PACIFIC AFFILIATES
CONSULTING ENGINEERS
990 W. WATERFRONT DRIVE, EUREKA, CA 95501 • TEL (707) 445-3001 FAX (707) 445-3003

June 19, 2020

Ms. Kirsten Voorhees
Contech Engineered Solutions LLC
1869 E Seltice Way #317
Post Falls, ID 83854

Re: Review of Contech BridgeCor Single Radius Arch Culvert CANDE Finite Element Analysis Calculations and Plate Layout Drawings, Design of Precast Footings and Preparation of Load Rating Calculations
Mill Creek Fish Passage Project
Peshastin, WA
Contech ES Project No. 584279

Ms. Voorhees:

Please find attached report for the BridgeCor Single Radius Arch Culvert to be constructed as part of the Mill Creek Fish Passage project in Peshastin, Washington. It has been requested that Pacific Affiliates provide the following:

- Review of Contech BridgeCor Single Radius Arch CANDE Finite Element Analysis Calculations
- Review of Contech BridgeCor Single Radius Arch Plate Layout Drawings
- Design of Precast footings
- Load Rating Calculations

The attached report contains the above listed items. Pacific Affiliates' scope of work is limited to the review of CANDE Finite Element Analysis Calculations and plate layout drawings, as well as, design of precast footing and load rating calculations for the BridgeCor Single Radius Arch. Design of Keystone headwall and wingwalls for the structure is by others. Our scope does not include construction activities, scour analysis, or any other items not specifically discussed herein. All other aspects for this project are the responsibility of others than Pacific Affiliates and the only responsibility of Pacific Affiliates is as listed above.

Project Description

Contech Engineered Solutions is providing a 24'-8" span by 12'-4" rise BridgeCor Single Radius Arch to be installed for passage of Mill Creek below Mountain Home Ranch Road. The structure was specified in the project plans by Natural Systems Design and evaluated by Contech for HL-93 design traffic loading with minimum and maximum soil cover over the top of the culvert of 2'-6" and 4'-6", respectively. Footings for the culvert are to be precast and delivered to the project site. Foundation design is based on information provided by Contech and a geotechnical report (Final Geotechnical Report, Mill Creek Fish Passage Project, Chelan County, Washington, by PanGEO, Inc., dated March 23, 2020, Project No. 14-095).

Geotechnical Parameters

Geotechnical parameters were provided in the above referenced report. According to said documents, foundations constructed over a minimum of 12 inches well compacted coarse bedding material can be designed for the service and strength bearing capacities provided in either Figure 4A or 4B of report. Said figures provided a range of nominal bearing capacities at associated footing widths. Figure 4B, which was based on an allowable settlement of 1-inch was selected for this design.

A coefficient of friction of 0.65 was used for the interface between the concrete footing and the soil surface, as recommended in the geotechnical report. Passive earth pressures were based on an allowable equivalent fluid density of 200 pounds per cubic foot (pcf). It was noted that these values are nominal and provided the applicable resistance factors in Table 1.

Backfill of the culvert shall conform to Contech's requirements for structural plate backfill. Backfill material shall have a maximum unit weight of 130 pcf and maximum height over the culvert of 4'-6". The contractor is responsible for obtaining geotechnical engineer's approval of footing excavations and verifying soil conditions and the bearing capacity of the soil prior to installing the foundation.

Foundation Design

The foundation for the culvert structure was designed in accordance with AASHTO LRFD Bridge Design Specifications, 9th Edition. Service I limit state loads were used to calculate the width of the footing. Factored loads (AASHTO Strength I limit state) were used to design the concrete section and reinforcing steel and to check sliding and overturning.

Based on the loads applied to the foundation, a footing 4'-0" wide and 1'-6" thick was determined to be appropriate for the structure. The top of the footing shall be formed to create a four-inch tall by ten inch wide keyway to receive the leg of the culvert structure. Attached plans show the details of the footing and reinforcing steel. Footings will be precast and delivered to the project site. Precast footing segment lengths, lift locations, and picking hardware are the responsibility of others. Once in place, footing segments shall be adequately connected to one another to prevent tilting by either a weld plate as shown on the plans, or by other methods as approved by Pacific Affiliates and Contech.

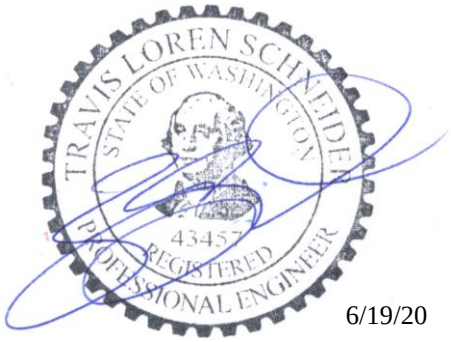
All concrete shall meet the specifications of Class A concrete with a minimum compressive strength of 4,000 psi as specified in AASHTO LRFD Bridge Design Specifications. Concrete shall be mixed and placed in conformance with AASHTO Standard Specifications for Highway Bridges. Reinforcing steel shall meet the requirements of ASTM 615, Grade 60 and shall be placed, bent and terminated in accordance with the requirements of the Concrete Steel Reinforcing Institute (CRSI) Manual of Standard Practice and as specified on the project plans.

Other Considerations

Foundation design shall be reviewed and approved by the Owner or the Owner's engineer prior to approval. Project site conditions were not independently verified by Pacific Affiliates. The foundation design is based on information provided by others. Site conditions should be verified during construction. If they differ from what is described herein or in other project documents, the engineer of record shall be contacted. Excavations shall be completed such that side slopes will not slip or cave during construction. It is not Pacific Affiliates' responsibility to design or specify temporary shoring, if necessary.

Should you have any questions or require additional information, please contact this office.

Sincerely,



6/19/20

Travis Schneider
R.P.E. 43457

cc: File 20-2673

Attachments: BridgeCor Single Radius Arch Plate Layout Drawings and Foundation Plans, June 19, 2020, 584279-020-BCORSRA-CON-A
BridgeCor Single Radius Arch Foundation Design Calculations, June 19, 2020
BridgeCor Single Radius Arch CANDE Calculations, June 19, 2020
BridgeCor Single Radius Arch Load Rating Calculations, June 19, 2020

CONTECH®
ENGINEERED SOLUTIONS LLC

BridgeCor®

BRIDGECOR SINGLE RADIUS ARCH
MILL CREEK FISH PASSAGE
PESHASTIN, WA

584279-INDEX		REVIEW AND APPROVAL		
SHEET NUMBER	SHEET TITLE	APPROVED FOR FABRICATION	APPROVED AS NOTED FOR FABRICATION	REVISE AND RESUBMIT
1	COVER SHEET	[ ]	[ ]	[ ]
2	GEOMETRY/TWO RING LAYOUT	[ ]	[ ]	[ ]
3	PLAN/SECTION	[ ]	[ ]	[ ]
4	ELEVATIONS	[ ]	[ ]	[ ]
5	PROFILES	[ ]	[ ]	[ ]
6	RECOMMENDED KEYSTONE HEADWALL DETAILS	[ ]	[ ]	[ ]
7	SPECIFICATIONS	[ ]	[ ]	[ ]
8	PLATE LAYOUT	[ ]	[ ]	[ ]
9	MOVEMENT CONTROL HOOK PLACEMENT DETAIL	[ ]	[ ]	[ ]
10	FOOTING DETAILS	[ ]	[ ]	[ ]

REVIEWED BY: _____

COMPANY: _____

DATE: _____

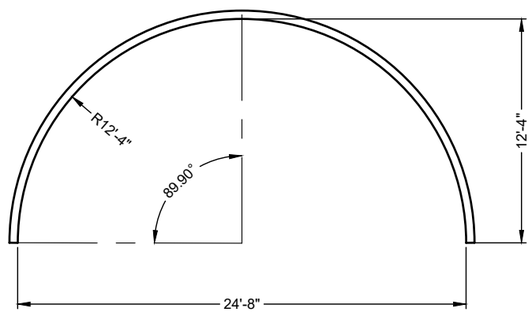
PLEASE CHECK ONE BOX FOR EACH SHEET AND ADD COMMENTS AS NEEDED ON APPROPRIATE SHEETS.

TRAVIS LOREN SCHNEIDER
STATE OF WASHINGTON
43457
REGISTERED PROFESSIONAL ENGINEER

6/19/20

PRE-584279-020-BCORSRA-CON-A

CONTECH PROJECT ID # 584279



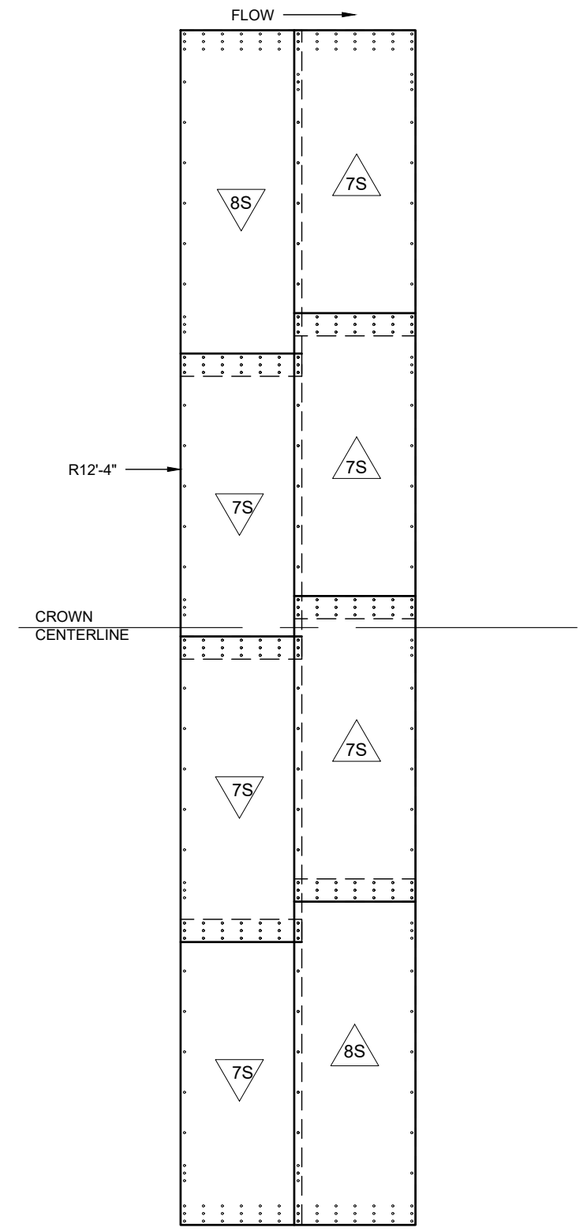
APPROX AREA = 238.3 SQ. FT.
PLATE MAKE UP: 1 @ 8 S, 3 @ 7 S
TOTAL= 29 S

NOTES:

1) MEASUREMENTS ARE TO THE INSIDE CRESTS OF THE CORRUGATIONS.
2) DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
3) CIRCUMFERENTIAL PLATE LENGTHS ARE IN TERMS OF S = 16 INCHES.

BRIDGECOR SINGLE RADIUS ARCH
24'-8" SPAN x 12'-4" RISE

SCALE = 1:100



TWO RING LAYOUT (OUTSIDE VIEW)

SCALE = 1:60

6/19/20

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MARK	DATE	REVISION DESCRIPTION	BY

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH STRUCTURAL PLATE

CONTRACT DRAWING

BRIDGECOR SINGLE RADIUS ARCH
24'-8" SPAN x 12'-4" RISE
MILL CREEK FISH PASSAGE
PESHASTIN, WA

PROJECT No.: 584279	SEQ. No.: 020	DATE: 6/4/2020
DESIGNED:	DRAWN: KKV/SCC	
CHECKED: DJS/JAH	APPROVED:	
SHEET NO.: 2 OF 10		

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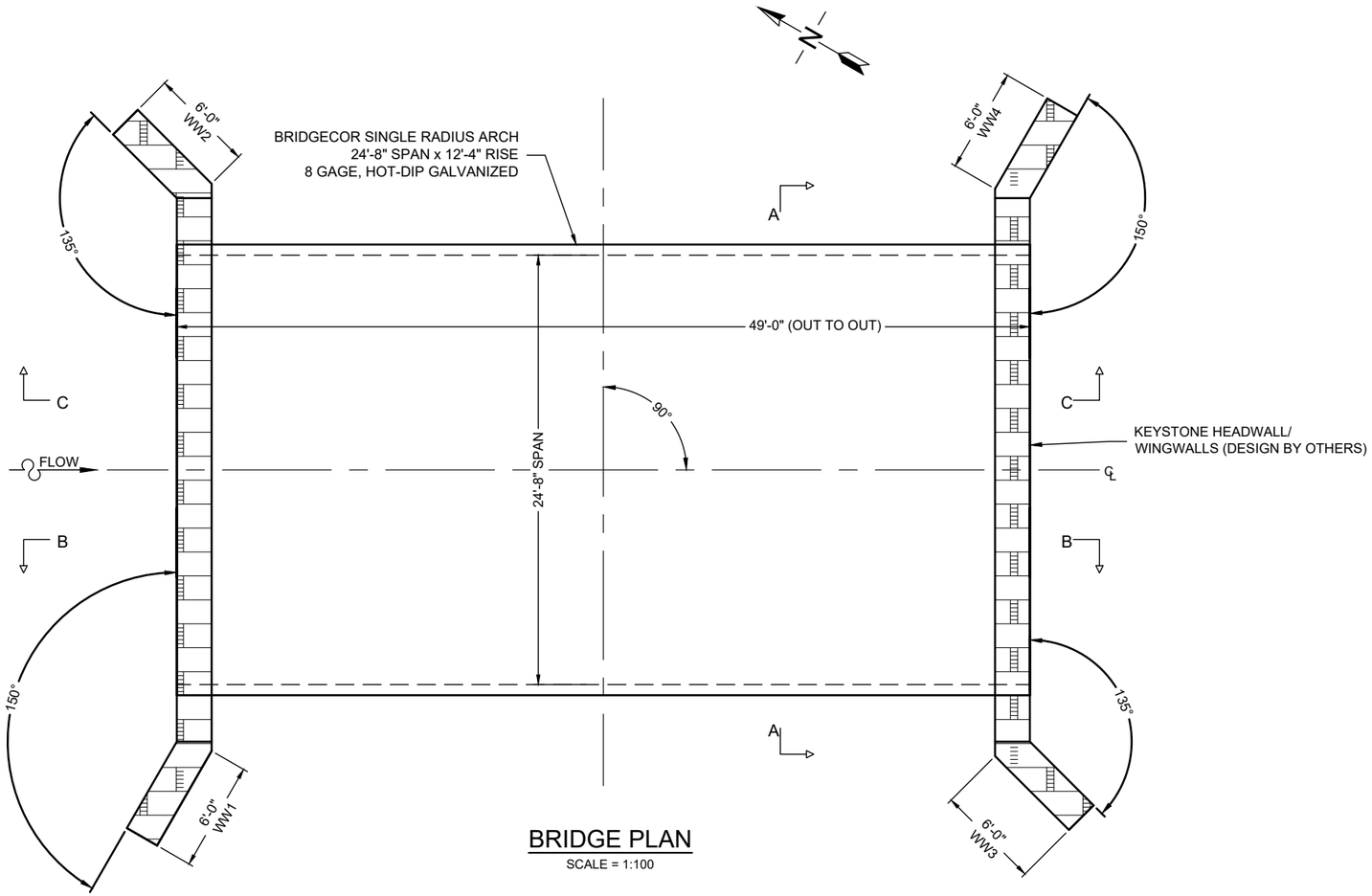
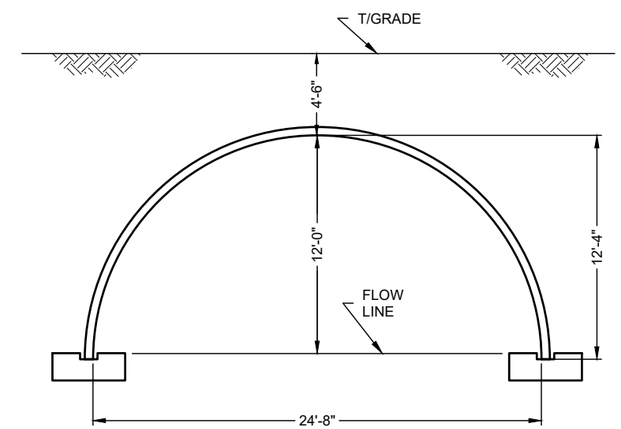


BRIDGE PLAN

SCALE = 1:100



Approximate Area: 230 sq. ft. used, 238 sq. ft. total

NOTES
•MEASUREMENTS ARE TO THE INSIDE CRESTS OF THE CORRUGATION
•DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES

CROSS SECTION A-A

SCALE = 1:100

6/19/20

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CONTECH STRUCTURAL PLATE

CONTRACT DRAWING

BRIDGECOR SINGLE RADIUS ARCH
24'-8" SPAN x 12'-4" RISE
MILL CREEK FISH PASSAGE
PESHASTIN, WA

PROJECT No.: 584279	SEQ. No.: 020	DATE: 6/4/2020
DESIGNED:	DRAWN: KKV/SCC	
CHECKED: DJS/JAH	APPROVED:	
SHEET NO.: 3 OF 10		

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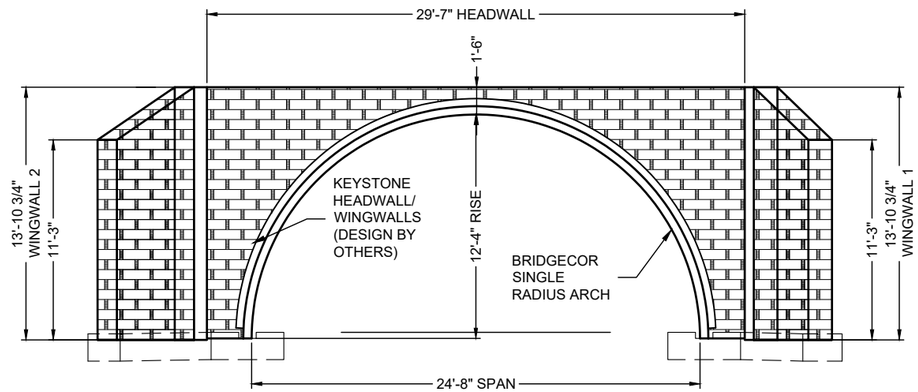

INLET END ELEVATION

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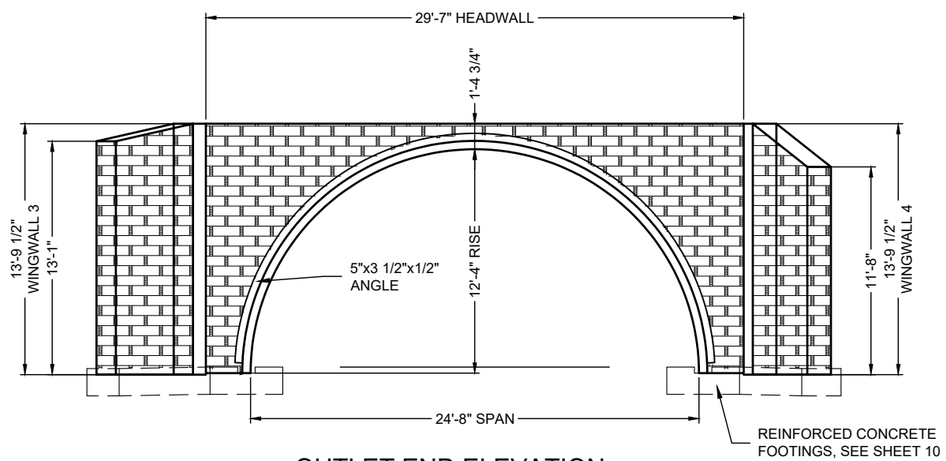

OUTLET END ELEVATION

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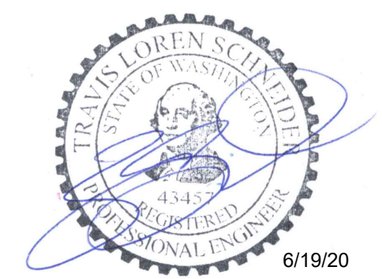

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CONTECH STRUCTURAL PLATE

CONTRACT DRAWING

BRIDGECOR SINGLE RADIUS ARCH
24'-8" SPAN x 12'-4" RISE
MILL CREEK FISH PASSAGE
PESHASTIN, WA

PROJECT No.:	SEQ. No.:	DATE:
584279	020	6/4/2020
DESIGNED:		DRAWN: KKV/SCC
CHECKED: DJS/JAH		APPROVED:
SHEET NO.: 4 OF 10		

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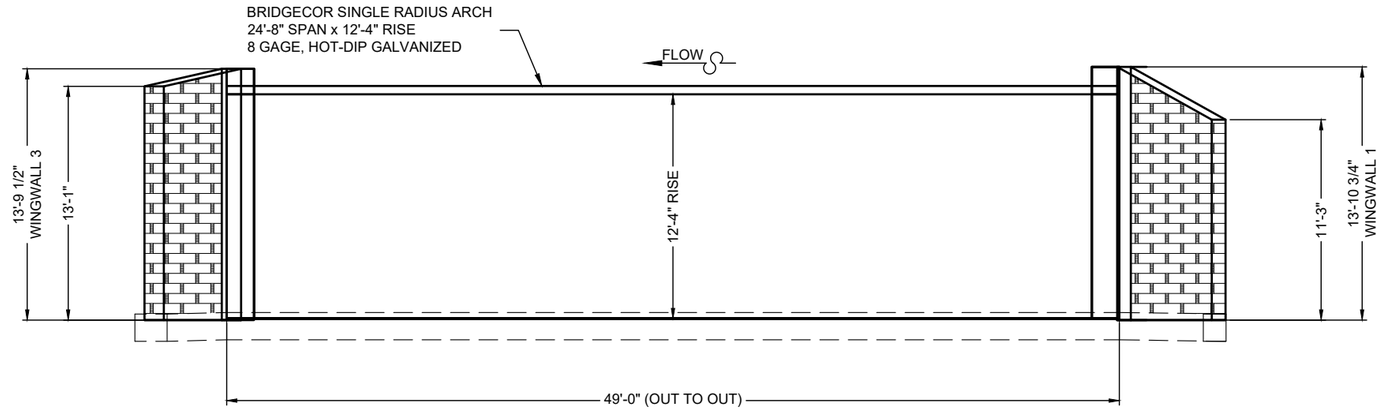
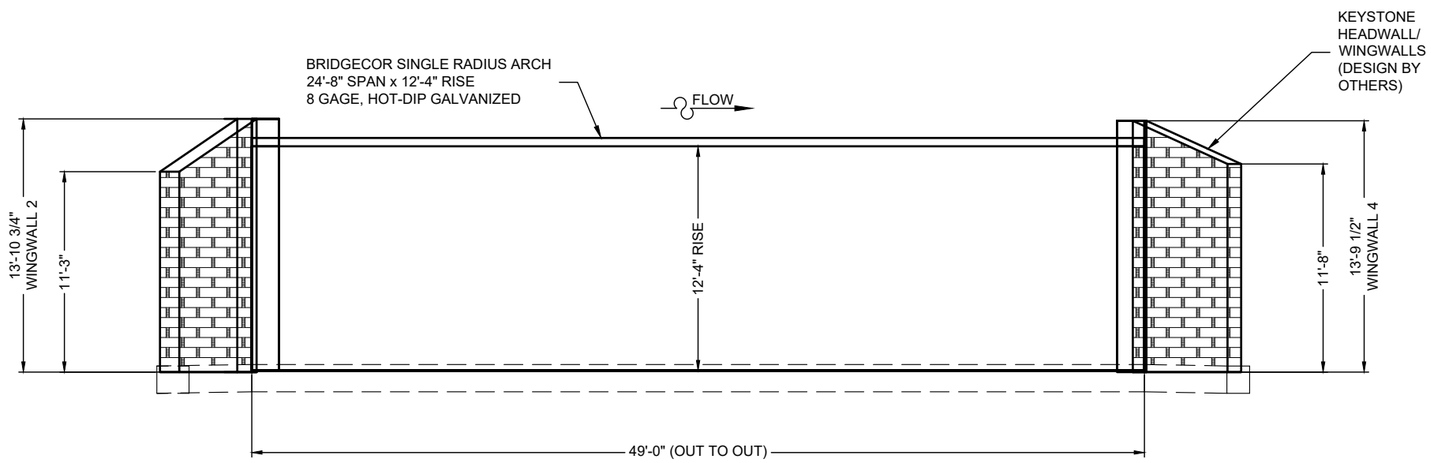


PROFILE SECTION B-B

SCALE = 1:100



PROFILE SECTION C-C

SCALE = 1:100

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CONTECH® STRUCTURAL PLATE

CONTRACT DRAWING

BRIDGECOR SINGLE RADIUS ARCH
24'-8" SPAN x 12'-4" RISE
MILL CREEK FISH PASSAGE
PESHASTIN, WA

PROJECT No.:	SEQ. No.:	DATE:
584279	020	6/4/2020
DESIGNED:		DRAWN: KKV/SCC
CHECKED: DJS/JAH		APPROVED:
SHEET NO.: 5 OF 10		

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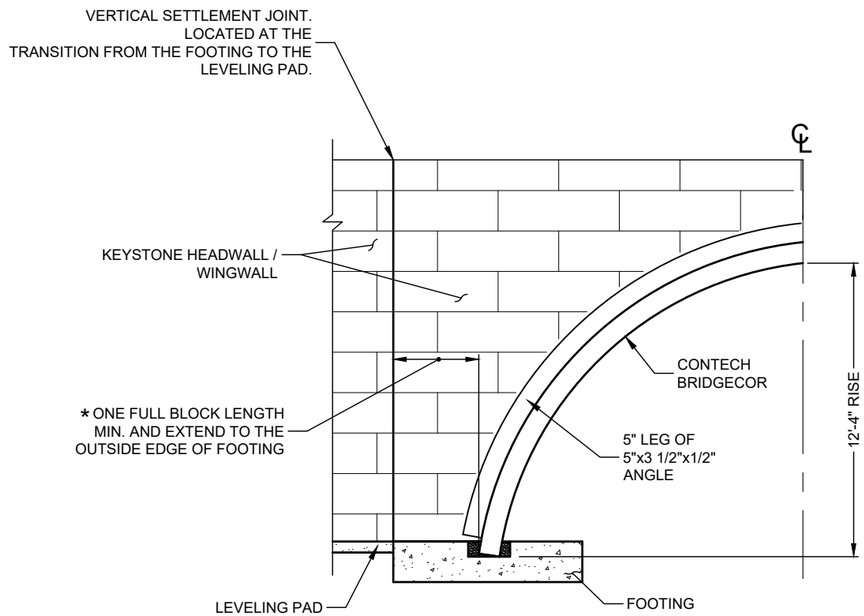

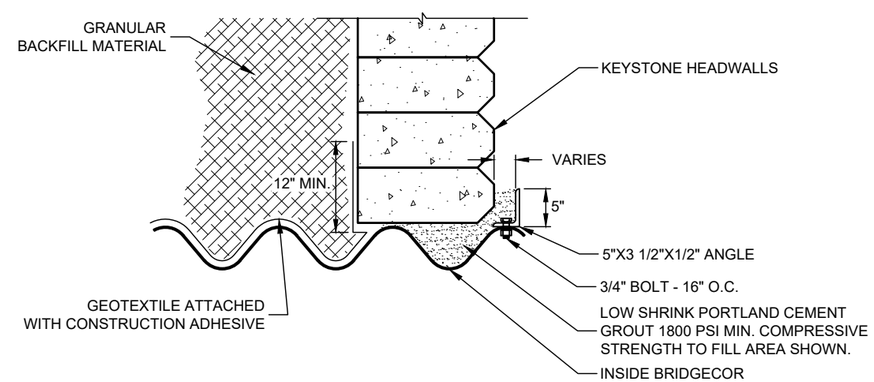

* AS DESIGNED BY THE ENGINEER, THE REINFORCED CONCRETE FOOTINGS MAY BE WIDENED AT THE ENDS OF THE STRUCTURE TO:

- ACCOUNT FOR THE HEADWALL WIDTH.
- MAINTAIN THE SETTLEMENT JOINT AT THE FOOTING / LEVELING PAD INTERSECTION.
- COMBINE THE ABOVE WITH A WINGWALL INTERSECTION AS REQUIRED.

