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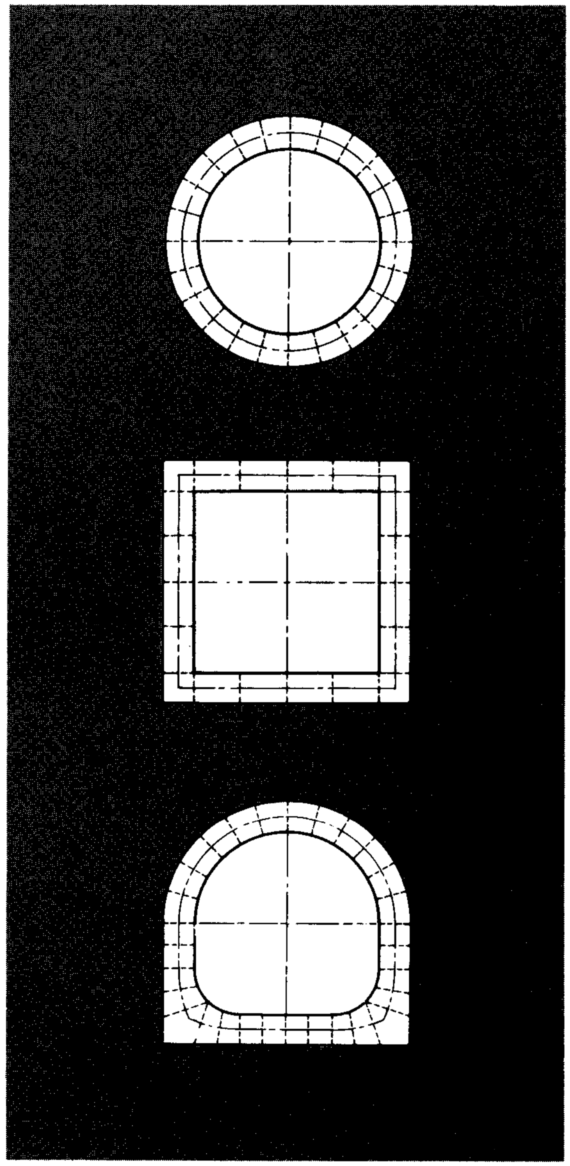
ENGINEERING MONOGRAPH No. 14



Beggs Deformeter Stress Analysis of Single-Barrel Conduits

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

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Bureau programs most frequently are the result of close cooperation with the U.S. Congress, other Federal agencies, States, local governments, academic institutions, water-user organizations, and other concerned groups.

A WATER RESOURCES TECHNICAL PUBLICATION

Engineering Monograph No. 14

Beggs Deformeter Stress Analysis of Single-Barrel Conduits

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Technical Engineering Analysis Branch,
Office of Chief Engineer,
Denver, Colorado

United States Department of the Interior

BUREAU OF RECLAMATION

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.

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CONTENTS

FIGURES

TABLE

INTRODUCTION

This monograph presents the results of the stress analysis, by means of the Beggs Deformeter apparatus,[1] of nine shapes of single-barrel conduits. A partial analytical check was made using the least work method to determine the redundant reactions for all shapes due to a uniform vertical load and a uniform horizontal load.

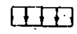
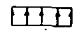
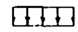
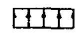
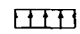
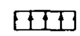
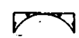
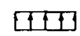
All personnel of the Experimental Design Analysis Section, including several rotation engineers who had training assignments in the section, assisted in the experimental work and computations. In particular, the assistance of W. T. Moody in computing the analytical solutions, and the work of H. E. Willmann, who prepared the drawings and also assisted in the experimental work and computations, is gratefully acknowledged.

The nine shapes of conduits studied are those most widely used in Bureau of Reclamation structures. All except shape D and the square shape have semicircular top portions of uniform thickness. They can be further described as follows:

1. Shape A: horseshoe-shaped interior with a horizontal exterior base.
2. Shape B: circular-shaped interior with a horizontal exterior base.
3. Shape C: circular-shaped interior with a curved exterior base.
4. Shape D: circular-shaped interior with a square-shaped exterior.
5. Shape E: uniform thickness with a horizontal base.
6. Shape F: uniform thickness of horseshoe shape.
7. Shape G: transition between shape B and shape E with fillets of ½ r radius in lower interior corners.
8. Circular shape of uniform thickness.
9. Square shape of uniform thickness.

Reaction coefficients for bending moment, thrust, and shear at selected locations along the centroidal axis of the conduits have been determined for 15 different loading conditions.

The 15 loading conditions considered are as follows:

1.  top with  foundation.
2.  top with  foundation.
3. top with  foundation.
4. top with  foundation.
5.  top with  foundation.
6.  top with  foundation.
7.  top with  foundation.
8.  top with  foundation.
9. Dead load with  foundation.
10. Uniform horizontal both sides.
11.  horizontal both sides.
12. Uniform internal radial.
13.  internal radial with  foundation.
14.  internal radial with  foundation.
15.  external hydrostatic including dead load.

Figures 1, 2, and 3 show cross sections of each shape, giving the dimensions and the location of points at which the reaction coefficients have been determined.

Each shape was analyzed for three values of crown thickness, t, expressed in terms of the internal crown radius, r. These three values were $t=r/2$, $t=r/3$, and $t=r/6$. A conduit of unit length was considered in the analysis. Bending moment, thrust, and shear coefficients were determined at the various locations shown, and are expressed in terms of unit intensity of loading and unit internal crown radius. Multiplying the reaction coefficient by the proper load factor gives the total bending moment, thrust, or shear at the centroid of the section under consideration.

[1] See Appendix for description of this instrument.

APPLICATION

The reaction coefficients determined in the study are tabulated in figures 4 through 50 for the various shapes and loading conditions. The reaction coefficients are given for points on the right side of the conduits only, since the conduits and loadings are symmetrical about the vertical centerline. The shear reactions on the left side of the vertical centerline will have an opposite sign from those given for the points on the right side.

Consistent units should be employed when using these data. Thus, if loads are expressed in pounds per square inch, all dimensions of the conduit must be expressed in inches. The bending moment will then be in inch-pounds per inch of conduit length and the thrust and shear in pounds per inch of conduit length. If the load is expressed in terms of pounds per square foot, the dimensions of the conduit must be expressed in feet, and the bending moment will be in foot-pounds per foot of conduit length and the thrust and shear in pounds per foot of conduit length. It will be noted that the bending moment in inch-pounds per inch is numerically equal to the bending moment in foot-pounds per foot.

One should bear in mind that this analysis assumes no restraint to the deformation of the conduit.

In some cases this restraint, or passive pressure, may be important. Some work on passive pressures on tunnel linings through rock has been done by R. S. Sandhu.[2] By using his method for determining the intensity of the passive pressure, and using the moment, thrust, and shear coefficients for a circular conduit given by figure 50, the effect of restraint may be approximated.

The foundation load distribution due to a vertical load on the conduit must be assumed, and is influenced by the modulus of elasticity of the foundation material. As the foundation modulus increases, the foundation load distribution approaches a concentration at the outside corners of the conduit, and as it decreases the load approaches a uniform distribution. For all vertical loading conditions except three, two distributions were assumed, viz., uniform, and triangular with zero at the center and maximum at the outside corners.

For the dead load the assumed foundation reaction is minimum at the center varying linearly to a maximum at the outside corners, with the intensity at the center equal to the intensity of the weight of the conduit at the center of the base.

For the triangular internal radial load the assumed foundation reactions were uniform, and triangular with zero at the outsides and maximum at the center.

For the triangular external hydrostatic load, including dead load, the unit weight of the conduit material and the unit weight of water were assumed to be 150 and 62.4 pounds per cubic foot, respectively. With these assumptions the weight of the conduit for the $t=r/6$ case, except shape D, is less than the uplift, causing the conduit to float. The reaction is assumed to be uniformly distributed across the top. The coefficients for this assumption (conduit floating) are given in figure 49. In the other figures of this loading condition, tension is assumed to develop uniformly along the foundation.

[2] Sandhu, R. S., "Design of Concrete Linings for Large Underground Conduits," *Journal of the American Concrete Institute*, December 1961, pp. 737–750.

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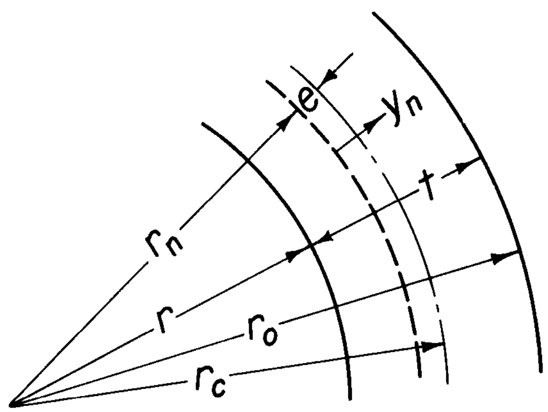
DETERMINATION OF NORMAL STRESS DISTRIBUTION

In a curved beam the neutral axis will not be coincident with the centroidal axis, and the normal stress distribution on radial lines, due to moment, will not be linear. However, the radius to the neutral axis and the normal stress distribution may be determined by the following equations, derived from the Winkler-Bach theory for curved beams: [3]



$$r_n=\frac{t}{ln\ (r_o/r)} \qquad (1)$$

where

r_n is the radius to the neutral axis
r is the internal radius
r_o is the external radius
t is the wall thickness (r_o-r)
ln is the log to the base e,

$$\sigma_\theta=\frac{T}{t}+\frac{My_n}{(r_n+y_n)te} \qquad (2)$$

where

σ_θ is the normal stress in the tangential direction
M is the bending moment at the centroidal axis
T is the thrust at the centroidal axis
y_n is the distance from the neutral axis to the point of interest (positive outward)
e is the distance from the centroidal axis to the neutral axis.

As t decreases e approaches zero, and the σ_θ distribution approaches linearity.

σ_θ, as computed by equation (2), is only for a constant thickness section. Where the section thickness is not constant, the distribution of stresses must be determined by some other method, such as photoelasticity.

The extreme fiber stress in a constant thickness curved beam due to bending moment may be determined by the equation:

$$\sigma_b=K\frac{Mt}{2I} \qquad (3)$$

where

σ_b is the extreme fiber stress
M is the bending moment at the section
t is the width of the section
I is the moment of inertia of the section
K is the factor by which the extreme fiber stress, assuming linear distribution, is modified to correct for curvature.

The following equation for K was obtained by equating equations (2) and (3):

$$K=\frac{ty_n}{6(r_n+y_n)e} \qquad (4)$$

The values of K and e for the t/r ratios used in this study are tabulated below:

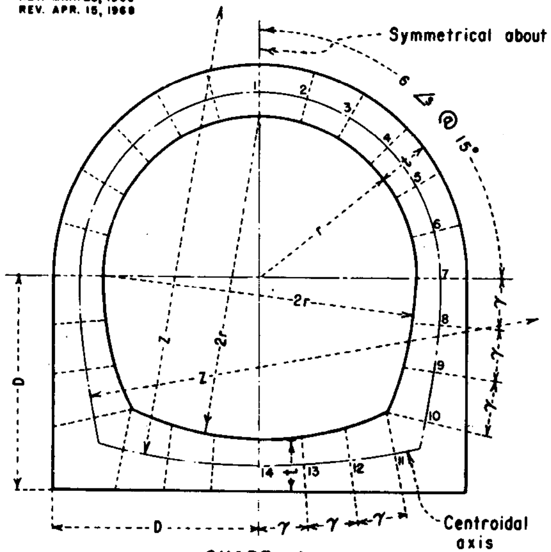
TABLE 1.—*Correction factors for different radii of curvature*

t	K		e
	Inside fiber	Outside fiber	
$r/2$	1. 153	0. 880	0. 0168r
$r/3$	1. 105	0. 912	0. 0080r
$r/6$	1. 054	0. 951	0. 0021r

[3] Murphy, Glenn, *Advanced Mechanics of Materials*, McGraw-Hill Book Co., Inc., New York, 1946, pp. 217-219.

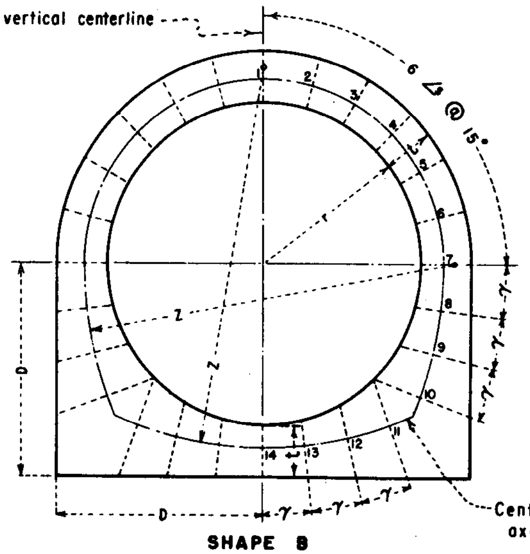
REV. JAN. 20, 1955
REV. SEP. 28, 1964
REV. MAR. 23, 1966
REV. APR. 15, 1968

SEP. 8, 1950



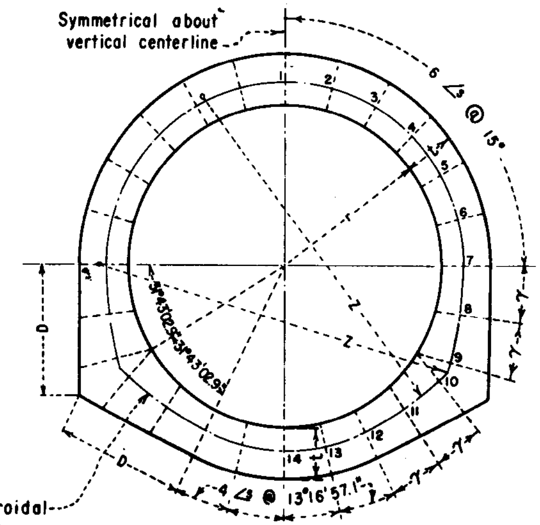
SHAPE A

	$t = \frac{r}{2}$	$t = \frac{r}{3}$	$t = \frac{r}{6}$
γ	3°47'05.0"	3°51'09.1"	3°55'32.2"
D	1.50000 r	1.33333 r	1.16667 r
Z	4.52507 r	4.36766 r	4.20727 r
POINT	LENGTH OF LINE		
8, 13	0.5210 r	0.3540 r	0.1870 r
9, 12	0.5844 r	0.4164 r	0.2483 r
10, 11	0.6906 r	0.5210 r	0.3512 r
Area (r^2)	4.7170	3.0308	1.5430



SHAPE B

	$t = \frac{r}{2}$	$t = \frac{r}{3}$	$t = \frac{r}{6}$
γ	6°31'49.8"	6°43'56.6"	6°57'36.1"
D	1.50000 r	1.33333 r	1.16667 r
Z	2.52962 r	2.38172 r	2.22989 r
POINT	LENGTH OF LINE		
8, 13	0.5371 r	0.3696 r	0.2020 r
9, 12	0.6496 r	0.4796 r	0.3091 r
10, 11	0.8416 r	0.6672 r	0.4919 r
Area (r^2)	4.8927	3.2065	1.7186



SHAPE C

	$t = \frac{r}{2}$	$t = \frac{r}{3}$	$t = \frac{r}{6}$
γ	7°00'54.0"	7°14'14.2"	7°29'22.5"
D	0.92705 r	0.82405 r	0.72104 r
Z	2.50324 r	2.35243 r	2.19770 r
POINT	LENGTH OF LINE		
8, 11	0.5419 r	0.3742 r	0.2064 r
9, 10	0.6693 r	0.4985 r	0.3271 r
Area (r^2)	4.2171	2.6727	1.3099

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

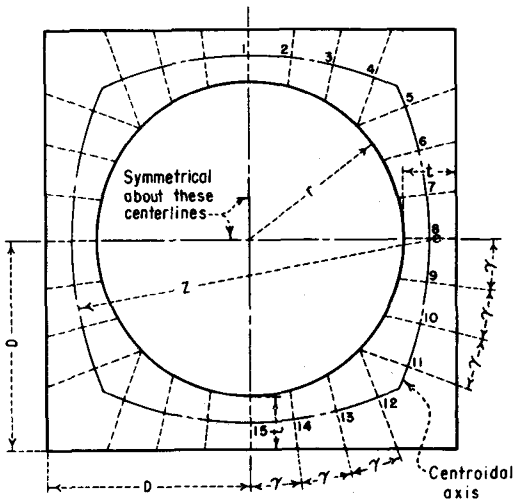
DIMENSIONS OF CONDUITS AND LOCATION OF POINTS STUDIED
SHAPES A, B, AND C

X-PEL-421

FIGURE 1

REV. MAR. 23, 1966
REV. APR. 15, 1968

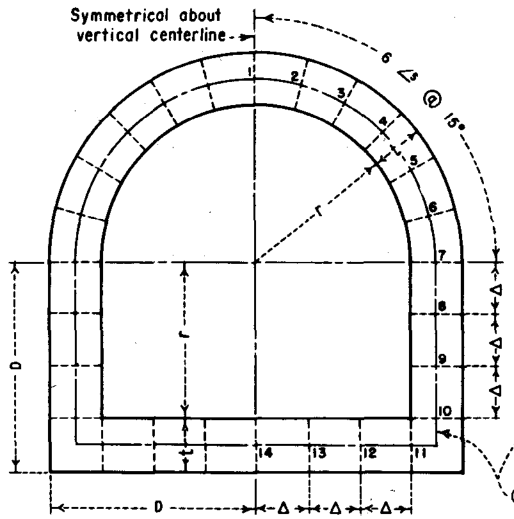
SEP. 28, 1964



SHAPE D

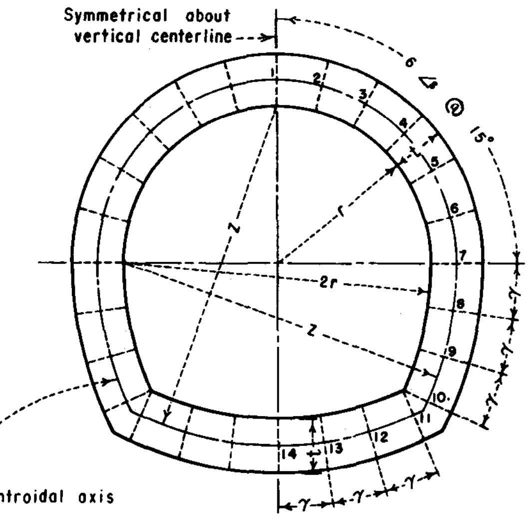
	$t = \frac{r}{2}$	$t = \frac{r}{3}$	$t = \frac{r}{6}$
γ	6° 31' 49.8"	6° 43' 56.6"	6° 57' 36.1"
D	1.50000r	1.33333r	1.16667r
Z	2.52962r	2.38172r	2.22989r
Area(r^2)	5.8584	3.9694	2.3028

For length of lines for Points 2 thru 7 and 9 thru 14, see Shape B.



SHAPE E

	$t = \frac{r}{2}$	$t = \frac{r}{3}$	$t = \frac{r}{6}$
Δ	0.33333r	0.33333r	0.33333r
D	1.50000r	1.33333r	1.16667r
Area(r^2)	4.4635	2.7773	1.2895



SHAPE F

	$t = \frac{r}{2}$	$t = \frac{r}{3}$	$t = \frac{r}{6}$
γ	8°05'54.2"	8°05'54.2"	8°05'54.2"
Z	2.25000r	2.16667r	2.08333r
Area(r^2)	4.0588	2.5301	1.1771

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

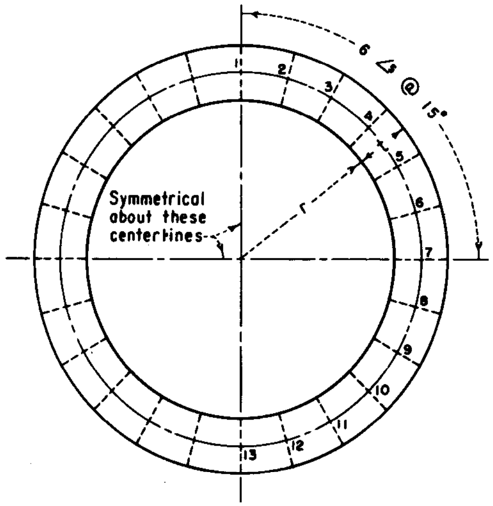
DIMENSIONS OF CONDUITS AND LOCATION OF POINTS STUDIED
SHAPES D, E, AND F

X-PEL-1032

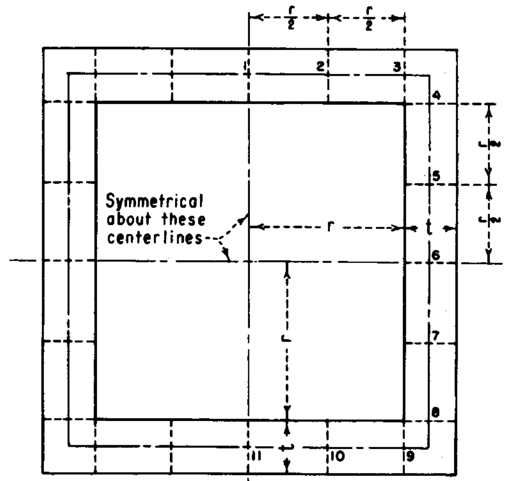
FIGURE 2

REV. MAR. 23, 1966
REV. APR. 15, 1968

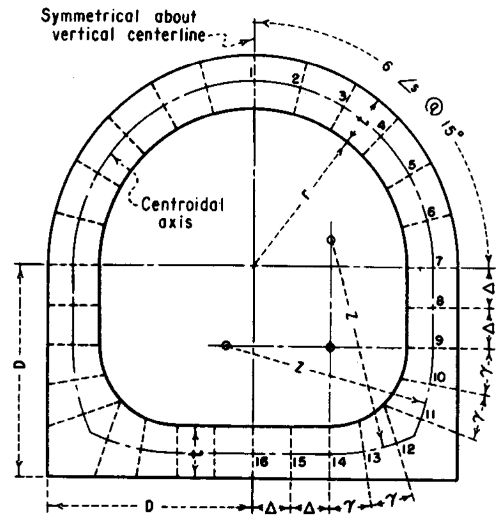
SEP. 28, 1964



CIRCULAR



SQUARE



SHAPE G

	$t = \frac{r}{2}$	$t = \frac{r}{3}$	$t = \frac{r}{6}$
Area(r^2)	3.9270	2.4435	1.1345

	$t = \frac{r}{2}$	$t = \frac{r}{3}$	$t = \frac{r}{6}$
Area(r^2)	5.0000	3.1111	1.4444

	$t = \frac{r}{2}$	$t = \frac{r}{3}$	$t = \frac{r}{6}$
γ	9° 03' 29.1"	9° 31' 30.4"	10° 05' 53.8"
Δ	0.25000r	0.25000r	0.25000r
D	1.50000r	1.33333r	1.16667r
Z	1.47711r	1.33699r	1.19089r
POINT	LENGTH OF LINE		
10, 13	0.5442r	0.3761r	0.2076r
11, 12	0.6802r	0.5076r	0.3336r
Area(r^2)	4.5708	2.8846	1.3968

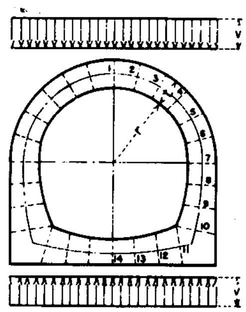
SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

DIMENSIONS OF CONDUITS AND LOCATION OF POINTS STUDIED
SHAPES CIRCULAR, SQUARE, AND G

X-PEL-1033

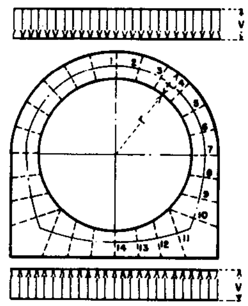
FIGURE 3

SHAPE A



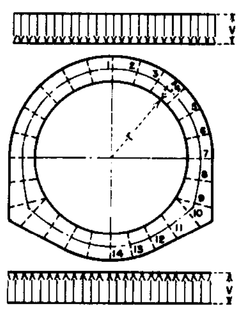
POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
	$t = \frac{r}{2}$			$t = \frac{r}{3}$			$t = \frac{r}{6}$		
1	+0.357	+0.033	0	+0.317	+0.030	0	+0.274	+0.031	0
2	+0.308	+0.132	+0.366	+0.274	+0.119	+0.325	+0.236	+0.108	+0.284
3	+0.175	+0.403	+0.633	+0.155	+0.360	+0.562	+0.132	+0.318	+0.490
4	-0.006	+0.773	+0.727	-0.006	+0.688	+0.645	-0.008	+0.605	+0.562
5	-0.185	+1.141	+0.621	-0.165	+1.015	+0.551	-0.147	+0.890	+0.479
6	-0.312	+1.408	+0.343	-0.279	+1.252	+0.304	-0.246	+1.096	+0.262
7	-0.352	+1.500	-0.033	-0.314	+1.333	-0.030	-0.276	+1.167	-0.031
8	-0.327	+1.495	-0.132	-0.292	+1.328	-0.120	-0.256	+1.162	-0.110
9	-0.273	+1.483	-0.230	-0.244	+1.317	-0.209	-0.213	+1.152	-0.190
10	-0.190	+1.464	-0.328	-0.169	+1.300	-0.297	-0.147	+1.136	-0.268
11	+0.042	+0.157	-0.947	+0.004	+0.156	-0.915	-0.031	+0.153	-0.882
12	+0.261	+0.051	-0.633	+0.216	+0.052	-0.612	+0.174	+0.050	-0.590
13	+0.394	-0.012	-0.317	+0.345	-0.010	-0.307	+0.298	-0.010	-0.296
14	+0.439	-0.033	0	+0.388	-0.030	0	+0.340	-0.031	0

SHAPE B

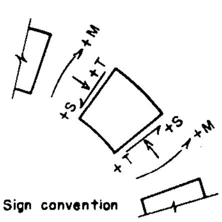


POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.353	+0.028	0	+0.311	+0.030	0	+0.265	+0.038	0
2	+0.304	+0.127	+0.368	+0.268	+0.118	+0.326	+0.227	+0.115	+0.282
3	+0.170	+0.399	+0.636	+0.149	+0.359	+0.563	+0.125	+0.325	+0.486
4	-0.012	+0.770	+0.730	-0.012	+0.688	+0.646	-0.015	+0.610	+0.556
5	-0.192	+1.139	+0.625	-0.172	+1.015	+0.552	-0.152	+0.894	+0.472
6	-0.321	+1.407	+0.348	-0.285	+1.252	+0.305	-0.249	+1.098	+0.255
7	-0.362	+1.500	-0.028	-0.321	+1.333	-0.030	-0.277	+1.167	-0.038
8	-0.330	+1.487	-0.198	-0.291	+1.321	-0.186	-0.247	+1.153	-0.179
9	-0.248	+1.455	-0.366	-0.217	+1.290	-0.339	-0.180	+1.123	-0.318
10	-0.119	+1.404	-0.529	-0.101	+1.241	-0.488	-0.076	+1.076	-0.452
11	+0.069	+0.305	-0.941	+0.044	+0.296	-0.890	+0.030	+0.279	-0.838
12	+0.260	+0.119	-0.634	+0.226	+0.113	-0.600	+0.202	+0.101	-0.566
13	+0.381	+0.008	-0.319	+0.341	+0.006	-0.302	+0.311	-0.004	-0.285
14	+0.423	-0.028	0	+0.380	-0.030	0	+0.348	-0.038	0

SHAPE C



POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.368	-0.004	0	+0.328	-0.008	0	+0.286	-0.015	0
2	+0.318	+0.097	+0.376	+0.283	+0.082	+0.335	+0.246	+0.063	+0.296
3	+0.180	+0.372	+0.651	+0.160	+0.326	+0.581	+0.138	+0.278	+0.513
4	-0.008	+0.747	+0.753	-0.008	+0.661	+0.672	-0.011	+0.573	+0.594
5	-0.197	+1.123	+0.653	-0.177	+0.996	+0.584	-0.160	+0.867	+0.518
6	-0.335	+1.399	+0.379	-0.301	+1.242	+0.341	-0.271	+1.085	+0.306
7	-0.387	+1.500	+0.004	-0.348	+1.333	+0.008	-0.314	+1.167	+0.016
8	-0.360	+1.489	-0.179	-0.326	+1.324	-0.160	-0.296	+1.159	-0.137
9	-0.277	+1.456	-0.360	-0.253	+1.293	-0.326	-0.235	+1.131	-0.287
10	-0.187	+0.840	-0.974	-0.188	+0.779	-0.883	-0.195	+0.719	-0.789
11	+0.031	+0.542	-0.809	+0.014	+0.498	-0.729	-0.010	+0.455	-0.646
12	+0.209	+0.303	-0.598	+0.177	+0.274	-0.530	+0.138	+0.247	-0.460
13	+0.319	+0.083	-0.335	+0.274	+0.078	-0.296	+0.223	+0.076	-0.257
14	+0.359	+0.004	0	+0.309	+0.008	0	+0.253	+0.015	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

UNIFORM VERTICAL LOAD-UNIFORM FOUNDATION REACTION

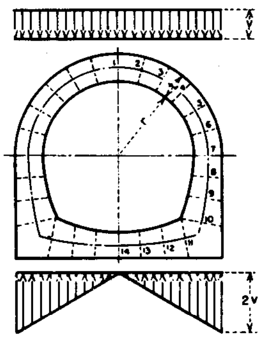
SHAPES A, B, AND C

REV. JULY 9, 1953
REV. SEP. 28, 1964

SEP. 8, 1950

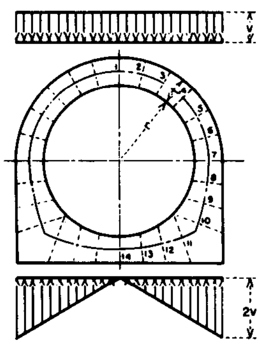
X-PEL-372

SHAPE A



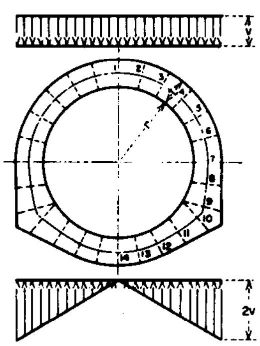
POINT	$\frac{M}{vr^2}$ ($t = \frac{r}{2}$)	$\frac{T}{vr}$ ($t = \frac{r}{2}$)	$\frac{S}{vr}$ ($t = \frac{r}{2}$)	$\frac{M}{vr^2}$ ($t = \frac{r}{3}$)	$\frac{T}{vr}$ ($t = \frac{r}{3}$)	$\frac{S}{vr}$ ($t = \frac{r}{3}$)	$\frac{M}{vr^2}$ ($t = \frac{r}{6}$)	$\frac{T}{vr}$ ($t = \frac{r}{6}$)	$\frac{S}{vr}$ ($t = \frac{r}{6}$)
1	+0.302	+0.132	0	+0.280	+0.113	0	+0.244	+0.102	0
2	+0.257	+0.228	+0.341	+0.240	+0.198	+0.304	+0.209	+0.177	+0.265
3	+0.136	+0.489	+0.583	+0.131	+0.431	+0.521	+0.113	+0.380	+0.454
4	-0.025	+0.843	+0.657	-0.015	+0.746	+0.587	-0.015	+0.656	+0.511
5	-0.178	+1.191	+0.535	-0.155	+1.056	+0.480	-0.138	+0.926	+0.417
6	-0.276	+1.434	+0.247	-0.245	+1.273	+0.224	-0.218	+1.115	+0.193
7	-0.283	+1.500	-0.132	-0.255	+1.333	-0.113	-0.228	+1.167	-0.102
8	-0.229	+1.488	-0.231	-0.209	+1.323	-0.202	-0.187	+1.157	-0.182
9	-0.145	+1.470	-0.329	-0.137	+1.306	-0.290	-0.124	+1.142	-0.261
10	-0.033	+1.445	-0.425	-0.039	+1.284	-0.378	-0.037	+1.121	-0.338
11	+0.091	-0.009	-0.627	+0.071	+0.019	-0.654	+0.050	+0.040	-0.692
12	+0.205	-0.096	-0.283	+0.192	-0.074	-0.295	+0.181	-0.060	-0.311
13	+0.250	-0.127	-0.075	+0.239	-0.108	-0.077	+0.231	-0.097	-0.081
14	+0.257	-0.132	0	+0.246	-0.113	0	+0.239	-0.102	0

