heloRI

PT. HELORI GRAHASARANA

GENERAL CONTRACTOR & FACTORY

CATALOGUE

ECONOMICAL
QUICK AND EASY

Head Office : Puri Sentra Niaga Blok A-16
Jl. Raya Kalimalang, Jakarta 13620
Telp. (021) 86605447, 29361863, Fax. (021) 8601117
Workshop : Arah Golf River Side Ujung
Kp. Cikuda - Gunung Putri Bogor
Email : info@helorigrahasarana.com
Website : www.helorigrahasarana.com

OUR PRODUCTS

1. Corrugated Steel Pipe Armco
   - Nestable Flange E-100
   - Multi Plate Pipe
2. Flex Beam Guardrail
3. Electric Pole
4. Street and Flood Light Pole
5. High Mast Automatic Lowering
6. Stadium Pole

CORRUGATED STEEL PIPE

heloRI

PT. HELORI GRAHASARANA

GENERAL CONTRACTOR & FACTORY

SPECIFICATION

ITEM	DESCRIPTION	AASHTO	ASTM	AS	SNI
Design	Structural design of corrugated steel pipe and structural plate pipe	Bridge Section 12	A-796	AS 2041 AS 2042	SNI 07-0950
Galvanized	Steel base steel with 2 oz. per ft2. Zinc coating for corrigated steel pipe	M- 218	A - 123	AS 1650	SNI 07 - 7033
Cold Applied Bituminous Coating	Fibrated mastic or asphalt base coatings of various vicosities for field or shop coating of corrugated pipe or structural plate	M-190	A-849 ASTM D147	AS 2758.2 AS 1289	SNI-06-6452-2000 SK SNI - M - 09 -1991 -03 SK SNI - M - 1011994 - 04
INSTALLATION	Corrugated Steel pipe	Bridge Section 26	A-798	AS 2041 AS 2042	SNI 07-0950

Corrugated Steel Pipe offers some very distinct advantages over other drainage product. This unique product offers a wide variety of sizes, shapes, profiles, and thicknesses, coupler types, fittings, a range lengths, and special coatings. Corrugated Steel pipe is so versatile that it's not just for traditional drainage anymore! Applications include :

- Culvert
- Small Bridges
- Storm Drainage
- Storm Water Detention
- Underpasses and Cattle Crossings
- Utility Conduits
- Cisterns
- Mine Portals
- Pipeline Crossings
- Stockpile Tunnels
- Road and Rail Grade Separations
- Cut and Cover Pedestrian Tunnels
- Underground Storage Structures

Consider the many benefits of specifying corrugated steel Products :

STRENGTH
The inherent strength of Corrugated steel pipe is derived from the mechanical properties of steel combined with the steel-soil interaction. Advanced steel manufacturing process ensures all material meet specification every time. The steel-soil interaction allows for high-ring compression strength in a relatively thin-walled structure. Corrugated steel pipe absorbs and transfers the vertical live and dead loads to the surrounding soil around the entire circumference of the pipe.

Durability
With more than 50 years of service, much is known about the factors which affect the durability of Corrugated Steel Pipe. Using the right mix of high performance coatings, installation techniques, backfill and pipe materials, Corrugated Steel Pipe structures can be designed to provide a service l ife of 50 years or more.

Low Cost
Corrugated steel pipe is more cost effective than other drainage structures when all aspects of the application are considered.

Reduced Maintenance
Although all roadway structures require Periodic inspections, Corrugated Steel Plate structure typically requires less maintenance than a bridge.

Control Stream Flows
Corrugated Steel Plate structures can be used to control and redirect meandering stream flows which might otherwise threaten to undercut bridge piers and abutments.

Ideal
Corrugated Steel is ideal for new site developments, council and municipal stream crossings, as well as urban rehabilitations. It maintains natural streambeds and reduces environmental impacts.

Given its many advantages, a corrugated steel pipe structure often represents the best value for concrete structure and bridge replacement.

heloRI

PT. HELORI GRAHASARANA

GENERAL CONTRACTOR & FACTORY

MATERIAL SPECIFICATION

- Chemical Composition

The Raw material shall be tested and the cast analysis values shall conform to below :

Steel		Coating	
Element	Percentage	Element	Percentage
C	0.15 (max)	Zn	99.88
P	0.05 (max)		
S	0.05 (max)	Ai	0.02
Mn	0.6 (max)		
Si	0.35 (max)		

- Mechanical Properties

Yield Strength	:	230 Mpa (Minimum)
Elongation Gauge Length	:	16% minimum on 200mm
Anti-corrosion coating	:	By hot dip galvanized with a thickness pf 610 gr/cm2

Design Factors

Design begins with reconnaissance and location surveys. The services of experienced soils and drainage engineers provide the best assurance of economical construction and subsequent minimum maintenance. The following design factors must be considered :

1. Size, shape, alignment, grade and other configuration. These depend on hydrology and hydraulics, and on service requirements.

2. Structural adequacy to meet embankment and superimposed live loads, along with hydraulic forces.

3. Trouble-free service through selection of materials to resist wear and provide durability.

4. Economics – First cost of materials and installation, plus maintenance cost evaluated on the basis of present worth.

5. Influence of climate or season of the year.

6. Ease of repair or replacement in relation to the importance or service of the facility.

Features

Correct installation procedures will ensure maximum performance. The interaction of a well compacted engineered backfill with the superior section properties of corrugated steel plate ensures a structure capable of supporting high loads with the most economical use of steel.

