LOW COST BRIDGE REPLACEMENT USING FACTORY MADE CORRUGATED METAL PIPE

PACIFIC CORRUGATED PIPE CO.

LOW COST REPLACEMENT WITH CORRUGATED METAL PIPE (CMP) & PIPE-ARCHES (CMPA)

Consider the many benefits of specifing corrugated metal products:

STRUCTURALLY SOUND

CMP products are offered in a wide variety of materials, shapes, corrugations and sheet thickness that can be installed using a variety of backfill methods and materials to meet specific project requirements. CMP structures are routinely specified to meet highway, railroad, and airport loading requirements. Materials are manufactured and installed according to national specifications such as AASHTO, ASTM, and FHWA. The structural properties of corrugated metal products are well known and have been proven over many years of service.

REDUCED MAINTENANCE

Although all roadway structures require periodic inspections, a buried CMP structure typically requires less maintenance than a bridge. In fact, a properly designed CMP structure should remain essentially maintenance free for its designed life. Its useful life can at any time be further extended by timely maintenance.

INCREASED SAFETY

Bridges are notoriously dangerous during freezing weather because they are more prone to icing than the adjacent roadway. This hazardous driving condition is due to exposure of the bridge deck to freezing air above and below, without the warming effect of earth contact. This condition is greatly reduced or eliminated when culverts are used.

(Continued on Opposite Panel)

A 1997 Federal Highway Administration (FHWA) bridge survey reports there are more than 575,000 bridges throughout the country of which more than 188,000 are considered functionally or structurally deficient. More that 103,000 of these are under city, county, and township ownership with local responsibility for hazard liability, maintenance and repair.

There may well be a tendency for designers to consider replacing a bridge with another bridge as the only option. In some cases, the required waterway or other factors may indeed call for a bridge as the only viable option. In many cases, however, full round corrugated metal pipe (CMP), pipe-arch (CMPA), or arch structures can be used as economical and permanent replacements for inadequate short span bridges. When the required waterway is greater than that of a single corrugated metal pipe, multiple pipe barrels, or other corrugated metal structures should be considered.

Most deficient bridges are short spans averaging less than 50 feet in length and are on rural or secondary roads. Many of these are timber structures which are less than 50 years old and failing prematurely due to rot, insect infestation, or other causes. Some were simply not designed for current traffic loads and are considered functionally obsolete.

Over 50,000 of these deficient structures are in need of immediate repair or replacement. Most of these are already load rated, limiting use to lightweight traffic and restricting access to some areas by construction equipment and emergency vehicles.

The many bridges in need of repair or replacement represent a burdensome liability for agency budgets already strained by other needs. The installed cost of a corrugated metal structure is often in the range of 30% to 50% of the cost of a comparable wooden bridge. The savings are even greater when compared to the cost of a steel or concrete bridge.

Clove Valley Estates, Rocklin, CA. - Eleven 76 ft. Runs of 60″ diameter CSP .064, 3″x1″ corrugation

LOW COST REPLACEMENT WITH CORRUGATED METAL PIPE

The extra avoided costs represent a significant source of revenue for funding other needed projects. The lower cost of CMP structure can mean the difference between doing a much needed project now or waiting until additional funding is available. Postponement can sometimes be very expensive in terms of additional required maintenance or by extending the owner's liability for an unsafe structure.

Buried inverts are becoming an increasingly popular design feature of CMP structures. The depression created by the buried invert is quickly filled in with natural streambed material as the stream reestablishes its original gradient. These natural materials protect the pipe invert from scour and abrasion, thus extending the service life of the structure. In addition, a more natural habitat for fish and other living organisms is extended through the CMP structure.