SHAPE B

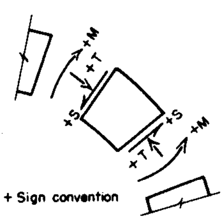


POINT	$\frac{M}{vr^2}$ ($t = \frac{r}{2}$)	$\frac{T}{vr}$ ($t = \frac{r}{2}$)	$\frac{S}{vr}$ ($t = \frac{r}{2}$)	$\frac{M}{vr^2}$ ($t = \frac{r}{3}$)	$\frac{T}{vr}$ ($t = \frac{r}{3}$)	$\frac{S}{vr}$ ($t = \frac{r}{3}$)	$\frac{M}{vr^2}$ ($t = \frac{r}{6}$)	$\frac{T}{vr}$ ($t = \frac{r}{6}$)	$\frac{S}{vr}$ ($t = \frac{r}{6}$)
1	+0.303	+0.135	0	+0.274	+0.119	0	+0.234	+0.116	0
2	+0.259	+0.231	+0.340	+0.234	+0.204	+0.302	+0.200	+0.191	+0.262
3	+0.138	+0.492	+0.582	+0.126	+0.437	+0.518	+0.106	+0.392	+0.447
4	-0.022	+0.845	+0.655	-0.019	+0.751	+0.582	-0.020	+0.666	+0.501
5	-0.175	+1.192	+0.533	-0.157	+1.060	+0.474	-0.140	+0.933	+0.404
6	-0.271	+1.434	+0.245	-0.245	+1.275	+0.218	-0.216	+1.119	+0.179
7	-0.278	+1.500	-0.135	-0.254	+1.333	-0.119	-0.223	+1.167	-0.116
8	-0.215	+1.475	-0.305	-0.198	+1.310	-0.275	-0.172	+1.144	-0.257
9	-0.103	+1.431	-0.470	-0.100	+1.269	-0.426	-0.084	+1.104	-0.394
10	+0.056	+1.368	-0.630	+0.040	+1.210	-0.572	+0.040	+1.049	-0.525
11	+0.123	+0.092	-0.660	+0.108	+0.116	-0.660	+0.105	+0.129	-0.665
12	+0.217	-0.069	-0.301	+0.207	-0.051	-0.299	+0.209	-0.045	-0.301
13	+0.258	-0.126	-0.082	+0.248	-0.110	-0.081	+0.252	-0.107	-0.082
14	+0.265	-0.135	0	+0.256	-0.119	0	+0.260	-0.116	0

SHAPE C



POINT	$\frac{M}{vr^2}$ ($t = \frac{r}{2}$)	$\frac{T}{vr}$ ($t = \frac{r}{2}$)	$\frac{S}{vr}$ ($t = \frac{r}{2}$)	$\frac{M}{vr^2}$ ($t = \frac{r}{3}$)	$\frac{T}{vr}$ ($t = \frac{r}{3}$)	$\frac{S}{vr}$ ($t = \frac{r}{3}$)	$\frac{M}{vr^2}$ ($t = \frac{r}{6}$)	$\frac{T}{vr}$ ($t = \frac{r}{6}$)	$\frac{S}{vr}$ ($t = \frac{r}{6}$)
1	+0.309	+0.109	0	+0.287	+0.085	0	+0.253	+0.065	0
2	+0.263	+0.205	+0.347	+0.245	+0.172	+0.311	+0.217	+0.141	+0.275
3	+0.140	+0.469	+0.595	+0.133	+0.407	+0.535	+0.117	+0.348	+0.473
4	-0.026	+0.827	+0.673	-0.018	+0.727	+0.606	-0.018	+0.629	+0.538
5	-0.186	+1.179	+0.556	-0.164	+1.043	+0.504	-0.149	+0.907	+0.449
6	-0.290	+1.428	+0.270	-0.262	+1.266	+0.251	-0.239	+1.105	+0.229
7	-0.305	+1.500	-0.109	-0.281	+1.333	-0.085	-0.260	+1.167	-0.065
8	-0.244	+1.476	-0.291	-0.230	+1.312	-0.253	-0.219	+1.148	-0.216
9	-0.128	+1.429	-0.469	-0.131	+1.270	-0.416	-0.136	+1.110	-0.364
10	-0.078	+0.635	-0.908	-0.088	+0.619	-0.841	-0.103	+0.599	-0.774
11	+0.064	+0.259	-0.587	+0.055	+0.254	-0.533	+0.040	+0.246	-0.479
12	+0.157	+0.037	-0.317	+0.146	+0.043	-0.277	+0.128	+0.046	-0.238
13	+0.197	-0.087	-0.102	+0.182	-0.067	-0.088	+0.161	-0.049	-0.075
14	+0.205	-0.109	0	+0.189	-0.085	0	+0.167	-0.065	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

UNIFORM VERTICAL LOAD-TRIANGULAR FOUNDATION REACTION

SHAPES A, B, AND C

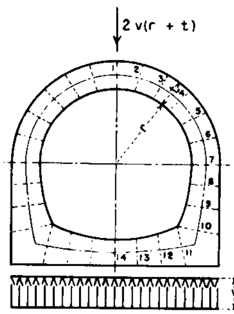
REV. SEP. 28, 1964

SEP. 8, 1960

X-PEL-373

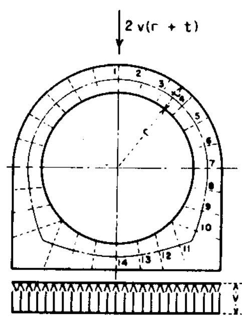
314-498 O - 68 - 3

SHAPE A



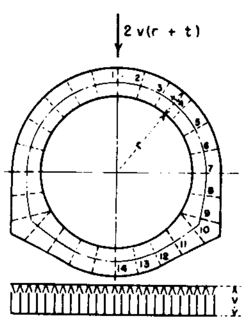
POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.062	+0.240	+1.500	+0.873	+0.214	+1.333	+0.712	+0.184	+1.167
2	+0.587	+0.621	+1.387	+0.479	+0.552	+1.232	+0.392	+0.480	+1.079
3	+0.165	+0.958	+1.179	+0.128	+0.852	+1.048	+0.107	+0.743	+0.918
4	-0.176	+1.231	+0.891	-0.154	+1.094	+0.791	-0.123	+0.955	+0.695
5	-0.411	+1.419	+0.542	-0.349	+1.262	+0.481	-0.283	+1.102	+0.424
6	-0.526	+1.511	+0.156	-0.444	+1.343	+0.138	-0.361	+1.175	+0.124
7	-0.512	+1.500	-0.240	-0.433	+1.333	-0.214	-0.352	+1.167	-0.184
8	-0.426	+1.481	-0.339	-0.357	+1.316	-0.303	-0.288	+1.151	-0.263
9	-0.310	+1.455	-0.436	-0.255	+1.293	-0.391	-0.201	+1.131	-0.342
10	-0.165	+1.423	-0.531	-0.127	+1.263	-0.477	-0.091	+1.105	-0.418
11	+0.123	-0.047	-0.987	+0.083	-0.024	-0.951	+0.046	-0.003	-0.913
12	+0.352	-0.155	-0.661	+0.304	-0.130	-0.637	+0.258	-0.101	-0.611
13	+0.491	-0.219	-0.331	+0.439	-0.193	-0.319	+0.387	-0.163	-0.306
14	+0.538	-0.240	0	+0.484	-0.214	0	+0.430	-0.184	0

SHAPE B

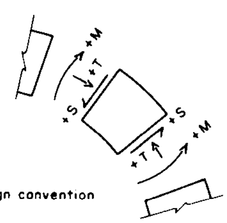


POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.043	+0.255	+1.500	+0.866	+0.221	+1.333	+0.700	+0.206	+1.167
2	+0.569	+0.634	+1.383	+0.472	+0.559	+1.231	+0.380	+0.501	+1.074
3	+0.148	+0.971	+1.172	+0.122	+0.858	+1.044	+0.098	+0.762	+0.907
4	-0.189	+1.241	+0.881	-0.159	+1.099	+0.787	-0.129	+0.971	+0.679
5	-0.421	+1.426	+0.529	-0.353	+1.265	+0.475	-0.283	+1.113	+0.405
6	-0.532	+1.515	+0.142	-0.446	+1.345	+0.132	-0.356	+1.180	+0.103
7	-0.513	+1.500	-0.255	-0.432	+1.333	-0.221	-0.341	+1.167	-0.206
8	-0.415	+1.461	-0.424	-0.349	+1.298	-0.376	-0.266	+1.133	-0.346
9	-0.270	+1.404	-0.587	-0.222	+1.245	-0.525	-0.154	+1.083	-0.481
10	-0.078	+1.328	-0.743	-0.055	+1.175	-0.668	-0.006	+1.017	-0.608
11	+0.168	+0.092	-1.017	+0.128	+0.116	-0.956	+0.123	+0.122	-0.898
12	+0.378	-0.102	-0.686	+0.326	-0.073	-0.645	+0.309	-0.062	-0.606
13	+0.510	-0.217	-0.345	+0.450	-0.184	-0.325	+0.426	-0.170	-0.305
14	+0.555	-0.255	0	+0.492	-0.221	0	+0.466	-0.206	0

SHAPE C



POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.051	+0.212	+1.500	+0.884	+0.172	+1.333	+0.724	+0.127	+1.167
2	+0.575	+0.593	+1.394	+0.488	+0.511	+1.244	+0.402	+0.425	+1.094
3	+0.149	+0.934	+1.193	+0.133	+0.815	+1.069	+0.111	+0.694	+0.947
4	-0.197	+1.211	+0.911	-0.157	+1.064	+0.822	-0.129	+0.915	+0.735
5	-0.440	+1.405	+0.566	-0.363	+1.240	+0.518	-0.301	+1.074	+0.473
6	-0.564	+1.504	+0.183	-0.470	+1.332	+0.179	-0.394	+1.160	+0.179
7	-0.559	+1.500	-0.212	-0.472	+1.333	-0.172	-0.402	+1.167	-0.127
8	-0.466	+1.463	-0.394	-0.396	+1.301	-0.338	-0.343	+1.140	-0.278
9	-0.318	+1.404	-0.569	-0.271	+1.248	-0.499	-0.242	+1.094	-0.425
10	-0.191	+0.676	-1.115	-0.183	+0.644	-1.001	-0.190	+0.613	-0.884
11	+0.067	+0.362	-0.929	+0.051	+0.348	-0.829	+0.020	+0.337	-0.726
12	+0.278	+0.110	-0.695	+0.241	+0.113	-0.610	+0.188	+0.119	-0.524
13	+0.409	-0.127	-0.384	+0.355	-0.097	-0.338	+0.285	-0.062	-0.290
14	+0.456	-0.212	0	+0.395	-0.172	0	+0.320	-0.127	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

CONCENTRATED VERTICAL LOAD – UNIFORM FOUNDATION REACTION

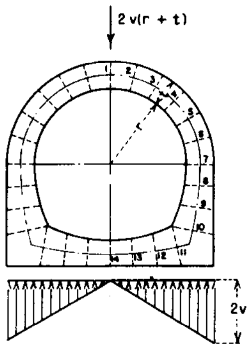
SHAPES A, B, AND C

REV. JULY 9, 1953
REV. SEP. 28, 1964

SEP. 8, 1950

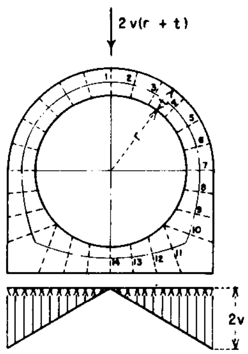
X-PEL-374

SHAPE A



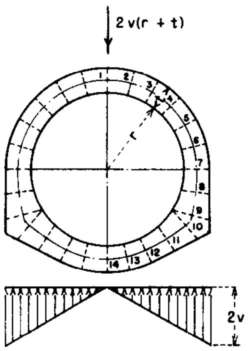
POINT	$t = \frac{r}{2}$ $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{3}$ $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{6}$ $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.007	+0.340	+1.500	+0.835	+0.297	+1.333	+0.683	+0.256	+1.167
2	+0.536	+0.716	+1.361	+0.444	+0.632	+1.211	+0.365	+0.549	+1.061
3	+0.126	+1.044	+1.129	+0.104	+0.924	+1.006	+0.088	+0.805	+0.883
4	-0.194	+1.301	+0.820	-0.163	+1.153	+0.733	-0.130	+1.006	+0.644
5	-0.404	+1.469	+0.456	-0.339	+1.303	+0.410	-0.274	+1.138	+0.362
6	-0.489	+1.537	+0.060	-0.411	+1.365	+0.059	-0.333	+1.193	+0.055
7	-0.443	+1.500	-0.340	-0.374	+1.333	-0.297	-0.305	+1.167	-0.256
8	-0.327	+1.474	-0.438	-0.274	+1.310	-0.386	-0.219	+1.146	-0.335
9	-0.182	+1.442	-0.534	-0.148	+1.282	-0.473	-0.112	+1.121	-0.413
10	-0.008	+1.404	-0.628	+0.003	+1.247	-0.558	+0.018	+1.090	-0.488
11	+0.172	-0.212	-0.668	+0.140	-0.161	-0.691	+0.126	-0.110	-0.724
12	+0.297	-0.301	-0.311	+0.271	-0.256	-0.319	+0.265	-0.212	-0.332
13	+0.347	-0.335	-0.089	+0.333	-0.291	-0.090	+0.319	-0.250	-0.092
14	+0.357	-0.340	0	+0.342	-0.297	0	+0.329	-0.256	0

SHAPE B

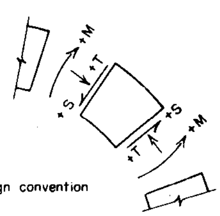


POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.994	+0.362	+1.500	+0.829	+0.311	+1.333	+0.669	+0.284	+1.167
2	+0.524	+0.738	+1.355	+0.439	+0.645	+1.208	+0.353	+0.576	+1.053
3	+0.117	+1.063	+1.118	+0.100	+0.936	+0.999	+0.079	+0.829	+0.868
4	-0.200	+1.316	+0.805	-0.165	+1.162	+0.723	-0.134	+1.026	+0.624
5	-0.404	+1.480	+0.437	-0.337	+1.310	+0.398	-0.271	+1.152	+0.337
6	-0.482	+1.542	+0.039	-0.405	+1.368	+0.045	-0.323	+1.200	+0.028
7	-0.429	+1.500	-0.362	-0.364	+1.333	-0.311	-0.287	+1.167	-0.284
8	-0.301	+1.449	-0.530	-0.255	+1.288	-0.465	-0.191	+1.124	-0.423
9	-0.124	+1.379	-0.691	-0.104	+1.224	-0.612	-0.058	+1.064	-0.556
10	+0.097	+1.292	-0.844	+0.087	+1.144	-0.752	+0.110	+0.989	-0.681
11	+0.222	-0.122	-0.736	+0.193	-0.064	-0.726	+0.198	-0.028	-0.725
12	+0.335	-0.290	-0.352	+0.307	-0.237	-0.344	+0.315	-0.208	-0.342
13	+0.387	-0.352	-0.108	+0.358	-0.300	-0.104	+0.367	-0.274	-0.102
14	+0.398	-0.362	0	+0.369	-0.311	0	+0.378	-0.284	0

SHAPE C



POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.992	+0.324	+1.500	+0.843	+0.265	+1.333	+0.692	+0.208	+1.167
2	+0.520	+0.701	+1.365	+0.451	+0.601	+1.219	+0.372	+0.502	+1.073
3	+0.108	+1.031	+1.137	+0.106	+0.896	+1.022	+0.090	+0.763	+0.907
4	-0.216	+1.290	+0.831	-0.167	+1.130	+0.756	-0.136	+0.972	+0.678
5	-0.430	+1.461	+0.469	-0.350	+1.287	+0.437	-0.290	+1.114	+0.404
6	-0.519	+1.533	+0.075	-0.431	+1.356	+0.089	-0.363	+1.181	+0.101
7	-0.478	+1.500	-0.324	-0.404	+1.333	-0.265	-0.347	+1.167	-0.208
8	-0.351	+1.449	-0.505	-0.300	+1.289	-0.431	-0.266	+1.130	-0.358
9	-0.169	+1.377	-0.678	-0.149	+1.225	-0.590	-0.142	+1.073	-0.502
10	-0.083	+0.471	-1.048	-0.085	+0.484	-0.959	-0.098	+0.493	-0.869
11	+0.099	+0.080	-0.706	+0.092	+0.105	-0.633	+0.070	+0.128	-0.559
12	+0.226	-0.156	-0.413	+0.210	-0.118	-0.357	+0.178	-0.081	-0.302
13	+0.287	-0.297	-0.152	+0.263	-0.242	-0.129	+0.224	-0.188	-0.108
14	+0.302	-0.324	0	+0.275	-0.265	0	+0.234	-0.208	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

CONCENTRATED VERTICAL LOAD-TRIANGULAR FOUNDATION REACTION

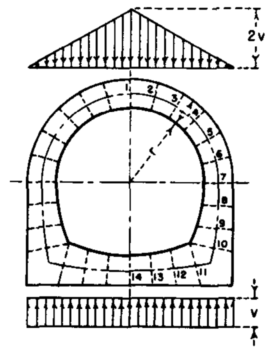
SHAPES A, B, AND C

REV. SEP. 28, 1964

SEP. 8, 1950

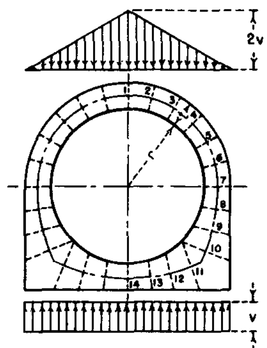
X-PEL-375

SHAPE A



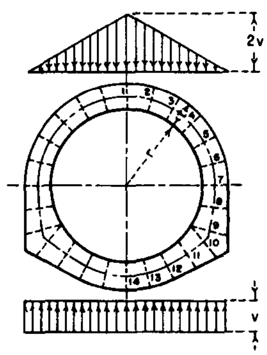
POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$t = \frac{r}{2}$: $\frac{T}{vr}$	$t = \frac{r}{2}$: $\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$t = \frac{r}{3}$: $\frac{T}{vr}$	$t = \frac{r}{3}$: $\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$t = \frac{r}{6}$: $\frac{T}{vr}$	$t = \frac{r}{6}$: $\frac{S}{vr}$
1	+0.511	+0.141	0	+0.444	+0.122	0	+0.377	+0.105	0
2	+0.423	+0.311	+0.617	+0.366	+0.273	+0.549	+0.309	+0.238	+0.481
3	+0.207	+0.684	+0.904	+0.176	+0.605	+0.805	+0.145	+0.529	+0.705
4	-0.055	+1.069	+0.870	-0.051	+0.948	+0.776	-0.047	+0.829	+0.680
5	-0.282	+1.346	+0.615	-0.245	+1.195	+0.549	-0.210	+1.045	+0.482
6	-0.420	+1.484	+0.252	-0.361	+1.318	+0.227	-0.306	+1.153	+0.200
7	-0.438	+1.500	-0.141	-0.378	+1.333	-0.122	-0.319	+1.167	-0.105
8	-0.381	+1.487	-0.239	-0.329	+1.322	-0.211	-0.278	+1.157	-0.185
9	-0.295	+1.468	-0.337	-0.254	+1.305	-0.299	-0.213	+1.141	-0.264
10	-0.180	+1.443	-0.433	-0.153	+1.282	-0.386	-0.126	+1.121	-0.341
11	+0.081	+0.051	-0.968	+0.039	+0.067	-0.933	+0.000	+0.080	-0.897
12	+0.305	-0.056	-0.648	+0.255	-0.038	-0.624	+0.209	-0.023	-0.600
13	+0.442	-0.120	-0.324	+0.387	-0.101	-0.313	+0.335	-0.085	-0.301
14	+0.488	-0.141	0	+0.431	-0.122	0	+0.378	-0.105	0

SHAPE B

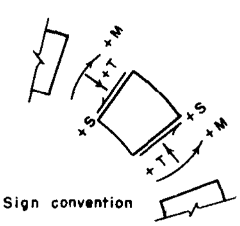


POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$t = \frac{r}{2}$: $\frac{T}{vr}$	$t = \frac{r}{2}$: $\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$t = \frac{r}{3}$: $\frac{T}{vr}$	$t = \frac{r}{3}$: $\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$t = \frac{r}{6}$: $\frac{T}{vr}$	$t = \frac{r}{6}$: $\frac{S}{vr}$
1	+0.504	+0.143	0	+0.434	+0.128	0	+0.364	+0.122	0
2	+0.416	+0.313	+0.616	+0.356	+0.279	+0.547	+0.297	+0.254	+0.476
3	+0.200	+0.686	+0.903	+0.167	+0.610	+0.802	+0.135	+0.543	+0.697
4	-0.061	+1.071	+0.869	-0.058	+0.952	+0.772	-0.054	+0.840	+0.668
5	-0.288	+1.347	+0.613	-0.251	+1.198	+0.544	-0.213	+1.053	+0.468
6	-0.425	+1.484	+0.250	-0.366	+1.319	+0.222	-0.305	+1.157	+0.184
7	-0.442	+1.500	-0.143	-0.380	+1.333	-0.128	-0.314	+1.167	-0.122
8	-0.377	+1.474	-0.313	-0.322	+1.309	-0.283	-0.262	+1.143	-0.262
9	-0.262	+1.429	-0.478	-0.222	+1.267	-0.434	-0.173	+1.103	-0.399
10	-0.101	+1.365	-0.638	-0.080	+1.207	-0.580	-0.047	+1.047	-0.529
11	+0.116	+0.197	-0.980	+0.085	+0.204	-0.924	+0.071	+0.201	-0.868
12	+0.316	+0.007	-0.660	+0.275	+0.018	-0.623	+0.250	+0.020	-0.586
13	+0.443	-0.106	-0.332	+0.395	-0.091	-0.314	+0.362	-0.086	-0.295
14	+0.486	-0.143	0	+0.435	-0.128	0	+0.401	-0.122	0

SHAPE C



POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$t = \frac{r}{2}$: $\frac{T}{vr}$	$t = \frac{r}{2}$: $\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$t = \frac{r}{3}$: $\frac{T}{vr}$	$t = \frac{r}{3}$: $\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$t = \frac{r}{6}$: $\frac{T}{vr}$	$t = \frac{r}{6}$: $\frac{S}{vr}$
1	+0.524	+0.108	0	+0.455	+0.082	0	+0.389	+0.056	0
2	+0.434	+0.279	+0.625	+0.375	+0.235	+0.559	+0.319	+0.190	+0.493
3	+0.214	+0.656	+0.920	+0.180	+0.571	+0.825	+0.150	+0.486	+0.730
4	-0.054	+1.046	+0.893	-0.053	+0.920	+0.804	-0.051	+0.794	+0.715
5	-0.290	+1.330	+0.643	-0.257	+1.175	+0.584	-0.224	+1.020	+0.525
6	-0.438	+1.475	+0.284	-0.385	+1.308	+0.265	-0.334	+1.140	+0.248
7	-0.467	+1.500	-0.108	-0.413	+1.333	-0.082	-0.361	+1.167	-0.056
8	-0.406	+1.476	-0.290	-0.363	+1.312	-0.249	-0.323	+1.149	-0.207
9	-0.289	+1.429	-0.468	-0.265	+1.271	-0.413	-0.242	+1.113	-0.355
10	-0.180	+0.755	-1.047	-0.189	+0.712	-0.942	-0.195	+0.666	-0.836
11	+0.059	+0.449	-0.871	+0.030	+0.423	-0.779	+0.002	+0.396	-0.686
12	+0.254	+0.204	-0.648	+0.206	+0.193	-0.570	+0.160	+0.184	-0.492
13	+0.375	-0.026	-0.360	+0.312	-0.009	-0.317	+0.250	+0.007	-0.274
14	+0.418	-0.108	0	+0.350	-0.082	0	+0.283	-0.056	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

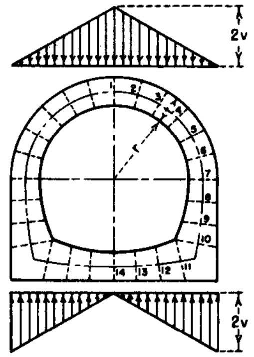
TRIANGULAR VERTICAL LOAD – UNIFORM FOUNDATION REACTION

SHAPES A, B, AND C

SEP. 28, 1964

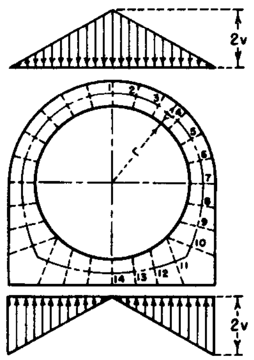
X-PEL-1034

SHAPE A



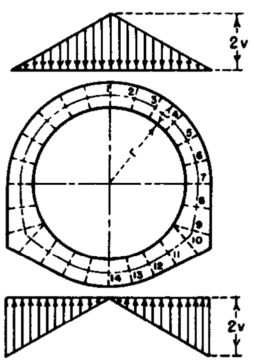
POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$t = \frac{r}{2}$: $\frac{T}{vr}$	$t = \frac{r}{2}$: $\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$t = \frac{r}{3}$: $\frac{T}{vr}$	$t = \frac{r}{3}$: $\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$t = \frac{r}{6}$: $\frac{T}{vr}$	$t = \frac{r}{6}$: $\frac{S}{vr}$
1	+0.456	+0.240	0	+0.406	+0.204	0	+0.347	+0.177	0
2	+0.372	+0.407	+0.591	+0.331	+0.353	+0.528	+0.282	+0.307	+0.462
3	+0.168	+0.770	+0.854	+0.151	+0.677	+0.764	+0.126	+0.591	+0.669
4	-0.073	+1.139	+0.800	-0.060	+1.006	+0.718	-0.054	+0.879	+0.629
5	-0.275	+1.396	+0.529	-0.235	+1.236	+0.478	-0.201	+1.081	+0.420
6	-0.383	+1.509	+0.156	-0.328	+1.339	+0.148	-0.278	+1.171	+0.131
7	-0.369	+1.500	-0.240	-0.319	+1.333	-0.204	-0.272	+1.167	-0.177
8	-0.282	+1.481	-0.338	-0.246	+1.317	-0.293	-0.209	+1.152	-0.256
9	-0.167	+1.455	-0.435	-0.147	+1.294	-0.381	-0.124	+1.132	-0.334
10	-0.022	+1.423	-0.531	-0.022	+1.265	-0.467	-0.016	+1.106	-0.411
11	+0.131	-0.115	-0.648	+0.106	-0.071	-0.673	+0.081	-0.033	-0.708
12	+0.250	-0.203	-0.298	+0.231	-0.164	-0.307	+0.215	-0.134	-0.321
13	+0.298	-0.235	-0.082	+0.281	-0.199	-0.083	+0.268	-0.171	-0.086
14	+0.306	-0.240	0	+0.289	-0.204	0	+0.276	-0.177	0

SHAPE B

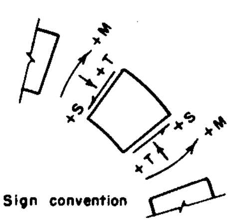


POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$t = \frac{r}{2}$: $\frac{T}{vr}$	$t = \frac{r}{2}$: $\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$t = \frac{r}{3}$: $\frac{T}{vr}$	$t = \frac{r}{3}$: $\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$t = \frac{r}{6}$: $\frac{T}{vr}$	$t = \frac{r}{6}$: $\frac{S}{vr}$
1	+0.455	+0.250	0	+0.397	+0.217	0	+0.334	+0.200	0
2	+0.371	+0.416	+0.588	+0.323	+0.365	+0.524	+0.269	+0.329	+0.456
3	+0.168	+0.779	+0.849	+0.144	+0.688	+0.757	+0.116	+0.610	+0.658
4	-0.071	+1.146	+0.793	-0.065	+1.015	+0.708	-0.060	+0.895	+0.613
5	-0.271	+1.401	+0.520	-0.236	+1.243	+0.467	-0.201	+1.092	+0.400
6	-0.376	+1.512	+0.146	-0.326	+1.343	+0.135	-0.273	+1.177	+0.109
7	-0.358	+1.500	-0.250	-0.313	+1.333	-0.217	-0.260	+1.167	-0.200
8	-0.262	+1.462	-0.419	-0.230	+1.299	-0.372	-0.187	+1.134	-0.340
9	-0.117	+1.405	-0.582	-0.105	+1.246	-0.522	-0.077	+1.084	-0.474
10	+0.073	+1.329	-0.738	+0.061	+1.176	-0.664	+0.069	+1.019	-0.602
11	+0.169	-0.017	-0.698	+0.149	+0.024	-0.694	+0.146	+0.051	-0.695
12	+0.273	-0.181	-0.326	+0.256	-0.146	-0.322	+0.256	-0.126	-0.321
13	+0.320	-0.241	-0.095	+0.302	-0.208	-0.093	+0.304	-0.190	-0.092
14	+0.329	-0.250	0	+0.311	-0.217	0	+0.313	-0.200	0