Speed

Installation times are measured in weeks rather than in months. This feature means shorter road closure periods and minimum disruption of environmentally sensitive locations such as fish-bearing streams.

Simplicity

Corrugated steel plate installation is economical, simple and rapid. Because of the increased plate stiffness and improved properties in bending, and less installation sensitive than concrete products.

Configuration

Three components are used to make up all

structures

: Curved corrugated Plate, Back filling, and foundation.

Note

- Some client may have their own design criteria
- Our Sales Engineers and Sales Representatives, with technical support from our engineering department, are trained to work with you on economical solutions to your design challenges

heloRI

PT. HELORI GRAHASARANA

GENERAL CONTRACTOR & FACTORY

FACTORS AFFECTING CORRUGATED STEEL PIPE DURABILITY

Durability in Soil

The durability of metal pipe in soil is a function of several interacting parameters including soil resistivity, acidity (pH), moisture content (aeration). However, all of the corrosion processes involve the flow of current from one location to another (a corrosion cell). Thus the higher the resistivity, the greater the durability. Table on follow is lists typical ranges of resistivity values for the primary soil types.

Table 4 :Typical soil resistivity

Classification	Resistivity Ohm-cm
Clay	750-2000
Loam	2000-10000
Gravel	10000-30000
Sand	30000-50000
Rock	50000-infinity*

*Theoretical

Table 5 : Corrosiveness of Soils

Soil Type		Description of Soil	Aeration	Drainage	Color	Water Table
I	Mildly Corrosive	1. Sands or sandy loams 2. Light textured silt loams 3. Porous loams or clay loams thoroughly oxidized to great depths	Good	Good	Uniform color	Very Low
II	Moderately Corrosive	1. Sandy loams 2. Silt loams 3. Clay loams	Fair	Fair	Slight mottling	Low
III	Extremely Corrosive	1. Clay loams 2. Clays	Poor	Poor	Heavy texture moderate mot-tling	0.5 to 1m be-low surface
IV	Severely Corrosive	1. Muck 2. Peat 3. Tidal marsh 4. Clays and organic soils	Very Poor	Very Poor	Bluish-gray mottling	At surface; or extreme imper-meability

- Durability in Water

There is little difference in the durability of steel in still natural waters in the pH range of 4.5 to 9.5, because the corrosion products maintain a pH of 9.5 at the steel surface. Increasing levels of dissolved oxygen and carbon dioxide can accelerate corrosion. The most important effect of carbon dioxide in water relates to its interference with the formation of the protective calcium carbonate scale. Dissolved salts can increase durability by decreasing oxygen solubility and neutralizing acidity.

- Resistance to Abrasion

The potential for metal loss in the invert of a drainage structure due to abrasive flows is often overlooked by designers and its effects are often mistaken for corrosion. Three factors must combine to caused invert abrasion :

• Abrasive Bed load • Sufficient velocity to carry the bed load • Flow duration and frequency

- Coating

Galvanized Z610 / EN ISO 1461 Galvanized Z610 / EN ISO 1461 is a hot-dip zing coating that forms a superior barrier over steel. Calcium attracted from naturally hard water can aid in providing additional protection as its develops mineral scale on the pipe surface. As the zing coating corrodes slowly over time, it galvanicaly protects the base steel as long as any zinc remains.

- Additional Coating

Additional service life can be provided by increasing the thickness of the base or with use Polymer Coating for additional coating. We recommend
to using polymer coating because it's environmentally friendly and also has been tested can add life time to 10 years or approval equivalent.

ECONOMICAL, QUICK AND EASY

NESTABLE FLANGE E 100

Nestable Flange E-100 is the most common and versatile of the corrugated steel pipe shapes. This shape is used primarily for culverts, small bridge, but is also appropriate for storage bins, storm water drains and sub-drains.

Section Properties

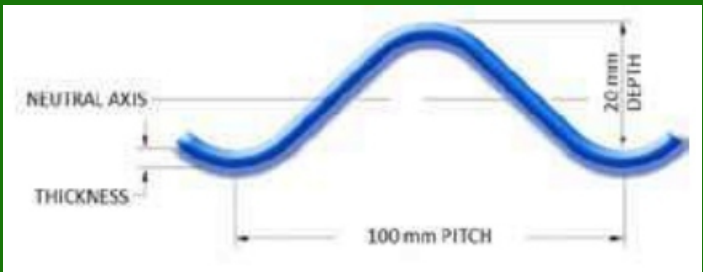


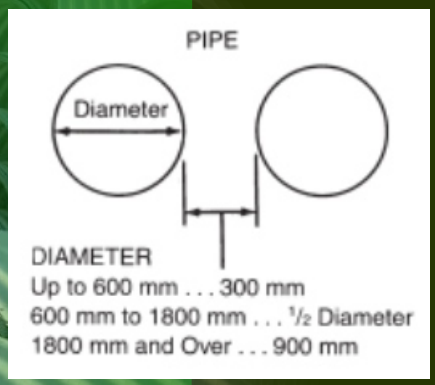
Table 6 : Section Properties of CSP 100mm x 20 mm

Thickness (mm)	Tangent Length (mm)	Moment of Inertia (mm^4/mm)	Area of Section (mm^2/mm)	Section Modulus (mm^3/mm)	Radius of Gyration (mm)	Ultimate Seam Strength (KN/m)
2	22.96	96.85	2.188	8.805	6.65	265
2.5	22.52	118.38	2.736	10.523	6.58	380
3	22.07	145.60	3.283	12.66	6.66	475
3.5	21.61	158.46	3.829	13.486	6.43	580