NOTES:

1. OUT TO OUT OF FOOTING IS A CRITICAL DIMENSION. SEE PLAN VIEW.
2. REFERENCE WALL DESIGN DETAILS FOR SPECIFIC INFORMATION.

RECOMMENDED KEYSTONE HEADWALL DETAILS

SCALE = N.T.S.

6/19/20

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MARK	DATE	REVISION DESCRIPTION	BY

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CONTECH STRUCTURAL PLATE

CONTRACT DRAWING

BRIDGECOR SINGLE RADIUS ARCH
24'-8" SPAN x 12'-4" RISE
MILL CREEK FISH PASSAGE
PESHASTIN, WA

PROJECT No.:	SEQ. No.:	DATE:
584279	020	6/4/2020
DESIGNED:	DRAWN: KKV/SCC	
CHECKED: DJS/JAH	APPROVED:	
SHEET NO.: 6 OF 10		

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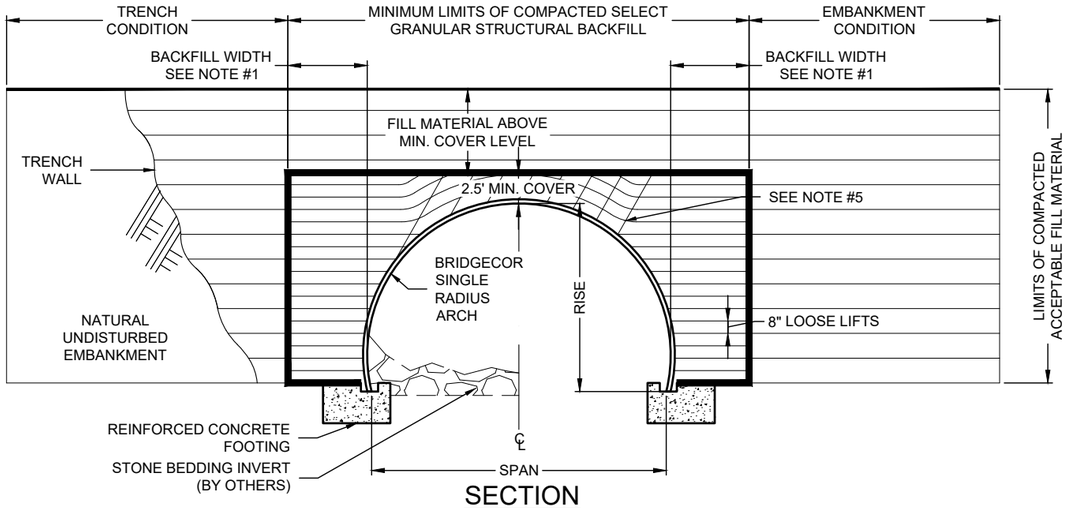

SECTION

SELECT GRANULAR STRUCTURAL BACKFILL LIMITS.

INITIAL LIFTS OVER THE CROWN OF STRUCTURE AS INDICATED BY SHADED AREA TO BE COMPACTED TO REQUIRED DENSITY WITH HAND OPERATED EQUIPMENT OR WITH LIGHTWEIGHT TRACTOR (D-4 OR LIGHTER) EQUIPMENT.

NOTES:

1. MINIMUM SELECT GRANULAR STRUCTURAL BACKFILL WIDTH IS BASED ON AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12 AND/OR THE RESULTS OF THE PROJECT SPECIFIC FINITE ELEMENT ANALYSIS.
2. ALL SELECT GRANULAR STRUCTURAL BACKFILL TO BE PLACED IN A BALANCED FASHION IN THIN LIFTS (8" LOOSE TYPICALLY) AND COMPACTED TO 90 PERCENT DENSITY PER AASHTO T-180.
3. MONITORING OF THE SINGLE RADIUS ARCH STRUCTURE IS REQUIRED DURING THE BACKFILLING PROCESS. THE METHOD, FREQUENCY AND DURATION SHALL BE DETERMINED BASED ON THE SIZE AND SHAPE OF THE STRUCTURE.
4. PREVENT DISTORTION OF SHAPE AS NECESSARY BY VARYING COMPACTION METHODS AND EQUIPMENT.
5. PLACE SELECT GRANULAR STRUCTURAL BACKFILL IN RADIAL LIFTS AT APPROXIMATELY 75% OF THE RISE OF THE SINGLE RADIUS ARCH STRUCTURE.
6. BECAUSE OF THE FLEXING AND VIBRATION OF THE CROWN PLATES, THE FULL COMPACTION DENSITY LEVELS OFTEN CAN NOT BE ACHIEVED IN THE FIRST SEVERAL INCHES OF FILL OVER THE CROWN.

BASED ON A PROJECT SPECIFIC ANALYSIS GAGE TO BE **8**, BACKFILL MATERIAL TO BE **A-1**, COMPACTED TO **90** % PER AASHTO T-180.

IF OTHER BACKFILL MATERIALS ARE TO BE EVALUATED, CONTACT YOUR LOCAL CONTECH REPRESENTATIVE.

ADDITIONAL SELECT GRANULAR STRUCTURAL BACKFILL NOTES:

SATISFACTORY BACKFILL MATERIAL, PROPER PLACEMENT, AND COMPACTION ARE KEY FACTORS IN OBTAINING MAXIMUM STRENGTH AND STABILITY.

THE BACKFILL MATERIAL SHOULD BE FREE OF ROCKS, FROZEN LUMPS, AND FOREIGN MATERIAL THAT COULD CAUSE HARD SPOTS OR DECOMPOSE TO CREATE VOIDS. BACKFILL MATERIAL SHOULD BE WELL GRADED GRANULAR MATERIAL THAT MEETS THE REQUIREMENTS OF THE PROJECT SPECIFIC ANALYSIS NOTED BELOW. REFERENCE THE STRUCTURAL PLATE BACKFILL GROUP CLASSIFICATION TABLE ON THIS SHEET. RECYCLED CONCRETE/SLAG ARE NOT RECOMMENDED FOR STRUCTURAL BACKFILL MATERIAL.
BACKFILL MUST BE PLACED SYMMETRICALLY ON EACH SIDE OF THE STRUCTURE IN 8" LOOSE LIFTS. EACH LIFT IS TO BE COMPACTED TO A MINIMUM OF 90% DENSITY PER AASHTO T-180.

A HIGH PERCENTAGE OF SILT OR FINE SAND IN THE NATIVE SOILS SUGGESTS THE NEED FOR A WELL GRADED GRANULAR BACKFILL MATERIAL TO PREVENT SOIL MIGRATION. IF THE PROPOSED BACKFILL IS NOT A WELL GRADED GRANULAR MATERIAL, A NON-WOVEN GEOTEXTILE FILTER FABRIC SHALL BE PLACED BETWEEN THE SELECT BACKFILL AND THE IN SITU MATERIAL.

DURING BACKFILL, ONLY LIGHTWEIGHT TRACKED VEHICLES (D-4 OR LIGHTER) SHOULD BE NEAR THE STRUCTURE AS FILL PROGRESSES ABOVE THE CROWN AND TO THE FINISHED GRADE. THE ENGINEER AND CONTRACTOR ARE CAUTIONED THAT THE MINIMUM COVER MAY NEED TO BE INCREASED TO HANDLE TEMPORARY CONSTRUCTION VEHICLE LOADS (HEAVIER THAN D-4).

STRUCTURAL PLATE BACKFILL GROUP CLASSIFICATION, REFERENCE AASHTO M-145		
GROUP CLASSIFICATION	**A-1-a**	**A-1-b**
Sieve Analysis Percent Passing		
No. 10 (2.000 mm)	**50 max.**	**----**
No. 40 (0.425 mm)	**30 max.**	**50 max.**
No. 200 (0.075 mm)	**15 max.**	**25 max.**
Atterberg Limits for Fraction Passing No. 40 (0.425 mm)		
Liquid Limits	**----**	**----**
Plasticity Index	**6 max.**	**6 max.**
Usual Materials	**Stone Fragment, Gravel and Sand**	

*Modified from AASHTO M-145.

Fine beach sands, windblown sands, stream deposited sands, etc., exhibiting fine, rounded particles and typically classified by AASHTO M-145 as A-3 Materials should not be used.

If 95% compaction per AASHTO T-180 is specified, the backfill material shall be A-1-a.

Reference the most current version of ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), for comparable soil groups.

1.0 STANDARDS AND DEFINITIONS

1.1 STANDARDS - All standards refer to the current ASTM/AASHTO edition unless otherwise noted.

1.1.1 ASTM A761 "Corrugated Steel Structural Plate, Zinc Coated for Field-Bolted Pipe, Pipe-Arches and Arches" (AASHTO Designation M-167).

1.1.2 AASHTO Standard Specification for Highway Bridges - Section 12 Division I - Design, AASHTO LRFD Bridge Design Specifications Section 12.

1.1.3 AASHTO Standard Specification for Highway Bridges - Section 26 Division II - Construction, AASHTO LRFD Bridge Construction Specifications - Section 26. ASTM A807, Standard Practice for Installing Corrugated Steel Structural Plate Pipe.

1.2 DEFINITIONS

1.2.1 Owner - In these specifications the word "Owner" shall mean NATURAL SYSTEM DESIGN.

1.2.2 Engineer - In these specifications the word "Engineer" shall mean the Engineer of Record or Owner's designated engineering representative.

1.2.3 Manufacturer - In these specifications the word "Manufacturer" shall mean CONTECH ENGINEERED SOLUTIONS 800-338-1122 KIMBERLY CIMAROLLI.

1.2.4 Contractor - In these specifications the word "Contractor" shall mean the firm or corporation undertaking the execution of any installation work under the terms of these specifications.

1.2.5 Approved - In these specifications the word "approved" shall refer to the approval of the Engineer or his designated representative.

1.2.6 As Directed - In these specifications the words "as directed" shall refer to the directions to the Contractor from the Owner or his designated representative.

2.0 GENERAL CONDITIONS

2.1 Any installation provided herein shall be endorsed by the Engineer; discrepancies herein are governed by the Engineer's plans and specifications.

2.2 The Contractor shall furnish all labor, material and equipment and perform all work and services except those set out and furnished by the Owner, necessary to complete in a satisfactory manner the site preparation, excavation, filling, compaction, grading as shown on the plans and as described therein. This work shall consist of all mobilization clearing and grading, grubbing, stripping, removal of existing material unless otherwise stated, preparation of the land to be filled, filling of the land, spreading and compaction of the fill, and all subsidiary work necessary to complete the grading of the cut and fill areas to conform with the lines, grades, slopes, and specifications. This work is to be accomplished under the observation of the Owner or his designated representative.

2.3 Prior to bidding the work, the Contractor shall examine, investigate and inspect the construction site as to the nature and location of the work, and the general and local conditions at the construction site, including without limitation, the character of surface or subsurface conditions and obstacles to be encountered on and around the construction site and shall make such additional investigation as he may deem necessary for the planning and proper execution of the work.

If conditions other than those indicated are discovered by the Contractor, the Owner shall be notified immediately. The material which the Contractor believes to be a changed condition shall not be disturbed so that the owner can investigate the condition.

2.4 The construction shall be performed under the direction of the Engineer.

2.5 All aspects of the structure design and site layout including foundations, backfill, end treatments and necessary scour consideration shall be performed by the Engineer.

3.0 ASSEMBLY AND INSTALLATION

3.1 Bolts and nuts shall conform to the requirements of ASTM A449. The single radius arch structure shall be assembled in accordance with the plate layout drawings provided by the Manufacturer and per the Manufacturer's recommendations.

Bolts shall be tightened using an applied torque of between 100 and 300 ft.-lbs.

3.2 The single radius arch structure shall be installed in accordance with the plans and specifications, the Manufacturer's recommendations, and AASHTO Standard Specification for Highway Bridges - Section 26 Division II - Construction/AASHTO LRFD Bridge Construction Specifications - Section 26.

3.3 Trench excavation shall be made in embankment material that is structurally adequate. The trench width shall be shown on the plans. Poor quality in situ embankment material must be removed and replaced with suitable backfill as directed by the Engineer.

3.4 Bedding preparation is critical to both structure performance and service life. The bed should be constructed to uniform line and grade to avoid distortions that may create undesirable stresses in the structure and/or rapid deterioration of the roadway. The bed should be free of rock formations, protruding stones, frozen lumps, roots, and other foreign matter that may cause unequal settlement.

3.5 The structure shall be assembled in accordance with the Manufacturer's instructions. All plates shall be unloaded and handled with reasonable care. Plates shall not be rolled or dragged over gravel rock and shall be prevented from striking rock or other hard objects during placement in trench or on bedding.

3.6 The structure shall be backfilled using clean well graded granular material. Backfill must be placed symmetrically on each side of the structure in 8 inch loose lifts. Each lift shall be compacted to the specified density.

3.7 If temporary construction vehicles are required to cross the structure, it is the Contractor's responsibility to contact the Engineer to determine the amount of additional minimum cover necessary to handle the specific loading condition.

Normal highway traffic is not allowed to cross the structure until the structure has been backfilled and paved. If the road is unpaved, cover allowance to accommodate rutting shall be as directed by the Engineer.

3.8 If a metal headwall and/or wingwall system is specified, the select granular structural backfill limits shall extend past the deadman anchor system. Contact the Engineer if stiff material or rock is encountered where the wingwalls and deadman are to be installed.

6/19/20

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www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH STRUCTURAL PLATE

CONTRACT DRAWING

BRIDGECOR SINGLE RADIUS ARCH
24'-8" SPAN x 12'-4" RISE
MILL CREEK FISH PASSAGE
PESHASTIN, WA

PROJECT No.: 584279	SEQ. No.: 020	DATE: 6/4/2020
DESIGNED:	DRAWN: KKV/SCC	
CHECKED: DJS/JAH	APPROVED:	
SHEET NO.: 7 OF 10		

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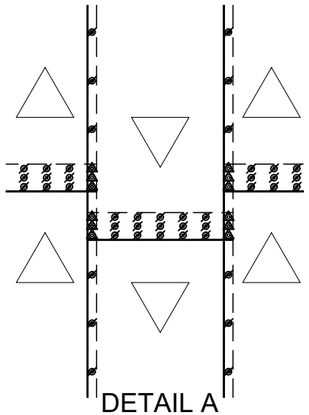
ALL COMPONENTS MUST BE ASSEMBLED IN THE SAME ORIENTATION AS SHOWN IN THIS DETAIL. PAY CLOSE ATTENTION TO MARK NUMBERS ON THE COMPONENTS.

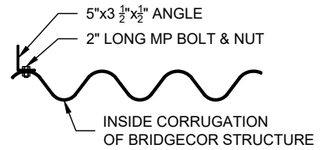


LEGEND

- ⌀ 2 PLATE LAP SEAMS - 1½" LONG BOLT
- △ 3-PLATE SEAM - 2" LONG BOLT

DETAIL A

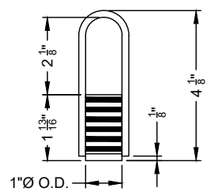
SCALE: N.T.S.

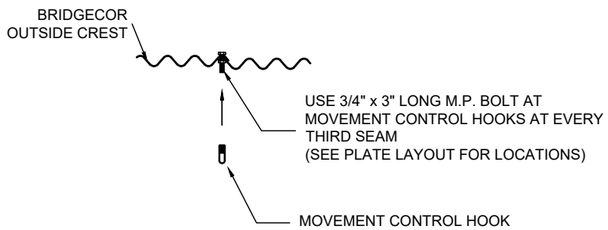


SECTION C-C

SCALE: N.T.S.

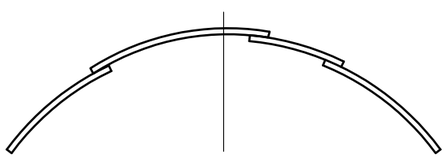
MATERIAL
8 GAGE HOT-DIP GALVANIZED





MOVEMENT CONTROL HOOK DETAIL

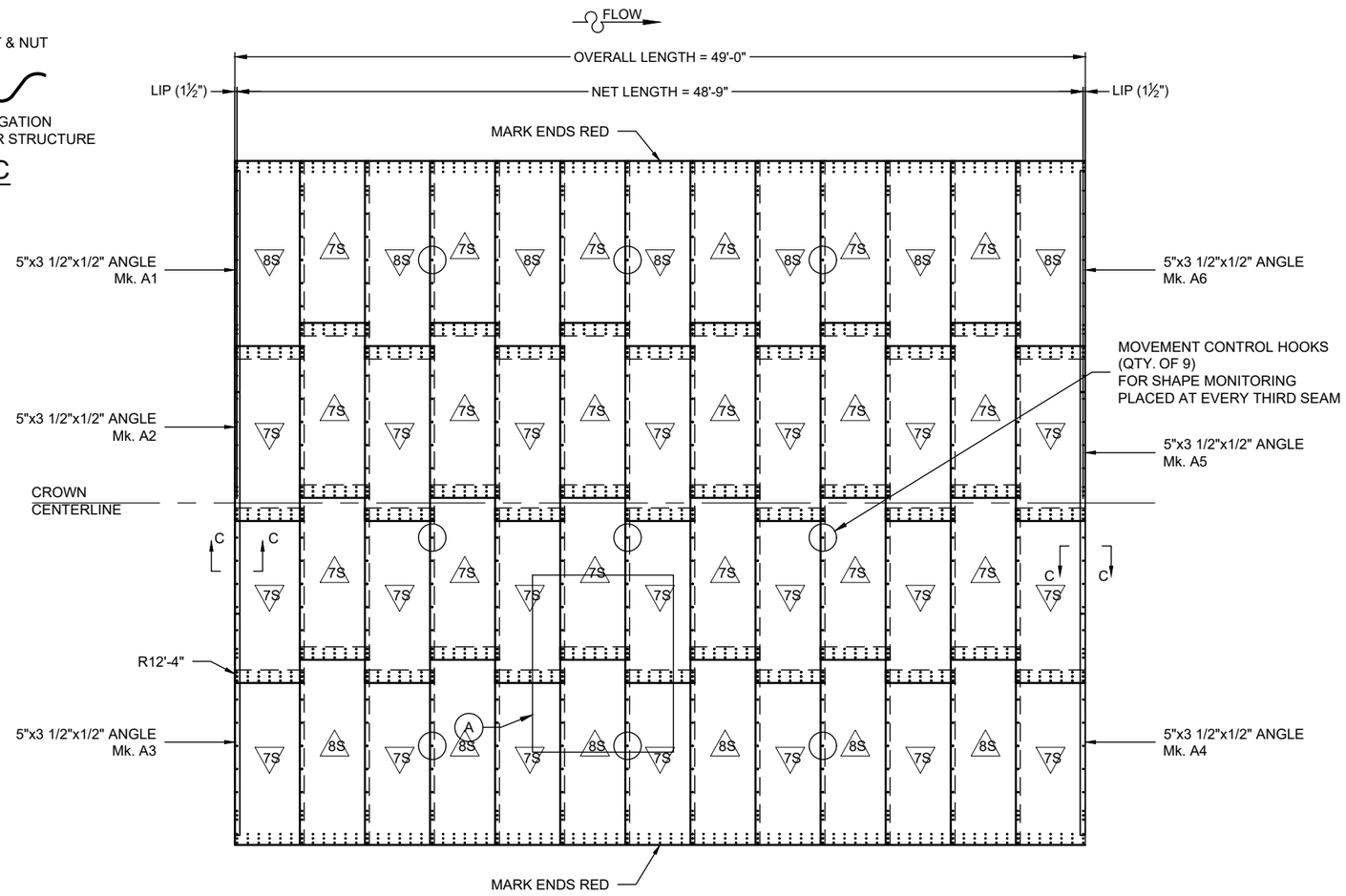
SCALE: N.T.S.



4 PLATE
STRUCTURE

PLATE LAPPING DETAIL (LOOKING DOWNSTREAM)

SCALE = N.T.S.



BRIDGECOR SINGLE RADIUS ARCH (OUTSIDE VIEW)

24'-8" SPAN x 12'-4" RISE

SCALE = 1:100

6/19/20

BridgeCor

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CONTECH STRUCTURAL PLATE

CONTRACT DRAWING

BRIDGECOR SINGLE RADIUS ARCH
24'-8" SPAN x 12'-4" RISE
MILL CREEK FISH PASSAGE
PESHASTIN, WA

PROJECT No.:	SEQ. No.:	DATE:
584279	020	6/4/2020
DESIGNED:	DRAWN: KKV/SCC	
CHECKED: DJS/JAH	APPROVED:	
SHEET NO.: 8 OF 10		

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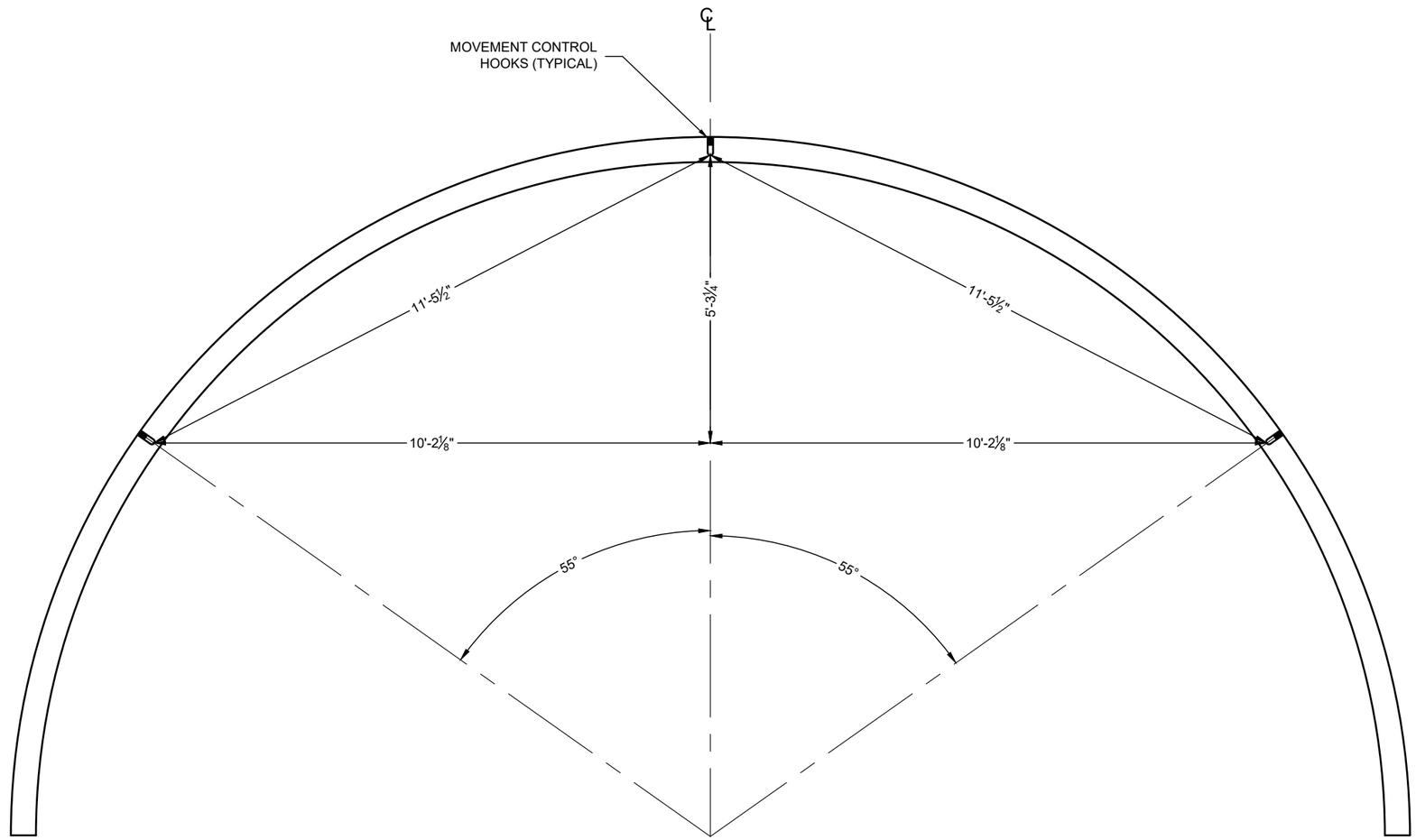

MOVEMENT CONTROL HOOK PLACEMENT DETAIL

SCALE = 1:30

BridgeCor

TRAVIS LOREN SCHNEIDER
STATE OF WASHINGTON
43457
REGISTERED
PROFESSIONAL ENGINEER
6/19/20

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CONTECH STRUCTURAL PLATE

CONTRACT DRAWING

BRIDGECOR SINGLE RADIUS ARCH
24'-8" SPAN x 12'-4" RISE
MILL CREEK FISH PASSAGE
PESHASTIN, WA

PROJECT No.:	SEQ. No.:	DATE:
584279	020	6/4/2020
DESIGNED:		DRAWN: KKV/SCC
CHECKED: DJS/JAH		APPROVED:
SHEET NO.: 9 OF 10		

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GENERAL NOTES:

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH 2020 WASHINGTON STANDARD SPECIFICATIONS, AASHTO GUIDELINES AND OTHER APPLICABLE LOCAL BUILDING CODES, STANDARDS AND ORDINANCES.
2. CONTRACTOR IS RESPONSIBLE FOR ALL CONSTRUCTION MEANS AND METHODS AND VERIFYING FIELD CONDITIONS AND DIMENSIONS MATCH THOSE DESCRIBED IN PROJECT PLANS AND REPORTS.
3. VERIFICATION OF LOCATION, DEPTH AND REQUIRED CLEARANCES FROM ALL UTILITIES (UNDERGROUND AND OTHERWISE) ARE THE RESPONSIBILITY OF THE CONTRACTOR.
4. FOOTINGS ARE TO BE PRECAST AND DELIVERED TO THE PROJECT SITE. PLAN DIMENSIONS, ORIENTATION AND ELEVATIONS SHALL MATCH CONTECH CULVERT PLANS AND PROJECT CIVIL PLANS. PRECASTING CONTRACTOR IS RESPONSIBLE FOR DETAILING PRECAST SECTIONS (LIFT POINTS, PICKING HARDWARE, SEGMENT LENGTHS, ETC.). ONCE IN PLACE, FOOTING SEGMENTS SHALL BE ADEQUATELY CONNECTED TO ONE ANOTHER PER DETAIL C THIS SHEET, OR OTHER METHODS AS APPROVED BY THE ENGINEER.
5. BRIDGECOR SINGLE RADIUS ARCH CULVERT STRUCTURE IS DESIGNED AND SUPPLIED BY CONTECH ENGINEERED SOLUTIONS, LLC.

DESIGN NOTES:

1. DESIGN BASED ON PROJECT PLANS "MILL CREEK FISH PASSAGE PROJECT, CHELAN COUNTY, WASHINGTON ", DATED APRIL 10, 2020.
2. FOUNDATION DESIGN BASED ON CONTECH PROJECT NO. 584279.
3. FOOTING IS DESIGNED FOR CULVERT WITH:
   SPAN = 24'-8"
   RISE = 12'-4"
   COVER OVER CULVERT = 4'-6"
4. DESIGN LOADS:

DEAD LOADS:	SOIL = 130 PCF
VEHICLE LOADS:	HL-93
ALLOWABLE SOIL BEARING CAPACITY:	9,500 PSF (SERVICE LIMIT STATE)
LATERAL EARTH PRESSURES:	ACTIVE = 35 PCF
	PASSIVE = 200 PCF

GEOTECHNICAL NOTES:

1. GEOTECHNICAL DESIGN PARAMETERS WERE PROVIDED BY PANGEO, INC. IN A REPORT TITLED, "FINAL GEOTECHNICAL REPORT, MILL CREEK FISH PASSAGE PROJECT, CHELAN COUNTY, WASHINGTON, PROJECT NO. 14-095" DATED MARCH 23, 2020.
2. CONTRACTOR IS RESPONSIBLE FOR COMPLIANCE WITH ALL RECOMMENDATIONS CONTAINED IN ABOVE REFERENCED REPORT.
3. FOUNDATION DESIGNED FOR ALLOWABLE BEARING CAPACITY OF 9.5 KSF (SERVICE) AND 29 KSF (STRENGTH), PER FIGURE 4B OF ABOVE REFERENCED REPORT.
4. FOUNDATIONS TO BE CONSTRUCTED OVER A MINIMUM OF 12" WELL COMPACTED COARSE BEDDING MATERIAL PER ABOVE REFERENCED REPORT.
5. CONTRACTOR IS RESPONSIBLE FOR OBTAINING GOTECHNICAL ENGINEERS APPROVAL OF FOUNDATION EXCAVATIONS.
6. BACKFILL SHALL HAVE A MAXIMUM UNIT WEIGHT OF 130 PCF AND SHALL BE PLACED AND COMPACTED PER CONTECH SPECIFICATIONS.
7. THE BOTTOM OF FOOTINGS SHALL EXTEND BELOW THE ANTICIPATED SCOUR DEPTH AND SHALL BE PROTECTED FROM SCOUR BY PROPERLY DESIGNED REVETMENT. SCOUR WAS NOT INDEPENDENTLY EVALUATED BY PACIFIC AFFILIATES OR CONTECH.
8. SUFFICIENT COVER SHOULD BE PROVIDED BELOW FINISHED GRADE TO PROTECT THE FOOTINGS FROM FROST (IF APPLICABLE).