SHAPE C



POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$t = \frac{r}{2}$: $\frac{T}{vr}$	$t = \frac{r}{2}$: $\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$t = \frac{r}{3}$: $\frac{T}{vr}$	$t = \frac{r}{3}$: $\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$t = \frac{r}{6}$: $\frac{T}{vr}$	$t = \frac{r}{6}$: $\frac{S}{vr}$
1	+0.464	+0.220	0	+0.413	+0.175	0	+0.357	+0.136	0
2	+0.380	+0.387	+0.596	+0.337	+0.325	+0.535	+0.290	+0.267	+0.473
3	+0.173	+0.753	+0.864	+0.154	+0.652	+0.778	+0.129	+0.555	+0.690
4	-0.073	+1.125	+0.814	-0.062	+0.986	+0.738	-0.058	+0.850	+0.658
5	-0.280	+1.386	+0.546	-0.244	+1.222	+0.503	-0.213	+1.060	+0.455
6	-0.393	+1.504	+0.175	-0.345	+1.332	+0.175	-0.302	+1.161	+0.170
7	-0.386	+1.500	-0.220	-0.345	+1.333	-0.175	-0.307	+1.167	-0.136
8	-0.290	+1.462	-0.402	-0.268	+1.301	-0.342	-0.246	+1.139	-0.287
9	-0.140	+1.402	-0.577	-0.142	+1.247	-0.503	-0.142	+1.092	-0.433
10	-0.072	+0.551	-0.981	-0.088	+0.551	-0.900	-0.104	+0.546	-0.821
11	+0.091	+0.166	-0.648	+0.071	+0.179	-0.583	+0.052	+0.187	-0.519
12	+0.202	-0.063	-0.367	+0.175	-0.038	-0.317	+0.150	-0.017	-0.269
13	+0.252	-0.196	-0.128	+0.220	-0.154	-0.109	+0.189	-0.118	-0.091
14	+0.264	-0.220	0	+0.230	-0.175	0	+0.197	-0.136	0



\+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

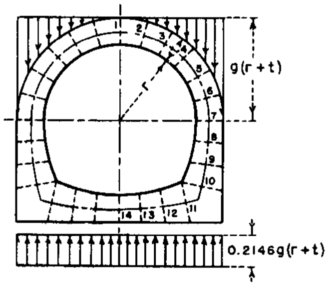
TRIANGULAR VERTICAL LOAD – TRIANGULAR FOUNDATION REACTION

SHAPES A, B, AND C

SEP. 28, 1964

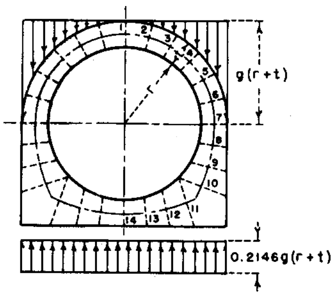
X-PEL-1035

SHAPE A



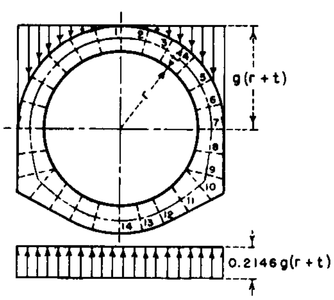
	$t = \frac{r}{2}$			$t = \frac{r}{3}$			$t = \frac{r}{6}$		
POINT	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$
1	+0.045	-0.054	0	+0.040	-0.039	0	+0.032	-0.027	0
2	+0.043	-0.050	+0.020	+0.039	-0.036	+0.015	+0.030	-0.025	+0.011
3	+0.034	-0.022	+0.069	+0.031	-0.015	+0.053	+0.025	-0.009	+0.039
4	+0.014	+0.064	+0.141	+0.014	+0.053	+0.109	+0.011	+0.043	+0.081
5	-0.014	+0.218	+0.188	-0.011	+0.174	+0.146	-0.011	+0.135	+0.109
6	-0.042	+0.391	+0.161	-0.037	+0.310	+0.123	-0.035	+0.238	+0.092
7	-0.063	+0.483	+0.054	-0.055	+0.382	+0.039	-0.049	+0.292	+0.027
8	-0.074	+0.485	+0.022	-0.063	+0.383	+0.013	-0.054	+0.293	+0.007
9	-0.076	+0.486	-0.010	-0.063	+0.383	-0.012	-0.053	+0.293	-0.013
10	-0.068	+0.484	-0.042	-0.056	+0.382	-0.038	-0.047	+0.291	-0.033
11	-0.011	+0.114	-0.292	-0.016	+0.091	-0.252	-0.022	+0.072	-0.214
12	+0.056	+0.080	-0.195	+0.043	+0.062	-0.169	+0.027	+0.047	-0.143
13	+0.097	+0.061	-0.098	+0.078	+0.045	-0.085	+0.057	+0.032	-0.072
14	+0.111	+0.054	0	+0.090	+0.039	0	+0.068	+0.027	0

SHAPE B



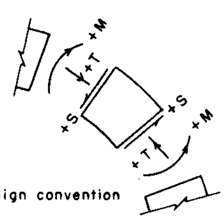
POINT	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$
1	+0.046	-0.059	0	+0.039	-0.043	0	+0.031	-0.028	0
2	+0.043	-0.055	+0.022	+0.037	-0.040	+0.016	+0.030	-0.026	+0.011
3	+0.033	-0.026	+0.072	+0.029	-0.018	+0.055	+0.024	-0.010	+0.040
4	+0.013	+0.061	+0.144	+0.012	+0.051	+0.111	+0.010	+0.042	+0.082
5	-0.016	+0.216	+0.193	-0.015	+0.172	+0.149	-0.013	+0.134	+0.110
6	-0.046	+0.390	+0.165	-0.042	+0.309	+0.127	-0.037	+0.238	+0.093
7	-0.068	+0.483	+0.059	-0.061	+0.382	+0.043	-0.052	+0.292	+0.028
8	-0.077	+0.486	+0.003	-0.067	+0.384	-0.002	-0.055	+0.293	-0.007
9	-0.070	+0.484	-0.052	-0.060	+0.381	-0.047	-0.048	+0.290	-0.043
10	-0.048	+0.475	-0.107	-0.040	+0.373	-0.091	-0.031	+0.283	-0.078
11	-0.005	+0.162	-0.280	-0.009	+0.133	-0.237	-0.010	+0.105	-0.196
12	+0.052	+0.104	-0.189	+0.039	+0.082	-0.160	+0.030	+0.062	-0.132
13	+0.087	+0.070	-0.095	+0.069	+0.053	-0.080	+0.055	+0.037	-0.067
14	+0.099	+0.059	0	+0.080	+0.043	0	+0.064	+0.028	0

SHAPE C



POINT	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$
1	+0.048	-0.067	0	+0.042	-0.049	0	+0.034	-0.036	0
2	+0.045	-0.063	+0.024	+0.040	-0.046	+0.018	+0.032	-0.034	+0.013
3	+0.034	-0.034	+0.076	+0.031	-0.024	+0.058	+0.026	-0.016	+0.044
4	+0.012	+0.055	+0.150	+0.012	+0.046	+0.116	+0.010	+0.036	+0.088
5	-0.019	+0.212	+0.200	-0.016	+0.169	+0.155	-0.014	+0.130	+0.117
6	-0.051	+0.388	+0.173	-0.045	+0.307	+0.134	-0.040	+0.236	+0.101
7	-0.076	+0.483	+0.067	-0.066	+0.382	+0.049	-0.057	+0.292	+0.036
8	-0.088	+0.487	+0.008	-0.073	+0.385	+0.001	-0.062	+0.294	-0.002
9	-0.081	+0.485	-0.052	-0.067	+0.382	-0.047	-0.056	+0.292	-0.041
10	-0.063	+0.320	-0.271	-0.054	+0.259	-0.222	-0.048	+0.204	-0.176
11	-0.005	+0.229	-0.224	-0.005	+0.182	-0.182	-0.007	+0.141	-0.144
12	+0.042	+0.157	-0.163	+0.035	+0.121	-0.130	+0.025	+0.091	-0.101
13	+0.071	+0.091	-0.093	+0.059	+0.068	-0.074	+0.043	+0.051	-0.057
14	+0.081	+0.067	0	+0.067	+0.049	0	+0.050	+0.036	0

NOTE: g represents the weight per unit volume of soil cover on the arch of the conduit section in units consistent with those of the radius r.



+ Sign convention

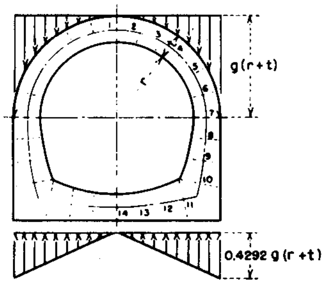
SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
VERTICAL ARCH LOAD - UNIFORM FOUNDATION REACTION
SHAPES A, B, AND C

REV. APR. 15, 1968

SEP. 28, 1964

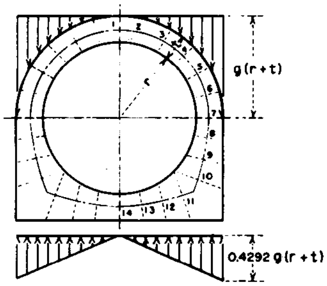
X-PEL-1036

SHAPE A



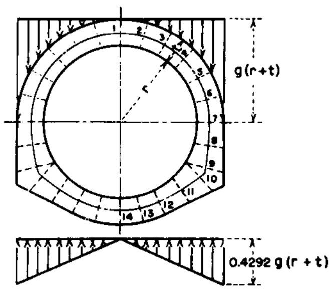
POINT	t = r/2: $\frac{M}{gr^3}$	t = r/2: $\frac{T}{gr^2}$	t = r/2: $\frac{S}{gr^2}$	t = r/3: $\frac{M}{gr^3}$	t = r/3: $\frac{T}{gr^2}$	t = r/3: $\frac{S}{gr^2}$	t = r/6: $\frac{M}{gr^3}$	t = r/6: $\frac{T}{gr^2}$	t = r/6: $\frac{S}{gr^2}$
1	+0.028	-0.022	0	+0.030	-0.015	0	+0.024	-0.009	0
2	+0.027	-0.020	+0.012	+0.029	-0.014	+0.009	+0.024	-0.008	+0.006
3	+0.021	+0.005	+0.053	+0.024	+0.006	+0.041	+0.020	+0.007	+0.030
4	+0.008	+0.087	+0.118	+0.012	+0.070	+0.092	+0.009	+0.056	+0.068
5	-0.011	+0.234	+0.161	-0.008	+0.186	+0.125	-0.009	+0.144	+0.094
6	-0.030	+0.399	+0.130	-0.028	+0.316	+0.101	-0.028	+0.243	+0.074
7	-0.041	+0.483	+0.022	-0.038	+0.382	+0.015	-0.037	+0.292	+0.009
8	-0.043	+0.483	-0.010	-0.039	+0.382	-0.010	-0.037	+0.292	-0.011
9	-0.035	+0.482	-0.042	-0.032	+0.380	-0.036	-0.031	+0.291	-0.031
10	-0.018	+0.478	-0.074	-0.018	+0.377	-0.061	-0.019	+0.288	-0.051
11	+0.005	+0.060	-0.189	+0.003	+0.052	-0.178	-0.002	+0.044	-0.166
12	+0.038	+0.033	-0.083	+0.036	+0.026	-0.078	+0.029	+0.019	-0.073
13	+0.051	+0.023	-0.020	+0.048	+0.017	-0.019	+0.040	+0.010	-0.018
14	+0.052	+0.022	0	+0.050	+0.015	0	+0.042	+0.009	0

SHAPE B



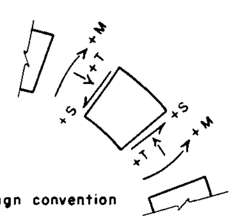
POINT	t = r/2: $\frac{M}{gr^3}$	t = r/2: $\frac{T}{gr^2}$	t = r/2: $\frac{S}{gr^2}$	t = r/3: $\frac{M}{gr^3}$	t = r/3: $\frac{T}{gr^2}$	t = r/3: $\frac{S}{gr^2}$	t = r/6: $\frac{M}{gr^3}$	t = r/6: $\frac{T}{gr^2}$	t = r/6: $\frac{S}{gr^2}$
1	+0.030	-0.024	0	+0.029	-0.017	0	+0.023	-0.009	0
2	+0.029	-0.022	+0.013	+0.029	-0.015	+0.009	+0.023	-0.008	+0.006
3	+0.023	+0.003	+0.054	+0.024	+0.004	+0.042	+0.019	+0.007	+0.030
4	+0.010	+0.085	+0.120	+0.011	+0.069	+0.093	+0.008	+0.056	+0.068
5	-0.011	+0.233	+0.163	-0.009	+0.185	+0.127	-0.010	+0.144	+0.093
6	-0.030	+0.399	+0.132	-0.030	+0.316	+0.102	-0.029	+0.243	+0.074
7	-0.041	+0.483	+0.024	-0.041	+0.382	+0.017	-0.038	+0.292	+0.009
8	-0.040	+0.482	-0.031	-0.039	+0.381	-0.028	-0.036	+0.291	-0.027
9	-0.024	+0.476	-0.085	-0.025	+0.375	-0.072	-0.024	+0.286	-0.062
10	+0.009	+0.463	-0.139	+0.001	+0.364	-0.116	-0.002	+0.276	-0.096
11	+0.013	+0.093	-0.190	+0.011	+0.081	-0.171	+0.008	+0.068	-0.153
12	+0.038	+0.044	-0.081	+0.035	+0.035	-0.074	+0.031	+0.026	-0.066
13	+0.048	+0.027	-0.019	+0.044	+0.019	-0.017	+0.040	+0.011	-0.016
14	+0.049	+0.024	0	+0.045	+0.017	0	+0.042	+0.009	0

SHAPE C



POINT	t = r/2: $\frac{M}{gr^3}$	t = r/2: $\frac{T}{gr^2}$	t = r/2: $\frac{S}{gr^2}$	t = r/3: $\frac{M}{gr^3}$	t = r/3: $\frac{T}{gr^2}$	t = r/3: $\frac{S}{gr^2}$	t = r/6: $\frac{M}{gr^3}$	t = r/6: $\frac{T}{gr^2}$	t = r/6: $\frac{S}{gr^2}$
1	+0.029	-0.031	0	+0.030	-0.023	0	+0.026	-0.016	0
2	+0.028	-0.028	+0.014	+0.029	-0.021	+0.011	+0.025	-0.014	+0.008
3	+0.021	-0.002	+0.058	+0.023	-0.000	+0.045	+0.020	+0.001	+0.034
4	+0.006	+0.081	+0.124	+0.010	+0.065	+0.097	+0.008	+0.051	+0.073
5	-0.016	+0.230	+0.168	-0.012	+0.182	+0.132	-0.011	+0.140	+0.100
6	-0.037	+0.397	+0.138	-0.034	+0.314	+0.108	-0.032	+0.241	+0.081
7	-0.050	+0.483	+0.031	-0.047	+0.382	+0.023	-0.043	+0.292	+0.016
8	-0.051	+0.483	-0.028	-0.046	+0.381	-0.025	-0.043	+0.292	-0.022
9	-0.033	+0.476	-0.087	-0.031	+0.375	-0.073	-0.031	+0.286	-0.060
10	-0.029	+0.254	-0.249	-0.025	+0.213	-0.210	-0.025	+0.174	-0.172
11	+0.005	+0.138	-0.152	+0.007	+0.112	-0.126	+0.005	+0.088	-0.102
12	+0.025	+0.071	-0.073	+0.026	+0.055	-0.058	+0.022	+0.040	-0.045
13	+0.031	+0.036	-0.018	+0.032	+0.027	-0.014	+0.028	+0.019	-0.011
14	+0.032	+0.031	0	+0.033	+0.023	0	+0.028	+0.016	0

NOTE: g represents the weight per unit volume of soil cover on the arch of the conduit section in units consistent with those of the radius r.



+ Sign convention

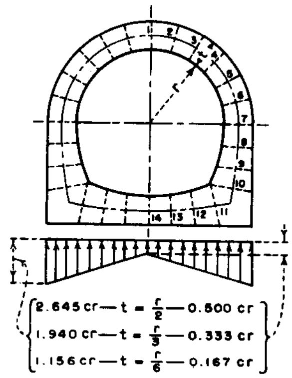
SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
VERTICAL ARCH LOAD–TRIANGULAR FOUNDATION REACTION
SHAPES A, B, AND C

REV. SEP. 28, 1964
REV. APR. 15, 1968

SEP. 8, 1950

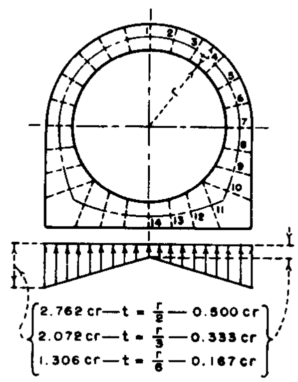
X-PEL-376

SHAPE A



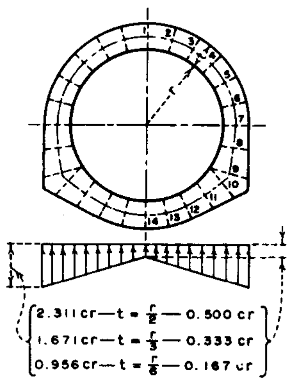
	$t = \frac{r}{2}$			$t = \frac{r}{3}$			$t = \frac{r}{6}$		
POINT	$\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$
1	+0.182	+0.041	0	+0.118	+0.010	0	+0.057	-0.006	0
2	+0.158	+0.082	+0.147	+0.103	+0.036	+0.096	+0.050	+0.006	+0.047
3	+0.090	+0.199	+0.263	+0.062	+0.111	+0.171	+0.031	+0.042	+0.085
4	-0.005	+0.376	+0.318	+0.003	+0.223	+0.209	+0.004	+0.096	+0.105
5	-0.105	+0.587	+0.292	-0.059	+0.358	+0.195	-0.026	+0.161	+0.100
6	-0.181	+0.801	+0.172	-0.108	+0.494	+0.122	-0.050	+0.227	+0.067
7	-0.203	+0.982	-0.041	-0.126	+0.611	-0.010	-0.061	+0.284	+0.006
8	-0.179	+1.128	-0.116	-0.116	+0.708	-0.058	-0.059	+0.333	-0.017
9	-0.130	+1.281	-0.212	-0.090	+0.814	-0.120	-0.050	+0.392	-0.048
10	-0.048	+1.450	-0.333	-0.043	+0.938	-0.202	-0.030	+0.472	-0.092
11	+0.041	+0.084	-0.627	+0.017	+0.086	-0.470	-0.002	+0.065	-0.284
12	+0.147	-0.002	-0.292	+0.101	+0.019	-0.219	+0.051	+0.024	-0.133
13	+0.189	-0.036	-0.080	+0.134	-0.006	-0.059	+0.072	+0.009	-0.035
14	+0.196	-0.041	0	+0.139	-0.010	0	+0.075	+0.006	0

SHAPE B



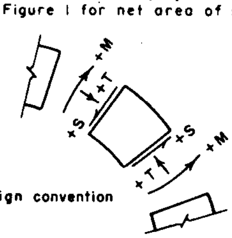
POINT	$\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$
1	+0.180	+0.050	0	+0.111	+0.016	0	+0.054	-0.003	0
2	+0.156	+0.091	+0.145	+0.096	+0.042	+0.094	+0.047	+0.009	+0.046
3	+0.090	+0.207	+0.258	+0.055	+0.116	+0.168	+0.028	+0.045	+0.083
4	-0.003	+0.383	+0.312	-0.002	+0.227	+0.205	+0.002	+0.098	+0.102
5	-0.101	+0.592	+0.284	-0.063	+0.361	+0.190	-0.027	+0.162	+0.097
6	-0.174	+0.803	+0.163	-0.111	+0.496	+0.116	-0.051	+0.228	+0.064
7	-0.193	+0.982	-0.050	-0.127	+0.611	-0.016	-0.061	+0.284	+0.003
8	-0.159	+1.116	-0.178	-0.111	+0.701	-0.099	-0.056	+0.330	-0.037
9	-0.083	+1.254	-0.342	-0.068	+0.798	-0.208	-0.039	+0.388	-0.093
10	+0.048	+1.407	-0.554	+0.011	+0.917	-0.354	-0.003	+0.474	-0.178
11	+0.071	+0.188	-0.679	+0.036	+0.162	-0.487	+0.013	+0.111	-0.284
12	+0.150	+0.023	-0.322	+0.098	+0.039	-0.230	+0.053	+0.037	-0.135
13	+0.186	-0.040	-0.093	+0.126	-0.009	-0.064	+0.071	+0.007	-0.037
14	+0.193	-0.050	0	+0.130	-0.016	0	+0.074	+0.003	0

SHAPE C



POINT	$\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$
1	+0.173	+0.045	0	+0.114	+0.008	0	+0.056	-0.009	0
2	+0.149	+0.086	+0.146	+0.099	+0.034	+0.096	+0.049	+0.003	+0.048
3	+0.082	+0.203	+0.261	+0.058	+0.109	+0.172	+0.029	+0.039	+0.087
4	-0.013	+0.379	+0.315	-0.001	+0.222	+0.210	+0.001	+0.094	+0.107
5	-0.112	+0.589	+0.288	-0.064	+0.357	+0.196	-0.029	+0.159	+0.103
6	-0.186	+0.802	+0.168	-0.114	+0.494	+0.124	-0.054	+0.226	+0.070
7	-0.206	+0.982	-0.045	-0.132	+0.611	-0.008	-0.066	+0.284	+0.009
8	-0.171	+1.125	-0.184	-0.116	+0.707	-0.098	-0.062	+0.334	-0.034
9	-0.086	+1.272	-0.365	-0.069	+0.813	-0.218	-0.044	+0.398	-0.097
10	-0.061	+0.624	-0.797	-0.052	+0.439	-0.517	-0.036	+0.241	-0.258
11	+0.038	+0.301	-0.535	+0.022	+0.216	-0.338	+0.007	+0.124	-0.167
12	+0.108	+0.101	-0.304	+0.071	+0.081	-0.180	+0.035	+0.051	-0.081
13	+0.136	-0.021	-0.107	+0.090	+0.006	-0.059	+0.045	+0.015	-0.024
14	+0.140	-0.045	0	+0.093	-0.008	0	+0.046	+0.009	0

NOTES: c represents the weight per unit volume of concrete or other material in units consistent with those of the radius r.
See Figure 1 for net area of shapes.



\+ Sign convention

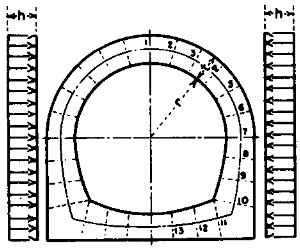
SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
DEAD WEIGHT OF CONDUIT
SHAPES A, B, AND C

REV. APR. 15, 1968

SEP. 28, 1964

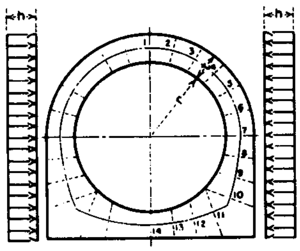
X-PEL-1037

SHAPE A



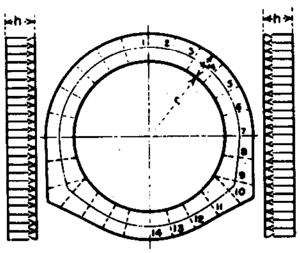
POINT	t = r/2 $\frac{M}{hr^2}$	t = r/2 $\frac{T}{hr}$	t = r/2 $\frac{S}{hr}$	t = r/3 $\frac{M}{hr^2}$	t = r/3 $\frac{T}{hr}$	t = r/3 $\frac{S}{hr}$	t = r/6 $\frac{M}{hr^2}$	t = r/6 $\frac{T}{hr}$	t = r/6 $\frac{S}{hr}$
1	-0.379	+1.520	0	-0.334	+1.349	0	-0.284	+1.169	0
2	-0.328	+1.419	-0.380	-0.289	+1.259	-0.337	-0.245	+1.090	-0.292
3	-0.188	+1.143	-0.660	-0.165	+1.013	-0.585	-0.138	+0.877	-0.506
4	+0.004	+0.764	-0.764	+0.005	+0.678	-0.678	+0.008	+0.585	-0.585
5	+0.196	+0.385	-0.667	+0.175	+0.341	-0.591	+0.154	+0.293	-0.507
6	+0.340	+0.106	-0.395	+0.301	+0.093	-0.348	+0.262	+0.079	-0.294
7	+0.397	0	-0.020	+0.351	0	-0.015	+0.301	0	-0.002
8	+0.358	+0.020	+0.295	+0.312	+0.019	+0.289	+0.260	+0.020	+0.292
9	+0.232	+0.081	+0.609	+0.189	+0.080	+0.593	+0.137	+0.081	+0.584
10	+0.020	+0.185	+0.920	-0.017	+0.183	+0.893	-0.065	+0.182	+0.874
11	-0.197	+1.451	+0.291	-0.181	+1.291	+0.264	-0.177	+1.140	+0.238
12	-0.269	+1.467	+0.195	-0.246	+1.306	+0.177	-0.234	+1.154	+0.159
13	-0.313	+1.476	+0.098	-0.285	+1.315	+0.089	-0.268	+1.162	+0.080
14	-0.328	+1.480	0	-0.298	+1.318	0	-0.280	+1.165	0

SHAPE B

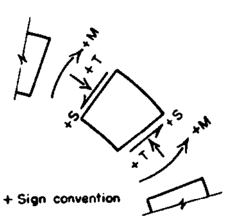


POINT	t = r/2 $\frac{M}{hr^2}$	t = r/2 $\frac{T}{hr}$	t = r/2 $\frac{S}{hr}$	t = r/3 $\frac{M}{hr^2}$	t = r/3 $\frac{T}{hr}$	t = r/3 $\frac{S}{hr}$	t = r/6 $\frac{M}{hr^2}$	t = r/6 $\frac{T}{hr}$	t = r/6 $\frac{S}{hr}$
1	-0.359	+1.491	0	-0.316	+1.321	0	-0.268	+1.140	0
2	-0.310	+1.391	-0.373	-0.272	+1.232	-0.330	-0.230	+1.063	-0.285
3	-0.173	+1.118	-0.645	-0.152	+0.989	-0.571	-0.126	+0.852	-0.492
4	+0.012	+0.744	-0.744	+0.013	+0.658	-0.658	+0.015	+0.564	-0.564
5	+0.198	+0.371	-0.642	+0.176	+0.327	-0.566	+0.155	+0.278	-0.482
6	+0.332	+0.098	-0.367	+0.295	+0.086	-0.321	+0.255	+0.071	-0.266
7	+0.380	0	+0.009	+0.335	0	+0.013	+0.286	0	+0.027
8	+0.337	+0.037	+0.325	+0.293	+0.037	+0.311	+0.243	+0.037	+0.307
9	+0.214	+0.148	+0.637	+0.176	+0.145	+0.606	+0.129	+0.144	+0.582
10	+0.023	+0.335	+0.940	-0.007	+0.328	+0.892	-0.047	+0.324	+0.849
11	-0.160	+1.421	+0.506	-0.149	+1.263	+0.465	-0.151	+1.115	+0.425
12	-0.282	+1.470	+0.341	-0.258	+1.309	+0.313	-0.248	+1.158	+0.287
13	-0.356	+1.499	+0.172	-0.324	+1.337	+0.158	-0.306	+1.184	+0.145
14	-0.381	+1.509	0	-0.346	+1.346	0	-0.326	+1.193	0

SHAPE C



POINT	t = r/2 $\frac{M}{hr^2}$	t = r/2 $\frac{T}{hr}$	t = r/2 $\frac{S}{hr}$	t = r/3 $\frac{M}{hr^2}$	t = r/3 $\frac{T}{hr}$	t = r/3 $\frac{S}{hr}$	t = r/6 $\frac{M}{hr^2}$	t = r/6 $\frac{T}{hr}$	t = r/6 $\frac{S}{hr}$
1	-0.368	+1.510	0	-0.328	+1.346	0	-0.286	+1.186	0
2	-0.318	+1.409	-0.377	-0.283	+1.257	-0.337	-0.246	+1.107	-0.297
3	-0.179	+1.133	-0.654	-0.159	+1.011	-0.584	-0.138	+0.891	-0.515
4	+0.010	+0.757	-0.757	+0.010	+0.676	-0.676	+0.012	+0.597	-0.597
5	+0.200	+0.380	-0.658	+0.180	+0.340	-0.589	+0.162	+0.301	-0.522
6	+0.340	+0.103	-0.384	+0.306	+0.093	-0.346	+0.273	+0.083	-0.310
7	+0.394	0	-0.010	+0.354	0	-0.003	+0.318	0	-0.019
8	+0.350	+0.040	+0.327	+0.314	+0.039	+0.304	+0.282	+0.037	+0.279
9	+0.219	+0.164	+0.658	+0.191	+0.159	+0.617	+0.168	+0.153	+0.571
10	+0.129	+0.778	+0.667	+0.126	+0.670	+0.583	+0.127	+0.563	+0.499
11	-0.037	+0.984	+0.653	-0.022	+0.661	+0.577	-0.003	+0.738	+0.499
12	-0.196	+1.191	+0.596	-0.166	+1.055	+0.527	-0.131	+0.916	+0.458
13	-0.305	+1.411	+0.333	-0.262	+1.250	+0.295	-0.215	+1.087	+0.257
14	-0.344	+1.490	0	-0.297	+1.320	0	-0.245	+1.148	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

UNIFORM HORIZONTAL LOAD - BOTH SIDES

SHAPES A, B, AND C

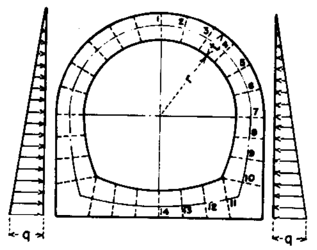
REV. JULY 9, 1953
REV. SEP. 28, 1964

SEP. 8, 1950

X-PEL-378

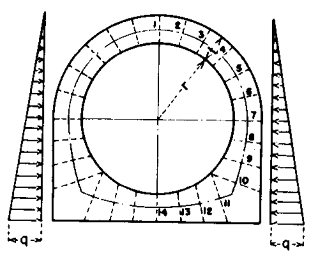
314-498 O - 68 - 4

SHAPE A



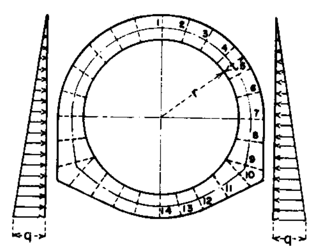
POINT	$\frac{M}{qr^2}$ (t = r/2)	$\frac{T}{qr}$ (t = r/2)	$\frac{S}{qr}$ (t = r/2)	$\frac{M}{qr^2}$ (t = r/3)	$\frac{T}{qr}$ (t = r/3)	$\frac{S}{qr}$ (t = r/3)	$\frac{M}{qr^2}$ (t = r/6)	$\frac{T}{qr}$ (t = r/6)	$\frac{S}{qr}$ (t = r/6)
1	-0.170	+0.447	0	-0.151	+0.404	0	-0.121	+0.360	0
2	-0.151	+0.432	-0.116	-0.135	+0.390	-0.105	-0.108	+0.347	-0.093
3	-0.097	+0.382	-0.220	-0.089	+0.345	-0.199	-0.069	+0.307	-0.177
4	-0.016	+0.294	-0.294	-0.020	+0.266	-0.266	-0.011	+0.237	-0.237
5	+0.075	+0.177	-0.306	+0.059	+0.161	-0.278	+0.057	+0.144	-0.249
6	+0.155	+0.062	-0.233	+0.130	+0.057	-0.214	+0.119	+0.052	-0.193
7	+0.202	0	-0.072	+0.172	0	-0.071	+0.156	0	-0.068
8	+0.200	+0.007	+0.102	+0.170	+0.007	+0.099	+0.153	+0.007	+0.097
9	+0.145	+0.041	+0.309	+0.116	+0.041	+0.303	+0.099	+0.041	+0.300
10	+0.031	+0.110	+0.549	+0.002	+0.111	+0.543	-0.015	+0.112	+0.539
11	-0.083	+1.032	+0.207	-0.088	+0.910	+0.186	-0.080	+0.790	+0.165
12	-0.135	+1.043	+0.139	-0.134	+0.921	+0.125	-0.119	+0.799	+0.110
13	-0.166	+1.050	+0.069	-0.162	+0.927	+0.062	-0.143	+0.805	+0.055
14	-0.176	+1.053	0	-0.171	+0.929	0	-0.151	+0.807	0