Approximate Weight (Kg/m)

Table 7 : Weight (Approximately)

DIAMETER (mm)	Weight / Meter (Kg)			
	2.0	2.5	3.0	3.5
450	30	38	45 5	4
500	35	44	53	61
600	40	48	60	68
800	49	61	74	89
900	55	69	83	96
1000	60	75	90	101
1200	75	96	113	126
1400	83	104	125	146
1500	92	115	137	159
1600	94	1 20	141	166
1800	-	136	164	191
2000	-	-	185	219



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

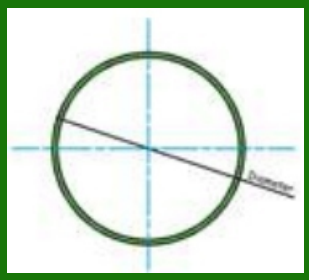
Note:

1. Minimum cover for High Way is 0.6 m until Top Of Pavement
2. Minimum cover for Rail Way is 1.0 m until Top Of Rail
3. 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 1.2m.
4. Minimum clear spacing between structures as indicated in follow

MULTI-PLATE

This shape is used for culverts, storm sewers, aggregate tunnels, vehicular and pedestrian tunnels and stream enclos Function well in all applications, but especially in those with high cover.

Section Properties



NOTE : MULTI PLATE PACKAGE : WRENCH, HAND HOOK, AND PINBAR

Table 9 : Section Properties of CSP 200 mm x 55 + 3

Thickness (mm)	A (°)	Tangent Length (mm)	Moment of Inertia (mm^4/mm)	Area of Section (mm2/mm)	Section Modulus (mm3/mm)	Radius of Gyration (mm)	Ultimate Seam Strength (KN/m)
3.0	45.20	32.20	1330	46	19.50	3.50	650
3.5	45.50	31.30	1580	53	19.50	4.15	815
4.0	45.70	30.40	1800	60	19.60	4.70	930
5.0	46.30	28.40	2300	74	19.60	5.90	1180
6.0	47.00	26.50	2750	88	19.70	7.10	1430
7.0	47.70	24.70	3200	103	19.70	8.30	1630

Table 10: Section Properties of Multi-plate Pipe

Structure Number	Diameter (mm)	Periphery (m)	End Area (m2)	Weight Per Meter (Kg)					
				3 mm	3,5 mm	4 mm	5 mm	6 mm	7 mm
20M	1500	4.7	1.8	168	194	219	272	323	375
24M	1800	5.6	2.5	196	226	257	318	378	439
28M	2100	6.6	3.4	231	267	302	374	445	517
30M	2250	7.1	4.0	245	283	321	398	471	549
32M	2400	7.5	4.5	266	307	347	431	512	594
36M	2700	8.5	5.7	294	339	385	477	567	659
40M	3000	9.4	7.0	329	380	430	533	634	736
42M	3150	9.9	7.8	343	396	449	557	662	769
44M	3300	10.3	8.5	364	420	475	590	701	814
48M	3600	11.3	10.1	392	452	513	636	757	878
52M	3900	12.2	11.9	427	493	558	692	823	956
54M	4050	12.7	12.8	441	509	577	716	851	988
56M	4200	13.2	13.8	462	533	604	749	890	1034
60M	4500	14.1	15.8	490	565	641	795	946	1098
64M	4800	15.0	18.0	525	606	686	851	1008	1176
66M	4950	15.5	19.1	539	622	705	874	1040	1208
68M	5100	16.0	20.3	560	646	732	908	1079	1253
72M	5400	16.9	22.8	588	678	769	954	1135	1318
76M	5700	17.9	25.4	-	719	814	1010	1201	1395
78M	5850	18.3	26.7	-	735	833	1033	1229	1427
80M	6000	18.8	28.1	-	759	860	1066	1268	1473
84M	6300	19.7	31.0	-	-	897	1113	1324	1537
88M	6600	20.7	34.0	-	-	-	1169	1390	1615
90M	6750	21.2	35.6	-	-	-	1192	1418	1647
92M	6900	21.6	37.2	-	-	-	1225	1457	1692
96M	7200	22.6	40.5	-	-	-	1272	1513	1757
100M	7500	23.5	43.9	-	-	-	-	1579	1834
102M	7650	24.0	45.7	-	-	-	-	1607	1866
104M	7800	24.4	47.5	-	-	-	-	1646	1911
108M	8100	25.4	51.3	-	-	-	-	-	1976
112M	8400	26.3	55.1	-	-	-	-	-	2054
114M	8550	26.8	57.1	-	-	-	-	-	2086

MULTI-PLATE PIPE ARCHES

Limited headroom. Has hydraulic advantages at low flow levels. Culverts, storm sewer, underpass and stream enclosures.