CONCRETE NOTES:

1. ALL CONCRETE SHALL MEET THE SPECIFICATIONS OF AASHTO CLASS A CONCRETE WITH A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI AT 28 DAYS.
2. ALL CONCRETE WORK SHALL CONFORM TO THE REQUIREMENTS OF 2020 WASHINGTON STANDARD SPECIFICATIONS AND AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, DIVISION II - CONSTRUCTION, SECTION 8, "CONCRETE STRUCTURES" FOR MATERIALS, QUALITY, MIXING, PLACING, FORMWORK AND DETAILING. IN CASE OF CONFLICT, THE MORE STRINGENT REQUIREMENT SHALL GOVERN.

REINFORCING STEEL NOTES:

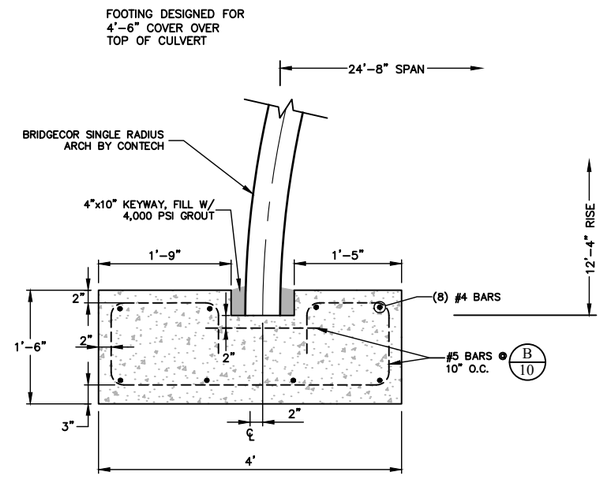
1. ALL REINFORCING STEEL IS TO MEET ASTM 615, GRADE 60.
2. REINFORCING BARS SHALL BE PROVIDED, PREPARED, PLACED AND PROTECTED IN ACCORDANCE WITH 2020 WASHINGTON STANDARD SPECIFICATIONS.
3. REINFORCING BARS SHALL BE HELD SECURELY IN PLACE DURING PLACING OF CONCRETE BY TIES AT ALL INTERSECTIONS. DOBIES, OR EQUIVALENT, SHALL BE USED TO SUPPORT BARS. OTHER METHODS MAY BE APPROVED TO SECURE AND/OR SUPPORT BARS.
4. CONCRETE COVER FOR REINFORCING BARS SHALL BE AS SHOWN ON THE PLANS AND SHALL COMPLY WITH 2020 WASHINGTON STANDARD SPECIFICATIONS OR AS FOLLOWS:

4.1. CONCRETE CAST AGAINST EARTH	3"
4.2. CONCRETE EXPOSED TO EARTH OR WEATHER	2"
4.3. CONCRETE NOT EXPOSED TO EARTH OR WEATHER	1½"

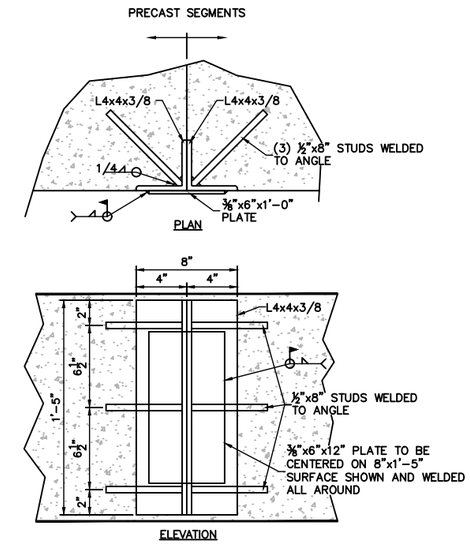
5. REINFORCING BARS SHALL BE IN AS LONG OF LENGTHS AS PRACTICABLE AND AS DETAILED. SPLICES SHALL BE CLASS A SPLICES OR 40 BAR DIAMETERS. SPLICES SHALL BE STAGGERED WITH SPLICES IN ADJACENT BARS BY A MINIMUM OF 30 INCHES.
6. MINIMUM BEND DIAMETERS SHALL COMPLY WITH THE CRSI "MANUAL OF STANDARD PRACTICE".
7. STANDARD HOOKS SHALL COMPLY WITH THE CRSI "MANUAL OF STANDARD PRACTICE".
8. ALL BARS SHALL TERMINATE IN A SPLICE OR A STANDARD HOOK.

SLOTTED KEYWAY NOTES:

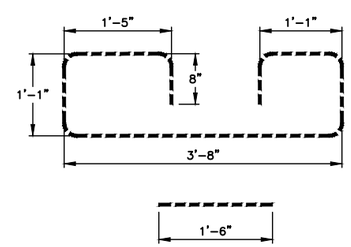
1. STRUCTURAL PLATE TO BE GROUTED INTO SLOTTED FOOTING WITH 4,000 PSI NON-METALLIC, NON-SHRINK GROUT
2. KEYWAY TO BE 4" DEEP BY 10" WIDE AND SHALL BE OFFSET 2" FROM THE CENTERLINE OF THE FOOTING TOWARD THE INTERIOR OF THE STRUCTURE.
3. INSTALL LEG OF STRUCTURE AT CENTER OF KEYWAY. BLOCKING OR SHIMMING SIDE PLATES TO ACHIEVE AND MAINTAIN PROPER BOTTOM SPAN AND SIDE RETURN ANGLE MAY BE REQUIRED.
4. GROUT AND SHIMMING MATERIAL SHOULD NOT CONTAIN ANY CORROSION-PROMOTING AGENTS



A TYPICAL FOOTING SECTION
NOT TO SCALE

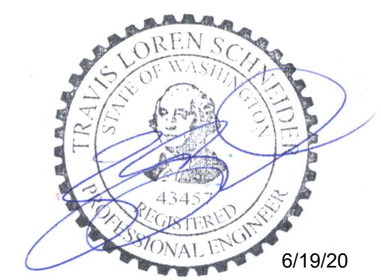


C WELD PLATE
NOT TO SCALE



NOTE:
HORIZONTAL DIMENSIONS SHOWN ASSUME CONCRETE CAST AGAINST FORMS. ADJUST DIMENSIONS FOR INCREASED COVER IF CONCRETE IS CAST AGAINST EARTH.

B REINFORCING DETAIL
NOT TO SCALE



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24'-8" SPAN x 12'-4" RISE
MILL CREEK FISH PASSAGE
PESHASTIN, WA

PROJECT No.:	SEQ. No.:	DATE:
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DESIGNED:		DRAWN: KKV/SCC
CHECKED: DJS/JAH		APPROVED:
SHEET NO.: 10 OF 10		

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FOUNDATION DESIGN CALCULATIONS

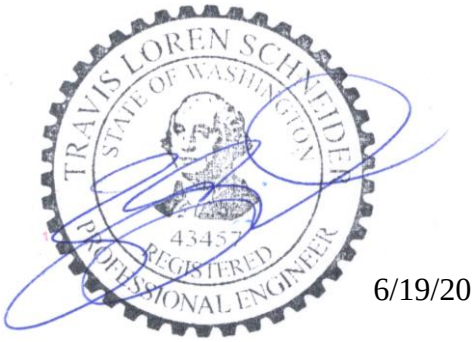
BRIDGECOR SINGLE RADIUS ARCH

MILL CREEK FISH PASSAGE
PESHASTIN, WA
CONTECH E.S. JOB NO. 584279
PA JOB NO. 20-2673

PREPARED BY:

PACIFIC AFFILIATES, INC.
A CONSULTING ENGINEERING GROUP
990 WEST WATERFRONT DRIVE
EUREKA, CA 95501
(707) 445-3001

JUNE 19, 2020



6/19/20

TRAVIS SCHNEIDER, R.P.E. 43457

June 19, 2020
PA Job No. 20-2673

BridgeCor Single Radius Arch Culvert Footing Design
Mill Creek Fish Passage Project
Peshastin, WA
Contech ES Job No. 584279

Design Criteria		
Culvert span, S (ft)	24.67	
Culvert rise, R (ft)	12.33	
Radius (ft)	12.33	
Height of cover above culvert, H_c (ft)	4.50	
Height of cover above top of foundation, H_1 (ft)	16.83	
Unit weight of soil, γ (pcf)	130	Geotech p. 7
Allowable bearing pressure, q_a (psf)	9500	Varies see Geotech Figure 4b
Nominal bearing pressure, q_n (psf)	29000	Varies see Geotech Figure 4b
Friction factor, f	0.65	Geotech Table 1, p. 8
Design vehicle loading	HL-93	
Number of Lanes	2	
Axle load, A_L (k)	50	
Sectional area inside of arch, A_t (sf)	238.3	
Return angle of structure, Δ (deg)	0.1	
Unfactored Reactions		
Live Load Reaction, V_{LL} (lb/ft)	2400	AASHTO 12.8.4.2
Dead Load Reaction, V_{DL} (lb/ft)	11500	AASHTO 12.8.4.2
Total Load, V (lb/ft)	13900	
Vertical Live Load Reaction (lb/ft)	2400	Reactions from CANDE Analysis Govern
Horizontal Live Load Reaction (lb/ft)	4	
Vertical Dead Load Reaction (lb/ft)	13810	
Horizontal Dead Load Reaction (lb/ft)	27	
Vertical Reaction, R_v (lb/ft)	16470	Reactions from CANDE Analysis Govern
Distance from O (ft)	0.17	
Horizontal Reaction, R_h (lb/ft)	32	
Distance from O (ft)	1.17	

Vertical Loads

Soil at exterior side of culvert

Soil pressure on top of footing (psf)	2188	
Width of footing supporting overburden soil (ft)	2.17	
Weight of soil on footing (lb/ft)	4741	
Distance from center of footing (ft)	-0.92	

Soil at interior side of culvert

Height of fill inside of culvert, H_i (ft)	4.00	
Soil pressure on top of footing (psf)	520	
Width of footing supporting overburden soil (ft)	1.83	
Weight of soil on footing (lb/ft)	953	
Distance from O (ft)	1.08	

Footing

Footing thickness (ft)	1.50	
Preliminary footing width, b (ft)	2.34	
Use B (ft)	4.00	
Weight of footing, W_{ftg} (lb/ft)	900	

Horizontal Loads

Soil

Active equivalent fluid pressure	35	Geotech p. 6
Rectangular pressure (psf)	589	
Rectangular force, P_1 (lb/ft)	884	
Distance from O (ft)	0.75	
Triangular force (lb/ft)	39	
Distance from O (ft)	0.50	
Horizontal Earth Force, F_h (lb/ft)	923	
Passive equivalent fluid pressure	200	Geotech Table 1, p. 8
Rectangular pressure (psf)	3367	
Rectangular force, P_1 (lb/ft)	5050	
Distance from O (ft)	0.75	
Triangular force (lb/ft)	225	
Distance from O (ft)	0.50	
Horizontal Earth Force, F_h (lb/ft)	5275	

Service I Limit State per AASHTO

Unfactored Loads

Live Load Reaction, V_{LL} (lb/ft)	2400
Dead Load Reaction, V_{DL} (lb/ft)	11500
Soil Weight, W_s (lb/ft)	5261
Weight of footing, W_{ftg} (lb/ft)	900
Vertical Reaction, R_v (lb/ft)	21731
Horizontal Reaction, R_h (lb/ft)	32
Total Vertical Load, V_v (lb/ft)	22631
Total Horizontal Load, V_h (lb/ft)	32

Soil Bearing Pressures

Moment about O, M_o (lb-ft)	77
Sum of Vertical Loads, Q (lb/ft)	23065
Eccentricity, e (ft)	0.003
B/6	0.667
e < B/6	**OK**
Maximum Gross Bearing Pressure, q_{max} (psf)	5795
Minimum Gross Bearing Pressure, q_{min} (psf)	5737
Maximum Net Bearing Pressure, q_{net} (psf)	5795
$q_a > q_{net}$	**OK**
Effective Footing Width, B' (ft)	3.99
Net Bearing Pressure on Effective Footing, q'_{net} (psf)	5776
$q_a > q'_{net}$	**OK**

Sliding

Horizontal Reaction, R_h (lb/ft)	32
Active earth pressure force, F_h (lb/ft)	923
Allowable frictional resistance, $R_{\tau,all}$ (lb/ft)	13263
Allowable passive pressure, $P_{p,all}$ (lb/ft)	5275
Factor of Safety	14.37
$R_{t,all}/F_h$, FS > 1.5	**OK**

Overturning

Overturning Moment, OM (lb-ft)	683
Resisting Moment, RM (lb-ft)	41821
Factor of Safety	61.3
RM/OM, FS > 1.5	**OK**

Strength I Limit State per AASHTO

Factored Loads

Vertical Live Load Reaction, $\gamma_{LL}V_{LL}$ (lb/ft)	4200
Vertical Dead Load Reaction, $\gamma_p V_{DL}$ (lb/ft)	20715
Horizontal Live Load Reaction, $\gamma_{LL}V_{LL}$ (lb/ft)	7
Horizontal Dead Load Reaction, $\gamma_p V_{DL}$ (lb/ft)	41
Soil weight at exterior, $\gamma_p W_s$ (lb/ft)	6164
Distance from O (ft)	-0.92
Soil weight at interior, $\gamma_p W_s$ (lb/ft)	1239
Distance from O (ft)	1.08
Weight of footing, $\gamma_p W_{ftg}$ (lb/ft)	1125
Vertical Reaction, γR_v (lb/ft)	24915
Distance from O (ft)	0.17
Horizontal Reaction, γR_h (lb/ft)	48
Distance from O (ft)	1.17
Total Vertical Load, γV_v (lb/ft)	33443
Total Horizontal Load, γV_h (lb/ft)	48

Horizontal Loads

Soil

Horizontal earth pressure factor, γ_p	1.5
Factored active equivalent fluid pressure (pcf)	52.5
Factored rectangular pressure (psf)	884
Factored rectangular force, $\gamma_p P_1$ (lb/ft)	1326
Distance from O (ft)	0.75
Factored triangular force, $\gamma_p P_2$ (lb/ft)	59
Distance from O (ft)	0.50
Factored horizontal earth force, $\gamma_p F_h$ (lb/ft)	1385

Passive earth pressure resistance factor, Φ_{ep}	0.5
Factored at rest equivalent fluid pressure (pcf)	100
Factored rectangular passive pressure (psf)	1683
Factored rectangular passive force, ϕP_1 (lb/ft)	2525
Distance from O (ft)	0.75
Factored triangular passive force, ϕP_2 (lb/ft)	113
Distance from O (ft)	0.50
Factored passive pressure, $\Phi_{ep}R_{ep}$ (lb/ft)	2638

Soil Bearing Pressures

Moment about O, M_o (lb-ft)	783
Sum of vertical loads, Q (lb/ft)	33443
Eccentricity, e (ft)	0.023
B/6	0.667
e < B/6	**OK**
Maximum factored bearing pressure, γq_{max} (psf)	8655
Minimum factored bearing pressure, γq_{min} (psf)	8067
Maximum net factored bearing pressure, γq_{net} (psf)	8655
Bearing resistance factor, ϕ_b	0.45
Factored soil bearing capacity, $\phi_b q$ (psf)	13050
$\phi_b q > \gamma q_{net}$	**OK**
Effective footing width, B' (ft)	3.95
Net bearing pressure on effective footing, $\gamma q'_{net}$ (psf)	8460
$\phi_b q > \gamma q'_{net}$	**OK**

Sliding

Factored horizontal culvert reaction, γR_h (lb/ft)	48
<u>Frictional resistance</u>	
Nominal coefficient of friction, f_n	0.65
Nominal horizontal friction, R_τ (lb/ft)	11379
Sliding resistance factor, ϕ_τ	0.80
Factored horizontal friction, $\Phi_\tau R_\tau$ (lb/ft)	9103

Active earth pressure	
Horizontal earth pressure factor, γ_p	1.5
Factored active earth pressure force, $\gamma_p F_h$ (lb/ft)	1385
Passive earth pressure	
Nominal passive pressure, R_{ep} (lb/ft)	5275
Passive earth pressure resistance factor, Φ_{ep}	0.5
Factored passive pressure, $\Phi_{ep} R_{ep}$ (lb/ft)	2638
Total resisting force	
Factored resistance to sliding, $\Phi_\tau R_\tau$ (lb/ft)	9103
$\Phi_\tau R_\tau > \gamma_p F_h$	**OK**

Overturning

Factored overturning moment, OM (lb-ft)	1024
Factored resisting moment, RM (lb-ft)	37639
Factor of Safety	36.8
RM > OM	**OK**

Concrete Design of Footing

Design Criteria	
Factored unit load, γw (lb/ft)	8655
Concrete compressive strength, f'_c (psi)	4000
Steel yield strength, f_y (psi)	60000
Length of footing heel, l_h (ft)	2.17
Length of footing toe, l_t (ft)	1.83
Factored design moment, M_u (lb-ft)	15691
Beam Design	
Beam width, b (in)	12.00
Beam height, h (in)	14.00
Distance to center of tensile rebar, d (in)	10.69
Reinforcing steel determination	
Strength reduction factor, ϕ	0.9
Rn	0.15
Minimum reinforcement ratio, ρ	0.0026
Area of steel required, $A_{s,req}$ (in^2)	0.33

Use: #5 rebar, A (in^2)	0.31
Spacing required, s (in)	11.1
Use: #5 bars at 10" o.c., As (in^2/ft)	0.37
Reinforcement ratio (As/Ag)	0.006

Flexure

β_1	0.85
c	0.64
c/d	0.06
Depth of equivalent stress block, a (in)	0.55
Nominal moment capacity, M_n (lb-ft)	19370
Strength reduction factor, ϕ	0.9
Factored moment capacity, ϕM_r (lb-ft)	17433
$M_u \leq \phi M_n$	**OK**

Code requirements for reinforcement

γ_1	1.6
γ_2	1
γ_3	0.67
Modulus of rupture, f_r (ksi)	0.48
Section modulus, S (in^3)	392
Gross moment of inertia, I_g (in^4)	2744
Cracking Moment, M_{cr} (lb-ft)	16809
1.33*M_u (lb-ft)	20869
M_{cr} governs	
$M_{cr} \leq \phi M_r$	**OK**

Rebar Spacing Check

Exposure factor, γ_e	1
Tension bar cover (in)	3
Distance from extreme tension fiber to center of rebar, d_c (in)	3.31
Stress in rebar at service limit state, f_{ss} (psi)	27459
β_s	1.44
Maximum bar spacing per AASHTO, s_{max} (in)	11.0
Actual spacing, s (in)	10
$s \leq s_{max}$	**OK**

Shear

Effective shear depth of concrete, d_v (in)	10.54
Contact Stress at Distance dv, q_{HEEL}	8256
Contact Stress at Distance dv, q_{TOE}	8514
Design shear force at Heel, V_u (lb)	7979
Design shear force at Toe, V_u (lb)	7753
β	2
Concrete shear strength, V_c (lb)	15982
θ	45
α	90
Steel shear strength, V_s (lb)	0
Nominal shear strength, V_n (lb)	15982
Strength reduction factor, ϕ	0.9
Factored shear capacity, ϕV_n (lb)	14384
$\phi V_n > V_u$	**OK**

Shrinkage and Temperature Reinforcement

Area of reinforcement in each direction and each face, $A_{s,req}$ (in^2/ft)	0.14
Number of #4 bars required in each face per foot	0.7
Use #4 @ 16" o.c. maximum in each face, A_s (in^2/ft)	0.15
$A_{s,req} \leq A_s$	**OK**

Summary:

Footing shall be 1'-6" thick by 4'-0" wide with a 4" by 10" keyway constructed 2" towards the interior of the structure from the centerline of the footing to receive the leg of the culvert structure. Install bent #5 rebar @ 10" o.c. transverse with eight (total) #4 rebar longitudinal, evenly spaced in the top and bottom of the footing. See project plans for footing details and material specifications. Footings to be precast and delivered to the project site. Precast segment lengths and lift points are the responsibility of others.

CULVERT ANALYSIS AND DESIGN (CANDE) CALCULATIONS

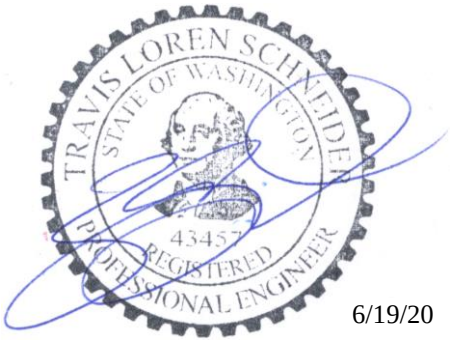
BRIDGECOR SINGLE RADIUS ARCH

MILL CREEK FISH PASSAGE
PESHASTIN, WA
CONTECH E.S. JOB NO. 584279
PA JOB NO. 20-2673

PREPARED BY:

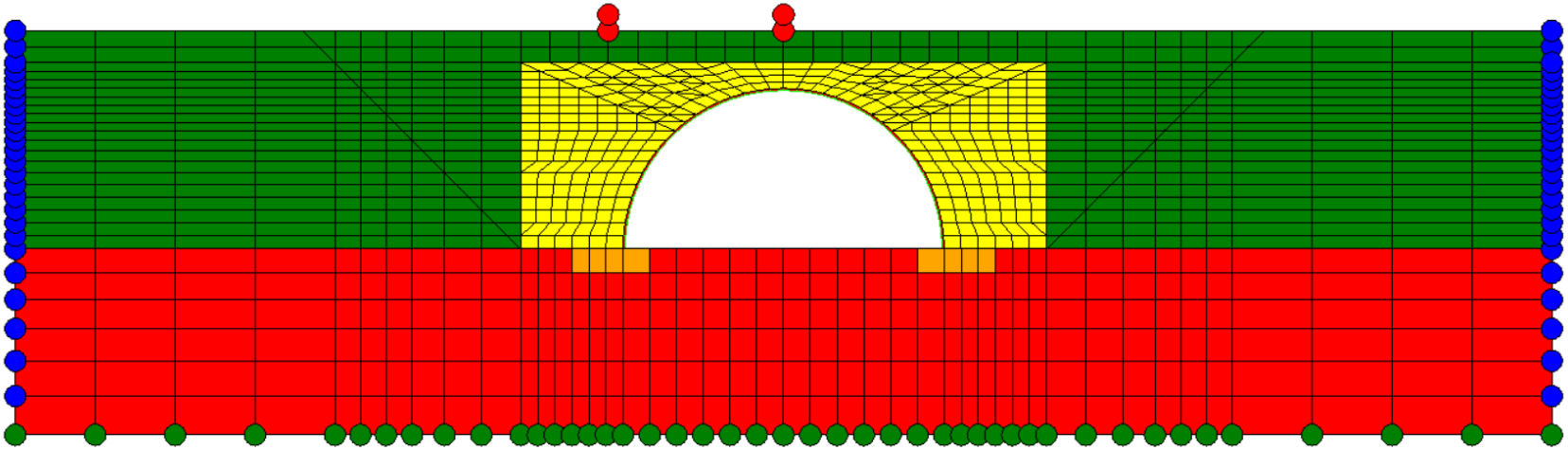
PACIFIC AFFILIATES, INC.
A CONSULTING ENGINEERING GROUP
990 WEST WATERFRONT DRIVE
EUREKA, CA 95501
(707) 445-3001

JUNE 19, 2020



6/19/20

TRAVIS SCHNEIDER, R.P.E. 43457



Mill Creek Fish Passage

Peshastin, WA

Merlin #: 584,279

24’-8” span x 12’-4” rise 29S Single Radius Arch BridgeCor

2’-6” Minimum Cover, 4’-6” Maximum Cover, HL-93 Live Load, A-1 Backfill

8 Gage Galvanized Steel

```
*** WELCOME TO CANDE-2019 (Version April 1, 2019) ***

MASTER CONTROL AND PIPE-TYPE DATA FOR PROBLEM #  1

USER TITLE: Single Radius 29S 4.5ft Cover 8Gage HL-93

EXECUTION MODE ..................   ANALYS

SOLUTION LEVEL ..................  #3 USER

METHODOLOGY (LRFD OR SERVICE) ...     LRFD

NUMBER OF PIPE-ELEMENT GROUPS ....       1

MAXIMUM ITERATIONS PER STEP ......     -99

PIPE ELEMENT TYPE ............... STEEL

NUMBER OF BEAM ELEMENTS .........       38

STEEL ELEMENT PROPERTIES ARE AS FOLLOWS:

      YOUNGS MODULUS OF METAL (PSI)......    0.29000E+08

      POISSONS RATIO OF METAL (-) .......    0.30000E+00

      YIELD STRESS OF METAL (PSI)........    0.44000E+05

      LONGITUDINAL SEAM STRENGTH (PSI)...    0.32223E+05

      DENSITY OF METAL (PCI).............    0.28400E+00

      MODULUS OF UPPER BI-SLOPE (PSI)....    0.00000E+00

 MATERIAL CHARACTER CODE, NONLIN .........    2

     NONLIN=2,MEANS BILINEAR ELASTIC-PLASTIC

 LARGE DEFORMATION/BUCKLING CODE, IBUCK...    4

     IBUCK=4, MEANS LARGE DEFORMATION THEORY FOR GROUP
     AND SIMPLIFIED BUCKLING PREDICTION, AASHTO 12.8.9.6-1

SECTION PROPERTIES OF CROSS-SECTION:

      THRUST AREA (IN**2/IN) ............   0.23020

      MOM. OF INERTIA (IN**4/IN) ........   0.87460
```

```
      SECTION MODULUS (IN**3/IN) ........   0.28840

      PLASTIC SECTION MOD(IN**3/IN) .....   0.40300

    NOTE: AASHTO COMBINED T&M CRITERION 12.8.9.5 IS ACTIVATED.



    LRFD RESISTANCE FACTORS FOR STRENGTH-LIMIT STATES
    AND DEFLECTION LIMIT AT SERVICE LOAD

      THRUST STRESS YIELDING ............   0.70000

      BUCKLING STRESS FAILURE............   0.70000

      SEAM STRENGTH FAILURE .............   0.67000

      FULL PLASTIC PENETRATION...........   0.90000

      ALLOWABLE % DEFLECTION (SERVICE)...   5.00000

      COMBINED MOMENT-THRUST CRITERION...   0.90000


- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -


 REVIEW SYSTEM INPUT DATA

 FINITE ELEMENT INPUT CONTROLS (PREP)


THE DATA TO BE RUN IS ENTITLED ...

BRIDGECOR

 PRINT AND PLOT CONTROL CODES ...
   PRINT CONTROL FOR MESH DATA------------    3
   PLOT FILE CONTROL MESH & RESULS--------    3
   PRINT FINITE ELEMENT RESULTS ----------    1
   INPUT DATA CHECK CODE------------------    0

   BANDWIDTH MINIMIZER IS ON, MINBW-------    1

 KEY NUMBERS DESCRIBING MESH ...
   THE NUMBER OF LOAD STEPS IS------------   23
   TOTAL NUMBER OF NODES IS--------------- 1204
   TOTAL NUMBER OF ELEMENTS IS------------ 1167
   TOTAL NUMBER OF BEAM ELEMENTS IS-------   38
   MAX NUMBER OF BOUNDARY CONDITIONS IS---  101
```