SHAPE B

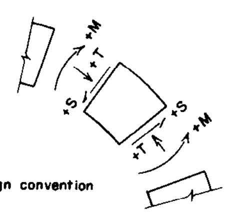


POINT	$\frac{M}{qr^2}$ (t = r/2)	$\frac{T}{qr}$ (t = r/2)	$\frac{S}{qr}$ (t = r/2)	$\frac{M}{qr^2}$ (t = r/3)	$\frac{T}{qr}$ (t = r/3)	$\frac{S}{qr}$ (t = r/3)	$\frac{M}{qr^2}$ (t = r/6)	$\frac{T}{qr}$ (t = r/6)	$\frac{S}{qr}$ (t = r/6)
1	-0.162	+0.431	0	-0.139	+0.391	0	-0.114	+0.347	0
2	-0.144	+0.416	-0.112	-0.123	+0.377	-0.101	-0.101	+0.335	-0.090
3	-0.092	+0.368	-0.212	-0.079	+0.334	-0.193	-0.064	+0.296	-0.171
4	-0.015	+0.282	-0.282	-0.012	+0.256	-0.256	-0.008	+0.228	-0.228
5	+0.072	+0.169	-0.292	+0.064	+0.154	-0.267	+0.057	+0.137	-0.237
6	+0.148	+0.058	-0.218	+0.131	+0.054	-0.201	+0.115	+0.048	-0.180
7	+0.189	0	-0.056	+0.169	0	-0.058	+0.148	0	-0.055
8	+0.184	+0.014	+0.119	+0.165	+0.013	+0.109	+0.144	+0.012	+0.102
9	+0.131	+0.076	+0.327	+0.115	+0.074	+0.308	+0.096	+0.073	+0.293
10	+0.031	+0.202	+0.567	+0.019	+0.199	+0.540	+0.002	+0.197	+0.517
11	-0.053	+1.007	+0.358	-0.051	+0.884	+0.325	-0.053	+0.766	+0.292
12	-0.139	+1.041	+0.242	-0.127	+0.916	+0.219	-0.119	+0.796	+0.197
13	-0.192	+1.062	+0.122	-0.174	+0.936	+0.110	-0.159	+0.814	+0.099
14	-0.209	+1.069	0	-0.189	+0.942	0	-0.173	+0.820	0

SHAPE C



POINT	$\frac{M}{qr^2}$ (t = r/2)	$\frac{T}{qr}$ (t = r/2)	$\frac{S}{qr}$ (t = r/2)	$\frac{M}{qr^2}$ (t = r/3)	$\frac{T}{qr}$ (t = r/3)	$\frac{S}{qr}$ (t = r/3)	$\frac{M}{qr^2}$ (t = r/6)	$\frac{T}{qr}$ (t = r/6)	$\frac{S}{qr}$ (t = r/6)
1	-0.172	+0.442	0	-0.143	+0.400	0	-0.122	+0.364	0
2	-0.153	+0.426	-0.114	-0.127	+0.386	-0.104	-0.109	+0.352	-0.094
3	-0.100	+0.377	-0.218	-0.081	+0.341	-0.197	-0.070	+0.311	-0.180
4	-0.020	+0.290	-0.290	-0.013	+0.263	-0.263	-0.011	+0.240	-0.240
5	+0.069	+0.174	-0.301	+0.065	+0.158	-0.274	+0.058	+0.146	-0.252
6	+0.148	+0.061	-0.228	+0.135	+0.056	-0.210	+0.121	+0.053	-0.197
7	+0.193	0	-0.067	+0.176	0	-0.067	+0.159	0	-0.073
8	+0.189	+0.015	+0.121	+0.173	+0.014	+0.111	+0.158	+0.013	+0.096
9	+0.132	+0.086	+0.345	+0.118	+0.084	+0.327	+0.107	+0.081	+0.302
10	+0.093	+0.477	+0.409	+0.088	+0.405	+0.352	+0.088	+0.329	+0.292
11	-0.003	+0.637	+0.423	+0.002	+0.552	+0.370	+0.013	+0.463	+0.313
12	-0.099	+0.809	+0.404	-0.087	+0.712	+0.356	-0.068	+0.610	+0.305
13	-0.167	+0.991	+0.234	-0.149	+0.874	+0.206	-0.123	+0.751	+0.177
14	-0.192	+1.058	0	-0.172	+0.933	0	-0.143	+0.802	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
TRIANGULAR HORIZONTAL LOAD - BOTH SIDES
SHAPES A, B, AND C

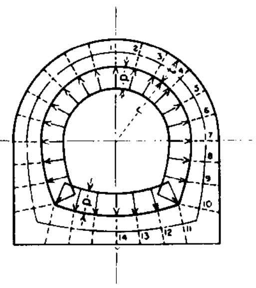
REV. SEP. 28, 1964

SEP. 8, 1950

X-PEL-379

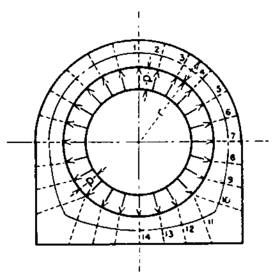
	$t = \frac{r}{2}$			$t = \frac{r}{3}$			$t = \frac{r}{6}$		

SHAPE A



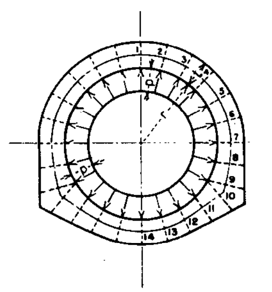
POINT	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$
1	+0.022	-1.053	0	+0.017	-1.046	0	+0.011	-1.033	0
2	+0.020	-1.052	+0.014	+0.015	-1.044	+0.012	+0.009	-1.032	+0.008
3	+0.013	-1.046	+0.027	+0.010	-1.040	+0.023	+0.006	-1.028	+0.016
4	+0.003	-1.038	+0.038	+0.001	-1.032	+0.032	+0.000	-1.023	+0.023
5	-0.011	-1.027	+0.046	-0.010	-1.023	+0.040	-0.007	-1.016	+0.028
6	-0.027	-1.014	+0.052	-0.023	-1.012	+0.044	-0.016	-1.008	+0.032
7	-0.045	-1.000	+0.053	-0.037	-1.000	+0.046	-0.025	-1.000	+0.033
8	-0.031	-0.993	-0.163	-0.021	-0.994	-0.169	-0.004	-0.995	-0.181
9	+0.041	-0.979	-0.379	+0.055	-0.981	-0.384	+0.075	-0.984	-0.394
10	+0.170	-0.958	-0.592	+0.187	-0.962	-0.596	+0.212	-0.967	-0.606
11	+0.155	-0.916	+0.655	+0.178	-0.926	+0.650	+0.207	-0.942	+0.644
12	+0.008	-0.933	+0.438	+0.030	-0.942	+0.435	+0.060	-0.956	+0.431
13	-0.081	-0.943	+0.220	-0.060	-0.951	+0.218	-0.030	-0.964	+0.216
14	-0.111	-0.947	0	-0.090	-0.954	0	-0.060	-0.967	0

SHAPE B

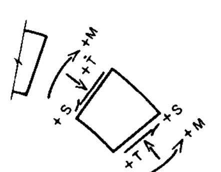


POINT	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$
1	+0.007	-1.019	0	+0.005	-1.017	0	+0.003	-1.012	0
2	+0.006	-1.019	+0.005	+0.005	-1.016	+0.004	+0.003	-1.011	+0.003
3	+0.003	-1.017	+0.010	+0.003	-1.015	+0.008	+0.002	-1.010	+0.006
4	-0.000	-1.014	+0.014	-0.001	-1.012	+0.012	-0.000	-1.008	+0.008
5	-0.005	-1.010	+0.017	-0.005	-1.008	+0.015	-0.003	-1.006	+0.010
6	-0.011	-1.005	+0.019	-0.009	-1.004	+0.016	-0.006	-1.003	+0.011
7	-0.018	-1.000	+0.019	-0.014	-1.000	+0.017	-0.009	-1.000	+0.012
8	-0.007	-0.987	-0.126	-0.002	-0.988	-0.126	+0.005	-0.989	-0.127
9	+0.033	-0.953	-0.270	+0.041	-0.955	-0.267	+0.051	-0.958	-0.264
10	+0.096	-0.897	-0.411	+0.108	-0.902	-0.404	+0.123	-0.909	-0.398
11	+0.091	-0.885	+0.436	+0.105	-0.892	+0.425	+0.121	-0.902	+0.413
12	+0.021	-0.938	+0.294	+0.031	-0.943	+0.287	+0.045	-0.950	+0.279
13	-0.025	-0.970	+0.148	-0.017	-0.973	+0.144	-0.005	-0.979	+0.140
14	-0.042	-0.981	0	-0.034	-0.983	0	-0.022	-0.988	0

SHAPE C



POINT	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$
1	+0.000	-1.006	0	+0.000	-1.005	0	+0.000	-1.004	0
2	0	-1.006	+0.001	-0.000	-1.005	+0.001	-0.000	-1.003	+0.001
3	-0.001	-1.005	+0.003	-0.001	-1.004	+0.003	-0.000	-1.003	+0.002
4	-0.002	-1.004	+0.004	-0.002	-1.004	+0.004	-0.001	-1.003	+0.003
5	-0.003	-1.003	+0.005	-0.003	-1.003	+0.004	-0.002	-1.002	+0.003
6	-0.005	-1.001	+0.006	-0.004	-1.001	+0.005	-0.003	-1.001	+0.003
7	-0.007	-1.000	+0.006	-0.006	-1.000	+0.005	-0.004	-1.000	+0.004
8	+0.009	-0.988	-0.147	+0.011	-0.988	-0.144	+0.014	-0.989	-0.142
9	+0.058	-0.951	-0.298	+0.063	-0.954	-0.291	+0.068	-0.957	-0.285
10	+0.057	-0.948	+0.308	+0.062	-0.951	+0.300	+0.067	-0.955	+0.290
11	+0.005	-0.983	+0.156	+0.008	-0.985	+0.152	+0.012	-0.986	+0.147
12	-0.013	-0.995	+0.003	-0.011	-0.995	+0.002	-0.007	-0.997	+0.002
13	-0.014	-0.994	+0.001	-0.012	-0.995	+0.001	-0.008	-0.997	+0.001
14	-0.014	-0.994	0	-0.012	-0.995	0	-0.008	-0.996	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

UNIFORM INTERNAL RADIAL LOAD

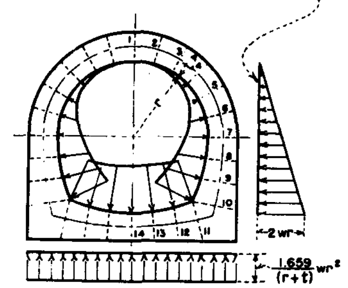
SHAPES A, B, AND C

REV. JULY 9, 1953
REV. JAN. 27, 1955
REV. SEP. 28, 1964

SEP. 8, 1950

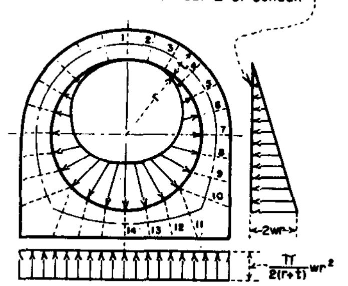
X-PEL-380

SHAPE A



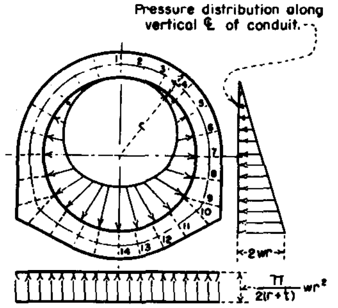
POINT	$t=\frac{r}{2}$ $\frac{M}{wr^3}$	$t=\frac{r}{2}$ $\frac{T}{wr^2}$	$t=\frac{r}{2}$ $\frac{S}{wr^2}$	$t=\frac{r}{3}$ $\frac{M}{wr^3}$	$t=\frac{r}{3}$ $\frac{T}{wr^2}$	$t=\frac{r}{3}$ $\frac{S}{wr^2}$	$t=\frac{r}{6}$ $\frac{M}{wr^3}$	$t=\frac{r}{6}$ $\frac{T}{wr^2}$	$t=\frac{r}{6}$ $\frac{S}{wr^2}$
1	+0.203	-0.577	0	+0.203	-0.588	0	+0.183	-0.591	0
2	+0.179	-0.558	+0.146	+0.180	-0.568	+0.149	+0.161	-0.571	+0.150
3	+0.110	-0.503	+0.265	+0.115	-0.513	+0.271	+0.100	-0.515	+0.272
4	+0.011	-0.423	+0.332	+0.020	-0.431	+0.340	+0.012	-0.433	+0.342
5	-0.100	-0.335	+0.329	-0.086	-0.341	+0.338	-0.087	-0.342	+0.340
6	-0.195	-0.258	+0.244	-0.178	-0.261	+0.255	-0.173	-0.262	+0.257
7	-0.250	-0.215	+0.077	-0.233	-0.215	+0.088	-0.225	-0.215	+0.091
8	-0.232	-0.207	-0.231	-0.218	-0.206	-0.220	-0.209	-0.206	-0.217
9	-0.120	-0.189	-0.616	-0.107	-0.188	-0.605	-0.098	-0.190	-0.602
10	+0.102	-0.154	-1.075	+0.115	-0.156	-1.064	+0.127	-0.159	-1.061
11	+0.209	-1.169	+0.314	+0.217	-1.140	+0.221	+0.214	-1.115	+0.101
12	+0.140	-1.309	+0.228	+0.167	-1.290	+0.166	+0.190	-1.277	+0.086
13	+0.095	-1.394	+0.120	+0.133	-1.381	+0.089	+0.172	-1.376	+0.049
14	+0.079	-1.423	0	+0.121	-1.412	0	+0.165	-1.409	0

SHAPE B



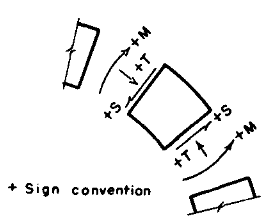
POINT	$t=\frac{r}{2}$ $\frac{M}{wr^3}$	$t=\frac{r}{2}$ $\frac{T}{wr^2}$	$t=\frac{r}{2}$ $\frac{S}{wr^2}$	$t=\frac{r}{3}$ $\frac{M}{wr^3}$	$t=\frac{r}{3}$ $\frac{T}{wr^2}$	$t=\frac{r}{3}$ $\frac{S}{wr^2}$	$t=\frac{r}{6}$ $\frac{M}{wr^3}$	$t=\frac{r}{6}$ $\frac{T}{wr^2}$	$t=\frac{r}{6}$ $\frac{S}{wr^2}$
1	+0.191	-0.538	0	+0.177	-0.549	0	+0.165	-0.555	0
2	+0.169	-0.520	+0.136	+0.156	-0.530	+0.139	+0.145	-0.536	+0.141
3	+0.105	-0.469	+0.246	+0.095	-0.478	+0.251	+0.088	-0.483	+0.254
4	+0.013	-0.396	+0.305	+0.008	-0.403	+0.312	+0.006	-0.407	+0.316
5	-0.087	-0.316	+0.295	-0.088	-0.321	+0.304	-0.085	-0.324	+0.309
6	-0.171	-0.248	+0.206	-0.170	-0.251	+0.217	-0.162	-0.253	+0.222
7	-0.213	-0.215	+0.038	-0.213	-0.215	+0.049	-0.203	-0.215	+0.055
8	-0.193	-0.203	-0.230	-0.194	-0.202	-0.220	-0.185	-0.202	-0.214
9	-0.104	-0.168	-0.560	-0.104	-0.169	-0.550	-0.094	-0.172	-0.543
10	+0.054	-0.100	-0.940	+0.058	-0.106	-0.929	+0.074	-0.115	-0.922
11	+0.133	-0.971	-0.012	+0.136	-0.937	-0.083	+0.146	-0.901	-0.171
12	+0.157	-1.241	+0.019	+0.166	-1.221	-0.028	+0.187	-1.202	-0.087
13	+0.166	-1.406	+0.018	+0.180	-1.393	-0.006	+0.208	-1.384	-0.035
14	+0.168	-1.462	0	+0.183	-1.451	0	+0.214	-1.445	0

SHAPE C



POINT	$t=\frac{r}{2}$ $\frac{M}{wr^3}$	$t=\frac{r}{2}$ $\frac{T}{wr^2}$	$t=\frac{r}{2}$ $\frac{S}{wr^2}$	$t=\frac{r}{3}$ $\frac{M}{wr^3}$	$t=\frac{r}{3}$ $\frac{T}{wr^2}$	$t=\frac{r}{3}$ $\frac{S}{wr^2}$	$t=\frac{r}{6}$ $\frac{M}{wr^3}$	$t=\frac{r}{6}$ $\frac{T}{wr^2}$	$t=\frac{r}{6}$ $\frac{S}{wr^2}$
1	+0.188	-0.536	0	+0.177	-0.551	0	+0.175	-0.570	0
2	+0.166	-0.518	+0.136	+0.155	-0.532	+0.140	+0.154	-0.550	+0.144
3	+0.102	-0.468	+0.245	+0.094	-0.480	+0.252	+0.096	-0.496	+0.262
4	+0.011	-0.395	+0.303	+0.006	-0.405	+0.313	+0.011	-0.418	+0.327
5	-0.089	-0.315	+0.293	-0.090	-0.322	+0.306	-0.083	-0.331	+0.322
6	-0.173	-0.248	+0.205	-0.172	-0.252	+0.218	-0.164	-0.256	+0.237
7	-0.214	-0.215	+0.036	-0.215	-0.215	+0.051	-0.209	-0.215	+0.070
8	-0.190	-0.202	-0.250	-0.194	-0.201	-0.236	-0.192	-0.200	-0.216
9	-0.087	-0.164	-0.606	-0.092	-0.165	-0.591	-0.092	-0.165	-0.571
10	-0.053	-0.630	-0.229	-0.060	-0.591	-0.256	-0.066	-0.541	-0.285
11	+0.001	-0.963	-0.312	+0.002	-0.939	-0.324	+0.006	-0.909	-0.337
12	+0.080	-1.204	-0.405	+0.087	-1.191	-0.398	+0.097	-1.174	-0.390
13	+0.145	-1.395	-0.230	+0.154	-1.381	-0.227	+0.166	-1.363	-0.222
14	+0.169	-1.464	0	+0.178	-1.449	0	+0.191	-1.430	0

NOTE: w represents the weight per unit volume of water in units consistent with those of the radius r.



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

TRIANGULAR INTERNAL RADIAL LOAD – UNIFORM FOUNDATION REACTION

SHAPES A, B, AND C

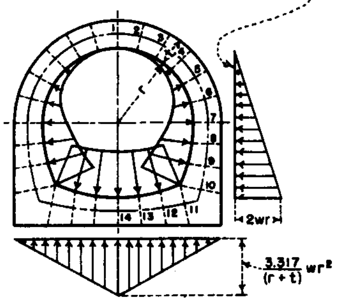
REV. JULY 9, 1953 – JAN. 26, 1954
REV. SEP. 28, 1964

SEP. 8, 1950

X-PEL-381

SHAPE A

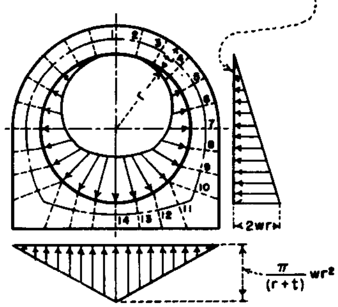
Pressure distribution along vertical ℄ of conduit



POINT	$t=\frac{r}{2}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t=\frac{r}{3}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t=\frac{r}{6}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.281	-0.687	0	+0.266	-0.691	0	+0.239	-0.693	0
2	+0.252	-0.664	+0.175	+0.239	-0.667	+0.176	+0.214	-0.669	+0.176
3	+0.169	-0.598	+0.320	+0.162	-0.601	+0.322	+0.142	-0.603	+0.323
4	+0.048	-0.501	+0.410	+0.048	-0.504	+0.413	+0.036	-0.505	+0.414
5	-0.090	-0.390	+0.424	-0.083	-0.392	+0.427	-0.085	-0.393	+0.429
6	-0.220	-0.287	+0.350	-0.204	-0.288	+0.354	-0.199	-0.288	+0.355
7	-0.310	-0.215	+0.187	-0.290	-0.215	+0.191	-0.278	-0.215	+0.193
8	-0.325	-0.199	-0.121	-0.304	-0.199	-0.117	-0.293	-0.199	-0.115
9	-0.245	-0.174	-0.508	-0.224	-0.175	-0.503	-0.210	-0.176	-0.501
10	-0.055	-0.132	-0.967	-0.031	-0.135	-0.963	-0.014	-0.138	-0.961
11	+0.171	-0.986	-0.040	+0.149	-0.970	-0.103	+0.114	-0.954	-0.169
12	+0.218	-1.147	-0.158	+0.212	-1.133	-0.229	+0.195	-1.120	-0.311
13	+0.271	-1.266	-0.148	+0.281	-1.259	-0.196	+0.282	-1.253	-0.257
14	+0.297	-1.313	0	+0.314	-1.309	0	+0.324	-1.307	0

SHAPE B

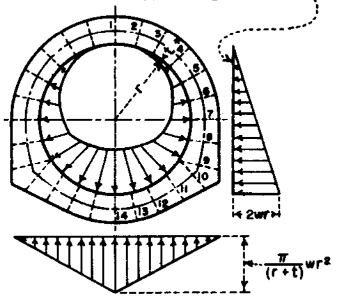
Pressure distribution along vertical ℄ of conduit



POINT	$t=\frac{r}{2}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t=\frac{r}{3}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t=\frac{r}{6}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.259	-0.645	0	+0.237	-0.654	0	+0.219	-0.660	0
2	+0.232	-0.623	+0.164	+0.211	-0.632	+0.166	+0.195	-0.637	+0.168
3	+0.155	-0.561	+0.299	+0.138	-0.570	+0.304	+0.127	-0.574	+0.307
4	+0.042	-0.471	+0.380	+0.031	-0.478	+0.387	+0.026	-0.482	+0.391
5	-0.086	-0.369	+0.387	-0.091	-0.374	+0.396	-0.088	-0.376	+0.400
6	-0.202	-0.276	+0.309	-0.202	-0.278	+0.319	-0.192	-0.280	+0.324
7	-0.279	-0.215	+0.145	-0.277	-0.215	+0.154	-0.263	-0.215	+0.160
8	-0.289	-0.191	-0.125	-0.288	-0.190	-0.115	-0.273	-0.190	-0.109
9	-0.230	-0.144	-0.457	-0.227	-0.145	-0.447	-0.210	-0.147	-0.441
10	-0.102	-0.064	-0.840	-0.092	-0.070	-0.830	-0.069	-0.078	-0.824
11	+0.106	-0.752	-0.309	+0.076	-0.725	-0.355	+0.059	-0.699	-0.404
12	+0.231	-1.051	-0.332	+0.204	-1.027	-0.383	+0.192	-1.005	-0.443
13	+0.324	-1.271	-0.230	+0.304	-1.256	-0.266	+0.300	-1.245	-0.309
14	+0.362	-1.355	0	+0.345	-1.346	0	+0.346	-1.340	0

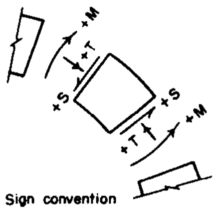
SHAPE C

Pressure distribution along vertical ℄ of conduit



POINT	$t=\frac{r}{2}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t=\frac{r}{3}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t=\frac{r}{6}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.265	-0.654	0	+0.241	-0.660	0	+0.234	-0.677	0
2	+0.237	-0.632	+0.166	+0.215	-0.638	+0.168	+0.209	-0.655	+0.172
3	+0.159	-0.570	+0.304	+0.141	-0.575	+0.307	+0.139	-0.590	+0.315
4	+0.045	-0.478	+0.387	+0.033	-0.482	+0.391	+0.035	-0.494	+0.403
5	-0.086	-0.374	+0.395	-0.090	-0.377	+0.401	-0.083	-0.385	+0.416
6	-0.205	-0.278	+0.318	-0.203	-0.280	+0.324	-0.192	-0.284	+0.341
7	-0.284	-0.215	+0.154	-0.279	-0.215	+0.160	-0.268	-0.215	+0.177
8	-0.296	-0.188	-0.134	-0.291	-0.187	-0.127	-0.282	-0.186	-0.109
9	-0.229	-0.135	-0.492	-0.221	-0.138	-0.484	-0.212	-0.137	-0.467
10	-0.151	-0.416	-0.298	-0.163	-0.402	-0.305	-0.175	-0.380	-0.305
11	-0.017	-0.667	-0.545	-0.031	-0.652	-0.555	-0.047	-0.627	-0.561
12	+0.149	-0.925	-0.699	+0.139	-0.920	-0.697	+0.126	-0.904	-0.689
13	+0.288	-1.216	-0.474	+0.278	-1.210	-0.472	+0.264	-1.194	-0.469
14	+0.344	-1.346	0	+0.335	-1.340	0	+0.321	-1.323	0

NOTE: w represents the weight per unit volume of water in units consistent with those of the radius r.



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

TRIANGULAR INTERNAL RADIAL LOAD - TRIANGULAR FOUNDATION REACTION

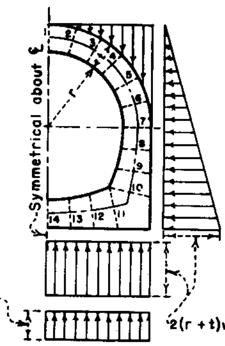
SHAPES A, B, AND C

SEP. 28, 1964

X-PEL-1038

SHAPE A

Dead weight of one-half of conduit
$t = \frac{r}{2}$, 5.670 wr^2
$t = \frac{r}{3}$, 3.643 wr^2
$t = \frac{r}{6}$, 1.855 wr^2

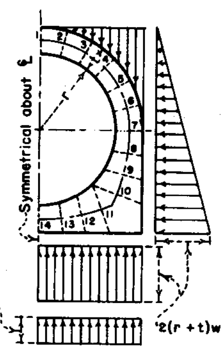


$t = \frac{r}{2}$, 1.102 wr
$t = \frac{r}{3}$, 0.352 wr
* $t = \frac{r}{6}$, −0.493 wr

POINT	$t = \frac{r}{2}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t = \frac{r}{3}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	* $t = \frac{r}{6}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.116	+1.131	0	-0.007	+0.905	0	-0.078	+0.713	0
2	+0.101	+1.194	+0.094	-0.008	+0.937	+0.008	-0.068	+0.719	-0.071
3	+0.060	+1.380	+0.168	-0.010	+1.034	+0.013	-0.039	+0.735	-0.128
4	+0.001	+1.668	+0.206	-0.013	+1.186	+0.014	+0.003	+0.766	-0.160
5	-0.060	+2.033	+0.193	-0.016	+1.383	+0.010	+0.049	+0.814	-0.157
6	-0.107	+2.438	+0.122	-0.016	+1.610	+0.000	+0.089	+0.882	-0.115
7	-0.122	+2.843	-0.006	-0.012	+1.850	-0.016	+0.111	+0.974	-0.033
8	-0.159	+3.235	+0.305	-0.048	+2.115	+0.297	+0.078	+1.116	+0.278
9	-0.283	+3.722	+0.663	-0.177	+2.471	+0.665	-0.049	+1.345	+0.655
10	-0.497	+4.351	+1.056	-0.404	+2.964	+1.078	-0.284	+1.705	+1.086
11	-0.290	+3.839	-2.002	-0.339	+2.990	-1.390	-0.308	+2.206	-0.737
12	+0.148	+3.583	-1.384	-0.027	+2.807	-0.974	-0.158	+2.102	-0.538
13	+0.426	+3.423	-0.707	+0.173	+2.691	-0.502	-0.024	+2.033	-0.283
14	+0.522	+3.369	0	+0.242	+2.651	0	-0.070	+2.009	0

SHAPE B

Dead weight of one-half of conduit
$t = \frac{r}{2}$, 5.881 wr^2
$t = \frac{r}{3}$, 3.854 wr^2
$t = \frac{r}{6}$, 2.066 wr^2

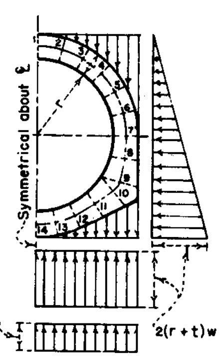


$t = \frac{r}{2}$, 1.243 wr
$t = \frac{r}{3}$, 0.510 wr
* $t = \frac{r}{6}$, −0.312 wr

POINT	$t = \frac{r}{2}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t = \frac{r}{3}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	* $t = \frac{r}{6}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.128	+1.065	0	+0.012	+0.852	0	-0.064	+0.667	0
2	+0.110	+1.131	+0.111	+0.009	+0.886	+0.021	-0.056	+0.674	-0.059
3	+0.061	+1.322	+0.201	+0.001	+0.988	+0.039	-0.032	+0.695	-0.105
4	-0.011	+1.622	+0.252	-0.012	+1.148	+0.052	+0.002	+0.733	-0.127
5	-0.089	+2.000	+0.250	-0.028	+1.356	+0.056	+0.038	+0.790	-0.117
6	-0.156	+2.421	+0.186	-0.042	+1.596	+0.052	+0.065	+0.870	-0.070
7	-0.192	+2.843	+0.060	-0.054	+1.850	+0.037	+0.075	+0.974	+0.014
8	-0.221	+3.244	+0.221	-0.086	+2.125	+0.236	+0.042	+1.128	+0.248
9	-0.271	+3.791	+0.389	-0.161	+2.540	+0.458	-0.050	+1.419	+0.521
10	-0.313	+4.560	+0.535	-0.258	+3.172	+0.673	-0.193	+1.920	+0.801
11	-0.136	+4.217	-1.602	-0.192	+3.257	-1.022	-0.203	+2.365	-0.434
12	+0.112	+3.792	-1.147	-0.025	+2.961	-0.756	-0.131	+2.207	-0.360
13	+0.296	+3.526	-0.598	+0.102	+2.770	-0.401	-0.066	+2.095	-0.202
14	+0.363	+3.435	0	+0.149	+2.704	0	-0.042	+2.055	0

SHAPE C

Dead weight of one-half of conduit
$t = \frac{r}{2}$, 5.069 wr^2
$t = \frac{r}{3}$, 3.213 wr^2
$t = \frac{r}{6}$, 1.575 wr^2

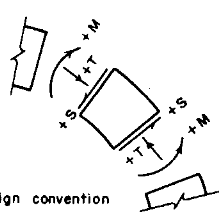


$t = \frac{r}{2}$, 0.926 wr
$t = \frac{r}{3}$, 0.229 wr
* $t = \frac{r}{6}$, −0.558 wr

POINT	$t = \frac{r}{2}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t = \frac{r}{3}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	* $t = \frac{r}{6}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.096	+1.087	0	+0.014	+0.861	0	-0.080	+0.696	0
2	+0.080	+1.152	+0.105	+0.011	+0.896	+0.019	-0.070	+0.702	-0.066
3	+0.033	+1.342	+0.190	+0.004	+0.996	+0.035	-0.043	+0.721	-0.119
4	-0.034	+1.637	+0.236	-0.007	+1.155	+0.045	-0.004	+0.754	-0.148
5	-0.107	+2.011	+0.230	-0.020	+1.361	+0.048	+0.038	+0.805	-0.142
6	-0.167	+2.426	+0.164	-0.032	+1.599	+0.042	+0.073	+0.877	-0.098
7	-0.195	+2.843	+0.038	-0.041	+1.850	+0.028	+0.090	+0.974	-0.015
8	-0.219	+3.271	+0.205	-0.073	+2.145	+0.237	+0.063	+1.138	+0.233
9	-0.265	+3.870	+0.380	-0.151	+2.605	+0.470	-0.031	+1.462	+0.523
10	-0.198	+3.764	-1.130	-0.133	+2.698	-0.607	-0.039	+1.698	-0.136
11	+0.001	+3.571	-0.802	-0.023	+2.637	-0.384	-0.019	+1.771	-0.015
12	+0.135	+3.490	-0.382	+0.035	+2.649	-0.091	-0.035	+1.877	+0.151
13	+0.200	+3.435	-0.217	+0.052	+2.683	-0.052	-0.062	+1.987	+0.086
14	+0.223	+3.413	0	+0.058	+2.694	0	-0.072	+2.026	0

NOTES: w represents the weight per unit volume of water in units consistent with those of the radius r
The assumed weight per unit volume of the conduit is 150w/62.4.