Section Properties

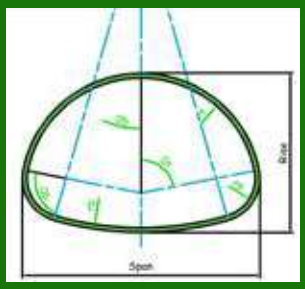


Table 13: Section Properties of Multi-plate Pipe-Arches

Structure Number	Span (mm)	Rise (mm)	Periphery (m)	End Area (m2)	Side Radius rs (mm)	Top Radius rt (mm)	Bottom Radius rb (mm)	Side Angle ϕs (deg)	Top Angle ϕt (deg)	Bottom Angle ϕb (deg)	Weight Per Meter (Kg)					
											3 mm	3,5 mm	4 mm	5 mm	6 mm	7 mm
11 MA 4-4	1850	1550	5.4	2.10	633	932	1724	85	79	16	195	224	254	315	374	434
12 MA 4-7	2280	1730	6.3	1.90	633	1181	1768	85	68	27	223	258	292	362	430	500
18 MA 4-7	2540	1880	7.0	3.60	633	1280	2912	85	79	16	251	290	328	407	483	561
18 MA 4-8	2890	2070	8.0	4.50	633	1448	4756	85	84	11	285	329	372	461	548	637
18 MA 4-11	3280	2200	8.7	5.30	633	1692	3158	85	72	23	307	354	401	497	591	686
20 MA 4-11	3430	2300	9.2	5.90	633	1740	4195	85	77	18	328	378	428	530	630	732
22 MA 4-12	3700	2440	9.9	6.80	633	1873	5057	85	79	16	349	402	456	565	672	780
22 MA 4-15	4100	2570	10.6	7.80	633	2157	3827	85	69	26	377	435	492	610	725	841
26 MA 4-15	4390	2770	11.5	9.10	633	2224	6174	85	79	16	412	474	537	666	792	919
27 MA 5-15	4580	3050	12.2	10.90	800	2323	5705	84	78	18	433	500	566	702	834	969
32 MA 5-15	4890	3300	13.4	13.00	800	2446	12623	84	88	8	475	548	620	770	915	1062
30 MA 5-17	5070	3280	13.4	13.00	800	2570	6650	84	79	17	470	540	612	760	905	1050
32 MA 5-18	5340	3430	14.1	14.30	800	2697	7600	84	80	16	496	572	648	804	957	1111
32 MA 5-20	5620	3510	14.6	15.20	800	2883	6380	84	75	21	-	596	675	838	996	1156
37 MA 5-20	5930	3770	15.7	17.70	800	2980	11000	84	84	12	-	644	730	905	1076	1250
39 MA 5-22	6350	3950	16.7	19.70	800	3195	10840	84	82	14	-	-	767	951	1131	1314

MULTI-PLATE ARCHES

Low clearance, large waterway opening. Aesthetic shapes and open natural bottoms for environmentally-friendly crossings.

Section Properties

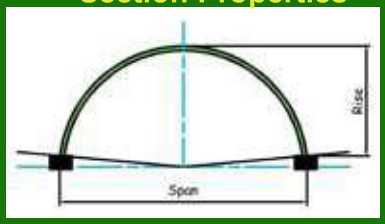


Table 14: Section Properties of Multi-plate Arches

Structure Number	Span (mm)	Rise (mm)	Periphery (m)	End Area (m^2)	Radius (mm)	Weight Per Meter (Kg)					
						3.0 mm	3.5 mm	4.0 mm	5.0 mm	6.0 mm	7.0 mm
12MA	2000	890	2.9	1.30	1006	108	123	139	169	199	229
15MA	2500	1100	3.6	2.01	1259	136	156	175	214	252	291
18MA	3000	1310	4.4	2.88	1513	157	180	203	249	294	339
22MA	3500	1640	5.3	4.31	1753	192	220	248	305	361	417
23MA	4000	1590	5.5	4.61	2051	199	228	257	316	374	433
26MB	4000	1970	6.2	6.02	2000	227	260	293	361	427	494
26MA	4500	1800	6.2	5.88	2305	227	260	293	361	427	494
29MB	4500	2180	6.9	7.48	2251	248	285	321	396	469	543
29MA	5000	2010	6.9	7.32	2559	248	285	321	396	469	543
33MB	5000	2510	7.9	9.68	2500	283	325	367	452	536	620
32MA	5500	2220	7.6	8.91	2813	276	317	357	441	522	604
36MB	5500	2720	8.6	11.50	2750	304	349	395	487	577	669
35MA	6000	2430	8.3	10.66	3067		341	385	475	563	652
39MB	6000	2930	9.3	13.48	3000		381	431	532	630	730
37MA	6500	2500	8.8	11.77	3363			412	508	603	698
42MB	6500	3140	10.0	15.63	3251			459	566	672	778
40MA	7000	2700	9.5	13.76	3616				543	644	746
46MB	7000	3470	10.9	18.74	3500				623	739	856
43MA	7500	2910	10.2	15.93	3870					697	807
49MB	7500	3670	11.6	21.25	3750					792	917
46MA	8000	3120	10.9	18.23	4123					739	856
52MB	8000	3880	12.3	23.91	4001					833	966
49MA	8500	3330	11.6	20.69	4377						917
56MB	8500	4210	13.3	27.74	4250						1043

Table 13: Section Properties of Multi-plate Arch Type AB

Structure Number	Span (mm)	Rise (mm)	Periphery (m)	End Area (m^2)	Internal Radius rt (mm)	Bottom Angle θb (deg)	Top Step (mm)	Botto m Step (mm)
26AB	**4000**	**1928**	6.230	6	2.08	2.08	500	295
29AB	**4500**	**2138**	6.935	7.45	2.94	2.94	563	295
33AB	**5000**	**2465**	7.875	9.64	0.79	0.79	625	295
36AB	**5500**	**2675**	8.580	11.47	1.58	1.58	688	295
39AB	**6000**	**2885**	9.285	13.45	2.24	2.24	751	295
42AB	**6500**	**3094**	9.990	15.59	2.83	2.83	814	295
46AB	**7000**	**3420**	10.930	18.69	1.32	1.32	875	295
49AB	**7500**	**3630**	11.635	21.2	1.87	1.87	938	295
52AB	**8000**	**3839**	12.340	23.86	2.34	2.34	1001	295
56AB	**8500**	**4167**	13.280	27.67	1.13	1.13	1063	295

MULTI-PLATE UNDERPASS

Offers efficient shape for passage of pedestrians or livestock, vehicular traffic and bicycles with minimal buried invert.