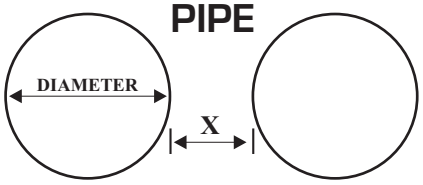
Fish passage through all stream crossing structures can be enhanced using relatively simple techniques to eliminate potential barriers. These might include buried inverts, custom fish baffle plates, downstream impoundments, or some other set of techniques. A fish biologist is required to determine which fish species are present, their migration habits, and their physical limitations. The designer or engineer considers this information along with the stream's hydrologic factors to design a CMP structure which accommodates both peak stormwater flows and fish passage requirements.

Each project presents a unique set of conditions. Fortunately, there are many CMP design options available which address all relevant concerns while providing the least cost solution to the short span bridge replacement problem.

Low cost, factory made corrugated metal pipe products can help you do that much needed bridge replacement *now*!

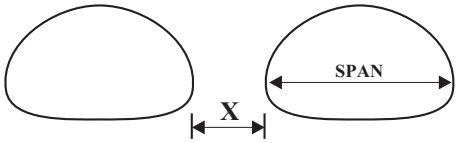
MINIMUM SPACING FOR MULTIPLE INSTALLATIONS

PIPE



DIAMETER	X (SPACING)
Up to 24 in. 24 to 72 in. 72 in. and over	12 in. 1/2 Diameter of pipe 36 in.

PIPE - ARCHES



SPAN	X (SPACING)
Up to 36 in. 36 to 108 in. 108 TO 189 IN.	12 in. 1/3 Span of pipe arch 36 in.

Note: Spacing between multiple barrel installations is to allow room for compaction equipment and to enable the structures to develop adequate side support. When height of cover exceeds 4′ and flowable backfill is used to 12″ above springline, clearance between large diameter pipes and pipe-arches can be less than shown above.

Adapted from *AISI Handbook of Steel Drainage and Highway Construction Products.*

LESS TRAFFIC DISRUPTION

CMP structures can often be placed and substantially backfilled before the failing bridge is removed. This procedure usually allows at least one lane of traffic to remain open during construction. CMP structures are typically installed in a matter of days whereas bridges can take weeks or months to complete. A CMP structure can also be widened more easily than a bridge structure.

CONTROL STREAM FLOWS

CMP structure can be used to control and redirect meandering stream flows which might otherwise threaten to undercut bridge piers and abutments.

DURABILITY

With more than 100 years of service, much is known about the factors which affect the durability of corrugated metal pipe. Using the right mix of high performance coatings, installation techniques, backfill and pipe materials, CMP structures can be designed to provide a service life of 100 years or more.

LOW COST

A CMP structure will almost always cost less in place than a comparable bridge replacement. The cost of a CMP structure is often less than half the cost of a bridge. Agency crews are sometimes used to install CMP structures to further reduce costs or better utilize agency resources.

Given its many advantages, a CMP structure often represents the best value for bridge replacement.

DESIGN TABLE

CORRUGATED STEEL PIPE-ARCH

H-20 or H-25

EQUIV. DIAM. (inch)	SPAN X RISE (inch)	END AREA (sq ft)	MIN. GAUGE [2]	MIN. COVER (inch) [1]	MAX. HT OF COVER BASED ON CORNER BEARING PRESSURES [3]			WEIGHT (lb/lf)	CORRU-GATION (inch)
					2 TON	3 TON	4 TON		
42	49 x 33	8.9	14	12	9	14	19	42	2 2/3 x 1/2
48	57 x 38	11.6	12	12	9	14	19	65	2 2/3 x 1/2
54	60 x 46	15.6	14	12	21	31	42	61	3 x 1
60	66 x 51	19.3	14	12	21	31	42	67	3 x 1
66	73 x 55	23.2	14	12	21	31	42	74	3 x 1
72	81 x 59	27.4	14	12	17	26	35	81	3 x 1
78	87 x 63	32.1	14	12	17	26	35	87	3 x 1
84	95 x 67	37.0	14	12	17	26	34	94	3 x 1
90	103 x 71	42.4	14	18	17	25	34	100	3 x 1
96	112 x 75	48.0	14	18	17	25	34	107	3 x 1
102	117 x 79	54.2	12	18	16	25	34	156	3 x 1
108	128 x 83	60.5	12	24	16	25	33	165	3 x 1
114	137 x 87	67.4	12	24	16	25	33	174	3 x 1
120	142 x 91	74.5	10	24	16	25	32	235	3 x 1
126 [4]	150 x 96	82.3	10	30	12	23	30	247	3 x 1
132 [4]	157 x 101	90.3	10	30	12	23	30	258	3 x 1
138 [4]	164 x 105	98.7	10	30	12	23	28	270	3 x 1
144 [4]	171 x 110	107.4	10	30	12	23	28	282	3 x 1

