

SPECIFICATIONS FOR THE MANUFACTURE AND DESIGN OF PRECAST THREE SIDED ARCH STRUCTURES, WINGWALLS AND HEADWALLS

1. DESCRIPTION

THESE SPECIFICATIONS ARE FOR A PRECAST THREE SIDED ARCH STRUCTURE, HEADWALLS AND WINGWALLS. MANUFACTURE OF PRECAST PIECES SHALL CONFORM TO THE MORE STRINGENT OF THESE SPECIFICATIONS OR ASTM C1504.

2. DESIGN

THE PRECAST UNITS ARE DESIGNED IN ACCORDANCE WITH THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS "LRFD BRIDGE DESIGN SPECIFICATIONS", SEVENTH EDITION AND ALL INTERM SPECIFICATIONS TO DATE.

CONSTRUCTION EQUIPMENT HEAVIER THAN A D-4 DOZER IS NOT ALLOWED OVER THE ARCH STRUCTURE UNTIL BACKFILL IS AT LEAST 1' OVER THE TOP OF THE ARCH. EQUIPMENT WITH AXLE WEIGHT OR TOTAL WEIGHT GREATER THAN THE DESIGN LOAD SHALL NOT BE OPERATED ON THE STRUCTURE WITHOUT WRITTEN APPROVAL FROM THE STRUCTURAL ENGINEER.

3. MATERIAL - CONCRETE

ALL PRECAST ELEMENTS THAT ARE EXPOSED TO FREEZE - THAW SHALL BE AIR ENTRAINED AND COMPOSED OF PORTLAND CEMENT, FINE AND COARSE AGGRAGATES, AND AN AIR ENTRAINED ADMIXTURE THAT CONFORMS TO AASHTO M154.

- CONCRETE SHALL HAVE 6±2 PERCENT AIR
- PORTLAND CEMENT SHALL CONFORM TO ASTM C150 TYPE I, TYPE II, OR TYPE III CEMENT
- COARSE AGGREGATE SHALL MEET ASTM C33 SPECIFICATION AND HAVE A MAXIMUM SIZE OF 1 INCH
- WATER REDUCING ADMIXTURES FOR THE PURPOSE OF INCREASING THE WORKABILITY OF THE CONCRETE, MAY BE SUBMITTED BY THE MANUFACTURE TO THE ENGINEER FOR APPROVAL.
- CALCIUM CHLORIDE OR ADMIXTURES CONTAINING IT ARE NOT ALLOWED TO BE ADDED TO THE CONCRETE
- CEMENT CONTENT MUST BE IN EXCESS OF 564 POUNDS PER CUBIC YARD
- MINIMUM COMPRESSIVE STRENGTH OF CONCRETE SHALL BE SPECIFIED ON SHOP DRAWINGS OF STRUCTURE

4. MATERIALS - STEEL REINFORCEMENT AND HARDWARE

ALL REINFORCEMENT USED IN THE PRECAST ELEMENTS SHALL CONFORM TO ASTM SPECIFICATION A 185 OR A 497. DEFORMED BILLET STEEL SHALL CONFORM TO ASTM A 615, GRADE 60. STEEL REINFORCING SHALL HAVE A MINIMUM YIELD STRENGTH OF 60,000 PSI. STEEL REINFORCING SHALL BE PLACED ACCORDING TO THE DETAILS AND PLANS SHOWN ON THE SHOP DRAWINGS. WELDED WIRE FABRIC USED FOR THE CIRCUMFERENTIAL STEEL SHALL HAVE A MINIMUM SPACING OF 2 INCHES AND MAXIMUM OF 4 INCHES. STEEL HARDWARE AND INSERTS USED BY MANUFACTURER SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

5. FABRICATION OF PRECAST ELEMENTS

FORMS SHALL BE SUFFICIENTLY RIGID TO MAINTAIN STRUCTURE SHAPE.

REINFORCEMENT SHALL BE BENT TO APPROXIMATELY MATCH THE OUTSIDE CORNER OF THE STRUCTURE. REINFORCEMENT SHALL BE WELDED WIRE FABRIC AND SUPPLEMENTED WITH A LAYER DEFORMED BILLET STEEL BARS WHEN NECESSARY. LONGITUDINAL REINFORCING MUST BE WITHIN 3 INCHES FROM ENDS OF PRECAST ELEMENTS.