Section Properties

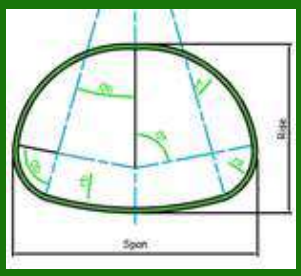
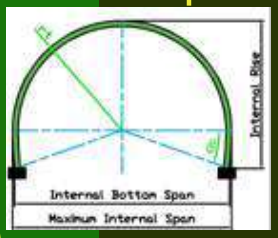


Table 14: Section Properties of Multi-plate Underpass

Structure Number	Span (mm)	Rise (mm)	Periphery (m)	End Area (m2)	Side Radius rs (mm)	Top Radius rt (mm)	Bottom Radius rb (mm)	Side Angle Θs (deg)	Top Angle Θt (deg)	Bottom Angle Θb (deg)	Weight Per Meter (Kg)					
											3 mm	3,5 mm	4 mm	5 mm	6 mm	7 mm
25 M 4-8	3220	2780	9.6	7.00	897	1609	3481	60	105	15	350	403	456	562	671	780
27 M 4-11	3690	3060	10.8	8.70	897	1843	3458	60	99	21	384	443	502	623	740	860
29 M 4-11	3830	3180	11.3	9.50	897	1913	4116	60	102	18	400	460	520	646	776	891
31 M 4-12	4080	3350	12.0	10.70	897	2039	4571	60	102	18	427	493	560	691	821	953
33 M 4-12	4220	3480	12.4	11.60	897	2108	5520	60	105	15	441	508	575	714	848	985
34 M 4-15	4630	3690	13.4	13.30	897	2314	4786	60	99	21	476	548	621	770	915	1062
37 M 4-15	4830	3880	14.1	14.80	897	2414	5997	60	103	17	504	581	659	815	968	1124
39 M 4-15	4960	4000	14.6	15.80	897	2481	7105	60	106	14	518	597	676	834	996	1156
39 M 4-18	5320	4150	15.3	17.30	897	2659	5699	60	99	21	539	621	703	868	1032	1204
41 M 4-19	5570	4320	16.0	18.90	897	2784	6123	60	99	21	565	653	740	917	1089	1266
43 M 4-20	5820	4500	16.7	20.60	897	2910	6558	60	99	21	-	686	776	963	1144	1328
46 M 4-20	6010	4680	17.4	22.40	897	3005	7935	60	103	17	-	710	804	997	1185	1376

heloRI

Section Properties



MULTI-PLATE HORSESHOE ARCH TYPE HA

Table 15: Section Properties of Multi-plate Horseshoe Arch Type HA

Structur Number	Max Span (mm)	Bottom Span (mm)	Rise (mm)	Periphery (mm)	End Area (m2)	Radius r (mm)	Bottom Angle Θb (deg)	Top Step (mm)	Bottom Step (mm)
HA 22	2400	2006	1859	5290	3.76	12003	3.31	6002	47
HA 27	3000	2568	2276	6465	5.75	15003	1.13	7502	53
HA 32	3500	2934	2704	7640	7.98	17503	3.03	8752	47
HA 36	3950	3326	3041	8580	10.12	19753	2.65	9882	48
HA 40	4400	3717	3377	9520	12.52	22003	2.35	11002	49
HA 44	4900	4206	3707	10460	15.31	24503	0.88	12252	53
HA 49	5450	4670	4130	11635	18.97	27253	1.03	13632	53
HA 54	6000	5135	4552	12810	23.02	30003	1.16	15002	53
HA 59	6550	5599	4974	13985	27.46	32753	1.26	16382	52
HA 64	7100	6066	5395	15160	32.28	35503	1.31	17752	52
HA 70	7800	6710	5896	16570	38.75	39003	0.79	19502	53
HA 76	8500	7335	6397	17980	45.82	42503	0.35	21252	55

Section Properties

MULTI-PLATE HORSESHOE ARCH TYPE EA

Table 16: Section Properties of Multi-plate Horseshoe Arch Type EA

Structure Number	Max Span (mm)	Bottom Span (mm)	Rise (mm)	Periphery (mm)	End Area (m^2)	Top Radius rt (mm)	Side Radius rs (mm)	Bottom Angle Θb (deg)	Top Step (mm)	Bottom Step (mm)
16 EA 5	2336	1923	2370	6230	4.79	1168	3600	19.5	584	278
20 EA 5	2934	2521	2669	7170	6.74	1467	3600	19.5	734	278
22 EA 6	3233	2805	3057	8110	8.56	1617	4950	16.92	808	282
24 EA 7	3533	2902	3421	9050	10.40	1766	4500	21.57	883	274
25 EA 10	3682	2932	4202	10695	13.43	1841	7620	18.05	921	281
28 EA 10	4131	3229	4407	11400	15.68	2066	6300	21.82	1033	274
31 EA 11	4580	3675	4872	12575	19.29	2290	7600	19.86	1145	277
36 EA 11	5328	4313	5231	13750	23.97	2664	6750	22.36	1332	273
40 EA 12	5926	1856	5765	15160	29.41	2963	7600	21.63	1482	274
44 EA 14	6525	5083	6493	17040	36.28	3262	7600	25.16	1631	267
48 EA 15	7121	5474	7002	18450	42.57	3561	7600	26.92	1780	263
52 EA 17	7720	5623	7711	20330	50.52	3860	7600	30.45	1930	254
57 EA 18	8468	6128	8285	21975	59.41	4234	7600	32.21	2117	250