* Tension is assumed to develop at the foundation. For the assumption that the conduits float see Figure 49.



+ Sign convention

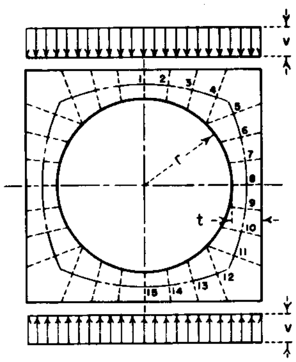
SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
TRIANGULAR EXTERNAL HYDROSTATIC LOAD INCLUDING DEAD LOAD
SHAPES A, B, AND C

REV. APR. 15, 1968

SEP. 28, 1964

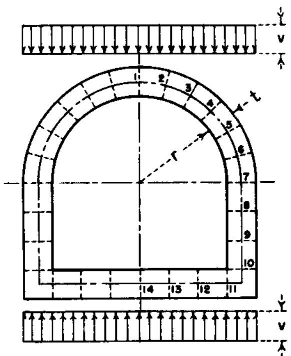
X-PEL-1039

SHAPE D



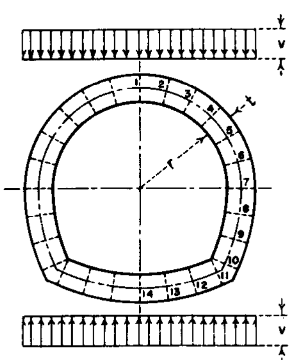
	$t = \frac{r}{2}$			$t = \frac{r}{3}$			$t = \frac{r}{6}$		
POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.393	0	0	+0.348	0	0	+0.302	0	0
2	+0.352	+0.036	+0.316	+0.310	+0.035	+0.299	+0.265	+0.034	+0.280
3	+0.232	+0.146	+0.628	+0.196	+0.142	+0.593	+0.158	+0.138	+0.556
4	+0.043	+0 332	+0 932	+0.017	+0.324	+0.880	-0.010	+0.315	+0 824
5	-0 137	+1.413	+0 503	-0.123	+1.251	+0.460	-0.111	+1.090	+0.416
6	-0.259	+1.461	+0.339	-0.231	+1.297	+0.310	-0.205	+1.132	+0.281
7	-0.332	+1.490	+0 171	-0.296	+1.324	+0.156	-0.262	+1.158	+0.141
8	-0.357	+1.500	0	-0.318	+1.333	0	-0.282	+1.167	0
9	-0.332	+1 490	-0.171	-0.296	+1.324	-0.156	-0.262	+1.158	-0.141
10	-0.259	+1 461	-0.339	-0.231	+1.297	-0.310	-0.205	+1.132	-0.281
11	-0.137	+1.413	-0.503	-0.123	+1.251	-0.460	-0.111	+1.090	-0.416
12	+0.043	+0.332	-0.932	+0.017	+0.324	-0.880	-0.010	+0.315	-0.824
13	+0.232	+0.146	-0.628	+0.196	+0.142	-0.593	+0.158	+0.138	-0.556
14	+0.352	+0.036	-0 316	+0.310	+0.035	-0.299	+0.265	+0.034	-0.280
15	+0.393	0	0	+0.348	0	0	+0.302	0	0

SHAPE E

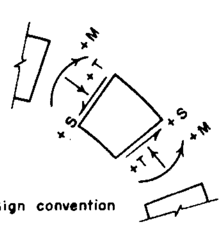


POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.353	+0.066	0	+0.317	+0.060	0	+0.279	+0.054	0
2	+0.306	+0.165	+0.358	+0.275	+0.147	+0.318	+0.242	+0.131	+0.278
3	+0.177	+0.433	+0.616	+0.160	+0.385	+0.547	+0.141	+0.339	+0.478
4	+0.003	+0.797	+0.703	+0.004	+0.709	+0.624	+0.005	+0.622	+0.545
5	-0.168	+1.158	+0.592	-0.148	+1.030	+0.525	-0.129	+0.902	+0.458
6	-0.285	+1.417	+0.311	-0.253	+1.260	+0 275	-0.221	+1.103	+0.239
7	-0.314	+1.500	-0 066	-0.280	+1.333	-0.060	-0.245	+1.167	-0.054
8	-0.292	+1.500	-0.066	-0.260	+1.333	-0.060	-0.227	+1.167	-0.054
9	-0.269	+1.500	-0.066	-0.240	+1.333	-0.060	-0.209	+1.167	-0.054
10	-0.247	+1.500	-0.066	-0.220	+1.333	-0.060	-0.191	+1.167	-0.054
11	+0.019	-0.066	-1.000	-0.043	-0.060	-1.000	-0.103	-0.054	-1.000
12	+0.297	-0.066	-0.667	+0.235	-0.060	-0.667	+0.175	-0.054	-0.667
13	+0.464	-0.066	-0.333	+0.401	-0.060	-0.333	+0.341	-0.054	-0.333
14	+0.519	-0.066	0	+0.457	-0.060	0	+0.397	-0.054	0

SHAPE F



POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.371	+0.019	0	+0.331	+0.018	0	+0.290	+0.017	0
2	+0.322	+0.119	+0.370	+0.287	+0.107	+0.329	+0.251	+0.095	+0.287
3	+0.187	+0.391	+0.640	+0.167	+0.349	+0.568	+0.146	+0.306	+0.497
4	+0.003	+0.763	+0.737	+0.003	+0.679	+0.654	+0.003	+0.595	+0.571
5	-0.180	+1.135	+0.633	-0.159	+1.009	+0.562	-0.139	+0.884	+0.490
6	-0.311	+1.404	+0.357	-0.276	+1.249	+0.316	-0.241	+1.093	+0.275
7	-0.355	+1.500	-0.019	-0.315	+1.333	-0.018	-0.275	+1.167	-0.017
8	-0.322	+1.458	-0.227	-0.285	+1.294	-0.202	-0.248	+1.131	-0.178
9	-0.238	+1.340	-0.409	-0.209	+1.186	-0.363	-0.180	+1.033	-0.318
10	-0.114	+1.158	-0.543	-0.096	+1.020	-0.480	-0.078	+0.881	-0.417
11	-0.008	+0.406	-0.945	-0.026	+0.379	-0.882	-0.043	+0.351	-0.820
12	+0.222	+0.176	-0.675	+0.189	+0.164	-0.630	+0.156	+0.152	-0.585
13	+0.369	+0.031	-0.351	+0.326	+0.029	-0.328	+0.283	+0.026	-0.305
14	+0.419	-0.019	0	+0.372	-0.017	0	+0.326	-0.017	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

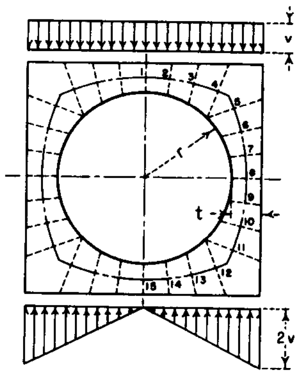
UNIFORM VERTICAL LOAD – UNIFORM FOUNDATION REACTION

SHAPES D, E, AND F

SEP. 28, 1964

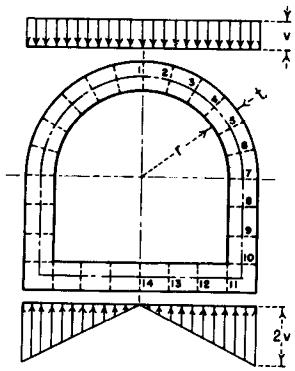
X-PEL-1040

SHAPE D



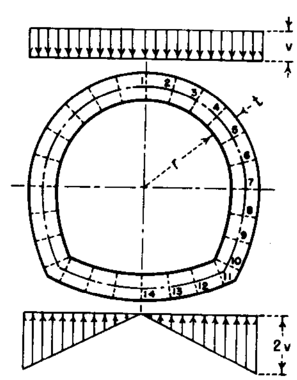
POINT	$t = \frac{r}{2}$ $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{3}$ $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{6}$ $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.333	+0.108	0	+0.300	+0.096	0	+0.255	+0.086	0
2	+0.294	+0.143	+0.304	+0.262	+0.131	+0.287	+0.220	+0.120	+0.270
3	+0.180	+0.251	+0.604	+0.154	+0.236	+0.571	+0.118	+0.222	+0.536
4	-0.001	+0.433	+0.896	-0.018	+0.414	+0.847	-0.044	+0.395	+0.794
5	-0.154	+1.449	+0.401	-0.139	+1.285	+0.370	-0.132	+1.121	+0.335
6	-0.245	+1.486	+0.234	-0.221	+1.319	+0.217	-0.204	+1.153	+0.197
7	-0.288	+1.503	+0.064	-0.260	+1.335	+0.061	-0.239	+1.169	+0.056
8	-0.282	+1.500	-0.108	-0.255	+1.333	-0.096	-0.234	+1.167	-0.086
9	-0.226	+1.478	-0.278	-0.206	+1.313	-0.252	-0.192	+1.148	-0.227
10	-0.122	+1.437	-0.444	-0.114	+1.274	-0.404	-0.112	+1.112	-0.365
11	+0.029	+1.377	-0.604	+0.020	+1.218	-0.551	+0.005	+1.059	-0.497
12	+0.089	+0.117	-0.651	+0.084	+0.137	-0.652	+0.065	+0.157	-0.654
13	+0.181	-0.042	-0.294	+0.181	-0.029	-0.294	+0.167	-0.016	-0.294
14	+0.221	-0.099	-0.079	+0.221	-0.088	-0.079	+0.209	-0.077	-0.078
15	+0.228	-0.108	0	+0.228	-0.096	0	+0.216	-0.086	0

SHAPE E

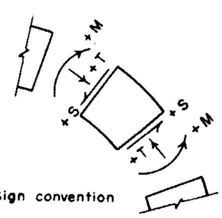


POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.309	+0.142	0	+0.288	+0.123	0	+0.258	+0.101	0
2	+0.265	+0.237	+0.338	+0.248	+0.208	+0.302	+0.223	+0.176	+0.265
3	+0.145	+0.498	+0.579	+0.140	+0.440	+0.516	+0.127	+0.380	+0.454
4	-0.014	+0.850	+0.650	-0.004	+0.754	+0.580	-0.001	+0.655	+0.512
5	-0.165	+1.196	+0.527	-0.141	+1.062	+0.471	-0.124	+0.926	+0.417
6	-0.259	+1.436	+0.238	-0.228	+1.276	+0.215	-0.205	+1.115	+0.194
7	-0.264	+1.500	-0.142	-0.236	+1.333	-0.123	-0.215	+1.167	-0.101
8	-0.217	+1.500	-0.142	-0.195	+1.333	-0.123	-0.181	+1.167	-0.101
9	-0.169	+1.500	-0.142	-0.154	+1.333	-0.123	-0.148	+1.167	-0.101
10	-0.122	+1.500	-0.142	-0.113	+1.333	-0.123	-0.114	+1.167	-0.101
11	+0.066	-0.142	-0.667	+0.028	-0.123	-0.750	-0.035	-0.101	-0.857
12	+0.223	-0.142	-0.296	+0.204	-0.123	-0.333	+0.167	-0.101	-0.381
13	+0.280	-0.142	-0.074	+0.269	-0.123	-0.083	+0.241	-0.101	-0.095
14	+0.288	-0.142	0	+0.278	-0.123	0	+0.251	-0.101	0

SHAPE F



POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.327	+0.116	0	+0.290	+0.097	0	+0.259	+0.078	0
2	+0.282	+0.212	+0.345	+0.250	+0.183	+0.308	+0.223	+0.153	+0.272
3	+0.159	+0.475	+0.592	+0.139	+0.417	+0.529	+0.125	+0.359	+0.466
4	-0.006	+0.832	+0.668	-0.010	+0.735	+0.598	-0.008	+0.638	+0.528
5	-0.163	+1.183	+0.549	-0.153	+1.048	+0.493	-0.136	+0.914	+0.438
6	-0.266	+1.429	+0.263	-0.248	+1.269	+0.240	-0.223	+1.109	+0.216
7	-0.278	+1.500	-0.116	-0.263	+1.333	-0.097	-0.240	+1.167	-0.078
8	-0.221	+1.420	-0.319	-0.213	+1.261	-0.277	-0.197	+1.102	-0.235
9	-0.128	+1.224	-0.476	-0.127	+1.082	-0.415	-0.119	+0.940	-0.354
10	-0.013	+0.946	-0.554	-0.019	+0.828	-0.480	-0.019	+0.710	-0.406
11	+0.049	+0.185	-0.690	+0.028	+0.196	-0.670	+0.008	+0.209	-0.653
12	+0.178	-0.021	-0.344	+0.158	-0.004	-0.332	+0.139	+0.012	-0.322
13	+0.232	-0.103	-0.098	+0.211	-0.084	-0.094	+0.192	-0.066	-0.090
14	+0.241	-0.116	0	+0.220	-0.097	0	+0.201	-0.078	0



+ Sign convention

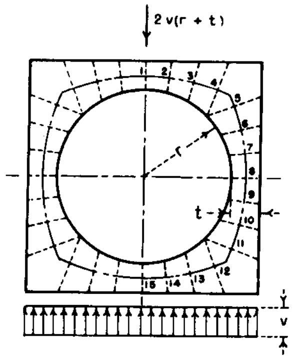
SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
UNIFORM VERTICAL LOAD – TRIANGULAR FOUNDATION REACTION

SHAPES D, E, AND F

SEP. 28, 1964

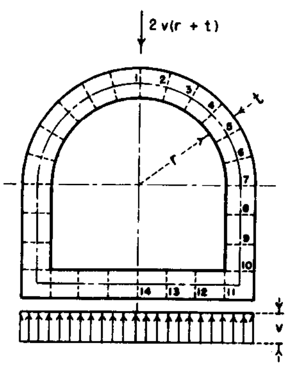
X-PEL-1041

SHAPE D



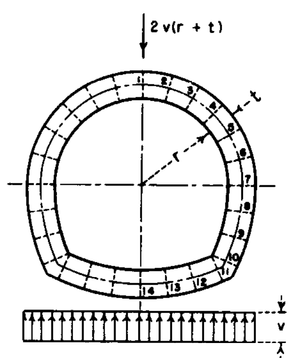
POINT	t = r/2: $\frac{M}{vr^2}$	t = r/2: $\frac{T}{vr}$	t = r/2: $\frac{S}{vr}$	t = r/3: $\frac{M}{vr^2}$	t = r/3: $\frac{T}{vr}$	t = r/3: $\frac{S}{vr}$	t = r/6: $\frac{M}{vr^2}$	t = r/6: $\frac{T}{vr}$	t = r/6: $\frac{S}{vr}$
1	+1.037	+0.249	+1.500	+0.841	+0.221	+1.333	+0.652	+0.200	+1.167
2	+0.610	+0.418	+1.462	+0.473	+0.376	+1.298	+0.340	+0.340	+1.134
3	+0.196	+0.581	+1.405	+0.116	+0.526	+1.245	+0.039	+0.475	+1.084
4	-0.199	+0.737	+1.330	-0.223	+0.668	+1.175	-0.246	+0.603	+1.019
5	-0.518	+1.497	+0.269	-0.443	+1.328	+0.253	-0.384	+1.161	+0.229
6	-0.571	+1.517	+0.097	-0.492	+1.348	+0.095	-0.426	+1.181	+0.086
7	-0.574	+1.519	-0.076	-0.496	+1.350	-0.063	-0.430	+1.182	-0.057
8	-0.527	+1.500	-0.249	-0.456	+1.333	-0.221	-0.395	+1.167	-0.200
9	-0.431	+1.462	-0.418	-0.373	+1.298	-0.376	-0.322	+1.134	-0.340
10	-0.287	+1.405	-0.581	-0.246	+1.245	-0.526	-0.212	+1.084	-0.475
11	-0.097	+1.330	-0.737	-0.079	+1.175	-0.668	-0.065	+1.019	-0.603
12	+0.147	+0.097	-1.015	+0.105	+0.116	-0.956	+0.064	+0.127	-0.896
13	+0.357	-0.097	-0.684	+0.302	-0.073	-0.645	+0.249	-0.056	-0.605
14	+0.489	-0.211	-0.344	+0.426	-0.184	-0.325	+0.365	-0.165	-0.305
15	+0.534	-0.249	0	+0.468	-0.221	0	+0.405	-0.200	0

SHAPE E

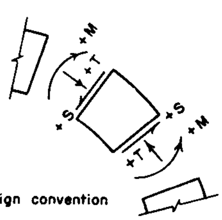


POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.062	+0.261	+1.500	+0.884	+0.225	+1.333	+0.723	+0.186	+1.167
2	+0.588	+0.640	+1.381	+0.490	+0.562	+1.230	+0.403	+0.481	+1.079
3	+0.168	+0.976	+1.169	+0.141	+0.862	+1.042	+0.118	+0.744	+0.917
4	-0.169	+1.245	+0.876	-0.139	+1.102	+0.784	-0.112	+0.956	+0.694
5	-0.399	+1.429	+0.524	-0.332	+1.267	+0.472	-0.271	+1.103	+0.422
6	-0.508	+1.516	+0.136	-0.424	+1.346	+0.128	-0.348	+1.175	+0.122
7	-0.487	+1.500	-0.261	-0.409	+1.333	-0.225	-0.339	+1.167	-0.186
8	-0.400	+1.500	-0.261	-0.334	+1.333	-0.225	-0.277	+1.167	-0.186
9	-0.313	+1.500	-0.261	-0.259	+1.333	-0.225	-0.216	+1.167	-0.186
10	-0.226	+1.500	-0.261	-0.184	+1.333	-0.225	-0.154	+1.167	-0.186
11	+0.089	-0.261	-1.000	+0.020	-0.225	-1.000	-0.055	-0.186	-1.000
12	+0.367	-0.261	-0.667	+0.298	-0.225	-0.667	+0.223	-0.186	-0.667
13	+0.533	-0.261	-0.333	+0.465	-0.225	-0.333	+0.390	-0.186	-0.333
14	+0.589	-0.261	0	+0.520	-0.225	0	+0.445	-0.186	0

SHAPE F



POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.070	+0.228	+1.500	+0.904	+0.190	+1.333	+0.729	+0.158	+1.167
2	+0.594	+0.608	+1.390	+0.508	+0.529	+1.239	+0.408	+0.454	+1.086
3	+0.171	+0.947	+1.185	+0.155	+0.831	+1.060	+0.120	+0.720	+0.932
4	-0.172	+1.222	+0.900	-0.132	+1.077	+0.809	-0.115	+0.936	+0.714
5	-0.412	+1.413	+0.553	-0.333	+1.250	+0.502	-0.280	+1.089	+0.447
6	-0.530	+1.508	+0.168	-0.435	+1.337	+0.162	-0.365	+1.168	+0.150
7	-0.520	+1.500	-0.228	-0.430	+1.333	-0.190	-0.364	+1.167	-0.158
8	-0.421	+1.428	-0.433	-0.348	+1.270	-0.373	-0.296	+1.111	-0.317
9	-0.272	+1.282	-0.609	-0.220	+1.139	-0.528	-0.187	+0.994	-0.453
10	-0.086	+1.072	-0.734	-0.058	+0.949	-0.637	-0.047	+0.824	-0.545
11	+0.046	+0.216	-1.031	+0.026	+0.222	-0.953	-0.006	+0.223	-0.877
12	+0.299	-0.024	-0.733	+0.260	-0.001	-0.678	+0.208	+0.017	-0.624
13	+0.459	-0.176	-0.381	+0.407	-0.142	-0.352	+0.344	-0.113	-0.324
14	+0.514	-0.228	0	+0.458	-0.190	0	+0.390	-0.158	0



+ Sign convention

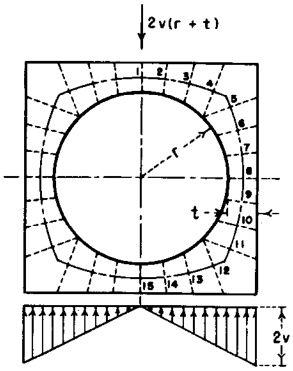
SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
CONCENTRATED VERTICAL LOAD - UNIFORM FOUNDATION REACTION

SHAPES D, E, AND F

SEP. 28, 1964

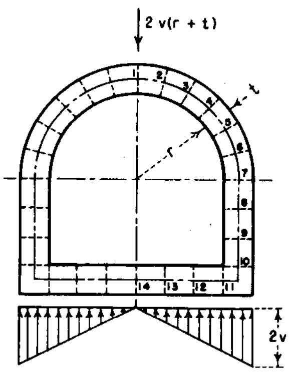
X-PEL-1042

SHAPE D



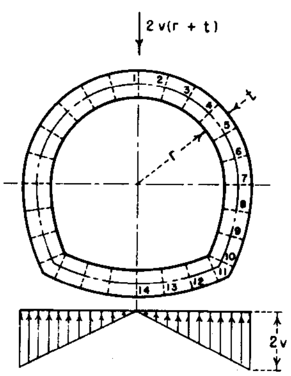
POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$t = \frac{r}{2}$: $\frac{T}{vr}$	$t = \frac{r}{2}$: $\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$t = \frac{r}{3}$: $\frac{T}{vr}$	$t = \frac{r}{3}$: $\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$t = \frac{r}{6}$: $\frac{T}{vr}$	$t = \frac{r}{6}$: $\frac{S}{vr}$
1	+0.977	+0.356	+1.500	+0.792	+0.318	+1.333	+0.605	+0.287	+1.167
2	+0.551	+0.525	+1.450	+0.425	+0.472	+1.287	+0.295	+0.426	+1.123
3	+0.143	+0.686	+1.381	+0.074	+0 619	+1.223	-0.002	+0.559	+1.063
4	-0.243	+0.839	+1.294	-0.258	+0.758	+1 142	-0.280	+0.684	+0.988
5	-0.535	+1.533	+0.167	-0.459	+1.361	+0.162	-0.405	+1.192	+0.148
6	-0.558	+1.542	-0.008	-0 482	+1.371	+0.002	-0.425	+1.201	+0.002
7	-0.530	+1.531	-0.184	-0 460	+1.361	-0.159	-0.406	+1.193	-0.143
8	-0.453	+1.500	-0.356	-0.393	+1.333	-0.318	-0.348	+1.167	-0.287
9	-0.325	+1.450	-0.525	-0.282	+1.287	-0.472	-0.251	+1.123	-0.426
10	-0.151	+1.381	-0.686	-0.130	+1.223	-0.619	-0.118	+1.063	-0.559
11	+0.069	+1.294	-0.839	+0.063	+1.142	-0.758	+0.051	+0.988	-0.684
12	+0.193	-0.117	-0.734	+0.171	-0.070	-0.728	+0.139	-0.030	-0.726
13	+0.305	-0.285	-0.351	+0.286	-0.244	-0.345	+0.257	-0.210	-0.342
14	+0.357	-0.346	-0.108	+0.337	-0.307	-0.105	+0.309	-0.276	-0.103
15	+0.368	-0.356	0	+0.348	-0.318	0	+0.319	-0.287	0

SHAPE E

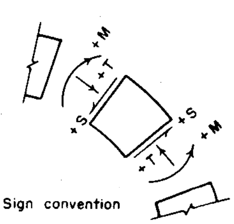


POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.018	+0.336	+1.500	+0.854	+0.288	+1.333	+0.702	+0.233	+1.167
2	+0.547	+0.713	+1.362	+0.463	+0.623	+1.213	+0.383	+0.527	+1.067
3	+0.137	+1.041	+1.131	+0.122	+0.916	+1.011	+0.104	+0.785	+0.894
4	-0.185	+1 298	+0.823	-0.147	+1.147	+0.739	-0.118	+0.990	+0.660
5	-0.396	+1.467	+0.459	-0.325	+1.299	+0.417	-0.266	+1.127	+0.382
6	-0.482	+1.536	+0.063	-0.399	+1.362	+0.067	-0.332	+1.187	+0.077
7	-0.437	+1.500	-0.336	-0.365	+1.333	-0.288	-0.310	+1.167	-0.233
8	-0.325	+1.500	-0.336	-0.269	+1.333	-0.288	-0.232	+1.167	-0.233
9	-0.213	+1.500	-0 336	-0.173	+1.333	-0.288	-0.154	+1.167	-0.233
10	-0.101	+1.500	-0 336	-0.077	+1.333	-0.288	-0.077	+1.167	-0.233
11	+0.136	-0.336	-0.667	+0.091	-0.288	-0.750	+0.013	-0.233	-0.857
12	+0.293	-0.336	-0.296	+0.267	-0.288	-0.333	+0.215	-0.233	-0.381
13	+0.350	-0.336	-0 074	+0.332	-0.288	-0.083	+0.289	-0.233	-0.095
14	+0.358	-0.336	0	+0.341	-0.288	0	+0.299	-0.233	0

SHAPE F



POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.025	+0.325	+1.500	+0.863	+0.269	+1.333	+0.698	+0.219	+1.167
2	+0.554	+0.702	+1.365	+0.471	+0.605	+1.218	+0.379	+0.513	+1.070
3	+0.142	+1.031	+1.137	+0.128	+0.900	+1.020	+0.098	+0.773	+0.901
4	-0.182	+1.290	+0.831	-0.145	+1.133	+0.752	-0.126	+0.980	+0.670
5	-0.395	+1.462	+0.469	-0.327	+1.289	+0.434	-0.278	+1.120	+0.394
6	-0.485	+1.533	+0.074	-0.406	+1.358	+0.085	-0.347	+1.184	+0.09[illegible]
7	-0.443	+1.500	-0.325	-0.378	+1.333	-0.269	-0.329	+1.167	-0.219
8	-0.320	+1.390	-0.526	-0.275	+1.236	-0.448	-0.244	+1.082	-0.375
9	-0.161	+1.166	-0.677	-0.138	+1.034	-0.581	-0.125	+0.900	-0.489
10	+0.016	+0.860	-0.745	+0.019	+0.757	-0.637	+0.013	+0.652	-0.534
11	+0.104	-0.006	-0.777	+0.081	+0.039	-0.741	+0.045	+0.081	-0.711
12	+0.256	-0.222	-0.402	+0.229	-0.170	-0.380	+0.191	-0.123	-0.362
13	+0.324	-0.310	-0.128	+0.293	-0.255	-0.118	+0.253	-0.205	-0.110
14	+0.338	-0.325	0	+0.306	-0.269	0	+0.265	-0.219	0

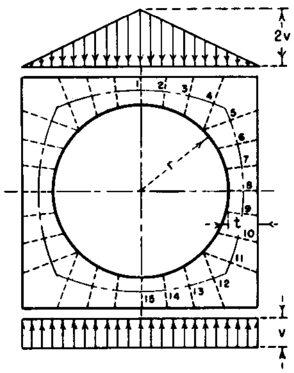


+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
CONCENTRATED VERTICAL LOAD – TRIANGULAR FOUNDATION REACTION
SHAPES D, E, AND F

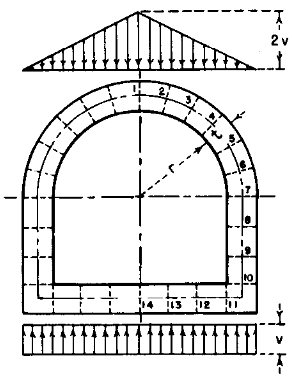
SEP. 28, 1984 X-PEL-1043

SHAPE D



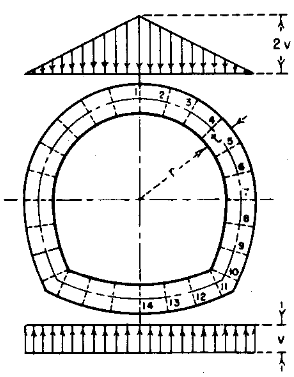
POINT	$t = \frac{r}{2}$			$t = \frac{r}{3}$			$t = \frac{r}{6}$		
	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.551	+0.108	0	+0.465	+0.096	0	+0.386	+0.086	0
2	+0.476	+0.172	+0.553	+0.394	+0.158	+0.519	+0.321	+0.146	+0.482
3	+0.276	+0.334	+0.962	+0.208	+0.313	+0.893	+0.149	+0.292	+0.819
4	-0.010	+0.546	+1.213	-0.054	+0.510	+1.108	-0.087	+0.472	+0.995
5	-0.311	+1.449	+0.401	-0.270	+1.285	+0.370	-0.228	+1.121	+0.335
6	-0.403	+1.486	+0.234	-0.352	+1.319	+0.217	-0.300	+1.153	+0.197
7	-0.446	+1.503	+0.064	-0.391	+1.335	+0.061	-0.334	+1.169	+0.056
8	-0.440	+1.500	-0.108	-0.386	+1.333	-0.096	-0.330	+1.167	-0.086
9	-0.384	+1.478	-0.278	-0.337	+1.313	-0.252	-0.288	+1.148	-0.227
10	-0.280	+1.437	-0.444	-0.245	+1.274	-0.404	-0.207	+1.112	-0.365
11	-0.129	+1.377	-0.604	-0.111	+1.218	-0.551	-0.091	+1.059	-0.497
12	+0.080	+0.230	-0.968	+0.048	+0.233	-0.913	+0.022	+0.234	-0.855
13	+0.277	+0.041	-0.653	+0.235	+0.048	-0.616	+0.198	+0.054	-0.577
14	+0.402	-0.071	-0.328	+0.353	-0.060	-0.310	+0.309	-0.052	-0.291
15	+0.445	-0.108	0	+0.393	-0.096	0	+0.347	-0.086	0