ALL ELEMENT DATA AS INPUT "I" AND GENERATED

	ELEMENT NUMBER	NODE-CONNECTIVITY I	J	K	L	MATERIAL NUMBER	CONSTR. INCR.	ELEMENT TYPE	BAND WIDTH	GENERATION INCREMENTS
I	1	38	39	0	0	1	1	BEAM	6	1, 0, 0
I	2	37	38	0	0	1	1	BEAM	6	1, 0, 0
I	3	36	37	0	0	1	1	BEAM	6	1, 0, 0
I	4	35	36	0	0	1	1	BEAM	6	1, 0, 0
I	5	34	35	0	0	1	1	BEAM	6	1, 0, 0
I	6	33	34	0	0	1	1	BEAM	6	1, 0, 0
I	7	32	33	0	0	1	1	BEAM	6	1, 0, 0
I	8	31	32	0	0	1	1	BEAM	6	1, 0, 0
I	9	30	31	0	0	1	1	BEAM	6	1, 0, 0
I	10	29	30	0	0	1	1	BEAM	6	1, 0, 0
I	11	28	29	0	0	1	1	BEAM	6	1, 0, 0
I	12	27	28	0	0	1	1	BEAM	6	1, 0, 0
I	13	26	27	0	0	1	1	BEAM	6	1, 0, 0
I	14	25	26	0	0	1	1	BEAM	6	1, 0, 0
I	15	24	25	0	0	1	1	BEAM	6	1, 0, 0
I	16	23	24	0	0	1	1	BEAM	6	1, 0, 0
I	17	22	23	0	0	1	1	BEAM	6	1, 0, 0
I	18	21	22	0	0	1	1	BEAM	6	1, 0, 0
I	19	20	21	0	0	1	1	BEAM	6	1, 0, 0
I	20	19	20	0	0	1	1	BEAM	6	1, 0, 0
I	21	18	19	0	0	1	1	BEAM	6	1, 0, 0
I	22	17	18	0	0	1	1	BEAM	6	1, 0, 0
I	23	16	17	0	0	1	1	BEAM	6	1, 0, 0
I	24	15	16	0	0	1	1	BEAM	6	1, 0, 0
I	25	14	15	0	0	1	1	BEAM	6	1, 0, 0
I	26	13	14	0	0	1	1	BEAM	6	1, 0, 0
I	27	12	13	0	0	1	1	BEAM	6	1, 0, 0
I	28	11	12	0	0	1	1	BEAM	6	1, 0, 0
I	29	10	11	0	0	1	1	BEAM	6	1, 0, 0
I	30	9	10	0	0	1	1	BEAM	6	1, 0, 0
I	31	8	9	0	0	1	1	BEAM	6	1, 0, 0
I	32	7	8	0	0	1	1	BEAM	6	1, 0, 0
I	33	6	7	0	0	1	1	BEAM	6	1, 0, 0
I	34	5	6	0	0	1	1	BEAM	6	1, 0, 0
I	35	4	5	0	0	1	1	BEAM	6	1, 0, 0
I	36	3	4	0	0	1	1	BEAM	6	1, 0, 0
I	37	2	3	0	0	1	1	BEAM	6	1, 0, 0
I	38	1	2	0	0	1	1	BEAM	6	1, 0, 0
I	39	464	462	39	308	2	1	QUAD	852	1, 0, 0
I	40	462	473	461	39	2	1	QUAD	870	1, 0, 0
I	41	296	285	1	284	2	1	QUAD	592	1, 0, 0
I	42	285	287	131	1	2	1	QUAD	574	1, 0, 0
I	43	1	131	143	77	3	2	QUAD	286	1, 0, 0
I	44	131	132	144	143	3	2	QUAD	28	1, 0, 0
I	45	132	133	145	144	3	2	QUAD	28	1, 0, 0
I	46	133	134	146	145	3	2	QUAD	28	1, 0, 0
I	47	134	135	147	146	3	2	QUAD	28	1, 0, 0
I	48	135	120	121	147	3	2	QUAD	56	1, 0, 0
I	49	77	143	148	78	3	3	QUAD	144	1, 0, 0
I	50	143	144	149	148	3	3	QUAD	14	1, 0, 0
I	51	144	145	150	149	3	3	QUAD	14	1, 0, 0
I	52	145	146	151	150	3	3	QUAD	14	1, 0, 0
I	53	146	147	152	151	3	3	QUAD	14	1, 0, 0
I	54	147	121	153	152	3	3	QUAD	66	1, 0, 0
I	55	121	122	153	0	3	3	TRI.	66	1, 0, 0
I	56	78	148	154	79	3	4	QUAD	154	1, 0, 0
I	57	148	149	155	154	3	4	QUAD	16	1, 0, 0

I	58	149	150	156	155	3	4	QUAD	16	1, 0, 0
I	59	150	151	157	156	3	4	QUAD	16	1, 0, 0
I	60	151	152	158	157	3	4	QUAD	16	1, 0, 0
I	61	152	153	159	158	3	4	QUAD	16	1, 0, 0
I	62	153	122	123	159	3	4	QUAD	76	1, 0, 0
I	63	79	154	160	80	3	5	QUAD	164	1, 0, 0
I	64	154	155	161	160	3	5	QUAD	16	1, 0, 0
I	65	155	156	162	161	3	5	QUAD	16	1, 0, 0
I	66	156	157	163	162	3	5	QUAD	16	1, 0, 0
I	67	157	158	164	163	3	5	QUAD	16	1, 0, 0
I	68	158	159	165	164	3	5	QUAD	16	1, 0, 0
I	69	159	123	124	165	3	5	QUAD	86	1, 0, 0
I	70	80	160	166	81	3	6	QUAD	174	1, 0, 0
I	71	160	161	167	166	3	6	QUAD	16	1, 0, 0
I	72	161	162	168	167	3	6	QUAD	16	1, 0, 0
I	73	162	163	169	168	3	6	QUAD	16	1, 0, 0
I	74	163	164	170	169	3	6	QUAD	16	1, 0, 0
I	75	164	165	171	170	3	6	QUAD	16	1, 0, 0
I	76	165	124	125	171	3	6	QUAD	96	1, 0, 0
I	77	81	166	172	82	3	7	QUAD	184	1, 0, 0
I	78	166	167	173	172	3	7	QUAD	16	1, 0, 0
I	79	167	168	174	173	3	7	QUAD	16	1, 0, 0
I	80	168	169	175	174	3	7	QUAD	16	1, 0, 0
I	81	169	170	176	175	3	7	QUAD	16	1, 0, 0
I	82	170	171	177	176	3	7	QUAD	16	1, 0, 0
I	83	171	125	126	177	3	7	QUAD	106	1, 0, 0
I	84	82	172	178	83	3	8	QUAD	194	1, 0, 0
I	85	172	173	179	178	3	8	QUAD	16	1, 0, 0
I	86	173	174	180	179	3	8	QUAD	16	1, 0, 0
I	87	174	175	181	180	3	8	QUAD	16	1, 0, 0
I	88	175	176	182	181	3	8	QUAD	16	1, 0, 0
I	89	176	177	183	182	3	8	QUAD	16	1, 0, 0
I	90	177	126	184	183	3	8	QUAD	118	1, 0, 0
I	91	126	127	184	0	3	8	TRI.	118	1, 0, 0
I	92	83	178	185	84	3	9	QUAD	206	1, 0, 0
I	93	178	179	186	185	3	9	QUAD	18	1, 0, 0
I	94	179	180	187	186	3	9	QUAD	18	1, 0, 0
I	95	180	181	188	187	3	9	QUAD	18	1, 0, 0
I	96	181	182	189	188	3	9	QUAD	18	1, 0, 0
I	97	182	183	190	189	3	9	QUAD	18	1, 0, 0
I	98	183	184	191	190	3	9	QUAD	18	1, 0, 0
I	99	184	127	128	191	3	9	QUAD	130	1, 0, 0
I	100	84	185	192	85	3	10	QUAD	218	1, 0, 0
I	101	185	186	193	192	3	10	QUAD	18	1, 0, 0
I	102	186	187	194	193	3	10	QUAD	18	1, 0, 0
I	103	187	188	195	194	3	10	QUAD	18	1, 0, 0
I	104	188	189	196	195	3	10	QUAD	18	1, 0, 0
I	105	189	190	197	196	3	10	QUAD	18	1, 0, 0
I	106	190	191	198	197	3	10	QUAD	18	1, 0, 0
I	107	191	128	129	198	3	10	QUAD	142	1, 0, 0
I	108	85	192	136	86	3	11	QUAD	216	1, 0, 0
I	109	192	193	137	136	3	11	QUAD	116	1, 0, 0
I	110	193	194	138	137	3	11	QUAD	116	1, 0, 0
I	111	194	195	139	138	3	11	QUAD	116	1, 0, 0
I	112	195	196	140	139	3	11	QUAD	116	1, 0, 0
I	113	196	197	141	140	3	11	QUAD	116	1, 0, 0
I	114	197	198	142	141	3	11	QUAD	116	1, 0, 0
I	115	198	129	130	142	3	11	QUAD	140	1, 0, 0
I	116	86	136	207	0	3	12	TRI.	244	1, 0, 0
I	117	136	137	214	207	3	12	QUAD	158	1, 0, 0
I	118	137	138	215	214	3	12	QUAD	158	1, 0, 0
I	119	138	139	216	215	3	12	QUAD	158	1, 0, 0
I	120	139	140	217	216	3	12	QUAD	158	1, 0, 0

I	121	140	141	218	217	3	12	QUAD	158	1, 0, 0
I	122	141	142	219	218	3	12	QUAD	158	1, 0, 0
I	123	142	130	200	219	3	12	QUAD	180	1, 0, 0
I	124	207	214	208	0	3	14	TRI.	16	1, 0, 0
I	125	214	215	220	208	3	14	QUAD	26	1, 0, 0
I	126	215	216	221	220	3	14	QUAD	14	1, 0, 0
I	127	216	217	222	221	3	14	QUAD	14	1, 0, 0
I	128	217	218	223	222	3	14	QUAD	14	1, 0, 0
I	129	218	219	224	223	3	14	QUAD	14	1, 0, 0
I	130	219	200	201	224	3	14	QUAD	50	1, 0, 0
I	131	208	220	209	0	3	15	TRI.	26	1, 0, 0
I	132	220	221	225	209	3	15	QUAD	34	1, 0, 0
I	133	221	222	226	225	3	15	QUAD	12	1, 0, 0
I	134	222	223	227	226	3	15	QUAD	12	1, 0, 0
I	135	223	224	228	227	3	15	QUAD	12	1, 0, 0
I	136	224	201	202	228	3	15	QUAD	56	1, 0, 0
I	137	209	225	210	0	3	16	TRI.	34	1, 0, 0
I	138	225	226	229	210	3	16	QUAD	40	1, 0, 0
I	139	226	227	230	229	3	16	QUAD	10	1, 0, 0
I	140	227	228	231	230	3	16	QUAD	10	1, 0, 0
I	141	228	202	203	231	3	16	QUAD	60	1, 0, 0
I	142	210	229	211	0	3	17	TRI.	40	1, 0, 0
I	143	229	230	232	211	3	17	QUAD	44	1, 0, 0
I	144	230	231	233	232	3	17	QUAD	8	1, 0, 0
I	145	231	203	204	233	3	17	QUAD	62	1, 0, 0
I	146	211	232	212	0	3	18	TRI.	44	1, 0, 0
I	147	232	233	234	212	3	18	QUAD	46	1, 0, 0
I	148	233	204	205	234	3	18	QUAD	62	1, 0, 0
I	149	212	234	213	0	3	19	TRI.	46	1, 0, 0
I	150	234	205	206	213	3	19	QUAD	60	1, 0, 0
I	151	213	206	199	0	3	19	TRI.	30	1, 0, 0
I	152	86	207	87	0	3	12	TRI.	244	1, 0, 0
I	153	207	208	273	0	3	14	TRI.	134	1, 0, 0
I	154	208	209	274	0	3	15	TRI.	134	1, 0, 0
I	155	209	210	276	275	3	16	QUAD	136	1, 0, 0
I	156	210	211	277	276	3	17	QUAD	136	1, 0, 0
I	157	211	212	278	277	3	18	QUAD	136	1, 0, 0
I	158	212	213	279	278	3	19	QUAD	136	1, 0, 0
I	159	213	199	242	279	3	19	QUAD	162	1, 0, 0
I	160	87	273	88	0	3	13	TRI.	374	1, 0, 0
I	161	273	274	267	0	3	15	TRI.	16	1, 0, 0
I	162	274	275	269	268	3	16	QUAD	16	1, 0, 0
I	163	275	276	269	0	3	16	TRI.	16	1, 0, 0
I	164	276	277	270	0	3	17	TRI.	16	1, 0, 0
I	165	277	278	271	0	3	18	TRI.	16	1, 0, 0
I	166	278	279	241	272	3	19	QUAD	78	1, 0, 0
I	167	279	242	241	0	3	19	TRI.	78	1, 0, 0
I	168	88	267	262	89	3	13	QUAD	360	1, 0, 0
I	169	267	268	263	262	3	16	QUAD	14	1, 0, 0
I	170	268	269	263	0	3	16	TRI.	14	1, 0, 0
I	171	269	270	264	0	3	17	TRI.	14	1, 0, 0
I	172	270	271	265	0	3	18	TRI.	14	1, 0, 0
I	173	271	272	240	266	3	19	QUAD	66	1, 0, 0
I	174	272	241	240	0	3	19	TRI.	66	1, 0, 0
I	175	89	262	257	90	3	13	QUAD	348	1, 0, 0
I	176	262	263	257	0	3	16	TRI.	14	1, 0, 0
I	177	263	264	259	258	3	17	QUAD	14	1, 0, 0
I	178	264	265	260	259	3	18	QUAD	14	1, 0, 0
I	179	265	266	261	260	3	19	QUAD	14	1, 0, 0
I	180	266	240	239	261	3	19	QUAD	56	1, 0, 0
I	181	90	257	253	91	3	13	QUAD	336	1, 0, 0
I	182	257	258	254	253	3	17	QUAD	12	1, 0, 0
I	183	258	259	254	0	3	17	TRI.	12	1, 0, 0

I	184	259	260	255	0	3	18	TRI.	12	1, 0, 0
I	185	260	261	238	256	3	19	QUAD	48	1, 0, 0
I	186	261	239	238	0	3	19	TRI.	48	1, 0, 0
I	187	91	253	249	92	3	13	QUAD	326	1, 0, 0
I	188	253	254	250	249	3	17	QUAD	12	1, 0, 0
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I	190	255	256	252	251	3	19	QUAD	12	1, 0, 0
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I	194	250	251	248	247	3	18	QUAD	10	1, 0, 0
I	195	251	252	236	248	3	19	QUAD	34	1, 0, 0
I	196	252	237	236	0	3	19	TRI.	34	1, 0, 0
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I	202	243	244	116	115	3	17	QUAD	260	1, 0, 0
I	203	244	245	117	116	3	18	QUAD	260	1, 0, 0
I	204	245	235	114	117	3	19	QUAD	264	1, 0, 0
I	205	119	292	280	118	1	1	QUAD	350	1, 0, 0
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I	207	293	294	282	281	1	1	QUAD	28	1, 0, 0
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I	226	13	88	51	0	12	13	FACE	152	1, 0, 0
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I	234	297	312	324	298	3	2	QUAD	56	1, 0, 0
I	235	312	311	323	324	3	2	QUAD	28	1, 0, 0
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I	244	322	321	326	327	3	3	QUAD	14	1, 0, 0
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I	248	330	329	335	336	3	4	QUAD	16	1, 0, 0
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I	254	300	336	342	301	3	5	QUAD	86	1, 0, 0
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I	292	368	367	374	375	3	10	QUAD	18	1, 0, 0
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I	328	379	405	408	380	3	16	QUAD	60	1, 0, 0
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I	337	381	410	411	382	3	18	QUAD	62	1, 0, 0
I	338	410	409	389	411	3	18	QUAD	46	1, 0, 0
I	339	409	388	389	0	3	18	TRI.	44	1, 0, 0
I	340	382	411	390	383	3	19	QUAD	60	1, 0, 0
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I	342	383	390	376	0	3	19	TRI.	30	1, 0, 0
I	343	104	103	384	0	3	12	TRI.	564	1, 0, 0
I	344	384	450	385	0	3	14	TRI.	134	1, 0, 0
I	345	385	451	386	0	3	15	TRI.	134	1, 0, 0
I	346	386	452	453	387	3	16	QUAD	136	1, 0, 0
I	347	387	453	454	388	3	17	QUAD	136	1, 0, 0
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I	350	390	456	419	376	3	19	QUAD	162	1, 0, 0
I	351	103	102	450	0	3	13	TRI.	698	1, 0, 0
I	352	450	444	451	0	3	15	TRI.	16	1, 0, 0
I	353	451	445	446	452	3	16	QUAD	16	1, 0, 0
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I	355	453	447	454	0	3	17	TRI.	16	1, 0, 0
I	356	454	448	455	0	3	18	TRI.	16	1, 0, 0
I	357	455	449	418	456	3	19	QUAD	78	1, 0, 0
I	358	456	418	419	0	3	19	TRI.	78	1, 0, 0
I	359	102	101	439	444	3	13	QUAD	688	1, 0, 0
I	360	444	439	440	445	3	16	QUAD	14	1, 0, 0
I	361	445	440	446	0	3	16	TRI.	14	1, 0, 0
I	362	446	441	447	0	3	17	TRI.	14	1, 0, 0
I	363	447	442	448	0	3	18	TRI.	14	1, 0, 0
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I	365	449	417	418	0	3	19	TRI.	66	1, 0, 0
I	366	101	100	434	439	3	13	QUAD	680	1, 0, 0
I	367	439	434	440	0	3	16	TRI.	14	1, 0, 0
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I	413	28	103	66	0	27	12	FACE	152	1, 0, 0
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I	420	35	110	73	0	34	5	FACE	152	1, 0, 0
I	421	36	111	74	0	35	4	FACE	152	1, 0, 0
I	422	37	112	75	0	36	3	FACE	152	1, 0, 0
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I	425	475	476	467	468	1	1	QUAD	20	1, 0, 0
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I	435	485	486	119	469	1	1	QUAD	736	1, 0, 0

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I	442	492	493	287	285	1	1	QUAD	418	1, 0, 0
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I	702	663	754	664	0	4	10	TRI.	184	1, 0, 0
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I	706	717	692	757	718	4	15	QUAD	132	1, 0, 0
I	707	718	757	758	719	4	16	QUAD	82	1, 0, 0
I	708	719	758	720	0	4	17	TRI.	80	1, 0, 0
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I	713	451	444	445	0	3	16	TRI.	16	1, 0, 0
I	714	453	446	447	0	3	17	TRI.	16	1, 0, 0
I	715	446	440	441	0	3	17	TRI.	14	1, 0, 0
I	716	440	434	435	0	3	17	TRI.	14	1, 0, 0
I	717	454	447	448	0	3	18	TRI.	16	1, 0, 0
I	718	447	441	442	0	3	18	TRI.	14	1, 0, 0
I	719	436	431	432	0	3	18	TRI.	12	1, 0, 0
I	720	455	448	449	0	3	19	TRI.	16	1, 0, 0
I	721	448	442	443	0	3	19	TRI.	14	1, 0, 0
I	722	437	432	433	0	3	19	TRI.	12	1, 0, 0
I	723	267	274	268	0	3	16	TRI.	16	1, 0, 0
I	724	274	209	275	0	3	16	TRI.	134	1, 0, 0
I	725	257	263	258	0	3	17	TRI.	14	1, 0, 0
I	726	263	269	264	0	3	17	TRI.	14	1, 0, 0
I	727	269	276	270	0	3	17	TRI.	16	1, 0, 0
I	728	270	277	271	0	3	18	TRI.	16	1, 0, 0
I	729	264	270	265	0	3	18	TRI.	14	1, 0, 0
I	730	254	259	255	0	3	18	TRI.	12	1, 0, 0
I	731	255	260	256	0	3	19	TRI.	12	1, 0, 0
I	732	265	271	266	0	3	19	TRI.	14	1, 0, 0
I	733	271	278	272	0	3	19	TRI.	16	1, 0, 0
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I	736	763	726	727	764	1	1	QUAD	78	1, 0, 0
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I	810	840	815	816	841	1	1	QUAD	54	1, 0, 0
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I	973	1022	1009	1010	0	4	19	TRI.	28	1, 0, 0
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I	975	121	1011	1012	122	4	3	QUAD	1784	1, 0, 0
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I	977	870	1013	871	0	4	5	TRI.	288	1, 0, 0
I	978	871	1013	1014	872	4	6	QUAD	288	1, 0, 0
I	979	872	1014	898	873	4	7	QUAD	286	1, 0, 0
I	980	898	1015	899	0	4	8	TRI.	236	1, 0, 0
I	981	899	1015	1016	900	4	9	QUAD	236	1, 0, 0
I	982	900	1016	926	901	4	10	QUAD	234	1, 0, 0
I	983	926	1017	927	0	4	11	TRI.	184	1, 0, 0
I	984	927	1017	1018	928	4	12	QUAD	184	1, 0, 0
I	985	928	1018	954	929	4	14	QUAD	182	1, 0, 0
I	986	954	1019	955	0	4	15	TRI.	132	1, 0, 0
I	987	955	1019	1020	956	4	16	QUAD	132	1, 0, 0
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I	989	982	1021	983	0	4	18	TRI.	80	1, 0, 0
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I	995	989	1026	1027	990	1	1	QUAD	78	1, 0, 0
I	996	990	1027	1028	991	1	1	QUAD	78	1, 0, 0
I	997	991	1028	1029	992	1	1	QUAD	78	1, 0, 0
I	998	992	1029	1030	993	4	2	QUAD	78	1, 0, 0
I	999	993	1030	1031	994	4	3	QUAD	78	1, 0, 0
I	1000	994	1031	1032	995	4	4	QUAD	78	1, 0, 0
I	1001	995	1032	1033	996	4	5	QUAD	78	1, 0, 0
I	1002	996	1033	1034	997	4	6	QUAD	78	1, 0, 0

I	1003	997	1034	1035	998	4	7	QUAD	78	1, 0, 0
I	1004	998	1035	1036	999	4	8	QUAD	78	1, 0, 0
I	1005	999	1036	1037	1000	4	9	QUAD	78	1, 0, 0
I	1006	1000	1037	1038	1001	4	10	QUAD	78	1, 0, 0
I	1007	1001	1038	1039	1002	4	11	QUAD	78	1, 0, 0
I	1008	1002	1039	1040	1003	4	12	QUAD	78	1, 0, 0
I	1009	1003	1040	1041	1004	4	14	QUAD	78	1, 0, 0
I	1010	1004	1041	1042	1005	4	15	QUAD	78	1, 0, 0
I	1011	1005	1042	1043	1006	4	16	QUAD	78	1, 0, 0
I	1012	1006	1043	1044	1007	4	17	QUAD	78	1, 0, 0
I	1013	1007	1044	1045	1008	4	18	QUAD	78	1, 0, 0
I	1014	1008	1045	1046	1009	4	19	QUAD	78	1, 0, 0
I	1015	1009	1046	1047	1010	4	19	QUAD	78	1, 0, 0
I	1016	1023	1048	1049	1024	1	1	QUAD	54	1, 0, 0
I	1017	1024	1049	1050	1025	1	1	QUAD	54	1, 0, 0
I	1018	1025	1050	1051	1026	1	1	QUAD	54	1, 0, 0
I	1019	1026	1051	1052	1027	1	1	QUAD	54	1, 0, 0
I	1020	1027	1052	1053	1028	1	1	QUAD	54	1, 0, 0
I	1021	1028	1053	1054	1029	1	1	QUAD	54	1, 0, 0
I	1022	1029	1054	1055	1030	4	2	QUAD	54	1, 0, 0
I	1023	1030	1055	1056	1031	4	3	QUAD	54	1, 0, 0
I	1024	1031	1056	1057	1032	4	4	QUAD	54	1, 0, 0
I	1025	1032	1057	1058	1033	4	5	QUAD	54	1, 0, 0
I	1026	1033	1058	1059	1034	4	6	QUAD	54	1, 0, 0
I	1027	1034	1059	1060	1035	4	7	QUAD	54	1, 0, 0
I	1028	1035	1060	1061	1036	4	8	QUAD	54	1, 0, 0
I	1029	1036	1061	1062	1037	4	9	QUAD	54	1, 0, 0
I	1030	1037	1062	1063	1038	4	10	QUAD	54	1, 0, 0
I	1031	1038	1063	1064	1039	4	11	QUAD	54	1, 0, 0
I	1032	1039	1064	1065	1040	4	12	QUAD	54	1, 0, 0
I	1033	1040	1065	1066	1041	4	14	QUAD	54	1, 0, 0
I	1034	1041	1066	1067	1042	4	15	QUAD	54	1, 0, 0
I	1035	1042	1067	1068	1043	4	16	QUAD	54	1, 0, 0
I	1036	1043	1068	1069	1044	4	17	QUAD	54	1, 0, 0
I	1037	1044	1069	1070	1045	4	18	QUAD	54	1, 0, 0
I	1038	1045	1070	1071	1046	4	19	QUAD	54	1, 0, 0
I	1039	1046	1071	1072	1047	4	19	QUAD	54	1, 0, 0
I	1040	1048	1073	1074	1049	1	1	QUAD	54	1, 0, 0
I	1041	1049	1074	1075	1050	1	1	QUAD	54	1, 0, 0
I	1042	1050	1075	1076	1051	1	1	QUAD	54	1, 0, 0
I	1043	1051	1076	1077	1052	1	1	QUAD	54	1, 0, 0
I	1044	1052	1077	1078	1053	1	1	QUAD	54	1, 0, 0
I	1045	1053	1078	1079	1054	1	1	QUAD	54	1, 0, 0
I	1046	1054	1079	1080	1055	4	2	QUAD	54	1, 0, 0
I	1047	1055	1080	1081	1056	4	3	QUAD	54	1, 0, 0
I	1048	1056	1081	1082	1057	4	4	QUAD	54	1, 0, 0
I	1049	1057	1082	1083	1058	4	5	QUAD	54	1, 0, 0
I	1050	1058	1083	1084	1059	4	6	QUAD	54	1, 0, 0
I	1051	1059	1084	1085	1060	4	7	QUAD	54	1, 0, 0
I	1052	1060	1085	1086	1061	4	8	QUAD	54	1, 0, 0
I	1053	1061	1086	1087	1062	4	9	QUAD	54	1, 0, 0
I	1054	1062	1087	1088	1063	4	10	QUAD	54	1, 0, 0
I	1055	1063	1088	1089	1064	4	11	QUAD	54	1, 0, 0
I	1056	1064	1089	1090	1065	4	12	QUAD	54	1, 0, 0
I	1057	1065	1090	1091	1066	4	14	QUAD	54	1, 0, 0
I	1058	1066	1091	1092	1067	4	15	QUAD	54	1, 0, 0
I	1059	1067	1092	1093	1068	4	16	QUAD	54	1, 0, 0
I	1060	1068	1093	1094	1069	4	17	QUAD	54	1, 0, 0
I	1061	1069	1094	1095	1070	4	18	QUAD	54	1, 0, 0
I	1062	1070	1095	1096	1071	4	19	QUAD	54	1, 0, 0
I	1063	1071	1096	1097	1072	4	19	QUAD	54	1, 0, 0
I	1064	1073	1098	1099	1074	1	1	QUAD	54	1, 0, 0
I	1065	1074	1099	1100	1075	1	1	QUAD	54	1, 0, 0

