.F.	5@ 48' = 240 L.F.
WOOD CURB (6" X 6")	2@ 28' = 56 L.F.	2@ 38' = 76 L.F.	2@ 48' = 96 L.F.
LATERAL BRACING (21/2"X21/2"X3/8")	24 EA. (APPROX. 55 L.F.)	32 EA. (APPROX. 75 L.F.)	40 EA. (APPROX. 90 L.F.)
BEARING PAD CONCRETE	2.4 CU. YD.	2.4 CU. YD.	2.4 CU. YD.
#5 BARS	530 L.F. = 553 LBS.	530 L.F. = 553 LBS.	530 L.F. = 553 LBS.
ALTERNATE BEARING PAD CONC.	0.74 CU. YD./FT. PAD HEIGHT	0.74 CU. YD./FT. PAD HEIGHT	0.74 CU. YD./FT. PAD HEIGHT
#5 BARS (ALT. BEARING PAD)	119 LBS./ FT. PAD HEIGHT	119 LBS./ FT. PAD HEIGHT	119 LBS./ FT. PAD HEIGHT
4" X 1/2" PLATE BOLTS	75 EA.	100 EA.	125 EA.
10" X 5/8" CURB BOLTS	16 EA.	22 EA.	26 EA.
5 1/2" X 1/2" LAG BOLTS (DECK)	168 EA.	228 EA.	288 EA.
1/2" X 6" ANCHOR BOLTS	20 EA.	20 EA.	20 EA.

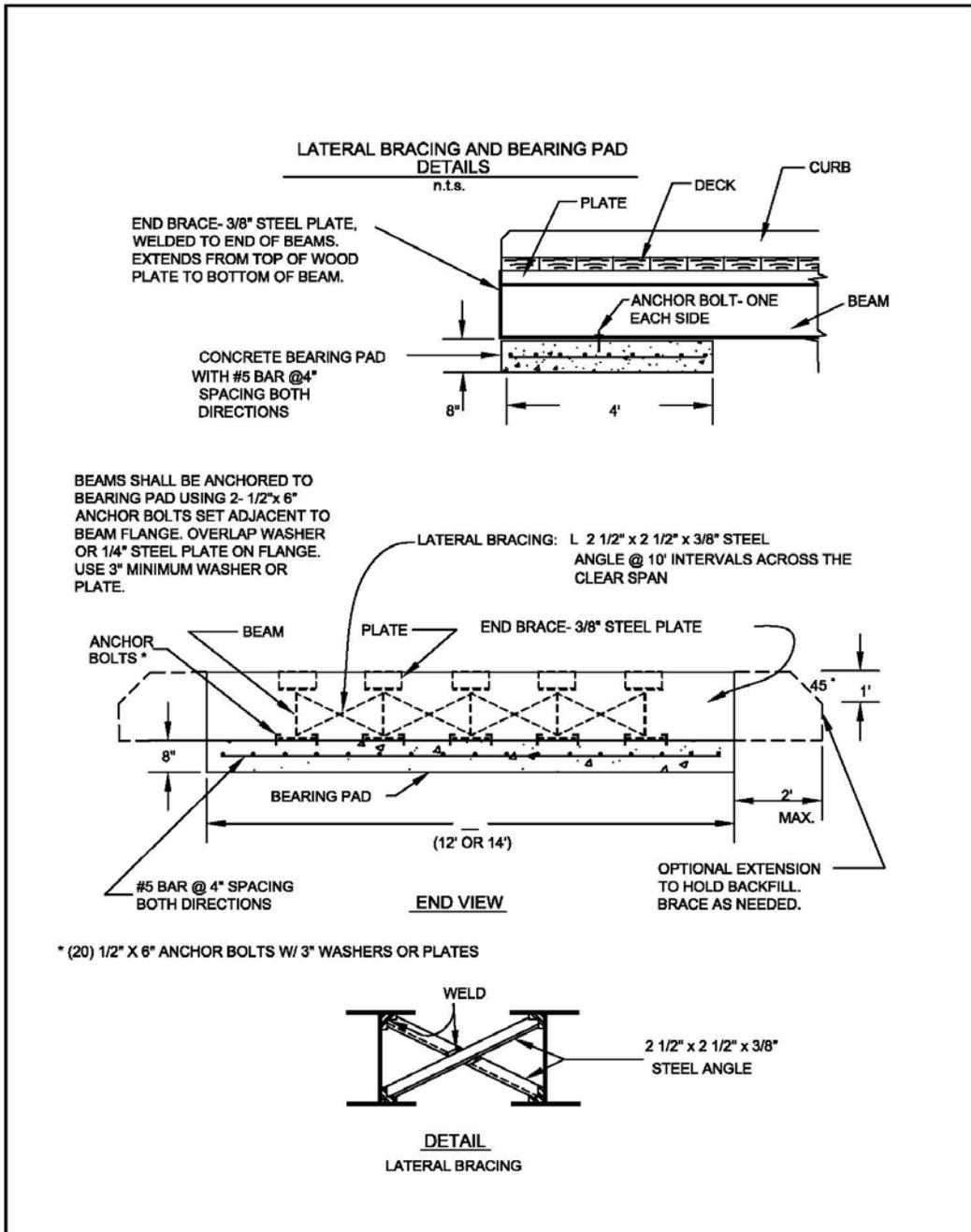
 <p>Natural Resources Conservation Service United States Department of Agriculture</p>	<p>TIMBER BRIDGE FOR LIVESTOCK AND VEHICULAR LOADS</p>	Date _____ Designed _____ Drawn _____ Checked _____ Approved _____	File Name DETAIL NO. TB-3 Drawing Name AL-ENG-578-003 ISSUE DATE: 5/12 Sheet of _____
---	---	--	--