SHAPE E

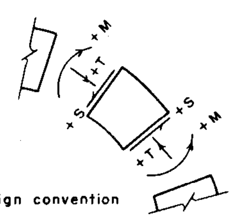


POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.513	+0.166	0	+0.448	+0.144	0	+0.387	+0.121	0
2	+0.426	+0.336	+0.610	+0.371	+0.294	+0.543	+0.320	+0.253	+0.477
3	+0.212	+0.707	+0.891	+0.184	+0.625	+0.794	+0.158	+0.542	+0.698
4	-0.044	+1.087	+0.852	-0.038	+0.964	+0.760	-0.032	+0.839	+0.669
5	-0.265	+1.359	+0.592	-0.227	+1.206	+0.530	-0.191	+1.052	+0.468
6	-0.395	+1.490	+0.227	-0.338	+1.324	+0.206	-0.283	+1.157	+0.185
7	-0.404	+1.500	-0.166	-0.347	+1.333	-0.144	-0.292	+1.167	-0.121
8	-0.349	+1.500	-0.166	-0.299	+1.333	-0.144	-0.252	+1.167	-0.121
9	-0.293	+1.500	-0.166	-0.251	+1.333	-0.144	-0.212	+1.167	-0.121
10	-0.238	+1.500	-0.166	-0.203	+1.333	-0.144	-0.172	+1.167	-0.121
11	+0.054	-0.166	-1.000	-0.012	-0.144	-1.000	-0.078	-0.121	-1.000
12	+0.331	-0.166	-0.667	+0.265	-0.144	-0.667	+0.199	-0.121	-0.667
13	+0.498	-0.166	-0.333	+0.432	-0.144	-0.333	+0.366	-0.121	-0.333
14	+0.554	-0.166	0	+0.488	-0.144	0	+0.422	-0.121	0

SHAPE F



POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.527	+0.124	0	+0.464	+0.105	0	+0.396	+0.087	0
2	+0.439	+0.295	+0.621	+0.385	+0.257	+0.553	+0.327	+0.220	+0.485
3	+0.220	+0.670	+0.912	+0.193	+0.591	+0.814	+0.161	+0.513	+0.714
4	-0.045	+1.058	+0.882	-0.036	+0.936	+0.788	-0.034	+0.815	+0.693
5	-0.276	+1.338	+0.629	-0.234	+1.186	+0.564	-0.201	+1.036	+0.498
6	-0.419	+1.479	+0.268	-0.356	+1.314	+0.244	-0.302	+1.148	+0.218
7	-0.442	+1.500	-0.124	-0.377	+1.333	-0.105	-0.321	+1.167	-0.087
8	-0.376	+1.443	-0.331	-0.320	+1.282	-0.288	-0.273	+1.121	-0.247
9	-0.259	+1.311	-0.510	-0.218	+1.162	-0.447	-0.184	+1.014	-0.385
10	-0.103	+1.114	-0.639	-0.080	+0.984	-0.559	-0.064	+0.853	-0.480
11	+0.015	+0.310	-0.989	-0.003	+0.300	-0.918	-0.026	+0.288	-0.848
12	+0.257	+0.075	-0.704	+0.222	+0.081	-0.654	+0.181	+0.085	-0.605
13	+0.411	-0.073	-0.366	+0.364	-0.057	-0.340	+0.312	-0.043	-0.314
14	+0.463	-0.124	0	+0.412	-0.105	0	+0.357	-0.087	0



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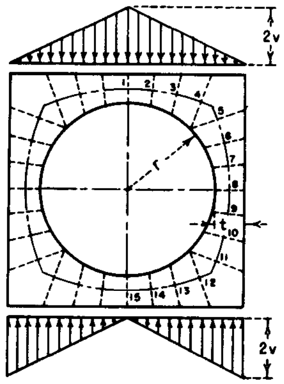
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
TRIANGULAR VERTICAL LOAD – UNIFORM FOUNDATION REACTION
SHAPES D, E, AND F

SEP. 28, 1964 X-PEL-1044

FIGURE 24

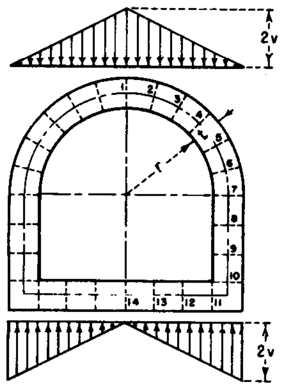
POINT	t = r/2: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	t = r/3: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	t = r/6: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$

SHAPE D



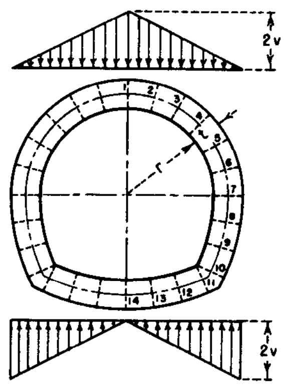
POINT	t = r/2: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	t = r/3: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	t = r/6: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.491	+0.216	0	+0.416	+0.193	0	+0.340	+0.173	0
2	+0.417	+0.279	+0.541	+0.347	+0.254	+0.508	+0.276	+0.232	+0.472
3	+0.223	+0.439	+0.938	+0.165	+0.407	+0.870	+0.109	+0.376	+0.798
4	-0.054	+0.648	+1.177	-0.089	+0.601	+1.074	-0.121	+0.553	+0.964
5	-0.328	+1.485	+0.300	-0.285	+1.318	+0.279	-0.249	+1.152	+0.254
6	-0.390	+1.510	+0.129	-0.342	+1.342	+0.123	-0.299	+1.174	+0.113
7	-0.402	+1.515	-0.044	-0.354	+1.347	-0.035	-0.310	+1.179	-0.030
8	-0.365	+1.500	-0.216	-0.322	+1.333	-0.193	-0.283	+1.167	-0.173
9	-0.278	+1.466	-0.385	-0.246	+1.302	-0.348	-0.217	+1.137	-0.313
10	-0.144	+1.412	-0.549	-0.128	+1.252	-0.498	-0.114	+1.091	-0.448
11	+0.038	+1.341	-0.706	+0.032	+1.185	-0.641	+0.025	+1.028	-0.577
12	+0.125	+0.016	-0.687	+0.115	+0.047	-0.685	+0.098	+0.076	-0.685
13	+0.226	-0.147	-0.319	+0.219	-0.122	-0.316	+0.206	-0.100	-0.315
14	+0.271	-0.206	-0.092	+0.265	-0.184	-0.090	+0.252	-0.163	-0.089
15	+0.279	-0.216	0	+0.273	-0.193	0	+0.261	-0.173	0

SHAPE E

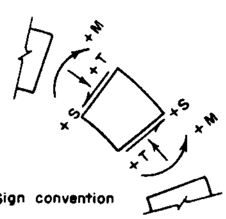


POINT	t = r/2: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	t = r/3: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	t = r/6: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.469	+0.242	0	+0.419	+0.207	0	+0.366	+0.168	0
2	+0.385	+0.408	+0.590	+0.344	+0.355	+0.527	+0.300	+0.298	+0.464
3	+0.181	+0.772	+0.853	+0.164	+0.679	+0.763	+0.143	+0.583	+0.674
4	-0.060	+1.141	+0.799	-0.046	+1.008	+0.716	-0.038	+0.873	+0.636
5	-0.261	+1.397	+0.527	-0.220	+1.237	+0.476	-0.187	+1.076	+0.428
6	-0.369	+1.510	+0.154	-0.313	+1.340	+0.145	-0.267	+1.169	+0.140
7	-0.354	+1.500	-0.242	-0.303	+1.333	-0.207	-0.262	+1.167	-0.168
8	-0.273	+1.500	-0.242	-0.234	+1.333	-0.207	-0.207	+1.167	-0.168
9	-0.193	+1.500	-0.242	-0.165	+1.333	-0.207	-0.151	+1.167	-0.168
10	-0.112	+1.500	-0.242	-0.096	+1.333	-0.207	-0.095	+1.167	-0.168
11	+0.101	-0.242	-0.667	+0.059	-0.207	-0.750	-0.010	-0.168	-0.857
12	+0.257	-0.242	-0.296	+0.235	-0.207	-0.333	+0.191	-0.168	-0.381
13	+0.315	-0.242	-0.074	+0.300	-0.207	-0.083	+0.265	-0.168	-0.095
14	+0.323	-0.242	0	+0.309	-0.207	0	+0.276	-0.168	0

SHAPE F



POINT	t = r/2: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	t = r/3: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	t = r/6: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.483	+0.222	0	+0.424	+0.184	0	+0.365	+0.148	0
2	+0.398	+0.389	+0.596	+0.348	+0.333	+0.533	+0.298	+0.279	+0.470
3	+0.192	+0.754	+0.863	+0.166	+0.659	+0.774	+0.139	+0.566	+0.684
4	-0.054	+1.126	+0.813	-0.049	+0.992	+0.732	-0.045	+0.859	+0.650
5	-0.260	+1.387	+0.545	-0.228	+1.226	+0.495	-0.198	+1.066	+0.445
6	-0.374	+1.505	+0.174	-0.327	+1.334	+0.167	-0.284	+1.164	+0.159
7	-0.365	+1.500	-0.222	-0.324	+1.333	-0.184	-0.285	+1.167	-0.148
8	-0.274	+1.405	-0.424	-0.248	+1.248	-0.363	-0.221	+1.092	-0.305
9	-0.148	+1.194	-0.578	-0.136	+1.057	-0.499	-0.123	+0.920	-0.421
10	-0.001	+0.902	-0.650	-0.003	+0.792	-0.559	-0.005	+0.682	-0.470
11	+0.073	+0.088	-0.734	+0.051	+0.117	-0.706	+0.025	+0.146	-0.682
12	+0.214	-0.122	-0.373	+0.191	-0.088	-0.356	+0.164	-0.055	-0.342
13	+0.275	-0.208	-0.113	+0.250	-0.171	-0.106	+0.221	-0.135	-0.100
14	+0.287	-0.222	0	+0.261	-0.184	0	+0.232	-0.148	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

TRIANGULAR VERTICAL LOAD – TRIANGULAR FOUNDATION REACTION

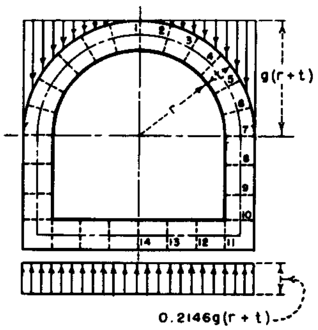
SHAPES D, E, AND F

SEP. 28, 1964

X-PEL-1045

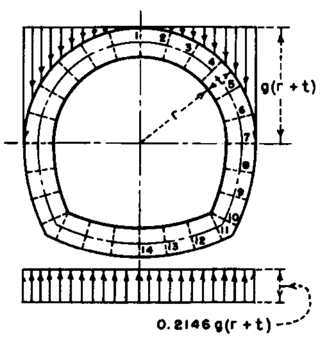
Note: No vertical arch load on Shape D.

SHAPE E



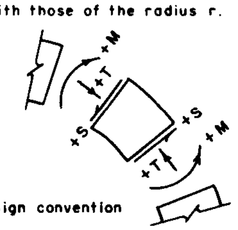
POINT	t = r/2 $\frac{M}{gr^3}$	t = r/2 $\frac{T}{gr^2}$	t = r/2 $\frac{S}{gr^2}$	t = r/3 $\frac{M}{gr^3}$	t = r/3 $\frac{T}{gr^2}$	t = r/3 $\frac{S}{gr^2}$	t = r/6 $\frac{M}{gr^3}$	t = r/6 $\frac{T}{gr^2}$	t = r/6 $\frac{S}{gr^2}$
1	+0.042	-0.038	0	+0.037	-0.027	0	+0.031	-0.017	0
2	+0.040	-0.035	+0.016	+0.036	-0.025	+0.012	+0.030	-0.015	+0.008
3	+0.033	-0.009	+0.062	+0.030	-0.004	+0.047	+0.025	+0.000	+0.034
4	+0.017	+0.075	+0.130	+0.015	+0.062	+0.100	+0.013	+0.050	+0.074
5	-0.007	+0.226	+0.175	-0.007	+0.180	+0.135	-0.007	+0.140	+0.100
6	-0.031	+0.395	+0.146	-0.030	+0.313	+0.112	-0.028	+0.241	+0.082
7	-0.047	+0.483	+0.038	-0.044	+0.382	+0.027	-0.040	+0.292	+0.017
8	-0.059	+0.483	+0.038	-0.053	+0.382	+0.027	-0.045	+0.292	+0.017
9	-0.073	+0.483	+0.038	-0.062	+0.382	+0.027	-0.051	+0.292	+0.017
10	-0.085	+0.483	+0.038	-0.071	+0.382	+0.027	-0.057	+0.292	+0.017
11	-0.015	+0.038	-0.322	-0.028	+0.027	-0.286	-0.037	+0.017	-0.250
12	+0.075	+0.038	-0.215	+0.051	+0.027	-0.191	+0.032	+0.017	-0.167
13	+0.129	+0.038	-0.107	+0.099	+0.027	-0.095	+0.074	+0.017	-0.083
14	+0.146	+0.038	0	+0.115	+0.027	0	+0.088	+0.017	0

SHAPE F



POINT	t = r/2 $\frac{M}{gr^3}$	t = r/2 $\frac{T}{gr^2}$	t = r/2 $\frac{S}{gr^2}$	t = r/3 $\frac{M}{gr^3}$	t = r/3 $\frac{T}{gr^2}$	t = r/3 $\frac{S}{gr^2}$	t = r/6 $\frac{M}{gr^3}$	t = r/6 $\frac{T}{gr^2}$	t = r/6 $\frac{S}{gr^2}$
1	+0.050	-0.057	0	+0.041	-0.041	0	+0.034	-0.028	0
2	+0.048	-0.053	+0.021	+0.039	-0.039	+0.016	+0.033	-0.026	+0.011
3	+0.038	-0.025	+0.071	+0.031	-0.017	+0.054	+0.027	-0.009	+0.039
4	+0.018	+0.062	+0.143	+0.014	+0.052	+0.110	+0.013	+0.042	+0.082
5	-0.011	+0.217	+0.191	-0.012	+0.173	+0.148	-0.010	+0.135	+0.110
6	-0.040	+0.390	+0.164	-0.039	+0.309	+0.126	-0.033	+0.238	+0.092
7	-0.062	+0.483	+0.057	-0.058	+0.382	+0.041	-0.048	+0.292	+0.028
8	-0.071	+0.478	-0.011	-0.063	+0.377	-0.012	-0.051	+0.288	-0.013
9	-0.064	+0.449	-0.071	-0.055	+0.352	-0.059	-0.043	+0.268	-0.049
10	-0.043	+0.399	-0.117	-0.036	+0.311	-0.095	-0.026	+0.234	-0.075
11	-0.017	+0.188	-0.278	-0.020	+0.151	-0.233	-0.019	+0.117	-0.192
12	+0.051	+0.117	-0.200	+0.036	+0.092	-0.167	+0.028	+0.069	-0.138
13	+0.094	+0.072	-0.104	+0.073	+0.054	-0.087	+0.058	+0.038	-0.072
14	+0.108	+0.057	0	+0.085	+0.041	0	+0.068	+0.028	0

NOTE: g represents the weight per unit volume of soil cover on the arch of the conduit section in units consistent with those of the radius r.



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SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
VERTICAL ARCH LOAD - UNIFORM FOUNDATION REACTION
SHAPES D, E, AND F

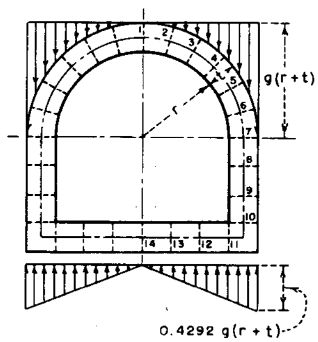
REV. APR. 15, 1968

SEP. 28, 1964

X-PEL-1046

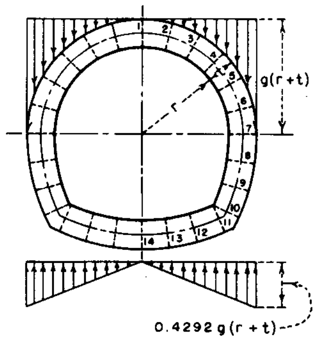
Note: No vertical arch load on Shape D.

SHAPE E



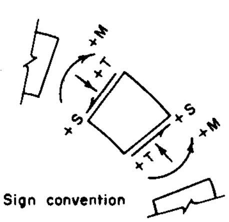
POINT	t = r/2: $\frac{M}{gr^3}$	t = r/2: $\frac{T}{gr^2}$	t = r/2: $\frac{S}{gr^2}$	t = r/3: $\frac{M}{gr^3}$	t = r/3: $\frac{T}{gr^2}$	t = r/3: $\frac{S}{gr^2}$	t = r/6: $\frac{M}{gr^3}$	t = r/6: $\frac{T}{gr^2}$	t = r/6: $\frac{S}{gr^2}$
1	+0.028	-0.014	0	+0.029	-0.009	0	+0.025	-0.005	0
2	+0.027	-0.012	+0.010	+0.028	-0.007	+0.007	+0.025	-0.004	+0.005
3	+0.023	+0.012	+0.049	+0.024	+0.011	+0.038	+0.022	+0.010	+0.028
4	+0.011	+0.092	+0.113	+0.013	+0.075	+0.087	+0.011	+0.058	+0.066
5	-0.006	+0.238	+0.154	-0.005	+0.189	+0.120	-0.006	+0.146	+0.090
6	-0.023	+0.402	+0.122	-0.023	+0.318	+0.094	-0.024	+0.244	+0.071
7	-0.031	+0.483	+0.014	-0.032	+0.382	+0.009	-0.032	+0.292	+0.005
8	-0.035	+0.483	+0.014	-0.035	+0.382	+0.009	-0.034	+0.292	+0.005
9	-0.040	+0.483	+0.014	-0.038	+0.382	+0.009	-0.030	+0.292	+0.005
10	-0.045	+0.483	+0.014	-0.041	+0.382	+0.009	-0.037	+0.292	+0.005
11	+0.001	+0.014	-0.215	-0.008	+0.009	-0.215	-0.020	+0.005	-0.215
12	+0.051	+0.014	-0.095	+0.042	+0.009	-0.095	+0.030	+0.005	-0.095
13	+0.070	+0.014	-0.024	+0.061	+0.009	-0.024	+0.049	+0.005	-0.024
14	+0.072	+0.014	0	+0.064	+0.009	0	+0.052	+0.005	0

SHAPE F



POINT	t = r/2: $\frac{M}{gr^3}$	t = r/2: $\frac{T}{gr^2}$	t = r/2: $\frac{S}{gr^2}$	t = r/3: $\frac{M}{gr^3}$	t = r/3: $\frac{T}{gr^2}$	t = r/3: $\frac{S}{gr^2}$	t = r/6: $\frac{M}{gr^3}$	t = r/6: $\frac{T}{gr^2}$	t = r/6: $\frac{S}{gr^2}$
1	+0.036	-0.026	0	+0.029	-0.019	0	+0.026	-0.012	0
2	+0.034	-0.023	+0.013	+0.028	-0.017	+0.010	+0.025	-0.011	+0.007
3	+0.029	+0.002	+0.055	+0.023	+0.003	+0.043	+0.021	+0.004	+0.032
4	+0.015	+0.084	+0.121	+0.010	+0.068	+0.094	+0.010	+0.053	+0.071
5	-0.006	+0.233	+0.164	-0.010	+0.184	+0.128	-0.009	+0.142	+0.096
6	-0.025	+0.399	+0.133	-0.031	+0.315	+0.104	-0.029	+0.242	+0.078
7	-0.037	+0.483	+0.026	-0.043	+0.382	+0.019	-0.039	+0.292	+0.012
8	-0.039	+0.466	-0.040	-0.042	+0.367	-0.033	-0.038	+0.280	-0.027
9	-0.028	+0.412	-0.093	-0.032	+0.322	-0.074	-0.027	+0.244	-0.058
10	-0.010	+0.330	-0.121	-0.014	+0.256	-0.095	-0.011	+0.191	-0.073
11	+0.002	+0.117	-0.196	-0.005	+0.098	-0.173	-0.006	+0.081	-0.150
12	+0.037	+0.054	-0.093	+0.028	+0.043	-0.082	+0.024	+0.034	-0.072
13	+0.050	+0.029	-0.023	+0.040	+0.022	-0.020	+0.035	+0.015	-0.018
14	+0.051	+0.026	0	+0.041	+0.019	0	+0.037	+0.012	0

NOTE: g represents the weight per unit volume of soil cover on the arch of the conduit section in units consistent with those of the radius r.



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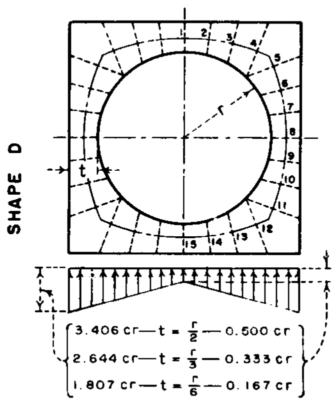
SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
VERTICAL ARCH LOAD-TRIANGULAR FOUNDATION REACTION
SHAPES D, E, AND F

REV. APR. 15, 1968

SEP. 28, 1964

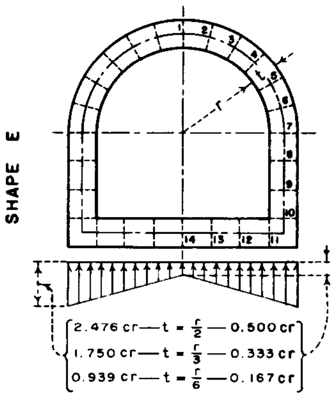
X-PEL-1047

SHAPE D



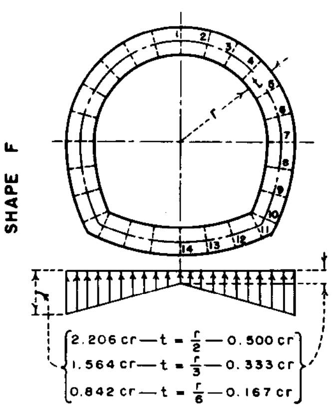
POINT	t = r/2: M/cr^3	t = r/2: T/cr^2	t = r/2: S/cr^2	t = r/3: M/cr^3	t = r/3: T/cr^2	t = r/3: S/cr^2	t = r/6: M/cr^3	t = r/6: T/cr^2	t = r/6: S/cr^2
1	+0.231	+0.005	0	+0.167	-0.017	0	+0.095	-0.028	0
2	+0.210	+0.022	+0.145	+0.153	-0.006	+0.098	+0.088	-0.022	+0.051
3	+0.145	+0.077	+0.308	+0.110	+0.033	+0.213	+0.065	+0.001	+0.119
4	+0.031	+0.183	+0.498	+0.033	+0.112	+0.355	+0.021	+0.053	+0.218
5	-0.083	+0.881	+0.308	-0.034	+0.576	+0.230	-0.011	+0.319	+0.152
6	-0.161	+1.116	+0.254	-0.093	+0.753	+0.198	-0.050	+0.438	+0.138
7	-0.220	+1.309	+0.145	-0.139	+0.889	+0.122	-0.082	+0.520	+0.092
8	-0.240	+1.465	-0.005	-0.159	+0.992	+0.017	-0.099	+0.576	+0.028
9	-0.211	+1.601	-0.188	-0.146	+1.083	-0.111	-0.096	+0.623	-0.048
10	-0.125	+1.734	-0.407	-0.094	+1.178	-0.264	-0.072	+0.678	-0.139
11	+0.033	+1.877	-0.674	+0.008	+1.287	-0.455	-0.018	+0.755	-0.258
12	+0.055	+0.301	-0.861	+0.039	+0.258	-0.653	+0.006	+0.194	-0.429
13	+0.157	+0.087	-0.399	+0.123	+0.089	-0.299	+0.067	+0.078	-0.198
14	+0.202	+0.007	-0.109	+0.159	+0.027	-0.080	+0.094	+0.035	-0.052
15	+0.210	-0.005	0	+0.165	+0.017	0	+0.097	+0.028	0

SHAPE E



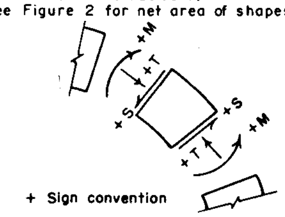
POINT	t = r/2: M/cr^3	t = r/2: T/cr^2	t = r/2: S/cr^2	t = r/3: M/cr^3	t = r/3: T/cr^2	t = r/3: S/cr^2	t = r/6: M/cr^3	t = r/6: T/cr^2	t = r/6: S/cr^2
1	+0.183	+0.054	0	+0.121	+0.019	0	+0.059	-0.000	0
2	+0.159	+0.094	+0.144	+0.107	+0.045	+0.093	+0.052	+0.012	+0.046
3	+0.093	+0.210	+0.257	+0.067	+0.119	+0.167	+0.034	+0.047	+0.082
4	+0.000	+0.385	+0.309	+0.010	+0.230	+0.202	+0.008	+0.100	+0.101
5	-0.097	+0.594	+0.281	-0.050	+0.362	+0.187	-0.021	+0.164	+0.095
6	-0.169	+0.804	+0.160	-0.097	+0.497	+0.113	-0.043	+0.228	+0.062
7	-0.186	+0.982	-0.054	-0.112	+0.611	-0.019	-0.053	+0.284	+0.000
8	-0.168	+1.148	-0.054	-0.105	+0.722	-0.019	-0.053	+0.339	+0.000
9	-0.150	+1.315	-0.054	-0.099	+0.833	-0.019	-0.053	+0.395	+0.000
10	-0.132	+1.482	-0.054	-0.092	+0.944	-0.019	-0.053	+0.450	+0.000
11	+0.032	-0.054	-0.659	-0.004	-0.019	-0.531	-0.026	+0.000	-0.331
12	+0.187	-0.054	-0.293	+0.121	-0.019	-0.236	+0.052	+0.000	-0.147
13	+0.243	-0.054	-0.073	+0.166	-0.019	-0.059	+0.080	+0.000	-0.037
14	+0.252	-0.054	0	+0.173	-0.019	0	+0.084	+0.000	0

SHAPE F



POINT	t = r/2: M/cr^3	t = r/2: T/cr^2	t = r/2: S/cr^2	t = r/3: M/cr^3	t = r/3: T/cr^2	t = r/3: S/cr^2	t = r/6: M/cr^3	t = r/6: T/cr^2	t = r/6: S/cr^2
1	+0.185	+0.057	0	+0.115	+0.019	0	+0.056	+0.001	0
2	+0.161	+0.098	+0.143	+0.100	+0.045	+0.093	+0.049	+0.013	+0.045
3	+0.096	+0.213	+0.255	+0.060	+0.118	+0.167	+0.031	+0.048	+0.081
4	+0.004	+0.388	+0.307	+0.003	+0.229	+0.203	+0.005	+0.101	+0.100
5	-0.092	+0.595	+0.278	-0.057	+0.362	+0.187	-0.023	+0.164	+0.094
6	-0.163	+0.805	+0.157	-0.104	+0.497	+0.113	-0.046	+0.229	+0.060
7	-0.179	+0.982	-0.057	-0.119	+0.611	-0.019	-0.054	+0.284	-0.001
8	-0.150	+1.067	-0.210	-0.104	+0.667	-0.114	-0.049	+0.311	-0.045
9	-0.096	+1.027	-0.358	-0.071	+0.642	-0.206	-0.034	+0.299	-0.088
10	-0.020	+0.886	-0.463	-0.022	+0.541	-0.270	-0.009	+0.255	-0.116
11	+0.019	+0.211	-0.606	-0.000	+0.163	-0.408	-0.002	+0.094	-0.211
12	+0.122	+0.031	-0.311	+0.074	+0.040	-0.205	+0.039	+0.029	-0.104
13	+0.164	-0.044	-0.095	+0.103	-0.011	-0.059	+0.056	+0.003	-0.029
14	+0.170	-0.057	0	+0.108	-0.019	0	+0.058	-0.001	0

NOTES: c represents the weight per unit volume of concrete or other material in units consistent with those of the radius r.
See Figure 2 for net area of shapes.