I	1066	1075	1100	1101	1076	1	1	QUAD	54	1, 0, 0
I	1067	1076	1101	1102	1077	1	1	QUAD	54	1, 0, 0
I	1068	1077	1102	1103	1078	1	1	QUAD	54	1, 0, 0
I	1069	1078	1103	1104	1079	1	1	QUAD	54	1, 0, 0
I	1070	1079	1104	1105	1080	4	2	QUAD	54	1, 0, 0
I	1071	1080	1105	1106	1081	4	3	QUAD	54	1, 0, 0
I	1072	1081	1106	1107	1082	4	4	QUAD	54	1, 0, 0
I	1073	1082	1107	1108	1083	4	5	QUAD	54	1, 0, 0
I	1074	1083	1108	1109	1084	4	6	QUAD	54	1, 0, 0
I	1075	1084	1109	1110	1085	4	7	QUAD	54	1, 0, 0
I	1076	1085	1110	1111	1086	4	8	QUAD	54	1, 0, 0
I	1077	1086	1111	1112	1087	4	9	QUAD	54	1, 0, 0
I	1078	1087	1112	1113	1088	4	10	QUAD	54	1, 0, 0
I	1079	1088	1113	1114	1089	4	11	QUAD	54	1, 0, 0
I	1080	1089	1114	1115	1090	4	12	QUAD	54	1, 0, 0
I	1081	1090	1115	1116	1091	4	14	QUAD	54	1, 0, 0
I	1082	1091	1116	1117	1092	4	15	QUAD	54	1, 0, 0
I	1083	1092	1117	1118	1093	4	16	QUAD	54	1, 0, 0
I	1084	1093	1118	1119	1094	4	17	QUAD	54	1, 0, 0
I	1085	1094	1119	1120	1095	4	18	QUAD	54	1, 0, 0
I	1086	1095	1120	1121	1096	4	19	QUAD	54	1, 0, 0
I	1087	1096	1121	1122	1097	4	19	QUAD	54	1, 0, 0
I	1088	860	835	1124	1123	4	20	QUAD	580	1, 0, 0
I	1089	835	810	1125	1124	4	20	QUAD	632	1, 0, 0
I	1090	810	785	1126	1125	4	20	QUAD	684	1, 0, 0
I	1091	785	748	1201	1126	4	20	QUAD	908	1, 0, 0
I	1092	748	723	1128	1127	4	20	QUAD	812	1, 0, 0
I	1093	723	698	1129	1128	4	20	QUAD	864	1, 0, 0
I	1094	698	673	1130	1129	4	20	QUAD	916	1, 0, 0
I	1095	673	648	1131	1130	4	20	QUAD	968	1, 0, 0
I	1096	648	623	1132	1131	4	20	QUAD	1020	1, 0, 0
I	1097	623	376	1133	1132	4	20	QUAD	1516	1, 0, 0
I	1098	376	419	1134	1133	4	20	QUAD	1518	1, 0, 0
I	1099	419	418	1135	1134	4	20	QUAD	1436	1, 0, 0
I	1100	418	417	1136	1135	4	20	QUAD	1440	1, 0, 0
I	1101	417	416	1137	1136	4	20	QUAD	1444	1, 0, 0
I	1102	416	415	1138	1137	4	20	QUAD	1448	1, 0, 0
I	1103	415	414	1139	1138	4	20	QUAD	1452	1, 0, 0
I	1104	414	413	1140	1139	4	20	QUAD	1456	1, 0, 0
I	1105	413	412	1141	1140	4	20	QUAD	1460	1, 0, 0
I	1106	412	114	1142	1141	4	20	QUAD	2058	1, 0, 0
I	1107	114	235	1143	1142	4	20	QUAD	2060	1, 0, 0
I	1108	235	236	1144	1143	4	20	QUAD	1820	1, 0, 0
I	1109	236	237	1145	1144	4	20	QUAD	1820	1, 0, 0
I	1110	237	238	1146	1145	4	20	QUAD	1820	1, 0, 0
I	1111	238	239	1147	1146	4	20	QUAD	1820	1, 0, 0
I	1112	239	240	1148	1147	4	20	QUAD	1820	1, 0, 0
I	1113	240	241	1149	1148	4	20	QUAD	1820	1, 0, 0
I	1114	241	242	1150	1149	4	20	QUAD	1820	1, 0, 0
I	1115	242	199	1151	1150	4	20	QUAD	1906	1, 0, 0
I	1116	199	885	1152	1151	4	20	QUAD	1908	1, 0, 0
I	1117	885	910	1153	1152	4	20	QUAD	538	1, 0, 0
I	1118	910	935	1154	1153	4	20	QUAD	490	1, 0, 0
I	1119	935	960	1155	1154	4	20	QUAD	442	1, 0, 0
I	1120	960	985	1156	1155	4	20	QUAD	394	1, 0, 0
I	1121	985	1010	1157	1156	4	20	QUAD	346	1, 0, 0
I	1122	1010	1047	1158	1203	4	20	QUAD	388	1, 0, 0
I	1123	1047	1072	1159	1158	4	20	QUAD	226	1, 0, 0
I	1124	1072	1097	1160	1159	4	20	QUAD	178	1, 0, 0
I	1125	1097	1122	1161	1160	4	20	QUAD	130	1, 0, 0
I	1126	1123	1124	1163	1162	4	21	QUAD	82	1, 0, 0
I	1127	1124	1125	1164	1163	4	21	QUAD	82	1, 0, 0
I	1128	1125	1126	1165	1164	4	21	QUAD	82	1, 0, 0

I 1129	1126	1201	1202	1165	4	21	QUAD	154	1, 0, 0
I 1130	1127	1128	1167	1166	4	21	QUAD	82	1, 0, 0
I 1131	1128	1129	1168	1167	4	21	QUAD	82	1, 0, 0
I 1132	1129	1130	1169	1168	4	21	QUAD	82	1, 0, 0
I 1133	1130	1131	1170	1169	4	21	QUAD	82	1, 0, 0
I 1134	1131	1132	1171	1170	4	21	QUAD	82	1, 0, 0
I 1135	1132	1133	1172	1171	4	21	QUAD	82	1, 0, 0
I 1136	1133	1134	1173	1172	4	21	QUAD	82	1, 0, 0
I 1137	1134	1135	1174	1173	4	21	QUAD	82	1, 0, 0
I 1138	1135	1136	1175	1174	4	21	QUAD	82	1, 0, 0
I 1139	1136	1137	1176	1175	4	21	QUAD	82	1, 0, 0
I 1140	1137	1138	1177	1176	4	21	QUAD	82	1, 0, 0
I 1141	1138	1139	1178	1177	4	21	QUAD	82	1, 0, 0
I 1142	1139	1140	1179	1178	4	21	QUAD	82	1, 0, 0
I 1143	1140	1141	1180	1179	4	21	QUAD	82	1, 0, 0
I 1144	1141	1142	1181	1180	4	21	QUAD	82	1, 0, 0
I 1145	1142	1143	1182	1181	4	21	QUAD	82	1, 0, 0
I 1146	1143	1144	1183	1182	4	21	QUAD	82	1, 0, 0
I 1147	1144	1145	1184	1183	4	21	QUAD	82	1, 0, 0
I 1148	1145	1146	1185	1184	4	21	QUAD	82	1, 0, 0
I 1149	1146	1147	1186	1185	4	21	QUAD	82	1, 0, 0
I 1150	1147	1148	1187	1186	4	21	QUAD	82	1, 0, 0
I 1151	1148	1149	1188	1187	4	21	QUAD	82	1, 0, 0
I 1152	1149	1150	1189	1188	4	21	QUAD	82	1, 0, 0
I 1153	1150	1151	1190	1189	4	21	QUAD	82	1, 0, 0
I 1154	1151	1152	1191	1190	4	21	QUAD	82	1, 0, 0
I 1155	1152	1153	1192	1191	4	21	QUAD	82	1, 0, 0
I 1156	1153	1154	1193	1192	4	21	QUAD	82	1, 0, 0
I 1157	1154	1155	1194	1193	4	21	QUAD	82	1, 0, 0
I 1158	1155	1156	1195	1194	4	21	QUAD	82	1, 0, 0
I 1159	1156	1157	1196	1195	4	21	QUAD	82	1, 0, 0
I 1160	1203	1158	1197	1204	4	21	QUAD	94	1, 0, 0
I 1161	1158	1159	1198	1197	4	21	QUAD	82	1, 0, 0
I 1162	1159	1160	1199	1198	4	21	QUAD	82	1, 0, 0
I 1163	1160	1161	1200	1199	4	21	QUAD	82	1, 0, 0
I 1164	748	1127	1201	0	4	20	TRI.	908	1, 0, 0
I 1165	1201	1127	1166	1202	4	21	QUAD	152	1, 0, 0
I 1166	1010	1203	1157	0	4	20	TRI.	388	1, 0, 0
I 1167	1157	1203	1204	1196	4	21	QUAD	96	1, 0, 0

FINAL LIST OF ALL NODE COORDINATES
(INCLUDING LAPLACE GENERATED NODES, IF ANY)

NODE NUMBER	X-AXIS COORD.	Y-AXIS COORD.	GENERATION TYPE
1	150.75	0.00	INPUT
2	150.21	12.43	INPUT
3	148.65	24.78	INPUT
4	146.07	36.95	INPUT
5	142.51	48.87	INPUT
6	137.97	60.46	INPUT
7	132.48	71.63	INPUT
8	126.10	82.31	INPUT
9	118.86	92.43	INPUT
10	110.80	101.92	INPUT
11	102.00	110.71	INPUT
12	92.49	118.74	INPUT
13	82.36	125.97	INPUT
14	71.67	132.33	INPUT
15	60.48	137.79	INPUT
16	48.89	142.31	INPUT

17	36.96	145.85	INPUT
18	24.78	148.40	INPUT
19	12.43	149.94	INPUT
20	0.00	150.45	INPUT
21	-12.43	149.94	INPUT
22	-24.78	148.40	INPUT
23	-36.96	145.85	INPUT
24	-48.89	142.31	INPUT
25	-60.48	137.79	INPUT
26	-71.67	132.33	INPUT
27	-82.36	125.97	INPUT
28	-92.49	118.74	INPUT
29	-102.00	110.71	INPUT
30	-110.80	101.92	INPUT
31	-118.86	92.43	INPUT
32	-126.10	82.31	INPUT
33	-132.48	71.63	INPUT
34	-137.97	60.46	INPUT
35	-142.51	48.87	INPUT
36	-146.07	36.95	INPUT
37	-148.65	24.78	INPUT
38	-150.21	12.43	INPUT
39	-150.75	0.00	INPUT
40	150.21	12.43	INPUT
41	148.65	24.78	INPUT
42	146.07	36.95	INPUT
43	142.51	48.87	INPUT
44	137.97	60.46	INPUT
45	132.48	71.63	INPUT
46	126.10	82.31	INPUT
47	118.86	92.43	INPUT
48	110.80	101.92	INPUT
49	102.00	110.71	INPUT
50	92.49	118.74	INPUT
51	82.36	125.97	INPUT
52	71.67	132.33	INPUT
53	60.48	137.79	INPUT
54	48.89	142.31	INPUT
55	36.96	145.85	INPUT
56	24.78	148.40	INPUT
57	12.43	149.94	INPUT
58	0.00	150.45	INPUT
59	-12.43	149.94	INPUT
60	-24.78	148.40	INPUT
61	-36.96	145.85	INPUT
62	-48.89	142.31	INPUT
63	-60.48	137.79	INPUT
64	-71.67	132.33	INPUT
65	-82.36	125.97	INPUT
66	-92.49	118.74	INPUT
67	-102.00	110.71	INPUT
68	-110.80	101.92	INPUT
69	-118.86	92.43	INPUT
70	-126.10	82.31	INPUT
71	-132.48	71.63	INPUT
72	-137.97	60.46	INPUT
73	-142.51	48.87	INPUT
74	-146.07	36.95	INPUT
75	-148.65	24.78	INPUT
76	-150.21	12.43	INPUT
77	150.21	12.43	INPUT
78	148.65	24.78	INPUT
79	146.07	36.95	INPUT

80	142.51	48.87	INPUT
81	137.97	60.46	INPUT
82	132.48	71.63	INPUT
83	126.10	82.31	INPUT
84	118.86	92.43	INPUT
85	110.80	101.92	INPUT
86	102.00	110.71	INPUT
87	92.49	118.74	INPUT
88	82.36	125.97	INPUT
89	71.67	132.33	INPUT
90	60.48	137.79	INPUT
91	48.89	142.31	INPUT
92	36.96	145.85	INPUT
93	24.78	148.40	INPUT
94	12.43	149.94	INPUT
95	0.00	150.45	INPUT
96	-12.43	149.94	INPUT
97	-24.78	148.40	INPUT
98	-36.96	145.85	INPUT
99	-48.89	142.31	INPUT
100	-60.48	137.79	INPUT
101	-71.67	132.33	INPUT
102	-82.36	125.97	INPUT
103	-92.49	118.74	INPUT
104	-102.00	110.71	INPUT
105	-110.80	101.92	INPUT
106	-118.86	92.43	INPUT
107	-126.10	82.31	INPUT
108	-132.48	71.63	INPUT
109	-137.97	60.46	INPUT
110	-142.51	48.87	INPUT
111	-146.07	36.95	INPUT
112	-148.65	24.78	INPUT
113	-150.21	12.43	INPUT
114	0.00	174.45	INPUT
115	0.00	156.45	INPUT
116	0.00	162.45	INPUT
117	0.00	168.45	INPUT
118	0.00	0.00	INPUT
119	0.00	-22.57	INPUT
120	246.75	0.00	INPUT
121	246.75	12.43	INPUT
122	246.75	24.78	INPUT
123	246.75	36.95	INPUT
124	246.75	48.87	INPUT
125	246.75	60.46	INPUT
126	246.75	71.63	INPUT
127	246.75	82.31	INPUT
128	246.75	92.43	INPUT
129	246.75	101.92	INPUT
130	246.75	110.71	INPUT
131	166.75	0.00	INPUT
132	182.75	0.00	INPUT
133	198.75	0.00	INPUT
134	214.75	0.00	INPUT
135	230.75	0.00	INPUT
136	120.09	110.71	INPUT
137	138.19	110.71	INPUT
138	156.28	110.71	INPUT
139	174.37	110.71	INPUT
140	192.47	110.71	INPUT
141	210.56	110.71	INPUT
142	228.66	110.71	INPUT

143	166.30	12.43	INPUT
144	182.39	12.43	INPUT
145	198.48	12.43	INPUT
146	214.57	12.43	INPUT
147	230.66	12.43	INPUT
148	162.66	24.78	INPUT
149	176.68	24.78	INPUT
150	190.69	24.78	INPUT
151	204.71	24.78	INPUT
152	218.72	24.78	INPUT
153	232.74	24.78	INPUT
154	160.46	36.95	INPUT
155	174.84	36.95	INPUT
156	189.22	36.95	INPUT
157	203.60	36.95	INPUT
158	217.99	36.95	INPUT
159	232.37	36.95	INPUT
160	157.40	48.87	INPUT
161	172.29	48.87	INPUT
162	187.18	48.87	INPUT
163	202.07	48.87	INPUT
164	216.97	48.87	INPUT
165	231.86	48.87	INPUT
166	153.50	60.46	INPUT
167	169.05	60.46	INPUT
168	184.59	60.46	INPUT
169	200.13	60.46	INPUT
170	215.67	60.46	INPUT
171	231.21	60.46	INPUT
172	148.81	71.63	INPUT
173	165.13	71.63	INPUT
174	181.46	71.63	INPUT
175	197.78	71.63	INPUT
176	214.10	71.63	INPUT
177	230.43	71.63	INPUT
178	141.18	82.31	INPUT
179	156.26	82.31	INPUT
180	171.34	82.31	INPUT
181	186.43	82.31	INPUT
182	201.51	82.31	INPUT
183	216.59	82.31	INPUT
184	231.67	82.31	INPUT
185	134.84	92.43	INPUT
186	150.83	92.43	INPUT
187	166.82	92.43	INPUT
188	182.80	92.43	INPUT
189	198.79	92.43	INPUT
190	214.78	92.43	INPUT
191	230.76	92.43	INPUT
192	127.80	101.92	INPUT
193	144.79	101.92	INPUT
194	161.78	101.92	INPUT
195	178.78	101.92	INPUT
196	195.77	101.92	INPUT
197	212.76	101.92	INPUT
198	229.76	101.92	INPUT
199	246.75	174.45	INPUT
200	246.75	118.68	INPUT
201	246.75	126.64	INPUT
202	246.75	134.61	INPUT
203	246.75	142.58	INPUT
204	246.75	150.55	INPUT
205	246.75	158.52	INPUT

206	246.75	166.48	INPUT
207	120.09	118.68	INPUT
208	138.19	126.64	INPUT
209	156.28	134.61	INPUT
210	174.37	142.58	INPUT
211	192.47	150.55	INPUT
212	210.56	158.52	INPUT
213	228.66	166.48	INPUT
214	138.19	118.68	INPUT
215	156.28	118.68	INPUT
216	174.37	118.68	INPUT
217	192.47	118.68	INPUT
218	210.56	118.68	INPUT
219	228.66	118.68	INPUT
220	156.28	126.64	INPUT
221	174.37	126.64	INPUT
222	192.47	126.64	INPUT
223	210.56	126.64	INPUT
224	228.66	126.64	INPUT
225	174.37	134.61	INPUT
226	192.47	134.61	INPUT
227	210.56	134.61	INPUT
228	228.66	134.61	INPUT
229	192.47	142.58	INPUT
230	210.56	142.58	INPUT
231	228.66	142.58	INPUT
232	210.56	150.55	INPUT
233	228.66	150.55	INPUT
234	228.66	158.52	INPUT
235	27.42	174.45	INPUT
236	54.83	174.45	INPUT
237	82.25	174.45	INPUT
238	109.67	174.45	INPUT
239	137.08	174.45	INPUT
240	164.50	174.45	INPUT
241	191.92	174.45	INPUT
242	219.33	174.45	INPUT
243	16.18	156.07	INPUT
244	19.93	162.20	INPUT
245	23.67	168.32	INPUT
246	32.30	154.91	INPUT
247	39.81	161.43	INPUT
248	47.32	167.94	INPUT
249	46.02	151.57	INPUT
250	55.08	157.29	INPUT
251	64.13	163.01	INPUT
252	73.19	168.73	INPUT
253	61.05	148.73	INPUT
254	73.20	155.16	INPUT
255	85.36	161.59	INPUT
256	97.51	168.02	INPUT
257	73.25	143.90	INPUT
258	86.02	150.01	INPUT
259	98.78	156.12	INPUT
260	111.55	162.23	INPUT
261	124.32	168.34	INPUT
262	87.14	139.35	INPUT
263	102.61	146.37	INPUT
264	118.08	153.39	INPUT
265	133.56	160.41	INPUT
266	149.03	167.43	INPUT
267	98.01	132.89	INPUT
268	113.66	139.82	INPUT

269	129.31	146.75	INPUT
270	144.96	153.67	INPUT
271	160.62	160.60	INPUT
272	176.27	167.53	INPUT
273	108.35	125.71	INPUT
274	124.20	132.67	INPUT
275	140.06	139.63	INPUT
276	155.91	146.60	INPUT
277	171.77	153.56	INPUT
278	187.62	160.53	INPUT
279	203.48	167.49	INPUT
280	25.12	0.00	INPUT
281	50.25	0.00	INPUT
282	75.38	0.00	INPUT
283	100.50	0.00	INPUT
284	125.62	0.00	INPUT
285	150.75	-22.57	INPUT
286	246.75	-22.57	INPUT
287	166.75	-22.57	INPUT
288	182.75	-22.57	INPUT
289	198.75	-22.57	INPUT
290	214.75	-22.57	INPUT
291	230.75	-22.57	INPUT
292	25.12	-22.57	INPUT
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294	75.38	-22.57	INPUT
295	100.50	-22.57	INPUT
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299	-246.75	24.78	INPUT
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321	-182.39	12.43	INPUT
322	-198.48	12.43	INPUT
323	-214.57	12.43	INPUT
324	-230.66	12.43	INPUT
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326	-176.68	24.78	INPUT
327	-190.69	24.78	INPUT
328	-204.71	24.78	INPUT
329	-218.72	24.78	INPUT
330	-232.74	24.78	INPUT
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332	-174.84	36.95	INPUT
333	-189.22	36.95	INPUT
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369	-127.80	101.92	INPUT
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372	-178.78	101.92	INPUT
373	-195.77	101.92	INPUT
374	-212.76	101.92	INPUT
375	-229.76	101.92	INPUT
376	-246.75	174.45	INPUT
377	-246.75	118.68	INPUT
378	-246.75	126.64	INPUT
379	-246.75	134.61	INPUT
380	-246.75	142.58	INPUT
381	-246.75	150.55	INPUT
382	-246.75	158.52	INPUT
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384	-120.09	118.68	INPUT
385	-138.19	126.64	INPUT
386	-156.28	134.61	INPUT
387	-174.37	142.58	INPUT
388	-192.47	150.55	INPUT
389	-210.56	158.52	INPUT
390	-228.66	166.48	INPUT
391	-138.19	118.68	INPUT
392	-156.28	118.68	INPUT
393	-174.37	118.68	INPUT
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395	-210.56	118.68	INPUT
396	-228.66	118.68	INPUT
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398	-174.37	126.64	INPUT
399	-192.47	126.64	INPUT
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401	-228.66	126.64	INPUT
402	-174.37	134.61	INPUT
403	-192.47	134.61	INPUT
404	-210.56	134.61	INPUT
405	-228.66	134.61	INPUT
406	-192.47	142.58	INPUT
407	-210.56	142.58	INPUT
408	-228.66	142.58	INPUT
409	-210.56	150.55	INPUT
410	-228.66	150.55	INPUT
411	-228.66	158.52	INPUT
412	-27.42	174.45	INPUT
413	-54.83	174.45	INPUT
414	-82.25	174.45	INPUT
415	-109.67	174.45	INPUT
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418	-191.92	174.45	INPUT
419	-219.33	174.45	INPUT
420	-16.18	156.07	INPUT
421	-19.93	162.20	INPUT
422	-23.67	168.32	INPUT
423	-32.30	154.91	INPUT
424	-39.81	161.43	INPUT
425	-47.32	167.94	INPUT
426	-46.02	151.57	INPUT
427	-55.08	157.29	INPUT
428	-64.13	163.01	INPUT
429	-73.19	168.73	INPUT
430	-61.05	148.73	INPUT
431	-73.20	155.16	INPUT
432	-85.36	161.59	INPUT
433	-97.51	168.02	INPUT
434	-73.25	143.90	INPUT
435	-86.02	150.01	INPUT
436	-98.78	156.12	INPUT
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438	-124.32	168.34	INPUT
439	-87.14	139.35	INPUT
440	-102.61	146.37	INPUT
441	-118.08	153.39	INPUT
442	-133.56	160.41	INPUT
443	-149.03	167.43	INPUT
444	-98.01	132.89	INPUT
445	-113.66	139.82	INPUT
446	-129.31	146.75	INPUT
447	-144.96	153.67	INPUT
448	-160.62	160.60	INPUT
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450	-108.35	125.71	INPUT
451	-124.20	132.67	INPUT
452	-140.06	139.63	INPUT
453	-155.91	146.60	INPUT
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462	-150.75	-22.57	INPUT
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464	-166.75	-22.57	INPUT
465	-182.75	-22.57	INPUT
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481	-125.62	-47.39	INPUT
482	-100.50	-47.39	INPUT
483	-75.38	-47.39	INPUT
484	-50.25	-47.39	INPUT
485	-25.12	-47.39	INPUT
486	0.00	-47.39	INPUT
487	25.12	-47.39	INPUT
488	50.25	-47.39	INPUT
489	75.38	-47.39	INPUT
490	100.50	-47.39	INPUT
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492	150.75	-47.39	INPUT
493	166.75	-47.39	INPUT
494	182.75	-47.39	INPUT
495	198.75	-47.39	INPUT
496	214.75	-47.39	INPUT
497	230.75	-47.39	INPUT
498	246.75	-47.39	INPUT
499	-246.75	-74.70	INPUT
500	-230.75	-74.70	INPUT
501	-214.75	-74.70	INPUT
502	-198.75	-74.70	INPUT
503	-182.75	-74.70	INPUT
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505	-150.75	-74.70	INPUT
506	-125.62	-74.70	INPUT
507	-100.50	-74.70	INPUT
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509	-50.25	-74.70	INPUT
510	-25.12	-74.70	INPUT
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512	25.12	-74.70	INPUT
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514	75.38	-74.70	INPUT
515	100.50	-74.70	INPUT
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517	150.75	-74.70	INPUT
518	166.75	-74.70	INPUT
519	182.75	-74.70	INPUT
520	198.75	-74.70	INPUT

521	214.75	-74.70	INPUT
522	230.75	-74.70	INPUT
523	246.75	-74.70	INPUT
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525	-230.75	-104.74	INPUT
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544	182.75	-104.74	INPUT
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547	230.75	-104.74	INPUT
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575	-230.75	-174.12	INPUT
576	-214.75	-174.12	INPUT
577	-198.75	-174.12	INPUT
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595	198.75	-174.12	INPUT
596	214.75	-174.12	INPUT
597	230.75	-174.12	INPUT
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602	-283.70	-74.70	INPUT
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607	-283.70	24.78	INPUT
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612	-283.70	82.31	INPUT
613	-283.70	92.43	INPUT
614	-283.70	101.92	INPUT
615	-283.70	110.71	INPUT
616	-283.70	118.68	INPUT
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689	-373.39	101.92	INPUT
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694	-373.39	142.58	INPUT
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778	-496.20	118.68	INPUT
779	-496.20	126.64	INPUT
780	-496.20	134.61	INPUT
781	-496.20	142.58	INPUT
782	-496.20	150.55	INPUT
783	-496.20	158.52	INPUT
784	-496.20	166.48	INPUT
785	-496.20	174.45	INPUT
786	-571.20	-174.12	INPUT
787	-571.20	-137.78	INPUT
788	-571.20	-104.74	INPUT
789	-571.20	-74.70	INPUT
790	-571.20	-47.39	INPUT
791	-571.20	-22.57	INPUT
792	-571.20	0.00	INPUT
793	-571.20	12.43	INPUT
794	-571.20	24.78	INPUT
795	-571.20	36.95	INPUT
796	-571.20	48.87	INPUT
797	-571.20	60.46	INPUT
798	-571.20	71.63	INPUT
799	-571.20	82.31	INPUT
800	-571.20	92.43	INPUT
801	-571.20	101.92	INPUT
802	-571.20	110.71	INPUT
803	-571.20	118.68	INPUT
804	-571.20	126.64	INPUT
805	-571.20	134.61	INPUT
806	-571.20	142.58	INPUT
807	-571.20	150.55	INPUT
808	-571.20	158.52	INPUT
809	-571.20	166.48	INPUT
810	-571.20	174.45	INPUT
811	-646.20	-174.12	INPUT
812	-646.20	-137.78	INPUT
813	-646.20	-104.74	INPUT
814	-646.20	-74.70	INPUT
815	-646.20	-47.39	INPUT
816	-646.20	-22.57	INPUT
817	-646.20	0.00	INPUT
818	-646.20	12.43	INPUT
819	-646.20	24.78	INPUT
820	-646.20	36.95	INPUT
821	-646.20	48.87	INPUT
822	-646.20	60.46	INPUT
823	-646.20	71.63	INPUT
824	-646.20	82.31	INPUT
825	-646.20	92.43	INPUT
826	-646.20	101.92	INPUT
827	-646.20	110.71	INPUT
828	-646.20	118.68	INPUT
829	-646.20	126.64	INPUT
830	-646.20	134.61	INPUT
831	-646.20	142.58	INPUT
832	-646.20	150.55	INPUT
833	-646.20	158.52	INPUT
834	-646.20	166.48	INPUT
835	-646.20	174.45	INPUT

836	-721.20	-174.12	INPUT
837	-721.20	-137.78	INPUT
838	-721.20	-104.74	INPUT
839	-721.20	-74.70	INPUT
840	-721.20	-47.39	INPUT
841	-721.20	-22.57	INPUT
842	-721.20	0.00	INPUT
843	-721.20	12.43	INPUT
844	-721.20	24.78	INPUT
845	-721.20	36.95	INPUT
846	-721.20	48.87	INPUT
847	-721.20	60.46	INPUT
848	-721.20	71.63	INPUT
849	-721.20	82.31	INPUT
850	-721.20	92.43	INPUT
851	-721.20	101.92	INPUT
852	-721.20	110.71	INPUT
853	-721.20	118.68	INPUT
854	-721.20	126.64	INPUT
855	-721.20	134.61	INPUT
856	-721.20	142.58	INPUT
857	-721.20	150.55	INPUT
858	-721.20	158.52	INPUT
859	-721.20	166.48	INPUT
860	-721.20	174.45	INPUT
861	283.70	-174.12	INPUT
862	283.70	-137.78	INPUT
863	283.70	-104.74	INPUT
864	283.70	-74.70	INPUT
865	283.70	-47.39	INPUT
866	283.70	-22.57	INPUT
867	283.70	0.00	INPUT
868	283.70	12.43	INPUT
869	283.70	24.78	INPUT
870	283.70	36.95	INPUT
871	283.70	48.87	INPUT
872	283.70	60.46	INPUT
873	283.70	71.63	INPUT
874	283.70	82.31	INPUT
875	283.70	92.43	INPUT
876	283.70	101.92	INPUT
877	283.70	110.71	INPUT
878	283.70	118.68	INPUT
879	283.70	126.64	INPUT
880	283.70	134.61	INPUT
881	283.70	142.58	INPUT
882	283.70	150.55	INPUT
883	283.70	158.52	INPUT
884	283.70	166.48	INPUT
885	283.70	174.45	INPUT
886	318.38	-174.12	INPUT
887	318.38	-137.78	INPUT
888	318.38	-104.74	INPUT
889	318.38	-74.70	INPUT
890	318.38	-47.39	INPUT
891	318.38	-22.57	INPUT
892	318.38	0.00	INPUT
893	318.38	12.43	INPUT
894	318.38	24.78	INPUT
895	318.38	36.95	INPUT
896	318.38	48.87	INPUT
897	318.38	60.46	INPUT
898	318.38	71.63	INPUT