- STORAGE OF UNITS SHOULD BE IN A MANNER THAT PREVENTS ANY DAMAGE OR CRACKING AND IN A FASHION APPROVED BY THE ENGINEER

- HARDWARE OR HOLES SHALL BE CAST INTO PRECAST ELEMENTS TO FACILITATE HANDLING

- CONCRETE SHALL MEET MINIMUM DESIGN STRENGTH BEFORE 28 DAYS AFTER IT WAS CAST AND BEFORE THE ELEMENT IS SHIPPED

- TENSION SPLICES IN CIRCUMFERENTIAL REINFORCING SHALL BE MADE BY LAPPING AND MUST CONFORM TO AASHTO 5.11.6.2 FOR SMOOTH WELDED WIRE FABRIC. THE DEFORMED WELDED WIRE REINFORCEMENT SHALL CONFORM TO AASHTO 5.11.6.1. LAPS MAY BE TACK WELDED FOR CONSTRUCTION PURPOSES ONLY. FOR SPLICES OTHER THAN TENSION SPLICES, THE OVERLAP SHALL BE AT LEAST 12 INCHES FOR WELDED WIRE FABRIC OR 24" DEFORMED BARS. OVERLAP OF WELDED WIRE FABRIC SHALL BE MEASURED FROM OUTER MOST CROSS WIRES OF EACH FABRIC SHEET. OVERLAP FOR DEFORMED BARS SHALL MEET AASHTO 5.11.5.

6. QUALITY ASSURANCE

THE PRECAST PLANT SHALL BE CERTIFIED BY THE NATIONAL PRECAST CONCRETE ASSOCIATION'S PLANT CERTIFICATION PROGRAM OR PRECAST/PRESTRESSED CONCRETE INSTITUTE PLANT CERTIFICATION DURING PRODUCTION OF ALL PRECAST ELEMENTS.

THE PRECAST PLANT SHALL RETAIN AN INDEPENDENT TESTING AGENCY TO PERFORM TESTS FOR AIR ENTRAINMENT AND COMPRESSIVE STRENGTH. THESE TESTS ARE TO COMPLY WITH ASTM C231 OR C173 FOR AIR ENTRAINMENT AND ASTM C39. THESE TESTS ARE TO BE DONE AT INTERVALS STATED IN SECTION 7 OF THIS SPECIFICATION. THE AGENCY MUST PROVIDE THE PRECAST PLANT CERTIFICATION, BY A LICENSED ENGINEER, STATING THAT THE PLANT IS IN COMPLIANCE WITH THESE TEST.

THE PRECAST PLANT SHALL PROVIDE PROOF OF COMPLIANCE OF THIS SECTION UPON REQUEST.

7. TESTING AND INSPECTION

COMPRESSION TESTING SHALL BE DONE ON CONCRETE CYLINDERS. A MINIMUM OF 3 CYLINDERS ARE TO BE MADE FOR EACH GROUP OF CONCRETE ELEMENTS CAST FROM THE SAME CONCRETE MIX ON THE SAME DAY. CYLINDERS ARE TO BE TESTED IN ACCORDANCE WITH ASTM C39.

IF THE AVERAGE COMPRESSIVE STRENGTH OF ALL CYLINDERS TAKEN FROM GIVEN CONCRETE MIX ON THE SAME DAY IS EQUAL TO OR GREATER THAN THE DESIGN COMPRESSIVE STRENGTH, THE CYLINDERS ARE ACCEPTED. IF THE CYLINDERS DO NOT MEET THIS CRITERIA, A MINIMUM OF THREE CORES SHALL BE OBTAINED FROM THE PRECAST ELEMENTS MADE WITH THE SAME CONCRETE MIX FROM THE FAILED CYLINDERS.

CORES SHALL BE OBTAINED AND TESTED IN ACCORDANCE WITH ASTM C42. IF THE AVERAGE COMPRESSIVE STRENGTH IS EQUAL TO OR GREATER THAN THE DESIGN COMPRESSIVE STRENGTH, THE CORES ARE ACCEPTABLE.

WHEN THE COMPRESSIVE STRENGTH OF ANY CORE IS LESS THAN THE DESIGN COMPRESSIVE STRENGTH, THE PRECAST ELEMENT THE CORE WAS TAKEN FROM SHALL BE REJECTED. THE REMAINING PRECAST ELEMENTS MADE FROM THE SAME CONCRETE MIX ON THE SAME DAY ARE TO BE REJECTED, UNLESS AT THE OPTION OF THE PRECAST PLANT, EACH ELEMENT CAN BE CORED AND ACCEPTED INDIVIDUALLY. CORE HOLES SHALL BE PLUGGED AND SEALED BY THE PRECAST PLANT IN A MANNER TO MEET THIS SPECIFICATION. THE OWNER OR OWNER'S AGENT MAY INSPECT THE MATERIAL, MANUFACTURE AND FINISHED PRECAST ELEMENTS AT THEIR DISCRETION.