MULTI-PLATE HORIZONTAL ELLIPSE

Section Properties

Table 17: Section Properties of Multi-plate Horizontal Ellipse

Structure Number	Max Span (mm)	Rise (mm)	Periphery (mm)	End Area (m2)	Top Radius rt (mm)	Side Radius rs (mm)	Top Angle Θt (deg)	Side Angle Θs (deg)	Top Step (mm)	Bottom Step (mm)
6 HE 6	1826	1643	5640	2.36	955	770	78.89	101.11	227	227
7 HE 7	2138	1928	6580	3.24	1163	905	79.07	100.93	266	266
10 HE 5	2306	2079	7050	3.74	1206	920	109.02	70.98	506	506
10 HE 6	2457	2223	7520	4.27	1293	1005	101.85	78.15	478	478
12 HE 6	2777	2508	8460	5.43	1452	1110	109.1	70.9	610	610
14 HE 6	3095	2796	9400	6.73	1609	1215	115.08	64.92	745	745
14 HE 7	3250	2935	9870	7.44	1699	1300	109.09	70.91	713	713
16 HE 6	3411	3085	10340	8.18	1765	1319	120.08	59.92	884	884
18 HE 6	3731	3371	11280	9.76	1925	1415	124.03	55.97	1022	1022
19 HE 7	4043	3656	12220	11.48	2091	1560	120.67	59.33	1056	1056
20 HE 7	4200	3801	12690	12.40	2169	1611	122.52	57.48	1126	1126
21 HE 7	4362	3942	13160	13.35	2251	1655	124.02	55.98	1195	1195
12 HE 18	4634	4188	14100	15.35	2614	2010	61.13	118.87	363	363
14 HE 18	4950	4478	15040	17.50	2743	2135	68	112	469	469
14 HE 19	5017	4615	15510	18.62	2850	2205	65.48	114.52	453	453
14 HE 20	5264	4752	15980	19.78	2957	2275	63.13	116.87	438	438
18 HE 18	5587	5051	16920	22.20	3032	2375	79.18	100.82	695	695
20 HE 18	5902	5338	17860	24.75	3178	2493	83.94	96.06	815	815
21 HE 18	6065	5478	18330	26.08	3258	2548	86	94	875	875
21 HE 19	6219	5618	18800	27.45	3353	2623	83.58	96.42	853	853
21 HE 20	6525	5901	19740	30.30	3540	2775	79.2	100.8	812	812
24 HE 20	6849	6191	20680	33.28	3671	2875	87.31	92.69	1015	1015
24 HE 21	7005	6330	21150	34.82	3797	2950	85.11	94.89	992	992
28 HE 18	7176	6486	21620	36.40	3791	2950	98.67	81.33	1321	1321
27 HE 21	7479	6760	22560	39.64	3992	3124	90.37	89.63	1178	1178
30 HE 20	7801	7052	23500	43.05	4128	3218	97.12	82.88	1396	1396
30 HE 21	7953	7194	23970	44.80	4218	3298	95.07	84.93	1370	1370
31 HE 21	8112	7338	24440	46.59	4295	3355	96.49	83.51	1435	1435
33 HE 21	8432	7623	25380	50.27	4452	3465	99.11	80.89	1654	1654
35 HE 21	8751	7910	26320	54.09	4608	3575	101.59	78.41	1695	1695