SECTION VI - Construction DETAILS for Agricultural Bridges



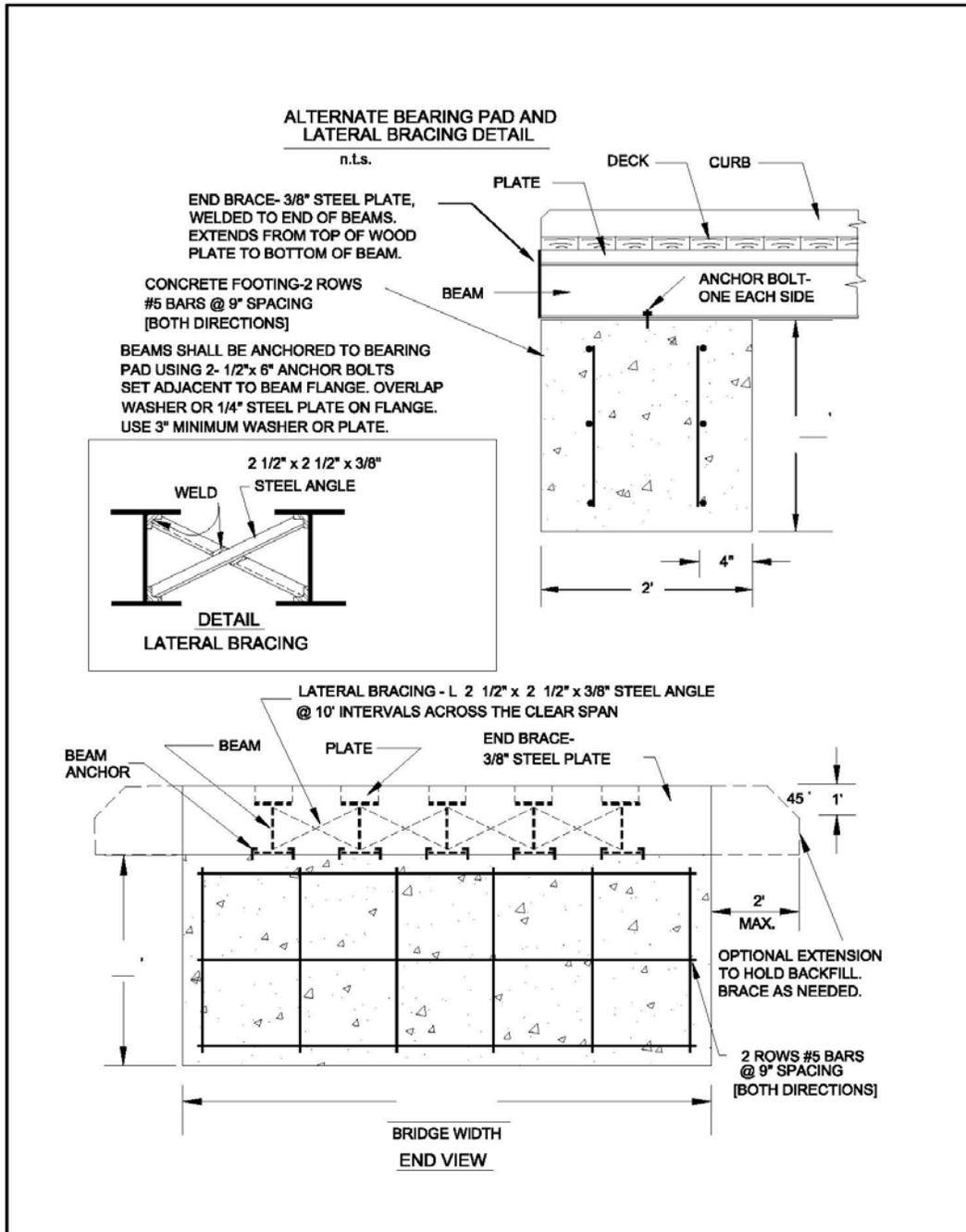
	<p>TIMBER BRIDGE DETAILS</p>	Designed _____ Date _____	File Name DETAIL NO. TB-2D
		Drawn _____	Drawing Name AL-ENG-578-004
		Checked _____	ISSUE DATE: 5/12
		Approved _____	Sheet _____ of _____