+ Sign convention

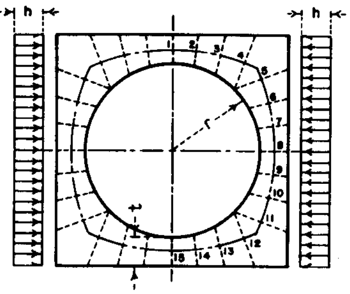
SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
DEAD WEIGHT OF CONDUIT
SHAPES D, E, AND F

REV. APR. 15, 1968

SEP. 28, 1964

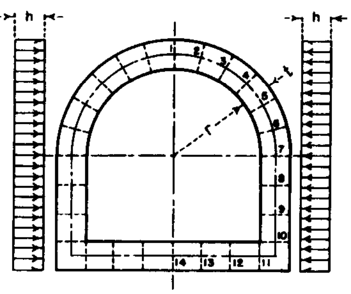
X-PEL-1048

SHAPE D



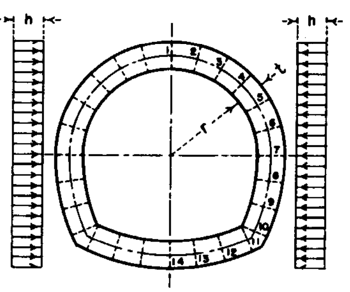
POINT	$t = \frac{r}{2}$: $\frac{M}{hr^2}$	$\frac{T}{hr}$	$\frac{S}{hr}$	$t = \frac{r}{3}$: $\frac{M}{hr^2}$	$\frac{T}{hr}$	$\frac{S}{hr}$	$t = \frac{r}{6}$: $\frac{M}{hr^2}$	$\frac{T}{hr}$	$\frac{S}{hr}$
1	-0.357	+1.500	0	-0.318	+1.333	0	-0.282	+1.167	0
2	-0.332	+1.490	-0.171	-0.296	+1.324	-0.156	-0.262	+1.158	-0.141
3	-0.259	+1.461	-0.339	-0.231	+1.297	-0.310	-0.205	+1.132	-0.281
4	-0.137	+1.413	-0.503	-0.123	+1.251	-0.460	-0.111	+1.090	-0.416
5	+0.043	+0.332	-0.932	+0.017	+0.324	-0.880	-0.010	+0.315	-0.824
6	+0.232	+0.146	-0.628	+0.196	+0.142	-0.593	+0.159	+0.138	-0.556
7	+0.352	+0.036	-0.316	+0.310	+0.035	-0.299	+0.265	+0.034	-0.280
8	+0.393	0	0	+0.348	0	0	+0.302	0	0
9	+0.352	+0.036	+0.316	+0.310	+0.035	+0.299	+0.265	+0.034	+0.280
10	+0.232	+0.146	+0.628	+0.196	+0.142	+0.593	+0.159	+0.138	+0.556
11	+0.043	+0.332	+0.932	+0.017	+0.324	+0.880	-0.010	+0.315	+0.824
12	-0.137	+1.413	+0.503	-0.123	+1.251	+0.460	-0.111	+1.090	+0.416
13	-0.259	+1.461	+0.339	-0.231	+1.297	+0.310	-0.205	+1.132	+0.281
14	-0.332	+1.490	+0.171	-0.296	+1.324	+0.156	-0.262	+1.158	+0.141
15	-0.357	+1.500	0	-0.318	+1.333	0	-0.282	+1.167	0

SHAPE E

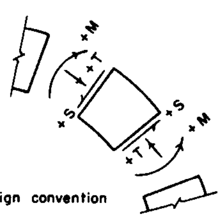


POINT	$t = \frac{r}{2}$: $\frac{M}{hr^2}$	$\frac{T}{hr}$	$\frac{S}{hr}$	$t = \frac{r}{3}$: $\frac{M}{hr^2}$	$\frac{T}{hr}$	$\frac{S}{hr}$	$t = \frac{r}{6}$: $\frac{M}{hr^2}$	$\frac{T}{hr}$	$\frac{S}{hr}$
1	-0.428	+1.588	0	-0.379	+1.415	0	-0.331	+1.243	0
2	-0.374	+1.485	-0.398	-0.331	+1.323	-0.355	-0.289	+1.162	-0.311
3	-0.225	+1.201	-0.694	-0.199	+1.071	-0.618	-0.174	+0.941	-0.543
4	-0.020	+0.812	-0.812	-0.018	+0.725	-0.725	-0.015	+0.637	-0.637
5	+0.190	+0.419	-0.726	+0.169	+0.374	-0.648	+0.148	+0.330	-0.571
6	+0.354	+0.123	-0.460	+0.314	+0.111	-0.413	+0.275	+0.098	-0.365
7	+0.433	0	-0.088	+0.384	0	-0.082	+0.335	0	-0.076
8	+0.406	0	+0.245	+0.355	0	+0.251	+0.305	0	+0.257
9	+0.269	0	+0.579	+0.216	0	+0.585	+0.163	0	+0.591
10	+0.021	0	+0.912	-0.034	0	+0.918	-0.089	0	+0.924
11	-0.207	+1.412	0	-0.187	+1.251	0	-0.166	+1.091	0
12	-0.207	+1.412	0	-0.187	+1.251	0	-0.166	+1.091	0
13	-0.207	+1.412	0	-0.187	+1.251	0	-0.166	+1.091	0
14	-0.207	+1.412	0	-0.187	+1.251	0	-0.166	+1.091	0

SHAPE F



POINT	$t = \frac{r}{2}$: $\frac{M}{hr^2}$	$\frac{T}{hr}$	$\frac{S}{hr}$	$t = \frac{r}{3}$: $\frac{M}{hr^2}$	$\frac{T}{hr}$	$\frac{S}{hr}$	$t = \frac{r}{6}$: $\frac{M}{hr^2}$	$\frac{T}{hr}$	$\frac{S}{hr}$
1	-0.389	+1.527	0	-0.346	+1.360	0	-0.304	+1.193	0
2	-0.338	+1.425	-0.382	-0.301	+1.270	-0.340	-0.264	+1.113	-0.298
3	-0.197	+1.148	-0.663	-0.176	+1.023	-0.591	-0.154	+0.897	-0.518
4	-0.004	+0.769	-0.769	-0.004	+0.685	-0.685	-0.004	+0.602	-0.602
5	+0.190	+0.388	-0.673	+0.169	+0.347	-0.600	+0.148	+0.305	-0.528
6	+0.336	+0.107	-0.401	+0.298	+0.096	-0.359	+0.261	+0.085	-0.317
7	+0.394	0	-0.027	+0.351	0	-0.026	+0.308	0	-0.026
8	+0.353	+0.046	+0.322	+0.313	+0.043	+0.299	+0.272	+0.039	+0.277
9	+0.217	+0.187	+0.644	+0.185	+0.174	+0.600	+0.154	+0.161	+0.556
10	-0.004	+0.412	+0.913	-0.020	+0.384	+0.851	-0.037	+0.356	+0.789
11	-0.104	+1.141	+0.515	-0.087	+1.003	+0.453	-0.070	+0.865	+0.390
12	-0.219	+1.320	+0.383	-0.192	+1.166	+0.339	-0.164	+1.013	+0.294
13	-0.296	+1.434	+0.204	-0.261	+1.271	+0.181	-0.226	+1.108	+0.158
14	-0.322	+1.473	0	-0.285	+1.307	0	-0.248	+1.141	0



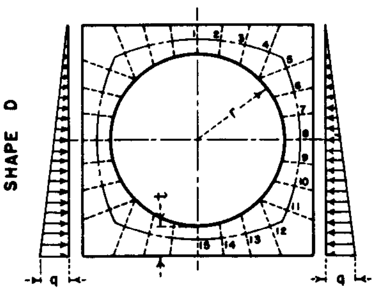
\+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
UNIFORM HORIZONTAL LOAD – BOTH SIDES
SHAPES D, E, AND F

SEP. 28, 1964

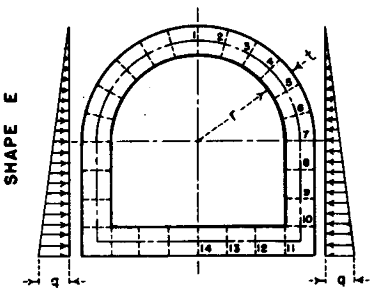
X-PEL-1049

SHAPE D



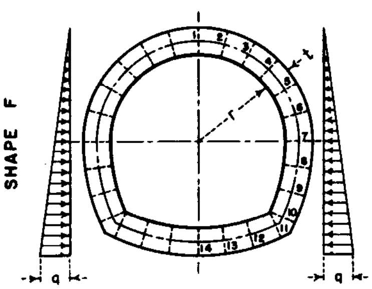
POINT	t = r/2 $\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	t = r/3 $\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	t = r/6 $\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$
1	-0.154	+0.431	0	-0.146	+0.401	0	-0.132	+0.366	0
2	-0.147	+0.428	-0.049	-0.139	+0.398	-0.047	-0.126	+0.363	-0.044
3	-0.126	+0.419	-0.097	-0.119	+0.390	-0.093	-0.108	+0.355	-0.088
4	-0.091	+0.406	-0.144	-0.087	+0.376	-0.138	-0.079	+0.342	-0.130
5	+0.005	+0.130	-0.365	-0.015	+0.128	-0.349	-0.030	+0.124	-0.326
6	+0.094	+0.070	-0.301	+0.071	+0.071	-0.295	+0.050	+0.070	-0.282
7	+0.161	+0.022	-0.196	+0.137	+0.024	-0.200	+0.114	+0.024	-0.197
8	+0.197	0	-0.056	+0.174	0	-0.068	+0.151	0	-0.074
9	+0.191	+0.014	+0.120	+0.172	+0.012	+0.099	+0.151	+0.010	+0.083
10	+0.138	+0.076	+0.327	+0.125	+0.072	+0.299	+0.108	+0.068	+0.274
11	+0.038	+0.202	+0.567	+0.032	+0.195	+0.531	+0.019	+0.190	+0.499
12	-0.046	+1.008	+0.359	-0.036	+0.875	+0.322	-0.032	+0.748	+0.285
13	-0.133	+1.042	+0.242	-0.112	+0.907	+0.217	-0.097	+0.777	+0.193
14	-0.185	+1.062	+0.122	-0.157	+0.926	+0.109	-0.136	+0.795	+0.097
15	-0.203	+1.069	0	-0.173	+0.932	0	-0.149	+0.801	0

SHAPE E

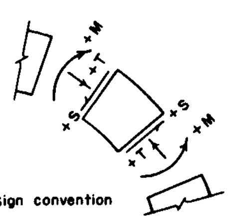


POINT	$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$
1	-0.195	+0.485	0	-0.172	+0.440	0	-0.147	+0.397	0
2	-0.174	+0.468	-0.125	-0.155	+0.425	-0.114	-0.132	+0.384	-0.103
3	-0.116	+0.414	-0.239	-0.105	+0.376	-0.217	-0.090	+0.340	-0.196
4	-0.028	+0.320	-0.320	-0.029	+0.291	-0.291	-0.025	+0.263	-0.263
5	+0.073	+0.195	-0.338	+0.059	+0.178	-0.309	+0.051	+0.162	-0.281
6	+0.164	+0.072	-0.269	+0.140	+0.066	-0.248	+0.123	+0.061	-0.229
7	+0.223	0	-0.110	+0.193	0	-0.107	+0.170	0	-0.106
8	+0.230	0	+0.076	+0.199	0	+0.081	+0.175	0	+0.085
9	+0.169	0	+0.298	+0.135	0	+0.310	+0.109	0	+0.323
10	+0.027	0	+0.557	-0.013	0	+0.581	-0.045	0	+0.609
11	-0.108	+1.015	0	-0.108	+0.893	0	-0.096	+0.769	0
12	-0.108	+1.015	0	-0.108	+0.893	0	-0.096	+0.769	0
13	-0.108	+1.015	0	-0.108	+0.893	0	-0.096	+0.769	0
14	-0.108	+1.015	0	-0.108	+0.893	0	-0.096	+0.769	0

SHAPE F



POINT	*$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$
1	-0.177	+0.451	0	-0.155	+0.409	0	-0.131	+0.368	0
2	-0.158	+0.435	-0.117	-0.138	+0.395	-0.106	-0.117	+0.356	-0.095
3	-0.103	+0.385	-0.222	-0.092	+0.349	-0.202	-0.078	+0.315	-0.182
4	-0.022	+0.296	-0.296	-0.022	+0.269	-0.269	-0.018	+0.243	-0.243
5	+0.070	+0.179	-0.309	+0.059	+0.163	-0.282	+0.051	+0.148	-0.256
6	+0.151	+0.063	-0.237	+0.131	+0.059	-0.218	+0.115	+0.054	-0.201
7	+0.199	0	-0.076	+0.175	0	-0.076	+0.155	0	-0.077
8	+0.197	+0.017	+0.119	+0.173	+0.015	+0.108	+0.154	+0.014	+0.095
9	+0.137	+0.099	+0.340	+0.116	+0.092	+0.316	+0.101	+0.085	+0.292
10	+0.016	+0.253	+0.560	+0.001	+0.237	+0.526	-0.008	+0.222	+0.491
11	-0.038	+0.762	+0.344	-0.036	+0.661	+0.298	-0.028	+0.560	+0.253
12	-0.109	+0.914	+0.265	-0.102	+0.800	+0.232	-0.087	+0.685	+0.199
13	-0.157	+1.014	+0.144	-0.147	+0.892	+0.127	-0.128	+0.769	+0.109
14	-0.174	+1.049	0	-0.163	+0.924	0	-0.143	+0.798	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

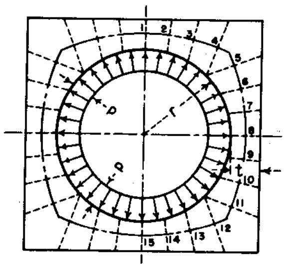
TRIANGULAR HORIZONTAL LOAD - BOTH SIDES

SHAPES D, E, AND F

SEP. 28, 1964

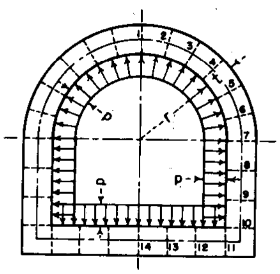
X-PEL-1050

SHAPE D



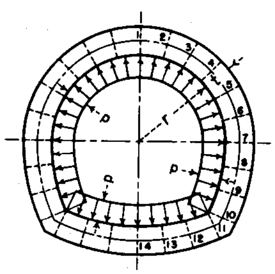
POINT	$t = \frac{r}{2}$: $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$t = \frac{r}{3}$: $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$t = \frac{r}{6}$: $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$
1	-0.036	-1.000	0	-0.030	-1.000	0	-0.020	-1.000	0
2	-0.020	-0.989	-0.146	-0.014	-0.990	-0.142	-0.003	-0.990	-0.139
3	+0.026	-0.957	-0.289	+0.034	-0.959	-0.283	+0.046	-0.961	-0.276
4	+0.094	-0.903	-0.429	+0.106	-0.908	-0.420	+0.121	-0.913	-0.409
5	+0.094	-0.903	+0.429	+0.106	-0.908	+0.420	+0.121	-0.913	+0.409
6	+0.026	-0.957	+0.289	+0.034	-0.959	+0.283	+0.046	-0.961	+0.276
7	-0.020	-0.989	+0.146	-0.014	-0.990	+0.142	-0.003	-0.990	+0.139
8	-0.036	-1.000	0	-0.030	-1.000	0	-0.020	-1.000	0
9	-0.020	-0.989	-0.146	-0.014	-0.990	-0.142	-0.003	-0.990	-0.139
10	+0.026	-0.957	-0.289	+0.034	-0.959	-0.283	+0.046	-0.961	-0.276
11	+0.094	-0.903	-0.429	+0.106	-0.908	-0.420	+0.121	-0.913	-0.409
12	+0.094	-0.903	+0.429	+0.106	-0.908	+0.420	+0.121	-0.913	+0.409
13	+0.026	-0.957	+0.289	+0.034	-0.959	+0.283	+0.046	-0.961	+0.276
14	-0.020	-0.989	+0.146	-0.014	-0.990	+0.142	-0.003	-0.990	+0.139
15	-0.036	-1.000	0	-0.030	-1.000	0	-0.020	-1.000	0

SHAPE E

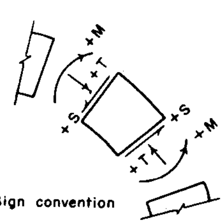


POINT	$t = \frac{r}{2}$: $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$t = \frac{r}{3}$: $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$t = \frac{r}{6}$: $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$
1	+0.074	-1.154	0	+0.062	-1.142	0	+0.051	-1.130	0
2	+0.068	-1.149	+0.040	+0.056	-1.137	+0.037	+0.046	-1.126	+0.034
3	+0.048	-1.134	+0.077	+0.040	-1.123	+0.071	+0.032	-1.113	+0.065
4	+0.018	-1.109	+0.109	+0.013	-1.100	+0.100	+0.010	-1.092	+0.092
5	-0.022	-1.077	+0.134	-0.021	-1.071	+0.123	-0.019	-1.065	+0.113
6	-0.069	-1.040	+0.149	-0.061	-1.037	+0.137	-0.053	-1.034	+0.126
7	-0.119	-1.000	+0.154	-0.104	-1.000	+0.142	-0.090	-1.000	+0.130
8	-0.115	-1.000	-0.179	-0.096	-1.000	-0.191	-0.078	-1.000	-0.203
9	+0.000	-1.000	-0.512	+0.024	-1.000	-0.525	+0.046	-1.000	-0.536
10	+0.227	-1.000	-0.846	+0.254	-1.000	-0.858	+0.279	-1.000	-0.870
11	+0.188	-0.846	+1.000	+0.231	-0.858	+1.000	+0.269	-0.870	+1.000
12	-0.090	-0.846	+0.667	-0.047	-0.858	+0.667	-0.009	-0.870	+0.667
13	-0.256	-0.846	+0.333	-0.214	-0.858	+0.333	-0.175	-0.870	+0.333
14	-0.312	-0.846	0	-0.269	-0.858	0	-0.231	-0.870	0

SHAPE F



POINT	$t = \frac{r}{2}$: $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$t = \frac{r}{3}$: $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$t = \frac{r}{6}$: $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$
1	+0.018	-1.046	0	+0.016	-1.044	0	+0.014	-1.043	0
2	+0.016	-1.044	+0.012	+0.014	-1.042	+0.011	+0.013	-1.041	+0.011
3	+0.010	-1.040	+0.023	+0.009	-1.038	+0.022	+0.008	-1.037	+0.021
4	+0.001	-1.032	+0.032	+0.001	-1.031	+0.031	+0.001	-1.030	+0.030
5	-0.011	-1.023	+0.040	-0.010	-1.022	+0.038	-0.009	-1.021	+0.037
6	-0.024	-1.012	+0.044	-0.022	-1.011	+0.043	-0.020	-1.011	+0.04[illegible]
7	-0.039	-1.000	+0.046	-0.036	-1.000	+0.044	-0.032	-1.000	+0.043
8	-0.031	-1.004	-0.096	-0.028	-1.004	-0.097	-0.024	-1.004	-0.098
9	+0.021	-1.027	-0.235	+0.023	-1.027	-0.236	+0.025	-1.028	-0.238
10	+0.118	-1.070	-0.370	+0.117	-1.070	-0.371	+0.115	-1.071	-0.372
11	+0.112	-1.047	+0.430	+0.113	-1.048	+0.430	+0.114	-1.049	+0.429
12	-0.003	-0.996	+0.292	+0.002	-0.997	+0.291	+0.007	-0.999	+0.291
13	-0.073	-0.965	+0.147	-0.065	-0.966	+0.147	-0.057	-0.968	+0.147
14	-0.096	-0.954	0	-0.087	-0.956	0	-0.079	-0.957	0



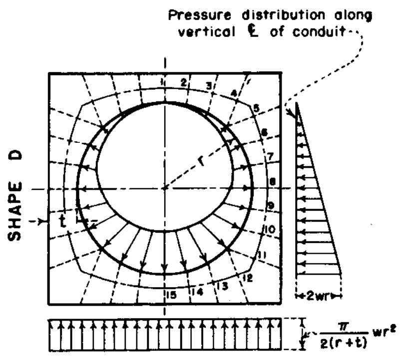
+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
UNIFORM INTERNAL RADIAL LOAD

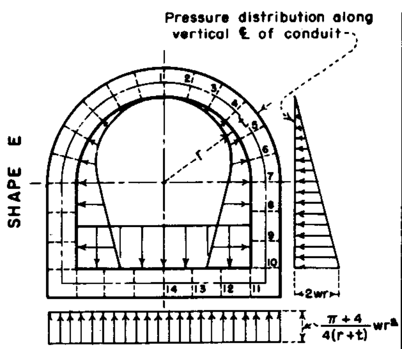
SHAPES D, E, AND F

SEP. 28, 1964

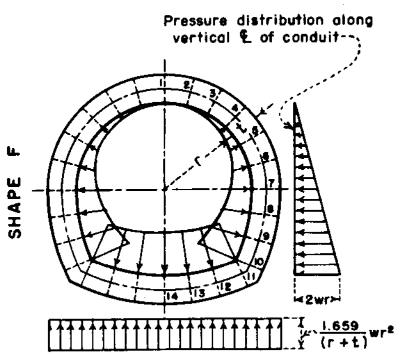
X-PEL-1051



POINT	$t=\frac{r}{2}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t=\frac{r}{3}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t=\frac{r}{6}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.169	-0.528	0	+0.177	-0.553	0	+0.183	-0.576	0
2	+0.160	-0.524	+0.057	+0.168	-0.549	+0.062	+0.173	-0.572	+0.067
3	+0.136	-0.511	+0.096	+0.143	-0.534	+0.106	+0.147	-0.556	+0.116
4	+0.099	-0.479	+0.102	+0.105	-0.501	+0.116	+0.109	-0.521	+0.130
5	-0.009	-0.223	+0.435	+0.017	-0.237	+0.456	+0.043	-0.250	+0.475
6	-0.112	-0.214	+0.363	-0.092	-0.222	+0.386	-0.071	-0.231	+0.407
7	-0.188	-0.214	+0.229	-0.176	-0.218	+0.253	-0.161	-0.222	+0.276
8	-0.223	-0.215	+0.028	-0.218	-0.215	+0.053	-0.209	-0.215	+0.076
9	-0.200	-0.204	-0.241	-0.200	-0.202	-0.216	-0.197	-0.200	-0.192
10	-0.108	-0.170	-0.570	-0.112	-0.168	-0.546	-0.111	-0.167	-0.522
11	+0.053	-0.103	-0.949	+0.050	-0.105	-0.925	+0.051	-0.107	-0.902
12	+0.135	-0.981	-0.016	+0.127	-0.933	-0.082	+0.120	-0.881	-0.163
13	+0.159	-1.251	+0.017	+0.156	-1.217	-0.027	+0.160	-1.181	-0.082
14	+0.168	-1.416	+0.017	+0.170	-1.389	-0.005	+0.179	-1.363	-0.033
15	+0.171	-1.472	0	+0.173	-1.447	0	+0.184	-1.424	0

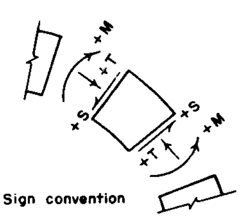


POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.262	-0.681	0	+0.256	-0.684	0	+0.239	-0.693	0
2	+0.233	-0.658	+0.173	+0.229	-0.661	+0.174	+0.214	-0.669	+0.176
3	+0.152	-0.593	+0.317	+0.152	-0.596	+0.319	+0.142	-0.603	+0.323
4	+0.032	-0.497	+0.406	+0.040	-0.499	+0.408	+0.036	-0.505	+0.414
5	-0.106	-0.387	+0.419	-0.089	-0.389	+0.421	-0.085	-0.393	+0.429
6	-0.233	-0.285	+0.345	-0.209	-0.286	+0.348	-0.199	-0.288	+0.355
7	-0.321	-0.215	+0.181	-0.292	-0.215	+0.184	-0.278	-0.215	+0.193
8	-0.320	-0.215	-0.208	-0.292	-0.215	-0.205	-0.281	-0.215	-0.196
9	-0.171	-0.215	-0.708	-0.144	-0.215	-0.705	-0.135	-0.215	-0.696
10	+0.164	-0.215	-1.319	+0.190	-0.215	-1.316	+0.196	-0.215	-1.307
11	+0.291	-1.319	+0.810	+0.299	-1.316	+0.661	+0.265	-1.307	+0.470
12	+0.066	-1.319	+0.540	+0.115	-1.316	+0.441	+0.135	-1.307	+0.313
13	-0.069	-1.319	+0.270	+0.005	-1.316	+0.220	+0.057	-1.307	+0.157
14	-0.114	-1.319	0	-0.031	-1.316	0	+0.031	-1.307	0



POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.222	-0.576	0	+0.206	-0.588	0	+0.193	-0.606	0
2	+0.198	-0.556	+0.146	+0.182	-0.569	+0.149	+0.171	-0.585	+0.154
3	+0.129	-0.502	+0.265	+0.117	-0.513	+0.271	+0.108	-0.528	+0.280
4	+0.030	-0.422	+0.331	+0.022	-0.431	+0.340	+0.017	-0.444	+0.352
5	-0.080	-0.334	+0.327	-0.083	-0.341	+0.338	-0.085	-0.349	+0.353
6	-0.175	-0.258	+0.243	-0.176	-0.261	+0.255	-0.175	-0.266	+0.271
7	-0.230	-0.215	+0.076	-0.231	-0.215	+0.088	-0.231	-0.215	+0.106
8	-0.217	-0.251	-0.212	-0.220	-0.250	-0.200	-0.224	-0.250	-0.182
9	-0.116	-0.385	-0.552	-0.122	-0.386	-0.539	-0.128	-0.388	-0.520
10	+0.085	-0.615	-0.914	+0.076	-0.621	-0.897	+0.065	-0.628	-0.875
11	+0.135	-1.179	-0.027	+0.117	-1.144	-0.073	+0.091	-1.098	-0.133
12	+0.114	-1.310	-0.037	+0.118	-1.287	-0.070	+0.117	-1.257	-0.113
13	+0.104	-1.395	-0.025	+0.122	-1.380	-0.042	+0.136	-1.359	-0.064
14	+0.102	-1.424	0	+0.123	-1.412	0	+0.143	-1.394	0

NOTE: w represents the weight per unit volume of water in units consistent with those of the radius r.



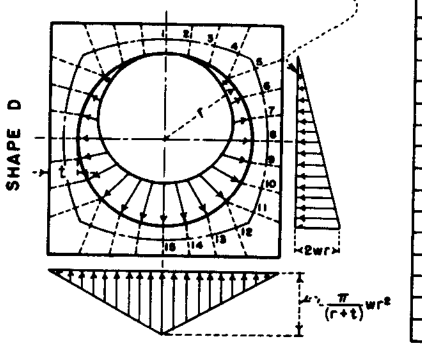
+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
TRIANGULAR INTERNAL RADIAL LOAD – UNIFORM FOUNDATION REACTION
SHAPES D, E, AND F

SEP. 28, 1964

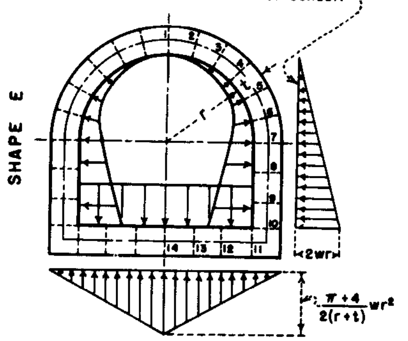
X-PEL-1052

SHAPE D



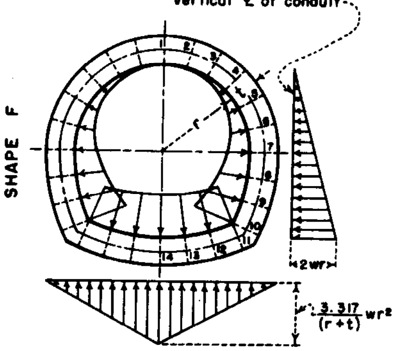
POINT	t = r/2: $\frac{M}{wr^3}$	t = r/2: $\frac{T}{wr^2}$	t = r/2: $\frac{S}{wr^2}$	t = r/3: $\frac{M}{wr^3}$	t = r/3: $\frac{T}{wr^2}$	t = r/3: $\frac{S}{wr^2}$	t = r/6: $\frac{M}{wr^3}$	t = r/6: $\frac{T}{wr^2}$	t = r/6: $\frac{S}{wr^2}$
1	+0.234	-0.644	0	+0.240	-0.668	0	+0.241	-0.691	0
2	+0.224	-0.640	+0.070	+0.229	-0.663	+0.075	+0.230	-0.686	+0.081
3	+0.194	-0.624	+0.123	+0.198	-0.646	+0.133	+0.198	-0.667	+0.143
4	+0.147	-0.588	+0.141	+0.151	-0.609	+0.155	+0.151	-0.629	+0.171
5	+0.010	-0.262	+0.545	+0.040	-0.276	+0.565	+0.068	-0.291	+0.583
6	-0.125	-0.240	+0.476	-0.100	-0.249	+0.498	-0.076	-0.259	+0.519
7	-0.235	-0.227	+0.345	-0.216	-0.231	+0.368	-0.196	-0.236	+0.390
8	-0.303	-0.215	+0.144	-0.290	-0.215	+0.168	-0.275	-0.215	+0.191
9	-0.313	-0.191	-0.125	-0.304	-0.188	-0.101	-0.294	-0.186	-0.078
10	-0.254	-0.144	-0.457	-0.248	-0.141	-0.433	-0.239	-0.139	-0.411
11	-0.126	-0.064	-0.840	-0.117	-0.065	-0.817	-0.106	-0.067	-0.794
12	+0.082	-0.753	-0.309	+0.049	-0.712	-0.350	+0.017	-0.670	-0.392
13	+0.207	-1.051	-0.332	+0.176	-1.014	-0.380	+0.148	-0.975	-0.435
14	+0.300	-1.271	-0.230	+0.275	-1.242	-0.264	+0.254	-1.214	-0.305
15	+0.338	-1.356	0	+0.316	-1.332	0	+0.299	-1.309	0

SHAPE E



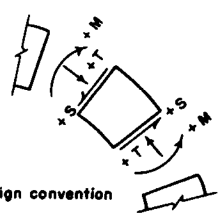
POINT	t = r/2: $\frac{M}{wr^3}$	t = r/2: $\frac{T}{wr^2}$	t = r/2: $\frac{S}{wr^2}$	t = r/3: $\frac{M}{wr^3}$	t = r/3: $\frac{T}{wr^2}$	t = r/3: $\frac{S}{wr^2}$	t = r/6: $\frac{M}{wr^3}$	t = r/6: $\frac{T}{wr^2}$	t = r/6: $\frac{S}{wr^2}$
1	+0.332	-0.771	0	+0.313	-0.769	0	+0.287	-0.765	0
2	+0.300	-0.745	+0.197	+0.283	-0.743	+0.196	+0.259	-0.739	+0.195
3	+0.207	-0.671	+0.362	+0.197	-0.669	+0.361	+0.180	-0.665	+0.359
4	+0.069	-0.560	+0.469	+0.068	-0.559	+0.468	+0.061	-0.556	+0.465
5	-0.091	-0.432	+0.497	-0.081	-0.431	+0.495	-0.076	-0.429	+0.491
6	-0.246	-0.309	+0.431	-0.225	-0.308	+0.429	-0.209	-0.307	+0.425
7	-0.363	-0.215	+0.271	-0.334	-0.215	+0.269	-0.309	-0.215	+0.265
8	-0.392	-0.215	-0.118	-0.361	-0.215	-0.120	-0.335	-0.215	-0.124
9	-0.272	-0.215	-0.618	-0.241	-0.215	-0.620	-0.213	-0.215	-0.624
10	+0.032	-0.215	-1.229	+0.064	-0.215	-1.231	+0.093	-0.215	-1.235
11	+0.253	-1.229	+0.413	+0.221	-1.231	+0.326	+0.177	-1.235	+0.251
12	+0.173	-1.229	+0.099	+0.174	-1.231	-0.006	+0.163	-1.235	-0.124
13	+0.167	-1.229	-0.039	+0.200	-1.231	-0.114	+0.227	-1.235	-0.208
14	+0.179	-1.229	0	+0.226	-1.231	0	+0.270	-1.235	0

SHAPE F



POINT	t = r/2: $\frac{M}{wr^3}$	t = r/2: $\frac{T}{wr^2}$	t = r/2: $\frac{S}{wr^2}$	t = r/3: $\frac{M}{wr^3}$	t = r/3: $\frac{T}{wr^2}$	t = r/3: $\frac{S}{wr^2}$	t = r/6: $\frac{M}{wr^3}$	t = r/6: $\frac{T}{wr^2}$	t = r/6: $\frac{S}{wr^2}$
1	+0.288	-0.683	0	+0.271	-0.687	0	+0.251	-0.693	0
2	+0.260	-0.660	+0.174	+0.244	-0.664	+0.175	+0.226	-0.669	+0.176
3	+0.178	-0.595	+0.318	+0.168	-0.598	+0.320	+0.154	-0.603	+0.323
4	+0.057	-0.499	+0.407	+0.054	-0.501	+0.410	+0.048	-0.505	+0.414
5	-0.080	-0.388	+0.421	-0.075	-0.390	+0.424	-0.074	-0.393	+0.429
6	-0.208	-0.286	+0.347	-0.196	-0.287	+0.350	-0.187	-0.288	+0.356
7	-0.298	-0.215	+0.183	-0.280	-0.215	+0.187	-0.267	-0.215	+0.193
8	-0.312	-0.209	-0.110	-0.294	-0.208	-0.106	-0.282	-0.208	-0.100
9	-0.222	-0.256	-0.478	-0.209	-0.256	-0.474	-0.201	-0.255	-0.468
10	-0.010	-0.380	-0.901	-0.005	-0.382	-0.897	-0.005	-0.384	-0.889
11	+0.088	-0.934	-0.308	+0.065	-0.917	-0.338	+0.033	-0.896	-0.370
12	+0.179	-1.092	-0.403	+0.172	-1.077	-0.441	+0.156	-1.058	-0.487
13	+0.272	-1.246	-0.304	+0.279	-1.239	-0.333	+0.279	-1.228	-0.369
14	+0.314	-1.317	0	+0.328	-1.313	0	+0.335	-1.307	0

NOTE: w represents the weight per unit volume of water in units consistent with those of the radius r.