MULTI-PLATE VERTICAL ELLIPSE

Section Properties

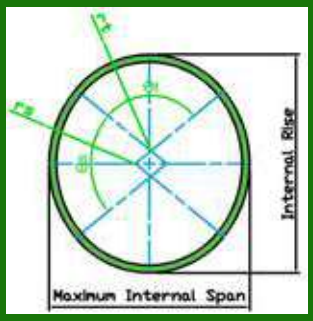


Table 18: Section Properties of Multi-plate Vertical Ellipse

Structure Number	Max Span (mm)	Rise (mm)	Periphery (mm)	End Area (m2)	Top Radius rt (mm)	Side Radius rs (mm)	Top Angle Θt (deg)	Side Angle Θs (deg)	Top Step (mm)	Bottom Step (mm)
6 VE 6	1643	1826	5640	2.36	770	995	101.11	78.89	424	424
7 VE 7	1928	2138	6580	3.24	905	1163	100.91	79.09	493	493
5 VE 10	2080	2305	7050	3.74	920	1206	70.94	109.06	403	403
6 VE 10	2223	2457	7520	4.27	1005	1293	78.13	101.87	448	448
6 VE 12	2507	2778	8460	5.43	1110	1452	70.93	109.07	485	485
6 VE 14	2795	3095	9400	6.73	1215	1609	64.94	115.06	523	523
7 VE 14	2935	3250	9870	7.44	1300	1699	70.92	109.08	566	566
6 VE 16	3085	3411	10340	8.18	1320	1765	59.89	120.11	561	561
6 VE 18	3371	3730	11280	9.76	1415	1925	55.95	124.05	616	616
7 VE 19	3656	4043	12220	11.48	1560	2091	59.32	120.68	666	666
7 VE 20	3801	4201	12690	12.40	1610	2169	57.51	122.49	689	689
7 VE 21	3942	4362	13160	13.35	1655	2251	55.97	124.03	720	720
18 VE 12	4188	4634	14100	15.35	2010	2614	118.86	61.14	1295	1295
18 VE 14	4478	4950	15040	17.50	2135	2743	112	68	1281	1281
19 VE 14	4615	5107	15510	18.62	2205	2850	114.51	65.49	1361	1361
20 VE 14	4752	5264	15980	19.78	2275	2957	116.88	63.12	1441	1441
18 VE 18	5051	5587	16920	22.20	2375	3032	100.82	79.18	1280	1280
18 VE 20	5341	5903	17860	24.77	24950	3178	96.02	83.98	1283	1283
18 VE 21	5481	6066	18330	26.10	2550	3258	93.97	86.03	1293	1293
19 VE 21	5621	6220	18800	27.47	2625	3353	96.39	83.61	1360	1360
21 VE 21	5901	6526	19740	30.30	2775	3540	100.8	79.2	1494	1494
20 VE 24	6190	6850	20680	33.28	2875	3672	92.7	87.3	1440	1440
21 VE 24	6330	7005	21150	34.82	2950	3767	94.88	85.12	1507	1507
18 VE 28	6486	7176	21620	36.40	2950	3791	81.33	98.67	1350	1350
21 VE 27	6762	7481	22560	39.67	3125	3992	89.62	90.38	1523	1523
20 VE 30	7055	7802	23500	43.07	3220	4128	82.86	97.14	1487	1487
21 VE 30	7197	7955	23970	44.83	3300	4218	84.91	95.09	1543	1543
21 VE 31	7339	8115	24440	46.61	3355	4297	83.53	96.47	1555	1555
21 VE 33	7625	8435	25380	50.30	3465	4454	80.9	99.1	1581	1581
21 VE 35	7911	8754	26320	54.12	3575	4610	78.43	101.57	1607	1607
21 VE 36	8055	8913	26790	56.08	3630	4688	77.26	102.74	1621	1621

MULTI-PLATE SUPER SPAN

MULTI-PLATE SUPER SPAN HORIZONTAL ELLIPSE

Larger culverts and bridges. Low headroom, wide-centered flow, good choice when poor foundations are encountered.

Section Properties

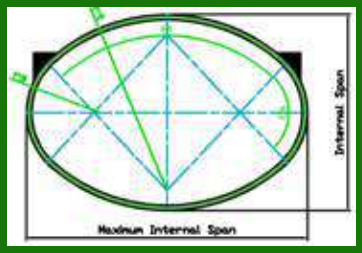


Table 19: Section Properties of Multi-Plate Super Span Horizontal Ellipse

Structure Number	Span (mm)	Rise (mm)	Periphery (m)	End Area (m2)	Top & Bottom Radius rt & rb (mm)	Side Radius rs (mm)	Top & Bottom Step (mm)
12 E 6	3110	2120	8.46	5.2	1990	778	470
15 E 6	3760	2360	9.87	6.9	2495	778	580
18 E 8	4600	3010	12.22	10.8	3000	1047	700
20 E 8	5040	3170	13.16	12.3	3336	1047	780
22 E 11	5760	3940	15.51	17.7	3673	1451	860
24 E 11	6190	4100	16.45	19.7	4009	1451	940
26 E 12	6720	4460	17.86	23.3	4346	1586	1020
28 E 12	7150	4620	18.80	25.6	4683	1586	1100
30 E 15	7870	5400	21.15	33.1	5019	1990	1170
32 E 15	8310	5550	22.09	35.8	5356	1990	1250
34 E 15	8740	5710	23.03	38.7	5692	1990	1330
36 E 15	9170	5870	23.97	41.6	6029	1990	1410
38 E 18	9890	6650	26.32	51.1	6366	2394	1490
39 E 18	10110	6720	26.79	52.8	6534	2394	1530
40 E 18	10330	6800	27.26	54.5	6702	2394	1570
41 E 19	10640	7090	28.20	58.5	6871	2528	1610
42 E 19	10860	7170	28.67	60.3	7039	2528	1650
43 E 19	11070	7250	29.14	62.2	7207	2528	1690
44 E 20	11380	7530	30.08	66.5	7375	2663	1730
45 E 21	11700	7820	31.02	71	7544	2798	1760
45 E 24	11990	8430	32.43	78.8	7544	3201	1760
45 E 28	12370	8260	31.31	89.7	7544	3740	1760

MULTI-PLATE SUPER SPAN HIGH PROFILE ARCH

Culverts, storm sewers, bridges, Higher rise, large area opening. Open natural bottoms for environmentally friendly crossings.