SECTION VI - Construction DETAILS for Agricultural Bridges (con't)



<p>NRCS Natural Resources Conservation Service United States Department of Agriculture</p>	TIMBER BRIDGE DETAILS	Date _____	File Name DETAIL NO. TB-3D
	Designed _____	Drawn _____	Drawing Name AL-ENG-578-005
	Checked _____	Approved _____	ISSUE DATE: 5/12
			Sheet _____ of _____

SECTION VI - Construction DETAILS for Agricultural Bridges (con't)



<p>NRCS Natural Resources Conservation Service United States Department of Agriculture</p>	TIMBER BRIDGE DETAILS		Date _____	File Name DETAIL NO. TB-4D
	Designed _____			Drawing Name AL-ENG-578-006
	Drawn _____			ISSUE DATE: 5/12
	Checked _____			Sheet of _____
	Approved _____			

SECTION VI - Construction DETAILS for Agricultural Bridges (con't)

MINIMUM NAIL PENETRATION 2.5 LAMINATIONS. USE 20d (min) GALVANIZED COMMON OR THREADED HARDENED STEEL NAILS. REDUCE NAIL SPACING TO 7 INCHES WHEN USING NAILS WITH A DIAMETER LESS THAN 0.177 INCHES.

4" nominal

1" x

4 1/2" 4 1/2" 9" 9"

NOMINAL 2" THICK LUMBER

- INDICATES NAILS IN FIRST LAMINATIONS
- x INDICATES NAILS IN SECOND LAMINATIONS
- + INDICATES NAILS IN THIRD LAMINATIONS

THE DECK MATERIAL SHALL BE SOUTHERN YELLOW PINE OR EQUAL MEETING AWWA UC3B TREATMENT LEVEL.

USE C-CLIPS TO ATTACH THE DECK TO THE STEEL BEAMS. FOLLOW MANUFACTURERS SPECIFICATIONS FOR INSTALLATION.

THE MINIMUM LENGTH OF A NAIL LAMINATED SECTION SHALL BE 18 INCHES.

18" min

1/2" GAP

REPEAT AS NEEDED

BEAM

18" min

1ST. LAMINATION

2 ND. LAMINATION

3 RD. LAMINATION

CONTINUE WITH LAMINATIONS IN THIS DIRECTION

THE DECK INSTALLS DIRECTLY TO THE BEAM. A NAILER PLATE IS NOT REQUIRED.

BILL OF MATERIALS FOR NAIL-LAMINATED DECK - TB1 AND TB3*			
	CLEAR SPAN LENGTH = 20'	CLEAR SPAN LENGTH = 30'	CLEAR SPAN LENGTH = 40'
DECK (10'X2"X4" NOMINAL BOARDS)	218 EA.	288 EA.	373 EA.
NAILS **	2500 EA.	3400 EA.	4300 EA.
C-CLIPS WITH CARRIAGE BOLT	38 EA.	50 EA.	64 EA.