8. PERMISSIBLE VARIATIONS

BRIDGE UNITS SHALL BE MANUFACTURED SO THAT ARCH AND LEG DIMENSIONS ARE NOT MORE THAN 1/4" DIFFERENT THAN WHAT IS SHOWN ON THE SHOP DRAWINGS. THE LAY LENGTH OF THE BRIDGE UNITS SHALL NOT VARY MORE THAN 1/2" OVER THE LENGTH OF THE STRUCTURE.

WINGWALL AND HEADWALL ARE TO BE MANUFACTURED SO THAT THE LENGTH, HEIGHT AND THICKNESS DOES NOT VARY MORE THAN 1/2" FROM WHAT IS SHOWN ON THE SHOP DRAWINGS.

REINFORCEMENT PLACING SHALL NOT VARY MORE THAN 1/2" FROM THAT WHICH IS SHOWN ON THE SHOP DRAWINGS. REINFORCING CONCRETE COVER SHALL NEVER BE LESS THAN 1-1/2"

9. JOINTS

BRIDGE UNITS UTILIZE BUTT ENDS AND ARE TO BE MANUFACTURED SO THAT WHEN PLACED NEXT TO EACH OTHER, THEY PROVIDE A CLEAN, CONTINUOUS LINE OF SECTIONS THAT ARE FREE OF ANY IRREGULARITIES. THE MAXIMUM PERMISSIBLE JOINT SHALL BE A MAXIMUM OF 3/4"

10. WORKMANSHIP AND FINISH

PRECAST ELEMENTS ARE TO HAVE A SMOOTH STEEL FORM OR TROWELED SURFACE. THE ENDS OF BRIDGE UNITS SHALL BE NORMAL TO THE WALLS AND CENTERLINE OF THE ARCH. THE PRECAST ELEMENTS SHALL BE FREE OF ANY SUBSTANTIAL FRACTURE OR BLEMISH.

REPAIRS TO A PRECAST ELEMENT BECAUSE OF FRACTURES OR BLEMISHES CAUSED BY HANDLING OR INSTALLING, MAY BE APPROVED, IN THE OPINION OF THE OWNER, IF THE REPAIRS ARE PROPERLY FINISHED AND CURED TO MEET THIS SPECIFICATION.

11. REJECTION

PRECAST ELEMENTS MAY BE REJECTED FOR EXCESSIVE HONEYCOMBING, DAMAGED ENDS OR FRACTURES AND CRACKS PASSING THROUGH THE WALL

12. MARKING

EACH PRECAST ELEMENT IS TO BE MARKED BY PERMANENT PAINT. THE MINIMUM MARKING SHALL INCLUDE THE DATE OF MANUFACTURE, TRADEMARK OR NAME OF PRECAST PLANT, AND PIECE MARK FROM SHOP DRAWINGS. BRIDGE UNITS SHALL INCLUDE SPAN AND RISE IN THE MARK.

13. CONSTRUCTION

THE BRIDGE UNITS AND WINGWALLS SHALL BE INSTALLED ON CAST IN PLACE FOUNDATIONS PER THE PLANS. THE PROJECT ENGINEER SHALL VERIFY THAT THE FOUNDATION SUBGRADE IS IN COMPLIANCE WITH THE GEOTECHNICAL REPORT FOR THE PROJECT.

THE FOOTINGS SHALL HAVE A SMOOTH FLOAT FINISH WITH A MINIMUM COMPRESSIVE STRENGTH AS SPECIFIED IN THE DESIGN NOTES. THE SURFACE OF THE FOUNDATION SHALL NOT VARY BY MORE THAN 1/4" WHEN MEASURED WITH A 10 FOOT STRAIGHT EDGE. THE FOOTINGS SHALL HAVE REACHED A MINIMUM OF 2000 PSI BEFORE INSTALLATION OF ANY PRECAST ELEMENTS. FOUNDATION DIMENSION SHALL MATCH THOSE THAT ARE SHOWN ON THE PLANS.