899	318.38	82.31	INPUT
900	318.38	92.43	INPUT
901	318.38	101.92	INPUT
902	318.38	110.71	INPUT
903	318.38	118.68	INPUT
904	318.38	126.64	INPUT
905	318.38	134.61	INPUT
906	318.38	142.58	INPUT
907	318.38	150.55	INPUT
908	318.38	158.52	INPUT
909	318.38	166.48	INPUT
910	318.38	174.45	INPUT
911	348.67	-174.12	INPUT
912	348.67	-137.78	INPUT
913	348.67	-104.74	INPUT
914	348.67	-74.70	INPUT
915	348.67	-47.39	INPUT
916	348.67	-22.57	INPUT
917	348.67	0.00	INPUT
918	348.67	12.43	INPUT
919	348.67	24.78	INPUT
920	348.67	36.95	INPUT
921	348.67	48.87	INPUT
922	348.67	60.46	INPUT
923	348.67	71.63	INPUT
924	348.67	82.31	INPUT
925	348.67	92.43	INPUT
926	348.67	101.92	INPUT
927	348.67	110.71	INPUT
928	348.67	118.68	INPUT
929	348.67	126.64	INPUT
930	348.67	134.61	INPUT
931	348.67	142.58	INPUT
932	348.67	150.55	INPUT
933	348.67	158.52	INPUT
934	348.67	166.48	INPUT
935	348.67	174.45	INPUT
936	373.39	-174.12	INPUT
937	373.39	-137.78	INPUT
938	373.39	-104.74	INPUT
939	373.39	-74.70	INPUT
940	373.39	-47.39	INPUT
941	373.39	-22.57	INPUT
942	373.39	0.00	INPUT
943	373.39	12.43	INPUT
944	373.39	24.78	INPUT
945	373.39	36.95	INPUT
946	373.39	48.87	INPUT
947	373.39	60.46	INPUT
948	373.39	71.63	INPUT
949	373.39	82.31	INPUT
950	373.39	92.43	INPUT
951	373.39	101.92	INPUT
952	373.39	110.71	INPUT
953	373.39	118.68	INPUT
954	373.39	126.64	INPUT
955	373.39	134.61	INPUT
956	373.39	142.58	INPUT
957	373.39	150.55	INPUT
958	373.39	158.52	INPUT
959	373.39	166.48	INPUT
960	373.39	174.45	INPUT
961	397.30	-174.12	INPUT

962	397.30	-137.78	INPUT
963	397.30	-104.74	INPUT
964	397.30	-74.70	INPUT
965	397.30	-47.39	INPUT
966	397.30	-22.57	INPUT
967	397.30	0.00	INPUT
968	397.30	12.43	INPUT
969	397.30	24.78	INPUT
970	397.30	36.95	INPUT
971	397.30	48.87	INPUT
972	397.30	60.46	INPUT
973	397.30	71.63	INPUT
974	397.30	82.31	INPUT
975	397.30	92.43	INPUT
976	397.30	101.92	INPUT
977	397.30	110.71	INPUT
978	397.30	118.68	INPUT
979	397.30	126.64	INPUT
980	397.30	134.61	INPUT
981	397.30	142.58	INPUT
982	397.30	150.55	INPUT
983	397.30	158.52	INPUT
984	397.30	166.48	INPUT
985	397.30	174.45	INPUT
986	421.20	-174.12	INPUT
987	421.20	-137.78	INPUT
988	421.20	-104.74	INPUT
989	421.20	-74.70	INPUT
990	421.20	-47.39	INPUT
991	421.20	-22.57	INPUT
992	421.20	0.00	INPUT
993	421.20	12.43	INPUT
994	421.20	24.78	INPUT
995	421.20	36.95	INPUT
996	421.20	48.87	INPUT
997	421.20	60.46	INPUT
998	421.20	71.63	INPUT
999	421.20	82.31	INPUT
1000	421.20	92.43	INPUT
1001	421.20	101.92	INPUT
1002	421.20	110.71	INPUT
1003	421.20	118.68	INPUT
1004	421.20	126.64	INPUT
1005	421.20	134.61	INPUT
1006	421.20	142.58	INPUT
1007	421.20	150.55	INPUT
1008	421.20	158.52	INPUT
1009	421.20	166.48	INPUT
1010	421.20	174.45	INPUT
1011	259.18	12.43	INPUT
1012	271.53	24.78	INPUT
1013	295.62	48.87	INPUT
1014	307.21	60.46	INPUT
1015	329.06	82.31	INPUT
1016	339.18	92.43	INPUT
1017	357.46	110.71	INPUT
1018	365.43	118.68	INPUT
1019	381.36	134.61	INPUT
1020	389.33	142.58	INPUT
1021	405.27	158.52	INPUT
1022	413.23	166.48	INPUT
1023	496.20	-174.12	INPUT
1024	496.20	-137.78	INPUT

1025	496.20	-104.74	INPUT
1026	496.20	-74.70	INPUT
1027	496.20	-47.39	INPUT
1028	496.20	-22.57	INPUT
1029	496.20	0.00	INPUT
1030	496.20	12.43	INPUT
1031	496.20	24.78	INPUT
1032	496.20	36.95	INPUT
1033	496.20	48.87	INPUT
1034	496.20	60.46	INPUT
1035	496.20	71.63	INPUT
1036	496.20	82.31	INPUT
1037	496.20	92.43	INPUT
1038	496.20	101.92	INPUT
1039	496.20	110.71	INPUT
1040	496.20	118.68	INPUT
1041	496.20	126.64	INPUT
1042	496.20	134.61	INPUT
1043	496.20	142.58	INPUT
1044	496.20	150.55	INPUT
1045	496.20	158.52	INPUT
1046	496.20	166.48	INPUT
1047	496.20	174.45	INPUT
1048	571.20	-174.12	INPUT
1049	571.20	-137.78	INPUT
1050	571.20	-104.74	INPUT
1051	571.20	-74.70	INPUT
1052	571.20	-47.39	INPUT
1053	571.20	-22.57	INPUT
1054	571.20	0.00	INPUT
1055	571.20	12.43	INPUT
1056	571.20	24.78	INPUT
1057	571.20	36.95	INPUT
1058	571.20	48.87	INPUT
1059	571.20	60.46	INPUT
1060	571.20	71.63	INPUT
1061	571.20	82.31	INPUT
1062	571.20	92.43	INPUT
1063	571.20	101.92	INPUT
1064	571.20	110.71	INPUT
1065	571.20	118.68	INPUT
1066	571.20	126.64	INPUT
1067	571.20	134.61	INPUT
1068	571.20	142.58	INPUT
1069	571.20	150.55	INPUT
1070	571.20	158.52	INPUT
1071	571.20	166.48	INPUT
1072	571.20	174.45	INPUT
1073	646.20	-174.12	INPUT
1074	646.20	-137.78	INPUT
1075	646.20	-104.74	INPUT
1076	646.20	-74.70	INPUT
1077	646.20	-47.39	INPUT
1078	646.20	-22.57	INPUT
1079	646.20	0.00	INPUT
1080	646.20	12.43	INPUT
1081	646.20	24.78	INPUT
1082	646.20	36.95	INPUT
1083	646.20	48.87	INPUT
1084	646.20	60.46	INPUT
1085	646.20	71.63	INPUT
1086	646.20	82.31	INPUT
1087	646.20	92.43	INPUT

1088	646.20	101.92	INPUT
1089	646.20	110.71	INPUT
1090	646.20	118.68	INPUT
1091	646.20	126.64	INPUT
1092	646.20	134.61	INPUT
1093	646.20	142.58	INPUT
1094	646.20	150.55	INPUT
1095	646.20	158.52	INPUT
1096	646.20	166.48	INPUT
1097	646.20	174.45	INPUT
1098	721.20	-174.12	INPUT
1099	721.20	-137.78	INPUT
1100	721.20	-104.74	INPUT
1101	721.20	-74.70	INPUT
1102	721.20	-47.39	INPUT
1103	721.20	-22.57	INPUT
1104	721.20	0.00	INPUT
1105	721.20	12.43	INPUT
1106	721.20	24.78	INPUT
1107	721.20	36.95	INPUT
1108	721.20	48.87	INPUT
1109	721.20	60.46	INPUT
1110	721.20	71.63	INPUT
1111	721.20	82.31	INPUT
1112	721.20	92.43	INPUT
1113	721.20	101.92	INPUT
1114	721.20	110.71	INPUT
1115	721.20	118.68	INPUT
1116	721.20	126.64	INPUT
1117	721.20	134.61	INPUT
1118	721.20	142.58	INPUT
1119	721.20	150.55	INPUT
1120	721.20	158.52	INPUT
1121	721.20	166.48	INPUT
1122	721.20	174.45	INPUT
1123	-721.20	189.45	INPUT
1124	-646.20	189.45	INPUT
1125	-571.20	189.45	INPUT
1126	-496.20	189.45	INPUT
1127	-421.20	189.45	INPUT
1128	-397.30	189.45	INPUT
1129	-373.39	189.45	INPUT
1130	-348.67	189.45	INPUT
1131	-318.38	189.45	INPUT
1132	-283.70	189.45	INPUT
1133	-246.75	189.45	INPUT
1134	-219.33	189.45	INPUT
1135	-191.92	189.45	INPUT
1136	-164.50	189.45	INPUT
1137	-137.08	189.45	INPUT
1138	-109.67	189.45	INPUT
1139	-82.25	189.45	INPUT
1140	-54.83	189.45	INPUT
1141	-27.42	189.45	INPUT
1142	0.00	189.45	INPUT
1143	27.42	189.45	INPUT
1144	54.83	189.45	INPUT
1145	82.25	189.45	INPUT
1146	109.67	189.45	INPUT
1147	137.08	189.45	INPUT
1148	164.50	189.45	INPUT
1149	191.92	189.45	INPUT
1150	219.33	189.45	INPUT

1151	246.75	189.45	INPUT
1152	283.70	189.45	INPUT
1153	318.38	189.45	INPUT
1154	348.67	189.45	INPUT
1155	373.39	189.45	INPUT
1156	397.30	189.45	INPUT
1157	421.20	189.45	INPUT
1158	496.20	189.45	INPUT
1159	571.20	189.45	INPUT
1160	646.20	189.45	INPUT
1161	721.20	189.45	INPUT
1162	-721.20	204.45	INPUT
1163	-646.20	204.45	INPUT
1164	-571.20	204.45	INPUT
1165	-496.20	204.45	INPUT
1166	-421.20	204.45	INPUT
1167	-397.30	204.45	INPUT
1168	-373.39	204.45	INPUT
1169	-348.67	204.45	INPUT
1170	-318.38	204.45	INPUT
1171	-283.70	204.45	INPUT
1172	-246.75	204.45	INPUT
1173	-219.33	204.45	INPUT
1174	-191.92	204.45	INPUT
1175	-164.50	204.45	INPUT
1176	-137.08	204.45	INPUT
1177	-109.67	204.45	INPUT
1178	-82.25	204.45	INPUT
1179	-54.83	204.45	INPUT
1180	-27.42	204.45	INPUT
1181	0.00	204.45	INPUT
1182	27.42	204.45	INPUT
1183	54.83	204.45	INPUT
1184	82.25	204.45	INPUT
1185	109.67	204.45	INPUT
1186	137.08	204.45	INPUT
1187	164.50	204.45	INPUT
1188	191.92	204.45	INPUT
1189	219.33	204.45	INPUT
1190	246.75	204.45	INPUT
1191	283.70	204.45	INPUT
1192	318.38	204.45	INPUT
1193	348.67	204.45	INPUT
1194	373.39	204.45	INPUT
1195	397.30	204.45	INPUT
1196	421.20	204.45	INPUT
1197	496.20	204.45	INPUT
1198	571.20	204.45	INPUT
1199	646.20	204.45	INPUT
1200	721.20	204.45	INPUT
1201	-436.20	189.45	INPUT
1202	-451.20	204.45	INPUT
1203	436.20	189.45	INPUT
1204	451.20	204.45	INPUT

BOUNDARY CONDITIONS AS GENERATED FROM INPUT
(FORCE=LBS/INCH; MOMENT=IN-LBS/INCH; DISPLACEMENT=INCHES; ROTATION=DEGREES)
(ONLY BEAM-ELEMENT NODES CAN SUSTAIN AN APPLIED MOMENT OR ROTATION)

BOUNDARY NODE	LOAD STEP	X-FORCE(F) -OR- X-DISPLACE.(D)	Y-FORCE(F) -OR- Y-DISPLACE.(D)	MOMENT(F) -OR- ROTATION (D)

1181	22	F =	0.000	F =	-127.6	F =	0.000
1181	23	F =	0.000	F =	-127.6	F =	0.000
1175	22	F =	0.000	F =	-127.6	F =	0.000
1175	23	F =	0.000	F =	-127.6	F =	0.000
574	1	D =	0.000	D =	0.000	D =	0.000
575	1	D =	0.000	D =	0.000	D =	0.000
576	1	D =	0.000	D =	0.000	D =	0.000
577	1	D =	0.000	D =	0.000	D =	0.000
578	1	D =	0.000	D =	0.000	D =	0.000
579	1	D =	0.000	D =	0.000	D =	0.000
580	1	D =	0.000	D =	0.000	D =	0.000
581	1	D =	0.000	D =	0.000	D =	0.000
582	1	D =	0.000	D =	0.000	D =	0.000
583	1	D =	0.000	D =	0.000	D =	0.000
584	1	D =	0.000	D =	0.000	D =	0.000
585	1	D =	0.000	D =	0.000	D =	0.000
586	1	D =	0.000	D =	0.000	D =	0.000
587	1	D =	0.000	D =	0.000	D =	0.000
588	1	D =	0.000	D =	0.000	D =	0.000
589	1	D =	0.000	D =	0.000	D =	0.000
590	1	D =	0.000	D =	0.000	D =	0.000
591	1	D =	0.000	D =	0.000	D =	0.000
592	1	D =	0.000	D =	0.000	D =	0.000
593	1	D =	0.000	D =	0.000	D =	0.000
594	1	D =	0.000	D =	0.000	D =	0.000
595	1	D =	0.000	D =	0.000	D =	0.000
596	1	D =	0.000	D =	0.000	D =	0.000
597	1	D =	0.000	D =	0.000	D =	0.000
598	1	D =	0.000	D =	0.000	D =	0.000
599	1	D =	0.000	D =	0.000	D =	0.000
624	1	D =	0.000	D =	0.000	D =	0.000
649	1	D =	0.000	D =	0.000	D =	0.000
674	1	D =	0.000	D =	0.000	D =	0.000
699	1	D =	0.000	D =	0.000	D =	0.000
724	1	D =	0.000	D =	0.000	D =	0.000
761	1	D =	0.000	D =	0.000	D =	0.000
786	1	D =	0.000	D =	0.000	D =	0.000
811	1	D =	0.000	D =	0.000	D =	0.000
836	1	D =	0.000	D =	0.000	D =	0.000
861	1	D =	0.000	D =	0.000	D =	0.000
886	1	D =	0.000	D =	0.000	D =	0.000
911	1	D =	0.000	D =	0.000	D =	0.000
936	1	D =	0.000	D =	0.000	D =	0.000
961	1	D =	0.000	D =	0.000	D =	0.000
986	1	D =	0.000	D =	0.000	D =	0.000
1023	1	D =	0.000	D =	0.000	D =	0.000
1048	1	D =	0.000	D =	0.000	D =	0.000
1073	1	D =	0.000	D =	0.000	D =	0.000
1098	1	D =	0.000	D =	0.000	D =	0.000
837	1	D =	0.000	F =	0.000	D =	0.000
838	1	D =	0.000	F =	0.000	D =	0.000
839	1	D =	0.000	F =	0.000	D =	0.000
840	1	D =	0.000	F =	0.000	D =	0.000
841	1	D =	0.000	F =	0.000	D =	0.000
842	1	D =	0.000	F =	0.000	D =	0.000
843	2	D =	0.000	F =	0.000	D =	0.000
844	3	D =	0.000	F =	0.000	D =	0.000
845	4	D =	0.000	F =	0.000	D =	0.000
846	5	D =	0.000	F =	0.000	D =	0.000
847	6	D =	0.000	F =	0.000	D =	0.000
848	7	D =	0.000	F =	0.000	D =	0.000
849	8	D =	0.000	F =	0.000	D =	0.000
850	9	D =	0.000	F =	0.000	D =	0.000

851	10	D =	0.000	F =	0.000	D =	0.000
852	11	D =	0.000	F =	0.000	D =	0.000
853	12	D =	0.000	F =	0.000	D =	0.000
854	14	D =	0.000	F =	0.000	D =	0.000
855	15	D =	0.000	F =	0.000	D =	0.000
856	16	D =	0.000	F =	0.000	D =	0.000
857	17	D =	0.000	F =	0.000	D =	0.000
858	18	D =	0.000	F =	0.000	D =	0.000
859	19	D =	0.000	F =	0.000	D =	0.000
860	19	D =	0.000	F =	0.000	D =	0.000
1123	20	D =	0.000	F =	0.000	D =	0.000
1162	21	D =	0.000	F =	0.000	D =	0.000
1161	20	D =	0.000	F =	0.000	D =	0.000
1200	21	D =	0.000	F =	0.000	D =	0.000
1099	1	D =	0.000	F =	0.000	D =	0.000
1100	1	D =	0.000	F =	0.000	D =	0.000
1101	1	D =	0.000	F =	0.000	D =	0.000
1102	1	D =	0.000	F =	0.000	D =	0.000
1103	1	D =	0.000	F =	0.000	D =	0.000
1104	1	D =	0.000	F =	0.000	D =	0.000
1105	2	D =	0.000	F =	0.000	D =	0.000
1106	3	D =	0.000	F =	0.000	D =	0.000
1107	4	D =	0.000	F =	0.000	D =	0.000
1108	5	D =	0.000	F =	0.000	D =	0.000
1109	6	D =	0.000	F =	0.000	D =	0.000
1110	7	D =	0.000	F =	0.000	D =	0.000
1111	8	D =	0.000	F =	0.000	D =	0.000
1112	9	D =	0.000	F =	0.000	D =	0.000
1113	10	D =	0.000	F =	0.000	D =	0.000
1114	11	D =	0.000	F =	0.000	D =	0.000
1115	12	D =	0.000	F =	0.000	D =	0.000
1116	14	D =	0.000	F =	0.000	D =	0.000
1117	15	D =	0.000	F =	0.000	D =	0.000
1118	16	D =	0.000	F =	0.000	D =	0.000
1119	17	D =	0.000	F =	0.000	D =	0.000
1120	18	D =	0.000	F =	0.000	D =	0.000
1121	19	D =	0.000	F =	0.000	D =	0.000
1122	19	D =	0.000	F =	0.000	D =	0.000

```
 * * * * * COMPLETED MESH GENERATION  * * * * *

BRIDGECOR

 CALCULATED KEY NUMBERS ...
   THE NUMBER OF DATA ERRORS IS-----------    0
   THE NUMBER OF SOIL MATERIALS IS--------    4
   THE NUMBER OF PIPE-TYPE GROUPS IS------    1
   THE NUMBER OF INTERFACE MATERIALS IS---   37
   BAND WIDTH ESTIMATE (MAX)-------------- 2060



 * * * * MESH DATA HAS BEEN SAVED ON UNIT 14 * * * *



  BEAM-NODE SEQUENCE NUMBERS FOR EACH GROUP


     BEAM-ELEMENT GROUP NUMBER =    1

      BEAM-NODE      MESH-NODE     CONNECTED-GROUP-ELEMENTS
```

SEQUENCE	NUMBER	FOREWARD-#	BACKWARD-#
1	39	1	0
2	38	2	1
3	37	3	2
4	36	4	3
5	35	5	4
6	34	6	5
7	33	7	6
8	32	8	7
9	31	9	8
10	30	10	9
11	29	11	10
12	28	12	11
13	27	13	12
14	26	14	13
15	25	15	14
16	24	16	15
17	23	17	16
18	22	18	17
19	21	19	18
20	20	20	19
21	19	21	20
22	18	22	21
23	17	23	22
24	16	24	23
25	15	25	24
26	14	26	25
27	13	27	26
28	12	28	27
29	11	29	28
30	10	30	29
31	9	31	30
32	8	32	31
33	7	33	32
34	6	34	33
35	5	35	34
36	4	36	35
37	3	37	36
38	2	38	37
39	1	0	38

MATERIAL DESCRIPTION FOR SOILS AND INTERFACE
(ALL DENSITY UNITS ARE pcf, ALL MODULUS UNITS ARE psi)

PROPERTIES FOR MATERIAL 1 ********In Situ

DENSITY = 0.10000E+01

YOUNGS MODULUS= 0.3000E+04
POISSONS RATIO= 0.3000E+00
CONFINED MOD.= 0.4038E+04
LATERAL COEFF.= 0.4286E+00

PROPERTIES FOR MATERIAL 2 ********Footing

DENSITY = 0.15000E+03

YOUNGS MODULUS= 0.3500E+07
POISSONS RATIO= 0.1800E+00

```
     CONFINED MOD.= 0.3800E+07
     LATERAL COEFF.= 0.2195E+00

PROPERTIES FOR MATERIAL  3   ********SW95

     DENSITY =    0.14500E+03

CONTROLS FOR DUNCAN SOIL MODEL
WITH SELIG HYPERBOLIC BULK MODULUS FORMULATION

      LRFD STRESS CONTROL..........       0

      ENTERING ELEMENT RATIO.......      0.5000

      ORIGINAL FORMULATION, ... NEWDS =  0

HYPERBOLIC STRESS-STRAIN PARAMETERS

      SOIL CLASSIFICATION ............SW95

      COHESION INTERCEPT  C ..........      0.0000

      FRICTION ANGLE  PHIO (DEG)......     48.0000

      10-FOLD REDUCTION IN PHIO(DEG)..     8.0000

      SCALED MODULUS NUMBER  ZK ......    950.0000

      MODULUS EXPONENT  ZN ...........      0.6000

      FAILURE RATIO  RF ..............      0.7000

      INIT. BULK MODULUS NUMBER BI....     74.8000

      ULT. VOLUMETRIC STRAIN EU ......      0.0200

PROPERTIES FOR MATERIAL  4   ********SM90

     DENSITY =    0.12500E+03

CONTROLS FOR DUNCAN SOIL MODEL
WITH DUNCAN POWER-LAW BULK MODULUS FORMULATION

      LRFD STRESS CONTROL..........       0

      ENTERING ELEMENT RATIO.......      0.5000

      ORIGINAL FORMULATION, ... NEWDS =  0

HYPERBOLIC STRESS-STRAIN PARAMETERS

      SOIL CLASSIFICATION ............SM90
```

COHESION INTERCEPT C 0.0000

FRICTION ANGLE PHIO (DEG)..... 32.0000

10-FOLD REDUCTION IN PHIO(DEG).. 4.0000

SCALED MODULUS NUMBER ZK 300.0000

MODULUS EXPONENT ZN 0.2500

FAILURE RATIO RF 0.7000

BULK MODULUS NUMBER BK 250.0000

BULK MODULUS EXPONENT BM 0.0000

INTERFACE ELEMENT MATERIAL-GROUP PROPERTIES

MAT. NO.	NORMAL-ANGLE	COEF-FRICTION	TENSILE-RUPTURE	INITIAL-GAP
1	4.84	0.30000	50.00000	0.00000
2	9.57	0.30000	50.00000	0.00000
3	14.31	0.30000	50.00000	0.00000
4	19.04	0.30000	50.00000	0.00000
5	23.77	0.30000	50.00000	0.00000
6	28.50	0.30000	50.00000	0.00000
7	33.23	0.30000	50.00000	0.00000
8	37.96	0.30000	50.00000	0.00000
9	42.69	0.30000	50.00000	0.00000
10	47.42	0.30000	50.00000	0.00000
11	52.15	0.30000	50.00000	0.00000
12	56.88	0.30000	50.00000	0.00000
13	61.62	0.30000	50.00000	0.00000
14	66.35	0.30000	50.00000	0.00000
15	71.08	0.30000	50.00000	0.00000
16	75.81	0.30000	50.00000	0.00000
17	80.54	0.30000	50.00000	0.00000
18	85.27	0.30000	50.00000	0.00000
19	90.00	0.30000	50.00000	0.00000
20	94.73	0.30000	50.00000	0.00000
21	99.46	0.30000	50.00000	0.00000
22	104.19	0.30000	50.00000	0.00000
23	108.92	0.30000	50.00000	0.00000
24	113.65	0.30000	50.00000	0.00000
25	118.39	0.30000	50.00000	0.00000
26	123.12	0.30000	50.00000	0.00000
27	127.85	0.30000	50.00000	0.00000
28	132.58	0.30000	50.00000	0.00000
29	137.31	0.30000	50.00000	0.00000
30	142.04	0.30000	50.00000	0.00000
31	146.77	0.30000	50.00000	0.00000
32	151.50	0.30000	50.00000	0.00000
33	156.23	0.30000	50.00000	0.00000
34	160.96	0.30000	50.00000	0.00000
35	165.69	0.30000	50.00000	0.00000
36	170.43	0.30000	50.00000	0.00000
37	175.16	0.30000	50.00000	0.00000

LRFD TOTAL LOAD FACTORS PER LOAD STEP

LOAD STEP	LOAD FACTOR	USER COMMENT
1	1.575	Factor for load step #1
2	1.575	Factor for load step #2
3	1.575	Factor for load step #3
4	1.575	Factor for load step #4
5	1.575	Factor for load step #5
6	1.575	Factor for load step #6
7	1.575	Factor for load step #7
8	1.575	Factor for load step #8
9	1.575	Factor for load step #9
10	1.575	Factor for load step #10
11	1.575	Factor for load step #11
12	1.575	Factor for load step #12
13	1.575	Factor for load step #13
14	1.575	Factor for load step #14
15	1.575	Factor for load step #15
16	1.575	Factor for load step #16
17	1.575	Factor for load step #17
18	1.575	Factor for load step #18
19	1.575	Factor for load step #19
20	1.575	Factor for load step #20
21	1.575	Factor for load step #21
22	1.750	Factor for load step #22
23	1.750	Factor for load step #23

+ +

SOLUTION OUTPUT RESULTS

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 1

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 1

LRFD STRENGTH-LIMIT RATIOS AT STEP 1, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	39	106.	30800.	0.003
BUCKLING THRUST (psi)	39	106.	25430.	0.004
SEAM THRUST (psi)	39	106.	21589.	0.005
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000

COMBINED T&M Ratio	6	0.013	1.000	0.013

LRFD SERVICE PERFORMANCE AT STEP 1, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.01

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.00

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 2

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 2

LRFD STRENGTH-LIMIT RATIOS AT STEP 2, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	39	111.	30800.	0.004
BUCKLING THRUST (psi)	39	111.	24520.	0.005
SEAM THRUST (psi)	39	111.	21589.	0.005
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	34	0.014	1.000	0.014

LRFD SERVICE PERFORMANCE AT STEP 2, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.01

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.00

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 3

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 3

LRFD STRENGTH-LIMIT RATIOS AT STEP 3, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	39	118.	30800.	0.004
BUCKLING THRUST (psi)	39	118.	24672.	0.005
SEAM THRUST (psi)	39	118.	21589.	0.005
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	5	0.017	1.000	0.017

LRFD SERVICE PERFORMANCE AT STEP 3, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.02

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.00

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 4

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 4

LRFD STRENGTH-LIMIT RATIOS AT STEP 4, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	1	122.	30800.	0.004
BUCKLING THRUST (psi)	1	122.	24628.	0.005
SEAM THRUST (psi)	1	122.	21589.	0.006
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	5	0.018	1.000	0.018