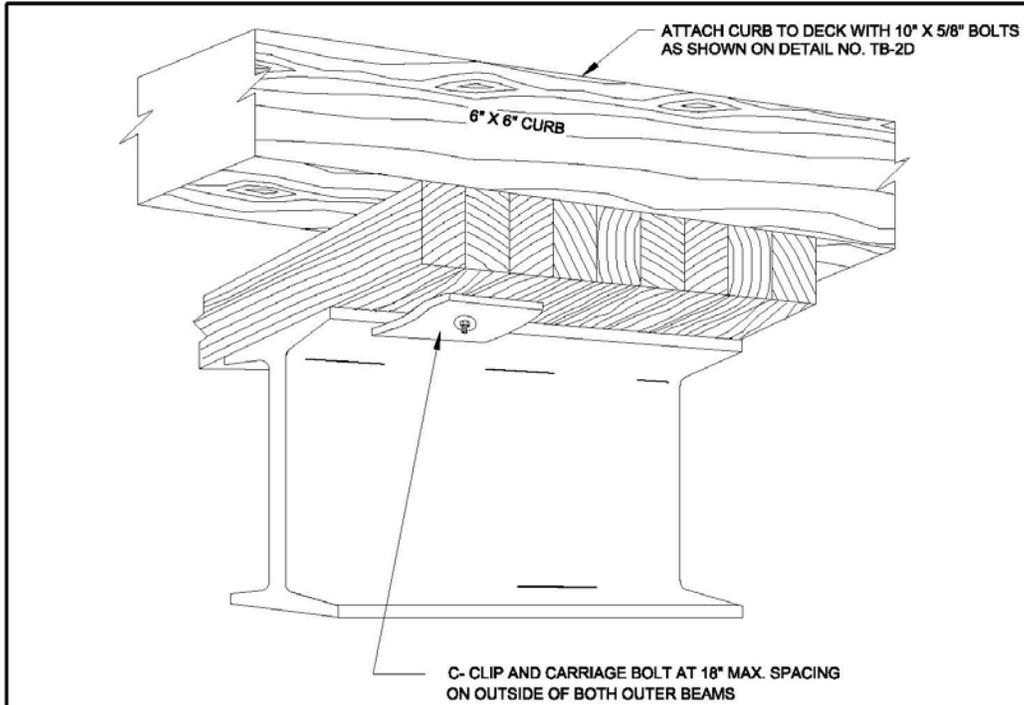
BILL OF MATERIALS FOR NAIL-LAMINATED DECK - TB2*			
	CLEAR SPAN LENGTH = 20'	CLEAR SPAN LENGTH = 30'	CLEAR SPAN LENGTH = 40'
DECK (14'X2"X4" NOMINAL BOARDS)	218 EA.	288 EA.	373 EA.
NAILS **	3600 EA.	5000 EA.	6200 EA.
C-CLIPS WITH CARRIAGE BOLT	38 EA.	50 EA.	64 EA.

* FOR OTHER BRIDGE COMPONENTS NOT LISTED (I-BEAMS, CONCRETE, LATERAL BRACING, CURBS, ETC.), SEE BILL OF MATERIALS FOR NON-NAIL LAMINATED DECKS FOR TB1, TB2 AND TB3. DOES NOT INCLUDE STREAM BANK RIPRAP OR GRAVEL APPROACH.

** INCREASE NAIL QUANTITIES BY APPROXIMATELY 15% WHEN USING A 7-INCH NAIL SPACING.

<p>Natural Resources Conservation Service United States Department of Agriculture</p>	<p>TIMBER BRIDGE - NAIL LAMINATED DECK DESIGN</p>	Designed _____ Date _____	File Name DETAIL NO. TB-5D
		Drawn _____	Drawing Name AL-ENG-578-007
		Checked _____	ISSUE DATE: 8/12
		Approved _____	Sheet of _____

SECTION VI - Construction DETAILS for Agricultural Bridges (con't)



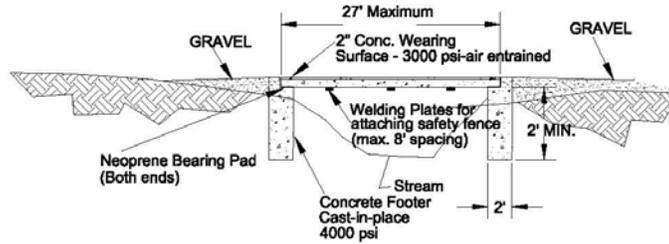
C-CLIPS ARE COMMERCIALY AVAILABLE AND SHOULD BE SIZED AND INSTALLED TO MANUFACTURERS RECOMMENDATIONS. AN ALTERNATIVE PRODUCT CAN BE FABRICATED BY USING A MINIMUM 2"x 2"x 3/16" STEEL PLATE. GALVANIZING OR STAINLESS STEEL IS REQUIRED. CARRIAGE BOLT AND HARDWARE SHALL MEET THAT SHOWN IN THE CONSTRUCTION SPECIFICATIONS.