Section Properties

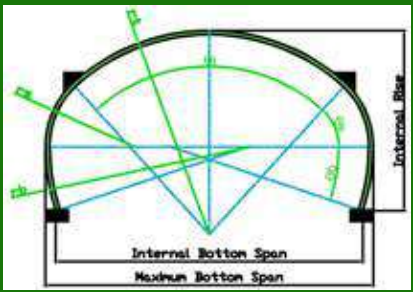


Table 20: Section Properties of Multi-plate Super Span High Profile Arch

Structure Number	Max Span (mm)	Bottom Span (mm)	Rise (mm)	Periphery (m)	End Area (m2)	Top & Bottom Radius rt & rb (mm)	Side Radius rs (mm)	Angle Below (deg)	Top Step (mm)
24 A 6 - 5	6290	5920	3360	10.810	18.10	4009	1586	17.518	940
25 A 6 - 6	650	6000	3620	11.515	20.30	4178	1586	20.017	980
26 A 6 - 6	6720	6230	3660	11.750	21.10	4346	1586	19.247	1020
27 A 6 - 6	6940	6470	3710	11.985	22.00	4514	1586	18.534	1060
28 A 6 - 6	7150	6700	3750	12.220	23.00	4683	1586	17.872	1100
30 A 6 - 6	7590	7160	3830	12.690	24.80	5019	1586	16.681	1170
31 A 6 - 6	7800	7390	3870	12.925	25.80	5187	1586	16.143	1210
32 A 6 - 6	8020	7620	3910	13.160	26.70	5356	1586	15.638	1250
33 A 6 - 6	8230	7850	3950	13.395	27.70	5524	1586	15.164	1290
34 A 9 - 8	9030	8380	5060	15.980	39.10	5692	2394	19.424	1330
35 A 9 - 8	9240	8610	5100	16.215	40.30	5861	2394	18.869	1370
36 A 9 - 9	9460	8690	5360	16.920	43.50	6029	2394	20.567	1410
37 A 9 - 8	9680	9080	5180	16.685	42.80	6197	2394	17.849	1450
37 A 9 - 10	9680	8760	5620	17.625	46.80	6197	2394	22.174	1450
38 A 9 - 11	9890	8820	5880	18.330	50.10	6366	2394	23.695	1490
39 A 9 - 12	10110	8870	6140	19.035	53.50	6534	2394	25.139	1530
40 A 9 - 12	10330	8120	6180	19.270	55.00	6702	2394	24.511	1570
41 A 10 - 12	10740	9560	6430	19.975	59.40	6871	2663	23.913	1610
42 A 10 - 12	10950	9800	6480	20.210	61.00	7039	2663	23.343	1650
43 A 10 - 10	11170	10380	6050	19.050	58.10	7207	2663	19.08	1690
44 A 10 - 15	11380	9690	7200	22.090	70.60	7375	2663	27.737	1730
45 A 10 - 15	11600	9640	7240	22.325	72.40	7544	2663	27.121	1760

MULTI-PLATE SUPER SPAN LOW PROFILE ARCH

Culvert, storm sewers, low headroom and large opening. Bridge structures, stream enclosures. Aesthetic shapes and open natural bottoms for environmentally friendly crossings.

Section Properties

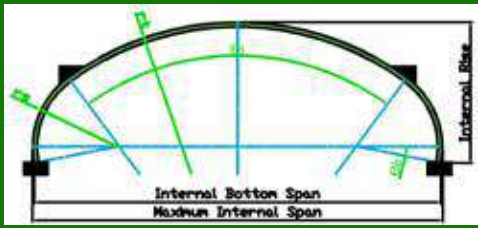


Table 21: Section Properties of Multi-plate Super Span Low Profile Arch

Structure Number	Max Span (mm)	Bottom Span (mm)	Rise (mm)	Periphery (m)	End Area (m2)	Top & Bottom Radius rt & rb (mm)	Side Radius rs (mm)	Angle Below (deg)	Top Step (mm)
27 A 8	7080	7020	2770	10.105	15.90	4514	1792	11	1060
28 A 8	7300	7230	2810	10.340	16.60	4683	1792	11	1100
29 A 8	7520	7450	2850	10.575	17.30	4851	1792	11	1130
30 A 8	7730	7670	2890	10.810	18.00	5019	1792	11	1170
31 A 8	7950	7880	2930	11.045	18.70	5187	1792	11	1210
32 A 8	8170	8100	2970	11.280	19.50	5356	1792	11	1250
33 A 8	8380	8320	3010	11.515	20.20	5524	1792	11	1290
34 A 11	9070	8980	3680	13.160	27.00	5692	2454	11	1330
35 A 11	9290	9200	3720	13.395	28.00	5861	2454	11	1370
36 A 11	9500	9410	3760	13.630	28.90	6029	2454	11	1410
37 A 11	9720	9630	3800	13.865	29.80	6197	2454	11	1450
38 A 11	9940	9850	3840	14.100	30.80	6366	2454	11	1490
39 A 11	10150	10060	3880	14.335	31.70	6534	2454	11	1530
40 A 11	10370	10280	3920	14.570	32.70	6702	2454	11	1570
41 A 12	10740	10640	4170	15.275	36.10	6871	2675	11	1610
42 A 12	10960	10860	4210	15.510	37.10	7039	2675	11	1650
43 A 12	11180	11080	4250	15.745	38.20	7207	2675	11	1690
44 A 12	11390	11290	4290	15.980	39.20	7375	2675	11	1730
45 A 12	11610	11510	4320	16.215	40.30	7544	2675	11	1760

heloRI

PT. HELORI GRAHASARANA

GENERAL CONTRACTOR & FACTORY

Head Office : Puri Sentra Niaga Blok A-16 Jl. Raya Kalimalang, Jakarta 13620
Telp. (021) 86605447, 29361863, Fax. (021) 8601117
Workshop : Arah Golf River Side Ujung Kp. Cikuda - Gunung Putri Bogor
Email : info@helorigrahasarana.com
Website : www.helorigrahasarana.com