LRFD SERVICE PERFORMANCE AT STEP 4, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..................	0.02
RISE HEIGHT OF VERTICAL DEFLECTION (IN)...........	150.45
RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-).....	0.00
HANDLING FACTOR RATIO = (SPAN**2/EI)/FF...........	0.18
SPAN LENGTH FOR HANDLING AND BUCKLING (IN)........	301.50
FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB)	0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 5

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 5

LRFD STRENGTH-LIMIT RATIOS AT STEP 5, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	1	131.	30800.	0.004
BUCKLING THRUST (psi)	1	131.	24473.	0.005

SEAM THRUST (psi)	1	131.	21589.	0.006
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	3	0.012	1.000	0.012

LRFD SERVICE PERFORMANCE AT STEP 5, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.01

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.00

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 6

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 6

LRFD STRENGTH-LIMIT RATIOS AT STEP 6, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	1	149.	30800.	0.005
BUCKLING THRUST (psi)	1	149.	24322.	0.006
SEAM THRUST (psi)	1	149.	21589.	0.007
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	2	0.005	1.000	0.005

LRFD SERVICE PERFORMANCE AT STEP 6, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.00

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.00

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 7

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 7

LRFD STRENGTH-LIMIT RATIOS AT STEP 7, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	1	183.	30800.	0.006
BUCKLING THRUST (psi)	1	183.	24192.	0.008
SEAM THRUST (psi)	1	183.	21589.	0.008
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	6	0.025	1.000	0.025

LRFD SERVICE PERFORMANCE AT STEP 7, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.02

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.00

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 8

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 8

LRFD STRENGTH-LIMIT RATIOS AT STEP 8, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	1	254.	30800.	0.008
BUCKLING THRUST (psi)	1	254.	24100.	0.011
SEAM THRUST (psi)	1	254.	21589.	0.012
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	6	0.052	1.000	0.052

LRFD SERVICE PERFORMANCE AT STEP 8, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%).................. 0.04

RISE HEIGHT OF VERTICAL DEFLECTION (IN).......... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.01

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF.......... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)........ 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 9

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 9

LRFD STRENGTH-LIMIT RATIOS AT STEP 9, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	1	344.	30800.	0.011
BUCKLING THRUST (psi)	1	344.	24060.	0.014
SEAM THRUST (psi)	1	344.	21589.	0.016
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	7	0.086	1.000	0.086

LRFD SERVICE PERFORMANCE AT STEP 9, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..................	0.07
RISE HEIGHT OF VERTICAL DEFLECTION (IN)..........	150.45
RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-).....	0.01
HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..........	0.18
SPAN LENGTH FOR HANDLING AND BUCKLING (IN)........	301.50
FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB)	0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 10

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 10

LRFD STRENGTH-LIMIT RATIOS AT STEP 10, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	1	465.	30800.	0.015
BUCKLING THRUST (psi)	1	465.	24034.	0.019
SEAM THRUST (psi)	1	465.	21589.	0.022
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	33	0.120	1.000	0.120

LRFD SERVICE PERFORMANCE AT STEP 10, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.10

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.02

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 11

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 11

LRFD STRENGTH-LIMIT RATIOS AT STEP 11, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	1	616.	30800.	0.020
BUCKLING THRUST (psi)	1	616.	24008.	0.026
SEAM THRUST (psi)	1	616.	21589.	0.029
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	8	0.157	1.000	0.157

LRFD SERVICE PERFORMANCE AT STEP 11, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.14

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.03

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 12

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 12

LRFD STRENGTH-LIMIT RATIOS AT STEP 12, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	39	799.	30800.	0.026
BUCKLING THRUST (psi)	39	799.	24010.	0.033
SEAM THRUST (psi)	39	799.	21589.	0.037
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	8	0.190	1.000	0.190

LRFD SERVICE PERFORMANCE AT STEP 12, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%).................. 0.17

RISE HEIGHT OF VERTICAL DEFLECTION (IN)........... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.03

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF........... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)........ 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 13

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 13

LRFD STRENGTH-LIMIT RATIOS AT STEP 13, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	6	1365.	30800.	0.044
BUCKLING THRUST (psi)	6	1365.	24999.	0.055
SEAM THRUST (psi)	6	1365.	21589.	0.063
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	8	0.149	1.000	0.149

LRFD SERVICE PERFORMANCE AT STEP 13, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%).................. 0.13

RISE HEIGHT OF VERTICAL DEFLECTION (IN)........... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.03

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF........... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)........ 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+

FINITE ELEMENT OUTPUT FOR LOAD STEP 14

+

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 14

LRFD STRENGTH-LIMIT RATIOS AT STEP 14, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	1	1693.	30800.	0.055
BUCKLING THRUST (psi)	1	1693.	25135.	0.067
SEAM THRUST (psi)	1	1693.	21589.	0.078

PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	8	0.168	1.000	0.168

LRFD SERVICE PERFORMANCE AT STEP 14, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.15

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.03

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 15

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 15

LRFD STRENGTH-LIMIT RATIOS AT STEP 15, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	39	1941.	30800.	0.063
BUCKLING THRUST (psi)	39	1941.	25013.	0.078
SEAM THRUST (psi)	39	1941.	21589.	0.090
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	8	0.196	1.000	0.196

LRFD SERVICE PERFORMANCE AT STEP 15, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.18

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.04

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 16

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 16

LRFD STRENGTH-LIMIT RATIOS AT STEP 16, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	39	2366.	30800.	0.077
BUCKLING THRUST (psi)	39	2366.	24957.	0.095
SEAM THRUST (psi)	39	2366.	21589.	0.110
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	20	0.232	1.000	0.232

LRFD SERVICE PERFORMANCE AT STEP 16, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.22

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.04

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 17

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 17

LRFD STRENGTH-LIMIT RATIOS AT STEP 17, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	39	3193.	30800.	0.104
BUCKLING THRUST (psi)	39	3193.	25482.	0.125
SEAM THRUST (psi)	39	3193.	21589.	0.148
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	20	0.227	1.000	0.227

LRFD SERVICE PERFORMANCE AT STEP 17, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%).................. 0.20

RISE HEIGHT OF VERTICAL DEFLECTION (IN).......... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.04

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF.......... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)........ 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 18

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 18

LRFD STRENGTH-LIMIT RATIOS AT STEP 18, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	39	3939.	30800.	0.128
BUCKLING THRUST (psi)	39	3939.	34219.	0.115
SEAM THRUST (psi)	39	3939.	21589.	0.182

PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	9	0.223	1.000	0.223

LRFD SERVICE PERFORMANCE AT STEP 18, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.19

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.04

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 19

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 19

LRFD STRENGTH-LIMIT RATIOS AT STEP 19, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	39	5131.	30800.	0.167
BUCKLING THRUST (psi)	39	5131.	40531.	0.127
SEAM THRUST (psi)	39	5131.	21589.	0.238
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	20	0.249	1.000	0.249

LRFD SERVICE PERFORMANCE AT STEP 19, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.20

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.04

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 20

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 20

LRFD STRENGTH-LIMIT RATIOS AT STEP 20, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	39	6528.	30800.	0.212
BUCKLING THRUST (psi)	39	6528.	51706.	0.126
SEAM THRUST (psi)	39	6528.	21589.	0.302
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	20	0.239	1.000	0.239

LRFD SERVICE PERFORMANCE AT STEP 20, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.19

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.04

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 21

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 21

LRFD STRENGTH-LIMIT RATIOS AT STEP 21, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	39	7919.	30800.	0.257
BUCKLING THRUST (psi)	39	7919.	58625.	0.135
SEAM THRUST (psi)	39	7919.	21589.	0.367
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	9	0.230	1.000	0.230

LRFD SERVICE PERFORMANCE AT STEP 21, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..................	0.17
RISE HEIGHT OF VERTICAL DEFLECTION (IN)...........	150.45
RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-).....	0.03
HANDLING FACTOR RATIO = (SPAN**2/EI)/FF...........	0.18
SPAN LENGTH FOR HANDLING AND BUCKLING (IN)........	301.50
FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB)	0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 22

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 22

LRFD STRENGTH-LIMIT RATIOS AT STEP 22, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	2	8781.	30800.	0.285
BUCKLING THRUST (psi)	2	8781.	60076.	0.146

SEAM THRUST (psi)	2	8781.	21589.	0.407
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	9	0.218	1.000	0.218

LRFD SERVICE PERFORMANCE AT STEP 22, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.13

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-)..... 0.03

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF..... 0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)..... 301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) 0.020

+ +

FINITE ELEMENT OUTPUT FOR LOAD STEP 23

+ +

ASSESSMENT SUMMARY STEEL-GROUP 1, LOAD-STEP 23

LRFD STRENGTH-LIMIT RATIOS AT STEP 23, FOR STEEL GROUP # 1

DESIGN-CRITERION	CONTROL NODE	FACTORED DEMAND	FACTORED CAPACITY	RATIO VALUE
MATERIAL THRUST (psi)	2	9633.	30800.	0.313
BUCKLING THRUST (psi)	2	9633.	60788.	0.158
SEAM THRUST (psi)	2	9633.	21589.	0.446
PLASTIC-PENETRATE (%)	0	0.00	90.00	0.000
COMBINED T&M Ratio	32	0.210	1.000	0.210