C-CLIP DETAIL
N.T.S.

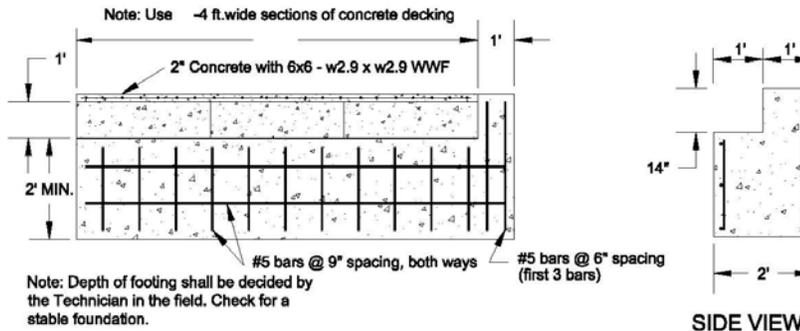
 <p>NRCS Natural Resources Conservation Service United States Department of Agriculture</p>	<p>TIMBER BRIDGE - NAIL LAMINATED DECK DESIGN</p>	<p>Designed _____ Date _____</p>	<p>File Name DETAIL NO. TB-6D</p>
		<p>Drawn _____</p>	<p>Drawing Name AL-ENG-578-008</p>
		<p>Checked _____</p>	<p>ISSUE DATE: 8/12</p>
		<p>Approved _____</p>	<p>Sheet of _____</p>

SECTION VI - Construction DETAILS for Agricultural Bridges (con't)

**PRECAST PRESTRESSED CONCRETE DECKING
(SOLID)**



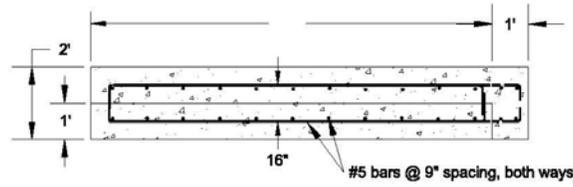
TYPICAL CL PROFILE OF CROSSING



Note: Depth of footing shall be decided by the Technician in the field. Check for a stable foundation.