1) Minimum cover is measured from top of pipe to top of subgrade or top of rigid pavement. Minimum cover for heavy construction equipment or other excessive loading is 48 inches. H 20 live loads are assumed in all cases.

2) Minimum gauge is based on conditions approaching maximum height of cover. With proper design and appropriate installation techniques, thinner gauges may be used when heights of cover are substantially reduced. (14 ga. is minimum required for 3″x1″ corrugation pipe-arch.)

3) Support under and around the haunch is critical for pipe-arch structures. Trench conditions to at least 12 inches above spring line with slurry or other flowable backfill material is recommended.

4) Flexibility increases with span in pipe-arch structures. Backfill methods and materials must be carefully controlled to insure proper installation of all pipe-arch structures and special care must be taken with these larger sizes.

DESIGN TABLE

CORRUGATED STEEL ROUND PIPE

H-20 or H-25

DIAM. (inch)	END AREA (sq ft)	MIN. GAUGE	MIN. COVER (inch) [1]	MAX COVER (ft) [2]	WEIGHT (lbs/lf)	CORRUGATION (inch)
42	9.62	16	12	71	34	2 2/3 x 1/2
48	12.57	16	12	62	38	2 2/3 x 1/2
54	15.90	14	12	66	54	2 2/3 x 1/2
60	19.64	16	12	50	55	3 x 1
66	23.67	16	12	46	60	3 x 1
72	28.27	16	12	42	66	3 x 1
78	33.18	16	12	39	71	3 x 1
84	38.49	16	12	36	77	3 x 1
90	44.18	16	12	33	82	3 x 1
96	50.27	14	12	39	107	3 x 1
102	56.75	14	18	37	114	3 x 1
108	63.62	14	18	35	120	3 x 1
114	70.88	14	18	32	127	3 x 1
120	78.54	12	18	41	183	3 x 1
126	86.59	10	24	50	247	3 x 1
132	95.03	10	24	47	258	3 x 1
138	103.87	10	24	43	270	3 x 1
144 [3]	113.10	10	24	40	282	3 x 1

1) Minimum cover is measured from top of pipe to top of subgrade or top of rigid pavement. Minimum cover for heavy construction equipment or other excessive loading is 48 inches. H 20 live loads are assumed in all cases.

2) Maximum height of cover is based on minimum gauge shown. Thicker gauges, where available, can accept greater heights of cover. (Contact Pacific Corrugated Pipe company for available gauges and corresponding height of cover tables.)

3) 144″ and larger sizes exceed the flexibility factor (ff≤.033) allowable in AASHTO Bridge Specifications (Section 12) for 3″x1″ corrugation pipe in embankment type installations. Flexibility factor can be increased to ff≤.060 in accordance with ASTM specification A 796 for trench type installations. (Contact Pacific Corrugated Pipe company for information on recommended backfill materials and procedures for installing large diameter corrugated metal pipe.)

The information in this brochure should be checked in detail by the professional engineer responsible for the design to verify its accuracy; also, the assumption and methods used to obtain the information should be reviewed to make certain they are applicable and suitable for the design.

Tables adapted from *AISI Handbook of Steel Drainage and Highway Construction Products.*

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