LRFD SERVICE PERFORMANCE AT STEP 23, FOR STEEL GROUP # 1

PERCENT VERTICAL DEFLECTION (%)..... 0.11

RISE HEIGHT OF VERTICAL DEFLECTION (IN)..... 150.45

```
RATIO OF VERTICAL DEFLECTION TO ALLOWABLE (-).....      0.02

HANDLING FACTOR RATIO = (SPAN**2/EI)/FF...........      0.18

SPAN LENGTH FOR HANDLING AND BUCKLING (IN)........    301.50

FLEXIBILITY FACTOR (FF) FOR HANDLING (IN/LB) .....     0.020


* * * * NORMAL EXIT FROM CANDE * * * *
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LOAD RATING CALCULATIONS

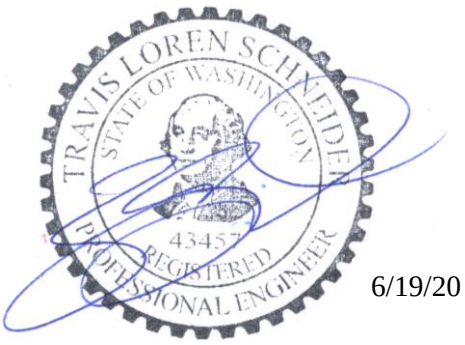
BRIDGECOR SINGLE RADIUS ARCH

MILL CREEK FISH PASSAGE
PESHASTIN, WA
CONTECH E.S. JOB NO. 584279
PA JOB NO. 20-2673

PREPARED BY:

PACIFIC AFFILIATES, INC.
A CONSULTING ENGINEERING GROUP
990 WEST WATERFRONT DRIVE
EUREKA, CA 95501
(707) 445-3001

JUNE 19, 2020



6/19/20

TRAVIS SCHNEIDER, R.P.E. 43457

BRIDGE RATING SUMMARY

6/19/20

Bridge Name: Mill Creek Fish Passage
Bridge Number:
SID Number:
Span Types: 24'-8" Span BridgeCor Steel Single Radius Arch Culvert
Bridge Length: 49 feet
Design Load: HL-93
Rated By: Nathan Meyers
Checked By: Travis Schneider
Date: June 19, 2020

Inspection Report Date:	No Inspection	Substructure Condition	N/A
Rating Method:	LRFR	Deck Condition	N/A
Overlay Thickness:	N/A	Superstructure Condition	N/A

Truck	RF	γ_L	Controlling Point
AASHTO Type 3	1.30	1.45	Minimum Cover, *See Remarks
AASHTO Type 3S2	1.30	1.45	Minimum Cover, *See Remarks
AASHTO Type 3-3	1.30	1.45	Minimum Cover, *See Remarks
NRL	1.30	1.45	Minimum Cover, *See Remarks
OL-1	1.30	1.45	Minimum Cover, *See Remarks
OL-2	1.30	1.45	Minimum Cover, *See Remarks
EV2	1.30	1.45	Minimum Cover, *See Remarks
EV3	1.30	1.45	Minimum Cover, *See Remarks

NBI Rating	RF	γ_L	Controlling Point
Inventory (HL-93)	1.00	1.75	Minimum Cover, *See Remarks
Operating (HL-93)	1.30	1.35	Minimum Cover, *See Remarks

Remarks:

*Rating factor for ring compression structures shall be the lower of two values based on wall strength or minimum cover requirements per NCSPA Design Data Sheet No. 19 (Appendix E). The minimum cover value selected for this design controls the rating factor for all vehicles, although it shall be noted the rating factor based on wall strength is significantly higher.

Bridge No:	0	Structure Name:	Mill Creek Fish Passage Project		
Feature Int.:	0	Sheet No:		Of	12
Year Built:	0	Load Rated By:	Nate Meyers	Date:	6/19/2020
Bridge Type:	Bridge:Cor Steel Single Radius Arch	hecked By:	Travis Schneider	Date:	6/19/2020

LRFR of In-Service, Corrugated Metal Pipe Structures

Based on **AASHTO LRFD** Bridge Design Specifications, Section 3, 4 & 12 & **NCSPA** Design Data Sheet No. 19 & **AASHTO MBE**

(do not use this spreadsheet to load rate Structural Plate Box Culverts)

A. Design Dimensions

1. For **typical structures**, use the actual field measured span for calculations.
2. For **unsymmetrical structures or those deflected over 5%**:

a. use 2 x the top radius ($2*R_t$) in lieu of span for calculations.

b. base critical buckling stress calculations on the theoretical design span, reducing the resulting allowable buckling stress by the appropriate multiplier to account for deflection " f " (NCSPA Design Data Sheet No. 19, Figure B.1.1).

3. For all **long span structures** (horizontal ellipse, low and high profile arches, inverted pear shapes and pear arches), as well as other horizontal ellipses, use 2 x actual top radius ($2*R_t$) in all cases.

For typical structures :	Design Span = Actual Span "S" (ft) =	24.67
For unsymmetrical or deflect more than 5% structures:	Design Span (ft) = $2*R_t$ =	24.67
	Pipe Crown Deflection =	0%
	Buckling Strength Reduction Factor, f * =	0.95

* reduction factor **f** is based on NCSPA Design Data Sheet No 19, II Structural Evaluation A.2.b & Appendix B.1, Figure B.1.1 for Unsymmetrical structures or structures deflected over 5% only.

long span structures:	Design Span (ft) = $2*R_t$ =	24.67

Structure Category: **Typical (NCSPA design data sheet No. 19, II. A. 1.)**

th used in Load Rating Calculation (ft)=	24.67
R_t used in Load Rating Calculation (ft)=	12.33
$R_{t\,(max)}$ * (ft) =	

* Maximum Plate Radius allowed if Long Span Structural Plate Structures Selected

B. Design Properties

Conduits Mechanical & Section Properties:

Mechanical Properties:

Metal Type:	Steel	
Minimum Yield Point of the Metal	44	ksi
um Tensile Strength of the Metal	55	ksi
= Modulus of elasticity of metal	29000	ksi

Bridge No:	0	Structure Name:	Mill Creek Fish Passage Project		
Feature Int.:	0	Sheet No:		Of	12
Year Built:	0	Load Rated By:	Nate Meyers	Date:	6/19/2020
Bridge Type:	Bridgecor Steel Single Radius Arch	hecked By:	Travis Schneide	Date:	6/19/2020

LRFR of In-Service, Corrugated Metal Pipe Structures

Section Properties:

Corrugation:	N/A
Gage Number:	N/A
c (in) =	15.00
d (in) =	5.50
t (in) =	0.170
$t_{(min)}$** (in) =	

** Required Minimum Top Arc Thickness if Long Span Stru

A_s (in^2/ft) =	2.762
r (in) =	1.9490
I x 10^{-3} (in^4/in) =	875.0

C. Design Calculations:

Structure Type:	Structural Plate Pipe
Seam Type:	Annular pipe w/ spot welded, riveted or bolted seam

Longitudinal Length of Structure "L" (ft) =	49.00
AASHTO minimum cover, "h" (ft) =	2.50
Depth of cover used to check AASHTO minimum cover requirment "H_{min}" (ft) =	2.50
ϕ_{loss} = Section Properties reduction factor on the basis of metal loss from the materials field	1.00
ϕ_1 = Resistance Factor for **wall area and buckling** (Table 12.5.5-1)	1.00
ϕ_2 = Resistance Factor for **seam strength** (Table 12.5.5-1)	0.67
δ = Soil density (k/ft^3)	0.130
k = soil stiffness factor =	0.22
ϕ_E = Factor for Distribution of Live Load with Depth of Fill based on Backfill Type (per AASHTO LRFD 3.6.1.2.6)=	1.15

Calculate the f_{cr} (critical buckling stress) : (AASHTO LRFD 12.7.2.4)

if: $S < \frac{r}{k}\sqrt{\frac{24E_m}{F_u}}, then\ f_{cr} = F_u - \frac{F_u^{\ 2}}{48E_m}\left(\frac{kS}{r}\right)^2$

if: $S > \frac{r}{k}\sqrt{\frac{24E_m}{F_u}}, then\ f_{cr} = \frac{12E_m}{(kS/r)^2}$

Compare: S (in) = 296.00 < $\frac{r}{k}\sqrt{\frac{24E_m}{F_u}}$ = 996.58

Bridge No:	0	Structure Name:	Mill Creek Fish Passage Project		
Feature Int.:	0	Sheet No:		Of	12
Year Built:	0	Load Rated By:	Nate Meyers	Date:	6/19/2020
Bridge Type:	Bridgecor Steel Single Radius Arch	hecked By:	Travis Schneider	Date:	6/19/2020

LRFR of In-Service, Corrugated Metal Pipe Structures

$k\sqrt{F_u}$

Therefore, f_{cr} = 52.57 ksi

Calculate the T_{cap} (thrust capacity of the wall) :

Seam Strength (k/ft) = 87.0

T_{cap} = less of:

1. wall yield strength = $\phi_1 \phi_{loss} F_y A$ =	121.5
2. wall buckling strength = $f \phi_1 \phi_{loss} f_c$	145.2
3. seam strength = ϕ_2 x (seam strengt	58.3

Therefore, T_{cap} = 58.3 k/ft

Calculate the T_E (pipe wall thrust due to earth cover) :

T_E = higher value of :

1. $\delta H (S/2)$ =	7.22	k/ft
2. $\delta H R_t$ =	7.22	k/ft

Therefore, T_E = 7.22 k/ft

Calculate the $T_{(L+IM)}$ (pipe wall thrust due to live load plus dynamic load allowance) :

$T_{(L+IM)}$ = higher value of :

1. $\rho_{(L+IM)}$ (S/2) =	k/ft
2. $\rho_{(L+IM)}$ R_t =	k/ft

$\rho_{(L+IM)}$: pressure at crown due to live load plus dynamic load allowance

Based on **AASHTO LRFD 3.6.2.2:**

Live Load Dynamic Load Allowance, **IM** = $33(1.0-0.125\ D_E) \geq 0\%$

where, D_E = the minimum depth of earth cover above the structure (ft)

For this structure: Depth of Fill, D_E = **H**= 4.50 ft

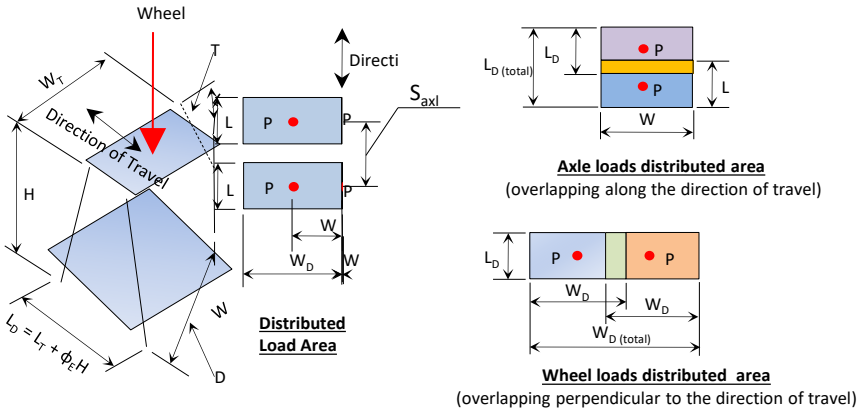
IM = 14%

(1+**IM**) = 1.14

Bridge No:	0	Structure Name:	Mill Creek Fish Passage Project		
Feature Int.:	0	Sheet No:		Of	12
Year Built:	0	Load Rated By:	Nate Meyers	Date:	6/19/2020
Bridge Type:	Bridgecor Steel Single Radius Arch	hecked By:	Travis Schneide	Date:	6/19/2020

LRFR of In-Service, Corrugated Metal Pipe Structures

Calculations will be based on **AASHTO LRFD 3.6.1.2.5 & 6**:



Where, $\mathbf{W_T}$ = Tire contact width, $\mathbf{L_T}$ = Tire contact length, $\mathbf{W_D}$ = Distributed load width, $\mathbf{L_D}$ = Distributed load length

The surface tire contact area for HL-93 loading (per AASHTO LRFD 3.6.1.2.5)**:**

$\mathbf{W_T}$ = 20" = 1.67 ft

$\mathbf{L_T}$ = 10" = 0.83 ft

Legal Rating Levels (LRL) for Washington Legal Trucks:

The surface tire contact area for AASHTO Legal Trucks; Legal Rating Level (per AASHTO LRFD C3.6.1.2.5 Guideline):

$\mathbf{W_T}$ (in) = P/0.8

$\mathbf{L_{T\ (LRL)}}$ (in) = $6.4\gamma(1+IM/100)$

where, P = wheel load (kips)

γ = Load Factor for Legal Loads $\gamma_{LL\ (LRL)}$ = 1.45

IM = dynamic load allowance percent

	Type 3	Type 3S2	Type 3-3	OL-1	OL-2	EV-2	EV-3	NRL
P "heavy axle" wheel load (kips) =	8.50	8.50	8.00	10.75	11.00	16.75	15.50	8.50
W_T (ft) =	0.89	0.89	0.83	1.12	1.15	1.74	1.61	0.89
$L_{T\ (LRL)}$ (ft) =	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88

Distribution of wheel loads through earth fills (per AASHTO LRFD 3.6.1.2.6):

for **HL-93** Design Truck:

$W_D = 1.67+\phi_E H$ = 6.84 ft

$L_D = 0.83 + \phi_E H$ = 6.01 ft

for **AASHTO Legal** Trucks (LRL):

	Type 3	Type 3S2	Type 3-3	OL-1	OL-2	EV-2	EV-3	NRL
$W_D = W_T + \phi_E H$ =	6.06	6.06	6.01	6.29	6.32	6.92	6.79	6.06
$L_{D\ (LRL)} = L_{T\ (LRL)} + \phi_E H$ =	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06

Bridge No:	0	Structure Name:	Mill Creek Fish Passage Project		
Feature Int.:	0	Sheet No:		Of	12
Year Built:	0	Load Rated By:	Nate Meyers	Date:	6/19/2020
Bridge Type:	Bridgecor Steel Single Radius Arch	hecked By:	Travis Schneide	Date:	6/19/2020

LRFR of In-Service, Corrugated Metal Pipe Structures

Fill depth, H = 4.50 ft

Structure Total Length, L = 49.00 ft

[if $W_{D\ (total)}$ > L, use L = $W_{D\ (total)}$ in the calculations]

	HL-93 Truck	HL-93 Tandem	Type 3	Type 3S2	Type 3-3	OL-1	OL-2	EV-2	EV-3	NRL
Heavy Axle Load (kips)	32.00	25.00	17.00	17.00	16.00	21.50	22.00	33.50	31.00	17.00
$P_{heavy\ (1+IM)}$ (kips) =	18.31	14.30	9.73	9.73	9.16	12.30	12.59	19.17	17.74	9.73
$S_{axle\ 1}$ (ft) =	0.00	4.00	4.00	4.00	0.00	4.00	0.00	0.00	4.00	4.00
Axle 2 Load (kips)	0.00	25.00	17.00	17.00	0.00	21.50	0.00	0.00	31.00	17.00
$P_{2\ (1+IM)}$ (kips) =	0.00	14.30	9.73	9.73	0.00	12.30	0.00	0.00	17.74	9.73
$S_{axle\ 2}$ (ft) =	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
Axle 3 Load (kips)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
$P_{3\ (1+IM)}$ (lbs) =	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.58
$S_{axle\ 3}$ (ft) =	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
Axle 4 Load (kips)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
$P_{4\ (1+IM)}$ (lbs) =	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.58
wheel spacing on axle (ft)	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
W_D (ft) =	6.84	6.84	6.06	6.06	6.01	6.29	6.32	6.92	6.79	6.06
$W_{D\ (total)}$ =	12.84	12.84	12.06	12.06	12.01	12.29	12.32	12.92	12.79	12.06
$L_{D\ \&\ D\ (LRL)}$ (ft) =	6.01	6.01	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06
$L_{D\ \&\ D\ (LRL)\ (total)}$ =	6.01	10.01	10.06	10.06	6.06	10.06	6.06	6.06	10.06	18.06
$A_D = W_{D\ (total)} \times L_{D\ \&\ D\ (LRL)\ (total)}$ =	77.2	128.5	121.3	121.3	72.8	123.7	74.7	78.3	128.7	217.8
P_D (kips) =	36.62	57.22	38.91	38.91	18.31	49.21	25.18	38.34	70.95	57.22
$\rho_{(L+IM)} = P_D/A_D$ =	0.47	0.45	0.32	0.32	0.25	0.40	0.34	0.49	0.55	0.26
$T_{(L+IM)}$ (k/ft) =	5.85	5.49	3.96	3.96	3.10	4.91	4.16	6.04	6.80	3.24

$P_{heavy\ (1+IM)}$ = heavy axle wheel load plus dynamic load allowance.

Axle 2 Load = 1st adjacent axle load to the heavy axle, if the $S_{axle\ 1}$ > 4.25', input Axle 2 load = 0.

$S_{axle\ 1}$ = distance from the heavy axle to the 1st adjacent axle, if the spacing is > 4.25', input $S_{axle\ 1}$ = 0.

Axle 3 Load = 2nd adjacent axle load to the heavy axle, if the $S_{axle\ 2}$ > 4.25', input Axle 3 load = 0.

$S_{axle\ 2}$ = distance from the 1st adjacent axle to the 2nd adjacent axle, if the spacing is > 4.25', input $S_{axle\ 2}$ = 0.

$\rho_{(L+IM)}$ = pressure at crown due to live load plus dynamic load allowance

A_D = Total Load Distributed Area

P_D = Total Load being Distributed

One lane loaded. Longitudinal pressure overlaps are considered for two adjacent heavy axle loads when the S_{axle} is ≤

Bridge No:	0	Structure Name:	Mill Creek Fish Passage Project		
Feature Int.:	0	Sheet No:		Of	12
Year Built:	0	Load Rated By:	Nate Meyers	Date:	6/19/2020
Bridge Type:	Bridgecor Steel Single Radius Arch	hecked By:	Travis Schneide	Date:	6/19/2020

LRFR of In-Service, Corrugated Metal Pipe Structures

D. Load Rating Factors for Ring Compression Structures:

1. **Operating & Legal Rating Level** Load Rating Factor (RF_O):

a. RF_O based on wall strength

$$RF_{O-W} = \frac{\varphi_c \varphi_s T_{cap} - \gamma_{EV} \eta_R T_E}{\gamma_{LL} T_{(L+IM)}}$$

b. RF_O based on minimum cover requirements

$$RF_{O-C} = \frac{H_{\min}^{\ 2}}{C(h)^2}$$

Where, $C = 2.36 \frac{H_{\min}}{S} + 0.528 \leq 1.0 =$ 0.77

So, RF_{O-C} = 1.30

Operating Load Rating Factors, RF_O			Legal Rating Level Load Rating Factors, RF_O							
	HL-93 Truck	HL-93 Tandem	Type 3	Type 3S2	Type 3-3	OL-1	OL-2	EV-2	EV-3	NRL
T_{cap}	58.29	58.29	58.29	58.29	58.29	58.29	58.29	58.29	58.29	58.29
$\varphi_c \varphi_s$	***1.00***									
T_E	7.22	7.22	7.22	7.22	7.22	7.22	7.22	7.22	7.22	7.22
γ_{EV}	***1.50***	***1.50***	***1.50***	***1.50***	***1.50***	***1.50***	***1.50***	***1.50***	***1.50***	***1.50***
η_R	***1.05***	***1.05***	***1.05***	***1.05***	***1.05***	***1.05***	***1.05***	***1.05***	***1.05***	***1.05***
$T_{(L+IM)}$	5.85	5.49	3.96	3.96	3.10	4.91	4.16	6.04	6.80	3.24
γ_{LL}	***1.35***	***1.35***	***1.45***	***1.45***	***1.45***	***1.45***	***1.45***	***1.45***	***1.45***	***1.45***
RF_{O-W}	5.94	6.33	8.18	8.18	10.43	6.60	7.78	5.36	4.76	9.99
RF_{O-C}	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
RF_O	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30

Bridge No:	*0*	Structure Name:	*Mill Creek Fish Passage Project*		
Feature Int.:	*0*	Sheet No:		Of	*12*
Year Built:	*0*	Load Rated By:	*Nate Meyers*	Date:	*6/19/2020*
Bridge Type:	*Bridgecor Steel Single Radius Arch*	hecked By:	*Travis Schneider*	Date:	*6/19/2020*

LRFR of In-Service, Corrugated Metal Pipe Structures

2. Inventory Load Rating Factor (RF_i):

a. RF_i based on wall strength

$$RF_{i-W} = \frac{\varphi_c \varphi_s T_{cap} - \gamma_{EV} \eta_R T_E}{\gamma_{LL} T_{(L+IM)}}$$

b. RF_i based on minimum cover requirements

$$RF_{i-c} = \frac{H_{\min}^{2}}{h^2}$$

Inventory Load Rating Factor, *RF_i*		
	HL-93 Truck	**HL-93 Tandem**
T_{cap}	58.29	58.29
φ_c φ_s	***1.00***	
T_E	7.22	7.22
γ_{EV}	***1.50***	***1.50***
η_R	***1.05***	***1.05***
$T_{(L+IM)}$	5.85	5.49
γ_{LL}	***1.75***	***1.75***
RF_{i-w}	4.58	4.88
RF_{i-c}	1.00	1.00
RF_i	1.00	1.00

Bridge No:	*0*	Structure Name:	*Mill Creek Fish Passage Project*		
Feature Int.:	*0*	Sheet No:		Of	*12*
Year Built:	*0*	Load Rated By:	*Nate Meyers*	Date:	*6/19/2020*
Bridge Type:	***BridgeCor Steel Single Radius Arch***	Checked By:	*ravis Schneide*	Date:	*6/19/2020*

LRFR of In-Service, Corrugated Metal Pipe Structures

Permit Rating Levels (PRL) for Washington Legal Trucks:

The surface tire contact area for AASHHTO Legal Trucks; Permit Rating Level (per AASHTO LRFD C3.6.1.2.5 Guideline):

$\mathbf{W_T}$ (in) = P/0.8

$\mathbf{L_{T\,(PRL)}}$ (in) = $6.4\gamma(1+IM/100)$

where, P = wheel load (kips)

γ = Load Factor for Legal Loads $\gamma_{LL\,(PRL)}$ = 1.20

IM = dynamic load allowance percent

So,

	Type 3	Type 3S2	Type 3-3	OL-1	OL-2	EV-2	EV-3	NRL
P "heavy axle" wheel load (kips) =	8.50	8.50	8.00	10.75	11.00	16.75	15.50	8.50
W_T (ft) =	0.89	0.89	0.83	1.12	1.15	1.74	1.61	0.89
$L_{T\,(PRL)}$ (ft) =	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73

Distribution of wheel loads through earth fills (per AASHTO LRFD 3.6.1.2.6):

for AASHTO **Legal** Trucks (PRL):

	Type 3	Type 3S2	Type 3-3	OL-1	OL-2	EV-2	EV-3	NRL
$W_D = W_T + \phi_E H$ =	6.06	6.06	6.01	6.29	6.32	6.92	6.79	6.06
$L_{D\,(PRL)} = L_{T\,(PRL)} + \phi_E H$ =	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91

Bridge No:	*0*	Structure Name:	*Mill Creek Fish Passage Project*		
Feature Int.:	*0*	Sheet No:		Of	*12*
Year Built:	*0*	Load Rated By:	*Nate Meyers*	Date:	*6/19/2020*
Bridge Type:	***BridgeCor Steel Single Radius Arch***	Checked By:	*ravis Schneide*	Date:	*6/19/2020*

LRFR of In-Service, Corrugated Metal Pipe Structures

Fill depth, H = 4.50 ft

Structure Total Length, L = 49.00 ft

[if $W_{D\ (total)}$ > L, use L = $W_{D\ (total)}$ in the calculations]

	Not Used	Not Used	Type 3	Type 3S2	Type 3-3	OL-1	OL-2	EV-2	EV-3	NRL
Heavy Axle Load (kips)			17.00	17.00	16.00	21.50	22.00	33.50	31.00	17.00
$P_{heavy\ (1+IM)}$ (kips) =			9.73	9.73	9.16	12.30	12.59	19.17	17.74	9.73
$S_{axle\ 1}$ (ft) =			4.00	4.00	0.00	4.00	0.00	0.00	4.00	4.00
Axle 2 Load (kips)			17.00	17.00	0.00	21.50	0.00	0.00	31.00	17.00
$P_{2\ (1+IM)}$ (kips) =			9.73	9.73	0.00	12.30	0.00	0.00	17.74	9.73
$S_{axle\ 2}$ (ft) =			0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
Axle 3 Load (kips)			0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
$P_{3\ (1+IM)}$ (lbs) =			0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.58
$S_{axle\ 3}$ (ft) =			0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
Axle 4 Load (kips)			0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
$P_{4\ (1+IM)}$ (lbs) =			0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.58
wheel spacing on axle (ft)			6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
W_D (ft) =			6.06	6.06	6.01	6.29	6.32	6.92	6.79	6.06
$W_{D\ (total)}$ =			12.06	12.06	12.01	12.29	12.32	12.92	12.79	12.06
$L_{D\ (PRL)}$ (ft) =			5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91
$L_{D\ (PRL)\ (total)}$ =			9.91	9.91	5.91	9.91	5.91	5.91	9.91	17.91
$A_D = W_{D\ (total)} \times L_{D\ (PRL)\ (total)}$ =			119.49	119.49	70.94	121.81	72.78	76.32	126.71	215.97
P_D (kips) =			38.91	38.91	18.31	49.21	25.18	38.34	70.95	57.22
$\rho_{(L+IM)} = P_D/A_D$ =			0.33	0.33	0.26	0.40	0.35	0.50	0.56	0.26
$T_{(L+IM)}$ (k/ft) =			4.02	4.02	3.18	4.98	4.27	6.20	6.91	3.27

$P_{heavy\ (1+IM)}$ = heavy axle wheel load plus dynamic load allowance.

Axle 2 Load = 1st adjacent axle load to the heavy axle, if the $S_{axle\ 1}$ > 4.25', input Axle 2 load = 0.

$S_{axle\ 1}$ = distance from the heavy axle to the 1st adjacent axle, if the spacing is > 4.25', input S_{axle1} = 0.

Axle 3 Load = 2nd adjacent axle load to the heavy axle, if the $S_{axle\ 2}$ > 4.25', input Axle 3 load = 0.

$S_{axle\ 2}$ = distance from the 1st adjacent axle to the 2nd adjacent axle, if the spacing is > 4.25', input S_{axle2} = 0.

$\rho_{(L+IM)}$ = pressure at crown due to live load plus dynamic load allowance

A_D = Total Load Distributed Area

P_D = Total Load being Distributed

One lane loaded. Longitudinal pressure overlaps are considered for two adjacent heavy axle loads when the S_{axle} is ≤ 4.25 feet.

If the span length is long enough for more axles of loads overlapping at crown location, hand calculations have to be done to consider the additional loads and P_D & A_D values have to be overwritten for those cases.

D. Load Rating Factors for Ring Compression Structures:

Bridge No:	*0*	Structure Name:	*Mill Creek Fish Passage Project*		
Feature Int.:	*0*	Sheet No:		Of	*12*
Year Built:	*0*	Load Rated By:	*Nate Meyers*	Date:	*6/19/2020*
Bridge Type:	***BridgeCor Steel Single Radius Arch***	Checked By:	*ravis Schneide*	Date:	*6/19/2020*

LRFR of In-Service, Corrugated Metal Pipe Structures

1. **Permit Rating Level** (using Operating equations) Load Rating Factor (RF_O):

a. RF_O based on wall strength

$$RF_{O-W} = \frac{\varphi_c \varphi_s T_{cap} - \gamma_{EV} \eta_R T_E}{\gamma_{LL} T_{(L+IM)}}$$

b. RF_O based on minimum cover requirements

$$RF_{O-C} = \frac{H_{\min}^{\ 2}}{C(h)^2}$$

Where, $C = 2.36\frac{H_{\min}}{S} + 0.528 \leq 1.0 =$ 0.77

So, RF_{O-C} = 1.30

Permit Rating Level Load Rating Factors, *RF_O*

	Not Used	Not Used	Type 3	Type 3S2	Type 3-3	OL-1	OL-2	EV-2	EV-3	NRL
T_{cap}			58.29	58.29	58.29	58.29	58.29	58.29	58.29	58.29
$\varphi_c \varphi_s$	***1.00***									
T_E			7.22	7.22	7.22	7.22	7.22	7.22	7.22	7.22
γ_{EV}			***1.50***	***1.50***	***1.50***	***1.50***	***1.50***	***1.50***	***1.50***	***1.50***
η_R			***1.05***	***1.05***	***1.05***	***1.05***	***1.05***	***1.05***	***1.05***	***1.05***
$T_{(L+IM)}$			4.02	4.02	3.18	4.98	4.27	6.20	6.91	3.27
γ_{LL}			***1.20***	***1.20***	***1.20***	***1.20***	***1.20***	***1.20***	***1.20***	***1.20***
RF_{O-W}			9.74	9.74	12.28	7.85	9.17	6.31	5.66	11.97
RF_{O-C}			1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
RF_O			1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30

Bridge No:	0	Structure Name:	Mill Creek Fish Passage Project		
Feature Int.:	0	Sheet No:		Of	12
Year Built:	0	Load Rated By:	Nate Meyers	Date:	6/19/2020
Bridge Type:	**BridgeCor Steel Single Radius Arch**	Checked By:	ravis Schneide	Date:	6/19/2020

LRFR of In-Service, Corrugated Metal Pipe Structures

Load Rating Summary:				
	Load	***GVW***	***Rating Factor***	***Safe Load***
Inventory	***HL-93***	*36 Tons*	*RF=1.00*	*36.0 Tons*
Operating	***HL-93***	*36 Tons*	*RF=1.30*	*46.9 Tons*
Legal	***Type 3***	*27 Tons*	*RF=1.30*	*35.2 Tons*
	Type 3S2	*40.0 Tons*	*RF=1.30*	*52.1 Tons*
	Type 3-3	*40.0 Tons*	*RF=1.30*	*52.1 Tons*
	OL-1	*48.0 Tons*	*RF=1.30*	*62.6 Tons*
	OL-2	*103.5 Tons*	*RF=1.30*	*134.9 Tons*
	EV-2	*28.8 Tons*	*RF=1.30*	*37.5 Tons*
	EV-3	*43.0 Tons*	*RF=1.30*	*56.0 Tons*
	NRL	*40.0 Tons*	*RF=1.30*	*52.1 Tons*
Permit	***Type 3***	*27 Tons*	*RF=1.30*	*35.2 Tons*
	Type 3S2	*40.0 Tons*	*RF=1.30*	*52.1 Tons*
	Type 3-3	*40.0 Tons*	*RF=1.30*	*52.1 Tons*
	OL-1	*48.0 Tons*	*RF=1.30*	*62.6 Tons*
	OL-2	*103.5 Tons*	*RF=1.30*	*134.9 Tons*
	EV-2	*28.8 Tons*	*RF=1.30*	*37.5 Tons*
	EV-3	*43.0 Tons*	*RF=1.30*	*56.0 Tons*
	NRL	*40.0 Tons*	*RF=1.30*	*52.1 Tons*

Bridge No:	*0*	Structure Name:	*Mill Creek Fish Passage Project*
Feature Int.:	*0*	Sheet No:	Of
Year Built:	*0*	Load Rated By: *Nate Meyers*	Date: *6/19/2020*
Bridge Type:	***BridgeCor Steel Single Radius Arch***	Checked By: *Travis Schneider*	Date: *6/19/2020*

LFR of In-Service, Corrugated Metal Pipe Structures

Based on **AASHTO LRFD** Bridge Design Specifications, Section 3, 4 & 12 & **NCSPA** Design Data Sheet No. 19 & **AASHTO MBE**

(do not use this spreadsheet to load rate Structural Plate Box Culverts)

A. Design Dimensions

1. For **typical structures**, use the actual field measured span for calculations.

2. For **unsymmetrical structures or those deflected over 5%**:

a. use 2 x the top radius ($2*R_t$) in lieu of span for calculations.

b. base critical buckling stress calculations on the theoretical design span, reducing the resulting allowable buckling stress by the appropriate multiplier to account for deflection " f " (NCSPA Design Data Sheet No. 19, Figure B.1.1).

3. For all **long span structures** (horizontal ellipse, low and high profile arches, inverted pear shapes and pear arches), as well as other horizontal ellipses, use 2 x actual top radius ($2*R_t$) in all cases.

For typical structures :	Design Span = Actual Span "S" (ft) =	24.67

For unsymmetrical or deflect more than 5% structures:	Design Span (ft) = $2*R_t$ =	24.67
	Pipe Crown Deflection =	0%
	Buckling Strength Reduction Factor, f * =	0.95

* reduction factor **f** is based on NCSPA Design Data Sheet No 19, II Structural Evaluation A.2.b & Appendix B.1, Figure B.1.1 for Unsymmetrical structures or structures deflected over 5% only.

long span structures:	Design Span (ft) = $2*R_t$ =	24.67

Structure Category: **Typical (NCSPA design data sheet No. 19, II. A. 1.)**

Then, **Span Length** used in Load Rating Calculation (ft)=	24.67
Then, $\mathbf{R_t}$ used in Load Rating Calculation (ft)=	12.33
$\mathbf{R_{t\ (max)}}$ * (ft) =	

* Maximum Plate Radius allowed if Long Span Structural Plate Structures Selected

B. Design Properties

Conduits Mechanical & Section Properties:

Mechanical Properties:

Metal Type:	Steel	
F_y = Minimum Yield Point of the Metal	44	ksi
F_u = Minimum Tensile Strength of the Metal	55	ksi
E_m = Modulus of elasticity of metal	29000	ksi

Section Properties:

Corrugation:	N/A
Gage Number:	N/A
c (in) =	15.00
d (in) =	5.50
t (in) =	0.170
$t_{(min)}$** (in) =	

** Required Minimum Top Arc Thickness if Long Span Structural Plate Structures Selected

A_s (in^2/ft) =	2.762
r (in) =	1.9490
I x 10^{-3} (in^4/in) =	875.000

Bridge No:	*0*	Structure Name:	*Mill Creek Fish Passage Project*		
Feature Int.:	*0*	Sheet No:		Of	
Year Built:	*0*	Load Rated By:	*Nate Meyers*	Date:	*6/19/2020*
Bridge Type:	***BridgeCor Steel Single Radius Arch***	Checked By:	*Travis Schneider*	Date:	*6/19/2020*

LFR of In-Service, Corrugated Metal Pipe Structures

C. Design Calculations:

Structure Type:	Structural Plate Pipe
Seam Type:	Annular pipe w/ spot welded, riveted or bolted seam
Longitudinal Length of Structure "L" (ft) =	49.00
AASHTO minimum cover, "h" (ft) =	2.50
Depth of cover used to check AASHTO minimum cover requirment "H_{min}" (ft) =	2.50
δ = Soil density (k/ft^3)	0.130
k = soil stiffness factor =	0.22
ϕ_2 = Resistance Factor for **seam strength** (Table 12.5.5-1)	0.67

Calculate the f_{cr} (critical buckling stress) :

if: $S < \frac{r}{k}\sqrt{\frac{24E_m}{F_u}}, then\ f_{cr} = F_u - \frac{F_u^2}{48E_m}\left(\frac{kS}{r}\right)^2$

if: $S > \frac{r}{k}\sqrt{\frac{24E_m}{F_u}}, then\ f_{cr} = \frac{12E_m}{(kS/r)^2}$

Compare: S (in) = 296.00 < $\frac{r}{k}\sqrt{\frac{24E_m}{F_u}} =$ 996.58

Therefore, f_{cr} = 52.57 ksi

Calculate the T_{cap} (thrust capacity of the wall) :

Seam Strength (k/ft) = 87.0

T_{cap} = less of:	1. wall yield strength = F_y A =	121.5
	2. wall buckling strength = f_{cr} A =	145.2
	3. seam strength = ϕ_2 x (seam strength) =	58.3

Therefore, T_{cap} = 58.3 k/ft

Calculate the T_E (pipe wall thrust due to earth cover) :

T_E = higher value of :	1. δ H (S/2) =	7.22	k/ft
	2. δ H R_t =	7.22	k/ft

Therefore, T_E = 7.22 k/ft

Calculate the $T_{(L+IM)}$ (pipe wall thrust due to live load plus dynamic load allowance) :

$T_{(L+IM)}$ = higher value of :	1. $\rho_{(L+IM)}$ (S/2) =	k/ft
	2. $\rho_{(L+IM)}$ R_t =	k/ft

$\rho_{(L+IM)}$: pressure at crown due to live load plus dynamic load allowance

Based on **AASHTO 3.8.2.3:**

Bridge No:	*0*	Structure Name:	*Mill Creek Fish Passage Project*		
Feature Int.:	*0*	Sheet No:		Of	
Year Built:	*0*	Load Rated By:	*Nate Meyers*	Date:	*6/19/2020*
Bridge Type:	***BridgeCor Steel Single Radius Arch***	Checked By:	*Travis Schneider*	Date:	*6/19/2020*

LFR of In-Service, Corrugated Metal Pipe Structures

For this structure: Depth of Fill, D_E = **H**=	4.50	ft
IM =	14%	
(1+**IM**) =	1.14	

Where, $\mathbf{W_T}$ = Tire contact width, $\mathbf{L_T}$ = Tire contact length, $\mathbf{W_D}$ = Distributed load width, $\mathbf{L_D}$ = Distributed load length

The surface tire contact area (per AASHTO 3.30)**:**

$\mathbf{W_T}$ = 20" =	1.67	ft
$\mathbf{L_T}$ = 10" =	0.83	ft

Distribution of wheel loads through earth fills (per AASHTO 6.4):

$W_D = W_T+2(H)(.875)=$	9.54	ft
$L_D = L_T+2(H)(.875) =$	8.71	ft

Bridge No:	0	Structure Name:	Mill Creek Fish Passage Project		
Feature Int.:	0	Sheet No:		Of	
Year Built:	0	Load Rated By:	Nate Meyers	Date:	6/19/2020
Bridge Type:	**BridgeCor Steel Single Radius Arch**	Checked By:	Travis Schneider	Date:	6/19/2020

LFR of In-Service, Corrugated Metal Pipe Structures

Fill depth, H = 4.50 ft

Structure Total Length, L = 49.00 ft

[if $W_{D\ (total)}$ > L, use L = $W_{D\ (total)}$ in the calculations]

	HS 20 Truck	Not Used	Type 3	Type 3S2	Type 3-3	OL-1	OL-2	EV-2	EV-3	NRL
Heavy Axle Load (kips)	32.00		17.00	17.00	16.00	21.50	22.00	33.50	31.00	17.00
$P_{heavy\ (1+\ IM)}$ (kips) =	18.31		9.73	9.73	9.16	12.30	12.59	19.17	17.74	9.73
$S_{axle\ 1}$ (ft) =	0.00		4.00	4.00	0.00	4.00	0.00	0.00	4.00	4.00
Axle 2 Load (kips)	0.00		17.00	17.00	0.00	21.50	0.00	0.00	31.00	17.00
$P_{2\ (1+\ IM)}$ (kips) =	0.00		9.73	9.73	0.00	12.30	0.00	0.00	17.74	9.73
$S_{axle\ 2}$ (ft) =	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
Axle 3 Load (kips)	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
$P_{3\ (1+\ IM)}$ (lbs) =	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.58
$S_{axle\ 3}$ (ft) =	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
Axle 4 Load (kips)	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
$P4_{(1+\ IM)}$ (lbs) =	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.58
wheel spacing on axle (ft)	6.00		6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
W_D (ft) =	9.54		9.54	9.54	9.54	9.54	9.54	9.54	9.54	9.54
$W_{D\ (total)}$ =	15.54		15.54	15.54	15.54	15.54	15.54	15.54	15.54	15.54
$L_{D\ \&\ D\ (LRL)}$ (ft) =	8.71		8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71
$L_{D\ \&\ D\ (LRL)\ (total)}$ =	8.71		12.71	12.71	8.71	12.71	8.71	8.71	12.71	20.71
$A_D = W_{D\ (total)} \times L_{D\ \&\ D\ (LRL)\ (total)}$ =	135.34		197.51	197.51	135.34	197.51	135.34	135.34	197.51	321.84
P_D (kips) =	36.62		38.91	38.91	18.31	49.21	25.18	38.34	70.95	57.22
$\rho_{(L+IM)} = P_D/A_D$ =	0.27		0.20	0.20	0.14	0.25	0.19	0.28	0.36	0.18
$T_{(L+IM)}$ (k/ft) =	3.34		2.43	2.43	1.67	3.07	2.29	3.49	4.43	2.19

$P_{heavy\ (1+\ IM)}$ = heavy axle wheel load plus dynamic load allowance.

Axle 2 Load = 1st adjacent axle load to the heavy axle, if the $S_{axle\ 1}$ > 4.25', input Axle 2 load = 0.

$S_{axle\ 1}$ = distance from the heavy axle to the 1st adjacent axle, if the spacing is > 4.25', input $S_{axle\ 1}$ = 0.

Axle 3 Load = 2nd adjacent axle load to the heavy axle, if the $S_{axle\ 2}$ > 4.25', input Axle 3 load = 0.

$S_{axle\ 2}$ = distance from the 1st adjacent axle to the 2nd adjacent axle, if the spacing is > 4.25', input $S_{axle\ 2}$ = 0.

$\rho_{(L+IM)}$ = pressure at crown due to live load plus dynamic load allowance

A_D = Total Load Distributed Area

P_D = Total Load being Distributed

One lane loaded. Longitudinal pressure overlaps are considered for two adjacent heavy axle loads when the S_{axle} is ≤ 4.25 feet. If the span length is long enough for more axles of loads overlapping at crown location, hand calculations have to be done to consider the additional loads and P_D & A_D values have to be overwritten for those cases.

D. Load Rating Factors for Ring Compression Structures:

1. **Operating & Legal Rating Level** Load Rating Factor (RF_O):

a. RF_O based on wall strength

$$RF_{O-W} = \frac{\phi_c T_{cap} - \gamma_{DL} T_E}{\gamma_{LL} T_{(L+IM)}}$$

b. RF_O based on minimum cover requirements

$$RF_{O-C} = \frac{H_{min}^2}{C(h)^2}$$

Where, $C = 2.36\frac{H_{min}}{S} + 0.528 \leq 1.0 =$ 0.77

So, RF_{O-C} = 1.30

Bridge No:	*0*	Structure Name:	*Mill Creek Fish Passage Project*		
Feature Int.:	*0*	Sheet No:		Of	
Year Built:	*0*	Load Rated By:	*Nate Meyers*	Date:	*6/19/2020*
Bridge Type:	***BridgeCor Steel Single Radius Arch***	Checked By:	*Travis Schneider*	Date:	*6/19/2020*

LFR of In-Service, Corrugated Metal Pipe Structures

	Operating Load Rating Factors, RF_O		Legal Rating Level Load Rating Factors, RF_O							
	HS 20 Truck	**Not Used**	**Type 3**	**Type 3S2**	**Type 3-3**	**OL-1**	**OL-2**	**EV-2**	**EV-3**	**NRL**
T_{cap}	58.29		58.29	58.29	58.29	58.29	58.29	58.29	58.29	58.29
$\varphi_c\ \varphi_s$	***1.00***									
T_E	7.22		7.22	7.22	7.22	7.22	7.22	7.22	7.22	7.22
γ_{DL}	***1.30***		***1.30***	***1.30***	***1.30***	***1.30***	***1.30***	***1.30***	***1.30***	***1.30***
$T_{(L+IM)}$	3.34		2.43	2.43	1.67	3.07	2.29	3.49	4.43	2.19
γ_{LL}	***1.30***		***1.30***	***1.30***	***1.30***	***1.30***	***1.30***	***1.30***	***1.30***	***1.30***
$RF_{O\text{-}W}$	11.27		15.49	15.49	22.55	12.24	16.40	10.77	8.49	17.16
$RF_{O\text{-}C}$	1.30		1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
RF_O	1.30		1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30

Bridge No:	0	Structure Name:	Mill Creek Fish Passage Project		
Feature Int.:	0	Sheet No:		Of	
Year Built:	0	Load Rated By:	Nate Meyers	Date:	6/19/2020
Bridge Type:	**BridgeCor Steel Single Radius Arch**	Checked By:	Travis Schneider	Date:	6/19/2020

LFR of In-Service, Corrugated Metal Pipe Structures

2. Inventory Load Rating Factor (RF_i):

a. RF_i based on wall strength

$$RF_{I-W} = \frac{\phi_c T_{cap} - \gamma_{DL} T_E}{\gamma_{LL} T_{(L+IM)}}$$

b. RF_i based on minimum cover requirements

$$RF_{i-c} = \frac{H_{min}^2}{h^2}$$

Inventory Load Rating Factor, RF_i			Legal Rating Level Load Rating Factors, RF_i							
	HS 20 Truck	Not Used	Type 3	Type 3S2	Type 3-3	OL-1	OL-2	EV-2	EV-3	NRL
T_{cap}	58.29		58.29	58.29	58.29	58.29	58.29	58.29	58.29	58.29
$\varphi_c\ \varphi_s$	***1.00***									
T_E	7.22		7.22	7.22	7.22	7.22	7.22	7.22	7.22	7.22
γ_{DL}	***1.30***		***1.30***	***1.30***	***1.30***	***1.30***	***1.30***	***1.30***	***1.30***	***1.30***
$T_{(L+IM)}$	3.34		2.43	2.43	1.67	3.07	2.29	3.49	4.43	2.19
γ_{LL}	***2.17***		***2.17***	***2.17***	***2.17***	***2.17***	***2.17***	***2.17***	***2.17***	***2.17***
RF_{i-w}	6.75		9.28	9.28	13.51	7.34	9.82	6.45	5.09	10.28
RF_{i-c}	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
RF_i	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Load Rating Summary:					
	Design Load	***GVW/Heavy Axle Load***	***Rating Factor***	***Safe Load***	***Controlling Rating***
Inventory	***HS 20 Truck***	*36 Tons*	*RF=1.00*	*36.0 Tons*	*HS 20.0*
Operating	***HS 20 Truck***	*36 Tons*	*RF=1.30*	*46.9 Tons*	*HS 26.1*
Inventory	***Type 3***	*27 Tons*	*RF=1.00*	*27.0 Tons*	
	Type 3S2	*40.0 Tons*	*RF=1.00*	*40.0 Tons*	
	Type 3-3	*40.0 Tons*	*RF=1.00*	*40.0 Tons*	
	OL-1	*48.0 Tons*	*RF=1.00*	*48.0 Tons*	
	OL-2	*103.5 Tons*	*RF=1.00*	*103.5 Tons*	
	EV-2	*28.8 Tons*	*RF=1.00*	*28.8 Tons*	
	EV-3	*43.0 Tons*	*RF=1.00*	*43.0 Tons*	
	NRL	*40.0 Tons*	*RF=1.00*	*40.0 Tons*	
Operating	***Type 3***	*27 Tons*	*RF=1.30*	*35.2 Tons*	
	Type 3S2	*40.0 Tons*	*RF=1.30*	*52.1 Tons*	
	Type 3-3	*40.0 Tons*	*RF=1.30*	*52.1 Tons*	
	OL-1	*48.0 Tons*	*RF=1.30*	*62.6 Tons*	
	OL-2	*103.5 Tons*	*RF=1.30*	*134.9 Tons*	
	EV-2	*28.8 Tons*	*RF=1.30*	*37.5 Tons*	
	EV-3	*43.0 Tons*	*RF=1.30*	*56.0 Tons*	
	NRL	*40.0 Tons*	*RF=1.30*	*52.1 Tons*	