X-SECTION OF CROSSING

SIDE VIEW



X-SECTION OF FOOTING

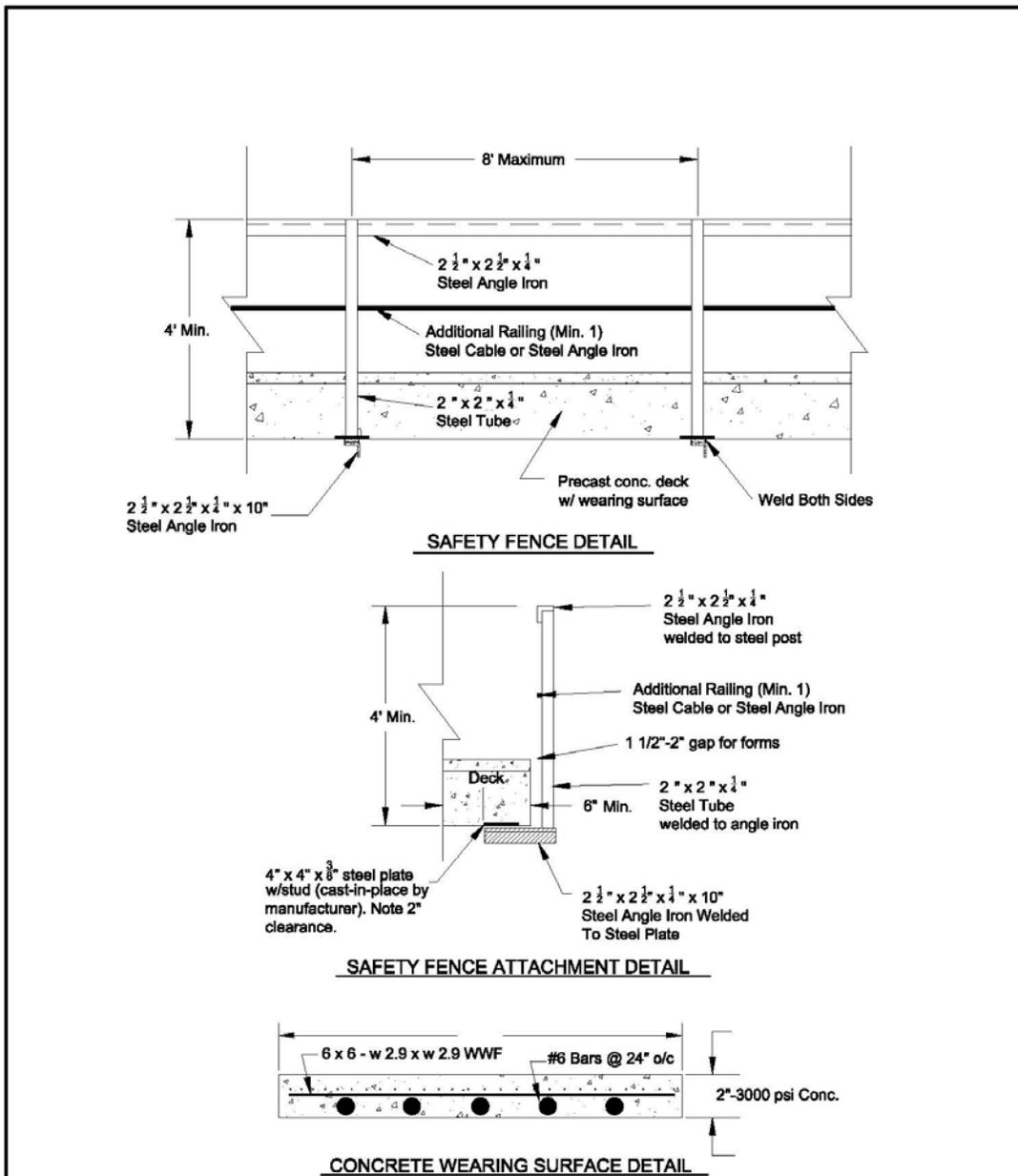
DESIGN LOAD
HS-20 (Highway Loading)
Livestock



**PRESTRESSED CONCRETE
BRIDGE DETAILS**

Designed _____	Date _____	File Name DETAIL NO. PCB-1
Drawn _____		Drawing Name AL-ENG-578-009
Checked _____		ISSUE DATE: 5/12
Approved _____		Sheet of _____

SECTION VI - Construction DETAILS for Agricultural Bridges (con't)



NOTE: If rebar not used then 3/4" - 1" chairs or concrete bricks can be used at 2' spacing o/c to position the WWF.



PRESTRESSED CONCRETE BRIDGE DETAILS

Designed _____	Date _____	File Name DETAIL NO. PCB-2
Drawn _____		Drawing Name AL-ENG-578-010
Checked _____		ISSUE DATE: 5/12
Approved _____		Sheet _____ of _____

SECTION VI - Construction DETAILS for Agricultural Bridges (con't)

SEQUENCE OF CONSTRUCTION

1. Contact the Natural Resources Conservation Service prior to starting construction.
2. Place silt fence/strawbale dike as indicated on the sediment control plan.
3. Excavate areas for concrete supports and riprap protection. Note: The stream flow is not to be disturbed and no equipment will be allowed in the stream channel.
4. All excavated material will be spread in areas away from the stream and wetlands.
5. Place concrete supports where indicated on the plan.
Allow 3-4 days to backfill abutments and set panels.
6. Place the concrete span deck on the concrete supports.
Allow 3-4 days before vehicular traffic.
7. Install safety fence.
8. Install concrete wearing surface as specified.
9. Final grade, remove straw bale dike, seed and mulch all disturbed areas.
10. Livestock will be excluded from seeded areas to allow establishment of vegetative cover.

 Natural Resources Conservation Service United States Department of Agriculture	PRESTRESSED CONCRETE BRIDGE DETAILS	Designed _____ Date _____	File Name DETAIL NO. PCB-3
		Drawn _____	Drawing Name AL-ENG-578-011
		Checked _____	ISSUE DATE: 5/12
		Approved _____	Sheet of _____