PRECAST ELEMENTS SHALL BE INSTALLED AS SHOWN ON THE PLANS AND SPECIAL CARE SHALL BE TAKEN TO VERIFY THAT ELEMENTS ARE PLACED TO FOLLOW THE DESIGNATED CENTERLINE OF THE STRUCTURE. BRIDGE STRUCTURES AND WINGWALLS ARE TO BE PLACED ON MASONITE SHIMS TO ALLOW A MINIMUM OF 1/2" CLEARANCE BETWEEN BOTTOM OF PRECAST ELEMENT AND TOP OF FOOTING. GAP SHALL BE FILLED WITH CEMENT GROUT WITH A MINIMUM COMPRESSIVE STRENGTH OF 2,500 PSI. GROUT TO BE COMPOSED OF PORTLAND CEMENT AND WATER OR CEMENT MORTAR COMPOSED OF ONE PART PORTLAND CEMENT AND THREE PARTS SAND BY VOLUME.

BUTT JOINTS BETWEEN BRIDGE UNITS SHALL BE COVERED WITH A 7/8" X 13/8" BUTYL ROPE AND A 9" WIDE STRIP OF JOINT WRAP. A PRIMER COMPATIBLE WITH THE JOINT WRAP SHALL BE APPLIED ON EACH SIDE OF THE BUTT JOINT ON A CLEAN SURFACE. JOINT PROTECTION SHALL EXTEND FROM BOTTOM OF ONE LEG, UP OVER ARCH AND DOWN OPPOSITE THE LEG. ANY LAPS SHALL HAVE 6" OF OVERLAP AND HAVE OVERLAP RUNNING DOWN HILL.

LIFT HOLES ARE TO BE FILLED, PRIMED AND COVERED WITH JOINT WRAP. EDGES ALONG THE HEADWALL COLLAR AND TOP OF BRIDGE UNIT SHALL BE COVERED WITH JOINT WRAP AND PRIMER. HEADWALLS THAT ARE CAST INTEGRAL WITH A BRIDGE UNIT REQUIRE NO TYPE OF JOINT PROTECTION.

JOINTS BETWEEN WINGWALL SECTIONS AND JOINTS BETWEEN A WINGWALL AND BRIDGE UNIT SHALL BE SEALED WITH A 2' WIDE STRIP OF FILTER FABRIC.

BACKFILL IS DEFINED AS ALL REPLACED EXCAVATION AND NEW EMBANKMENT MATERIAL THAT IS ADJACENT TO THE THREE SIDED STRUCTURE, WINGWALLS AND HEADWALLS. BACKFILL MATERIAL WITHIN ZONE A MUST MEET THE MATERIAL SPECIFICATIONS OF AASHTO SOIL TYPE A1 OR A3. SPANS LESS THAN OR EQUAL TO 24' WITH FILL HEIGHT LESS THAN 12' MAY ALSO USE AASHTO SOIL TYPE A2 OR A4. ZONE A IS DEFINED AS 4' HORIZONTALLY FROM THE OUTSIDE FACE OF EACH LEG AND 2' ABOVE THE TOP OF THE ARCH SLAB (OR FINISHED GRADE IF LESS THAN 2' COVER).

ALL BACKFILL IN ZONE A IS TO BE COMPACTED TO A MINIMUM DENSITY OF 95% STANDARD PROCTOR PER AASHTO T-99.

SPECIAL CARE IS TO BE TAKEN DURING BACKFILLING TO PROTECT THE PLACEMENT OF JOINT WRAP OR ANY WATERPROOFING MATERIAL.

MECHANICAL TAMPERS OR APPROVED COMPACTING EQUIPMENT SHALL BE USED ON ALL BACKFILL MATERIAL THAT IS DIRECTLY ADJACENT TO THE STRUCTURAL ELEMENTS AND OVER THE TOP OF THE STRUCTURE UNTIL THERE IS AT LEAST 1' OF COVER OVER THE TOP. BACKFILL MATERIAL IN ZONE A SHALL BE PLACED IN 8" LIFTS (MAXIMUM) BEFORE BEING COMPACTED. AT NO TIME SHALL HEAVY CONSTRUCTION OR BACKFILLING EQUIPMENT IN EXCESS OF 12 TONS BE PERMITTED OVER THE STRUCTURE OR WITHIN 3' OF ANY STRUCTURAL ELEMENT WITHOUT AT LEAST 2' OF COVER OVER THE STRUCTURE UNLESS THE STRUCTURE IS DESIGNED FOR LESS COVER.

DURING BACKFILLING, AT NO TIME SHALL THERE BE MORE THAN 24" DIFFERENCE BETWEEN BACKFILL HEIGHT ON EACH SIDE OF THE CULVERT.