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

TRIANGULAR INTERNAL RADIAL LOAD - TRIANGULAR FOUNDATION REACTION

SHAPES D, E, AND F

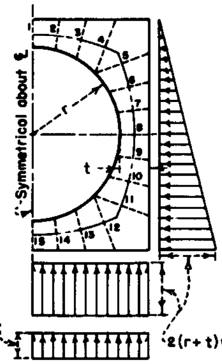
SEP. 28, 1964

X-PEL-1053

SHAPE D

Dead weight of one-half of conduit

$t = \frac{r}{2}$, $7.042\ wr^2$
$t = \frac{r}{3}$, $4.771\ wr^2$
$t = \frac{r}{6}$, $2.768\ wr^2$



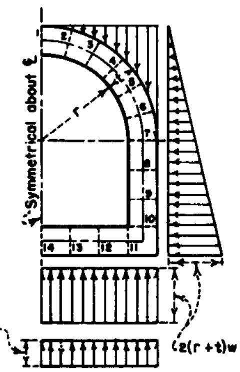
$t = \frac{r}{2}$, $1.695\ wr$
$t = \frac{r}{3}$, $0.912\ wr$
$t = \frac{r}{6}$, $0.039\ wr$

POINT	$t = \frac{r}{2}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t = \frac{r}{3}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	* $t = \frac{r}{6}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.240	+0.943	0	+0.142	+0.768	0	+0.001	+0.612	0
2	+0.205	+0.977	+0.244	+0.123	+0.790	+0.140	−0.004	+0.621	+0.040
3	+0.095	+1.090	+0.529	+0.060	+0.867	+0.322	−0.026	+0.661	+0.124
4	−0.103	+1.315	+0.885	−0.061	+1.030	+0.575	−0.078	+0.762	+0.282
5	−0.181	+2.385	−0.013	−0.081	+1.638	−0.132	−0.065	+0.995	−0.232
6	−0.202	+2.809	+0.059	−0.065	+1.938	−0.057	−0.017	+1.175	−0.158
7	−0.244	+3.173	+0.117	−0.068	+2.169	+0.019	+0.009	+1.285	−0.066
8	−0.290	+3.521	+0.182	−0.092	+2.386	+0.121	+0.007	+1.384	+0.069
9	−0.343	+3.930	+0.265	−0.138	+2.666	+0.256	−0.033	+1.541	+0.253
10	−0.396	+4.478	+0.355	−0.209	+3.082	+0.414	−0.120	+1.830	+0.476
11	−0.417	+5.240	+0.423	−0.284	+3.705	+0.566	−0.244	+2.321	+0.707
12	−0.190	+4.481	−1.982	−0.179	+3.465	−1.346	−0.227	+2.526	−0.700
13	+0.133	+3.977	−1.403	+0.052	+3.099	−0.973	−0.099	+2.308	−0.542
14	+0.366	+3.664	−0.726	+0.221	+2.867	−0.513	+0.000	+2.162	−0.295
15	+0.451	+3.557	0	+0.281	+2.788	0	+0.037	+2.110	0

SHAPE E

Dead weight of one-half of conduit

$t = \frac{r}{2}$, $5.365\ wr^2$
$t = \frac{r}{3}$, $3.338\ wr^2$
$t = \frac{r}{6}$, $1.550\ wr^2$



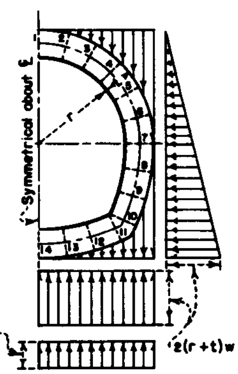
$t = \frac{r}{2}$, $0.899\ wr$
$t = \frac{r}{3}$, $0.123\ wr$
* $t = \frac{r}{6}$, $-0.754\ wr$

POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	* $\frac{M}{wr^3}$	* $\frac{T}{wr^2}$	* $\frac{S}{wr^2}$
1	+0.001	+1.365	0	−0.079	+1.085	0	−0.150	+0.866	0
2	−0.004	+1.421	+0.033	−0.073	+1.112	−0.039	−0.134	+0.866	−0.110
3	−0.016	+1.582	+0.051	−0.054	+1.190	−0.077	−0.089	+0.867	−0.204
4	−0.028	+1.834	+0.040	−0.024	+1.314	−0.113	−0.021	+0.874	−0.268
5	−0.028	+2.150	−0.010	+0.017	+1.473	−0.146	+0.059	+0.890	−0.289
6	−0.005	+2.498	−0.104	+0.068	+1.657	−0.174	+0.139	+0.921	−0.262
7	+0.057	+2.843	−0.240	+0.127	+1.850	−0.197	+0.204	+0.974	−0.185
8	+0.047	+3.244	+0.315	+0.112	+2.117	+0.303	+0.194	+1.107	+0.259
9	−0.166	+3.644	+0.982	−0.088	+2.384	+0.915	+0.018	+1.241	+0.815
10	−0.620	+4.045	+1.760	−0.510	+2.651	+1.637	−0.361	+1.375	+1.482
11	−0.375	+3.135	−2.697	−0.448	+2.470	−1.989	−0.386	+1.857	−1.178
12	+0.374	+3.135	−1.798	+0.104	+2.470	−1.326	−0.059	+1.857	−0.786
13	+0.824	+3.135	−0.899	+0.436	+2.470	−0.663	+0.138	+1.857	−0.393
14	+0.973	+3.135	0	+0.546	+2.470	0	+0.203	+1.857	0

SHAPE F

Dead weight of one-half of conduit

$t = \frac{r}{2}$, $4.879\ wr^2$
$t = \frac{r}{3}$, $3.041\ wr^2$
$t = \frac{r}{6}$, $1.415\ wr^2$

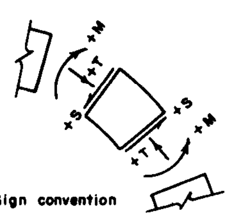


$t = \frac{r}{2}$, $0.794\ wr$
$t = \frac{r}{3}$, $0.088\ wr$
* $t = \frac{r}{6}$, $-0.713\ wr$

POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	* $\frac{M}{wr^3}$	* $\frac{T}{wr^2}$	* $\frac{S}{wr^2}$
1	+0.074	+1.188	0	−0.021	+0.945	0	−0.103	+0.763	0
2	+0.062	+1.250	+0.079	−0.021	+0.977	−0.003	−0.091	+0.767	−0.084
3	+0.027	+1.429	+0.140	−0.018	+1.069	−0.007	−0.057	+0.779	−0.153
4	−0.020	+1.709	+0.165	−0.014	+1.214	−0.014	−0.007	+0.801	−0.195
5	−0.066	+2.061	+0.143	−0.007	+1.403	−0.025	+0.050	+0.839	−0.201
6	−0.096	+2.452	+0.067	+0.005	+1.620	−0.039	+0.103	+0.895	−0.163
7	−0.092	+2.843	−0.063	+0.021	+1.850	−0.056	+0.139	+0.974	−0.083
8	−0.096	+3.205	+0.077	+0.010	+2.098	+0.142	+0.130	+1.112	+0.165
9	−0.156	+3.543	+0.248	−0.069	+2.368	+0.378	+0.043	+1.316	+0.456
10	−0.287	+3.860	+0.461	−0.226	+2.661	+0.647	−0.131	+1.584	+0.772
11	−0.220	+3.539	−1.344	−0.215	+2.655	−0.824	−0.142	+1.820	−0.313
12	+0.124	+3.418	−0.942	−0.002	+2.631	−0.571	−0.060	+1.895	−0.206
13	+0.338	+3.339	−0.485	+0.130	+2.616	−0.292	−0.011	+1.943	−0.102
14	+0.411	+3.312	0	+0.175	+2.611	0	+0.005	+1.959	0

NOTES: w represents the weight per unit volume of water in units consistent with those of the radius r.
The assumed weight per unit volume of the conduit is 150w/62.4.

* Tension is assumed to develop at the foundation. For the assumption that the conduits float see Figure 49.



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

TRIANGULAR EXTERNAL HYDROSTATIC LOAD INCLUDING DEAD LOAD

SHAPES D, E, AND F

REV. APR. 15, 1968

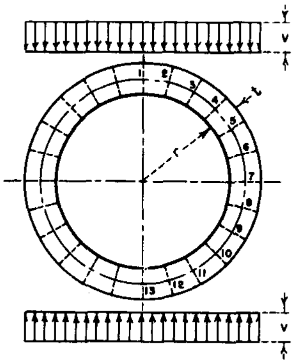
SEP. 28, 1964

X-PEL-1054

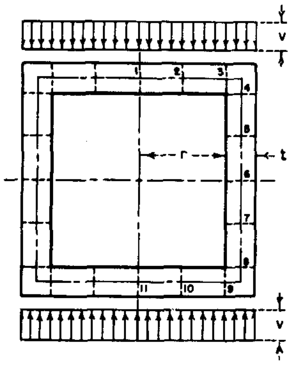
FIGURE 34

	$t = \frac{r}{2}$			$t = \frac{r}{3}$			$t = \frac{r}{6}$		
POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.375	0	0	+0.333	0	0	+0.292	0	0
2	+0.325	+0.100	+0.375	+0.289	+0.089	+0.333	+0.253	+0.078	+0.292
3	+0.188	+0.375	+0.650	+0.167	+0.333	+0.577	+0.146	+0.292	+0.505
4	0	+0.750	+0.750	0	+0.667	+0.667	0	+0.583	+0.583
5	-0.188	+1.125	+0.650	-0.167	+1.000	+0.577	-0.146	+0.875	+0.505
6	-0.325	+1.400	+0.375	-0.289	+1.244	+0.333	-0.253	+1.089	+0.292
7	-0.375	+1.500	0	-0.333	+1.333	0	-0.292	+1.167	0
8	-0.325	+1.400	-0.375	-0.289	+1.244	-0.333	-0.253	+1.089	-0.292
9	-0.188	+1.125	-0.650	-0.167	+1.000	-0.577	-0.146	+0.875	-0.505
10	0	+0.750	-0.750	0	+0.667	-0.667	0	+0.583	-0.583
11	+0.188	+0.375	-0.650	+0.167	+0.333	-0.577	+0.146	+0.292	-0.505
12	+0.325	+0.100	-0.375	+0.289	+0.089	-0.333	+0.253	+0.078	-0.292
13	+0.375	0	0	+0.333	0	0	+0.292	0	0

CIRCULAR

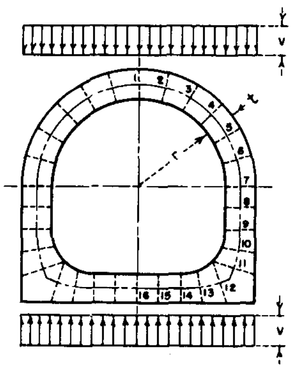


SQUARE

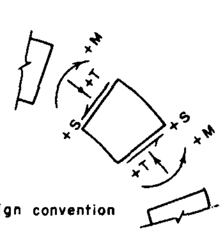


POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.505	0	0	+0.447	0	0	+0.390	0	0
2	+0.380	0	+0.500	+0.322	0	+0.500	+0.265	0	+0.500
3	+0.005	0	+1.000	-0.053	0	+1.000	-0.110	0	+1.000
4	-0.245	+1.500	0	-0.220	+1.333	0	-0.194	+1.167	0
5	-0.245	+1.500	0	-0.220	+1.333	0	-0.194	+1.167	0
6	-0.245	+1.500	0	-0.220	+1.333	0	-0.194	+1.167	0
7	-0.245	+1.500	0	-0.220	+1.333	0	-0.194	+1.167	0
8	-0.245	+1.500	0	-0.220	+1.333	0	-0.194	+1.167	0
9	+0.005	0	-1.000	-0.053	0	-1.000	-0.110	0	-1.000
10	+0.380	0	-0.500	+0.322	0	-0.500	+0.265	0	-0.500
11	+0.505	0	0	+0.447	0	0	+0.390	0	0

SHAPE G



POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.358	+0.031	0	+0.330	+0.026	0	+0.291	+0.021	0
2	+0.319	+0.130	+0.367	+0.286	+0.115	+0.326	+0.253	+0.098	+0.286
3	+0.185	+0.402	+0.634	+0.167	+0.356	+0.564	+0.148	+0.310	+0.495
4	+0.004	+0.772	+0.728	+0.006	+0.685	+0.648	+0.006	+0.598	+0.569
5	-0.176	+1.140	+0.623	-0.155	+1.013	+0.554	-0.135	+0.885	+0.487
6	-0.303	+1.408	+0.345	-0.269	+1.251	+0.308	-0.236	+1.094	+0.271
7	-0.344	+1.500	-0.031	-0.306	+1.333	-0.026	-0.269	+1.167	-0.021
8	-0.336	+1.500	-0.031	-0.299	+1.333	-0.026	-0.264	+1.167	-0.021
9	-0.328	+1.500	-0.031	-0.293	+1.333	-0.026	-0.259	+1.167	-0.021
10	-0.293	+1.476	-0.267	-0.262	+1.311	-0.247	-0.233	+1.145	-0.225
11	-0.204	+1.416	-0.496	-0.184	+1.252	-0.460	-0.165	+1.088	-0.422
12	-0.012	+0.302	-1.022	-0.045	+0.308	-0.972	-0.078	+0.315	-0.916
13	+0.177	+0.091	-0.771	+0.132	+0.099	-0.746	+0.085	+0.107	-0.719
14	+0.320	-0.031	-0.500	+0.267	-0.026	-0.500	+0.212	-0.021	-0.500
15	+0.414	-0.031	-0.250	+0.360	-0.026	-0.250	+0.305	-0.021	-0.250
16	+0.445	-0.031	0	+0.392	-0.026	0	+0.337	-0.021	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

UNIFORM VERTICAL LOAD – UNIFORM FOUNDATION REACTION

SHAPES CIRCULAR, SQUARE, AND G

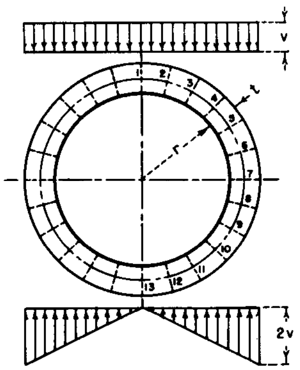
REV. APR. 15, 1968

SEP. 28, 1964

X-PEL-1055

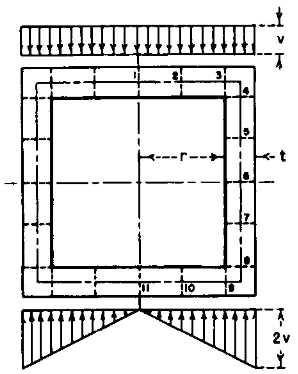
FIGURE 35

CIRCULAR



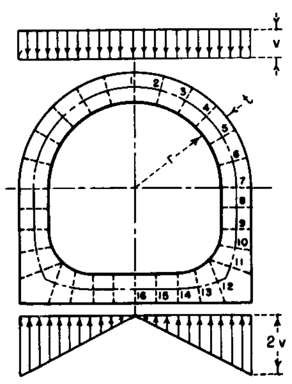
POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.323	+0.110	0	+0.289	+0.090	0	+0.259	+0.072	0
2	+0.278	+0.207	+0.347	+0.248	+0.176	+0.310	+0.222	+0.147	+0.273
3	+0.154	+0.470	+0.595	+0.136	+0.411	+0.532	+0.123	+0.354	+0.469
4	-0.012	+0.828	+0.672	-0.014	+0.730	+0.603	-0.010	+0.634	+0.533
5	-0.171	+1.180	+0.554	-0.159	+1.045	+0.499	-0.140	+0.911	+0.443
6	-0.275	+1.428	+0.269	-0.255	+1.267	+0.246	-0.228	+1.107	+0.223
7	-0.290	+1.500	-0.110	-0.273	+1.333	-0.090	-0.247	+1.167	-0.072
8	-0.217	+1.323	-0.468	-0.209	+1.178	-0.409	-0.192	+1.033	-0.351
9	-0.090	+0.919	-0.658	-0.090	+0.821	-0.578	-0.083	+0.722	-0.500
10	+0.050	+0.453	-0.608	+0.041	+0.408	-0.535	+0.038	+0.362	-0.463
11	+0.157	+0.092	-0.380	+0.142	+0.089	-0.334	+0.132	+0.084	-0.288
12	+0.211	-0.080	-0.125	+0.193	-0.064	-0.110	+0.178	-0.049	-0.094
13	+0.223	-0.110	0	+0.203	-0.090	0	+0.187	-0.072	0

SQUARE

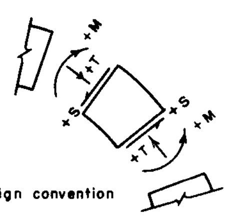


POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.477	+0.071	0	+0.425	+0.056	0	+0.374	+0.043	0
2	+0.352	+0.071	+0.500	+0.300	+0.056	+0.500	+0.249	+0.043	+0.500
3	-0.023	+0.071	+1.000	-0.075	+0.056	+1.000	-0.126	+0.043	+1.000
4	-0.256	+1.500	-0.071	-0.233	+1.333	-0.056	-0.206	+1.167	-0.043
5	-0.220	+1.500	-0.071	-0.204	+1.333	-0.056	-0.185	+1.167	-0.043
6	-0.185	+1.500	-0.071	-0.176	+1.333	-0.056	-0.163	+1.167	-0.043
7	-0.149	+1.500	-0.071	-0.148	+1.333	-0.056	-0.141	+1.167	-0.043
8	-0.113	+1.500	-0.071	-0.120	+1.333	-0.056	-0.120	+1.167	-0.043
9	+0.057	-0.071	-0.667	+0.010	-0.056	-0.750	-0.045	-0.043	-0.857
10	+0.252	-0.071	-0.167	+0.229	-0.056	-0.188	+0.205	-0.043	-0.214
11	+0.279	-0.071	0	+0.260	-0.056	0	+0.240	-0.043	0

SHAPE G



POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.322	+0.124	0	+0.292	+0.105	0	+0.260	+0.085	0
2	+0.277	+0.220	+0.343	+0.252	+0.190	+0.306	+0.224	+0.161	+0.270
3	+0.155	+0.482	+0.587	+0.142	+0.424	+0.525	+0.127	+0.366	+0.463
4	-0.008	+0.838	+0.662	-0.005	+0.741	+0.593	-0.004	+0.644	+0.523
5	-0.163	+1.187	+0.542	-0.147	+1.052	+0.487	-0.131	+0.918	+0.431
6	-0.263	+1.432	+0.255	-0.239	+1.271	+0.232	-0.215	+1.111	+0.209
7	-0.273	+1.500	-0.124	-0.252	+1.333	-0.105	-0.231	+1.167	-0.085
8	-0.242	+1.500	-0.124	-0.226	+1.333	-0.105	-0.209	+1.167	-0.085
9	-0.211	+1.500	-0.124	-0.200	+1.333	-0.105	-0.188	+1.167	-0.085
10	-0.155	+1.462	-0.359	-0.152	+1.298	-0.324	-0.149	+1.134	-0.288
11	-0.044	+1.387	-0.584	-0.057	+1.226	-0.534	-0.068	+1.066	-0.483
12	+0.059	+0.117	-0.757	+0.032	+0.155	-0.771	-0.001	+0.198	-0.784
13	+0.168	-0.059	-0.415	+0.145	-0.033	-0.436	+0.115	-0.005	-0.461
14	+0.229	-0.124	-0.167	+0.209	-0.105	-0.188	+0.183	-0.085	-0.214
15	+0.253	-0.124	-0.042	+0.236	-0.105	-0.047	+0.214	-0.085	-0.054
16	+0.257	-0.124	0	+0.240	-0.105	0	+0.218	-0.085	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

UNIFORM VERTICAL LOAD – TRIANGULAR FOUNDATION REACTION

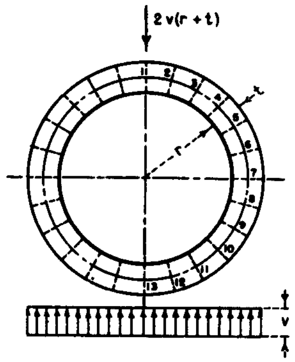
SHAPES CIRCULAR, SQUARE, AND G

REV. APR. 15, 1968

SEP. 28, 1964

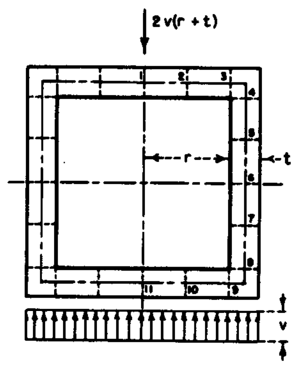
X-PEL-1056

CIRCULAR



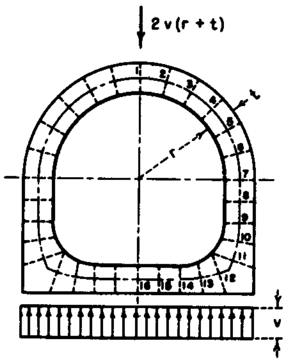
POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.077	+0.217	+1.500	+0.903	+0.178	+1.333	+0.735	+0.142	+1.167
2	+0.601	+0.598	+1.393	+0.508	+0.517	+1.242	+0.413	+0.439	+1.090
3	+0.176	+0.938	+1.190	+0.154	+0.821	+1.065	+0.123	+0.706	+0.939
4	-0.170	+1.214	+0.907	-0.135	+1.069	+0.817	-0.114	+0.926	+0.724
5	-0.411	+1.408	+0.562	-0.339	+1.244	+0.512	-0.283	+1.081	+0.460
6	-0.533	+1.505	+0.178	-0.444	+1.334	+0.173	-0.372	+1.164	+0.165
7	-0.527	+1.500	-0.217	-0.443	+1.333	-0.178	-0.375	+1.167	-0.142
8	-0.406	+1.343	-0.585	-0.345	+1.198	-0.506	-0.296	+1.052	-0.429
9	-0.204	+1.016	-0.838	-0.173	+0.911	-0.732	-0.152	+0.804	-0.628
10	+0.040	+0.596	-0.904	+0.037	+0.540	-0.793	+0.025	+0.483	-0.684
11	+0.271	+0.187	-0.758	+0.237	+0.179	-0.667	+0.196	+0.169	-0.576
12	+0.435	-0.109	-0.431	+0.380	-0.083	-0.380	+0.318	-0.059	-0.328
13	+0.495	-0.217	0	+0.431	-0.178	0	+0.362	-0.142	0

SQUARE

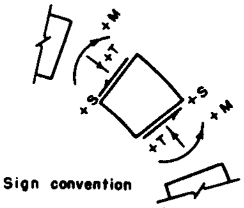


POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.321	+0.142	+1.500	+1.102	+0.113	+1.333	+0.910	+0.086	+1.167
2	+0.571	+0.142	+1.500	+0.435	+0.113	+1.333	+0.327	+0.086	+1.167
3	-0.179	+0.142	+1.500	-0.232	+0.113	+1.333	-0.257	+0.086	+1.167
4	-0.518	+1.500	-0.142	-0.435	+1.333	-0.113	-0.347	+1.167	-0.086
5	-0.447	+1.500	-0.142	-0.378	+1.333	-0.113	-0.304	+1.167	-0.086
6	-0.376	+1.500	-0.142	-0.322	+1.333	-0.113	-0.261	+1.167	-0.086
7	-0.305	+1.500	-0.142	-0.265	+1.333	-0.113	-0.218	+1.167	-0.086
8	-0.234	+1.500	-0.142	-0.208	+1.333	-0.113	-0.176	+1.167	-0.086
9	+0.052	-0.142	-1.000	-0.023	-0.113	-1.000	-0.085	-0.086	-1.000
10	+0.427	-0.142	-0.500	+0.352	-0.113	-0.500	+0.290	-0.086	-0.500
11	+0.552	-0.142	0	+0.477	-0.113	0	+0.415	-0.086	0

SHAPE G



POINT	$t = \frac{r}{2}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{3}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{6}$: $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.069	+0.234	+1.500	+0.900	+0.200	+1.333	+0.734	+0.160	+1.167
2	+0.593	+0.614	+1.388	+0.505	+0.538	+1.236	+0.413	+0.457	+1.085
3	+0.170	+0.953	+1.182	+0.153	+0.839	+1.055	+0.126	+0.722	+0.930
4	-0.172	+1.226	+0.895	-0.132	+1.084	+0.802	-0.109	+0.938	+0.711
5	-0.409	+1.416	+0.547	-0.331	+1.254	+0.494	-0.273	+1.091	+0.444
6	-0.526	+1.509	+0.162	-0.430	+1.340	+0.152	-0.358	+1.168	+0.147
7	-0.514	+1.500	-0.234	-0.423	+1.333	-0.200	-0.356	+1.167	-0.160
8	-0.456	+1.500	-0.234	-0.373	+1.333	-0.200	-0.316	+1.167	-0.160
9	-0.397	+1.500	-0.234	-0.323	+1.333	-0.200	-0.276	+1.167	-0.160
10	-0.315	+1.444	-0.467	-0.255	+1.282	-0.417	-0.221	+1.120	-0.363
11	-0.180	+1.353	-0.689	-0.139	+1.195	-0.624	-0.124	+1.040	-0.553
12	+0.057	+0.109	-1.085	+0.027	+0.144	-1.029	-0.024	+0.184	-0.965
13	+0.257	-0.109	-0.802	+0.213	-0.072	-0.775	+0.147	-0.031	-0.744
14	+0.403	-0.234	-0.500	+0.351	-0.200	-0.500	+0.276	-0.160	-0.500
15	+0.497	-0.234	-0.250	+0.445	-0.200	-0.250	+0.370	-0.160	-0.250
16	+0.528	-0.234	0	+0.476	-0.200	0	+0.401	-0.160	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

CONCENTRATED VERTICAL LOAD - UNIFORM FOUNDATION REACTION

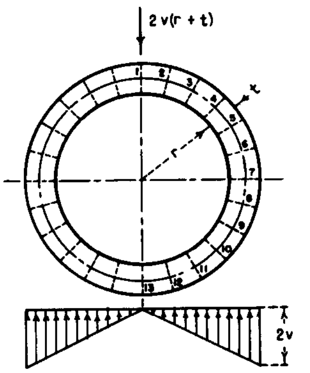
SHAPES CIRCULAR, SQUARE, AND G

REV. APR. 15, 1968

SEP. 28, 1964

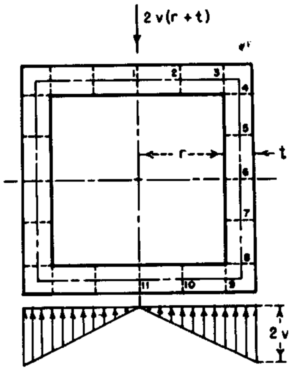
X-PEL-1057

CIRCULAR



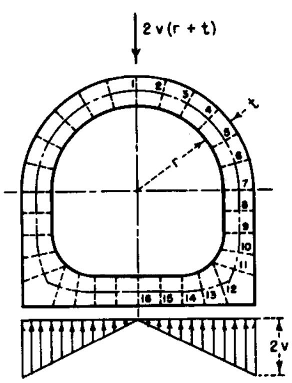
	$t = \frac{r}{2}$			$t = \frac{r}{3}$			$t = \frac{r}{6}$		
POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.025	+0.327	+1.500	+0.859	+0.269	+1.333	+0.702	+0.214	+1.167
2	+0.554	+0.704	+1.364	+0.467	+0.605	+1.218	+0.383	+0.508	+1.072
3	+0.143	+1.033	+1.136	+0.123	+0.899	+1.020	+0.101	+0.768	+0.903
4	-0.181	+1.292	+0.829	-0.149	+1.133	+0.753	-0.124	+0.976	+0.674
5	-0.394	+1.463	+0.467	-0.331	+1.289	+0.434	-0.277	+1.117	+0.398
6	-0.483	+1.534	+0.072	-0.412	+1.357	+0.086	-0.347	+1.182	+0.095
7	-0.441	+1.500	-0.327	-0.383	+1.333	-0.269	-0.330	+1.167	-0.214
8	-0.298	+1.267	-0.678	-0.265	+1.132	-0.581	-0.235	+0.996	-0.488
9	-0.105	+0.811	-0.846	-0.097	+0.732	-0.733	-0.090	+0.651	-0.623
10	+0.091	+0.299	-0.762	+0.078	+0.281	-0.661	+0.064	+0.261	-0.564
11	+0.241	-0.096	-0.488	+0.212	-0.066	-0.423	+0.182	-0.039	-0.359
12	+0.322	-0.290	-0.182	+0.284	-0.236	-0.156	+0.244	-0.186	-0.131
13	+0.343	-0.327	0	+0.301	-0.269	0	+0.258	-0.214	0

SQUARE

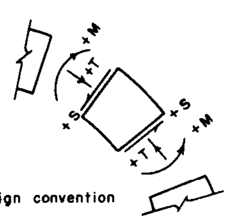


POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.293	+0.213	+1.500	+1.080	+0.170	+1.333	+0.894	+0.129	+1.167
2	+0.543	+0.213	+1.500	+0.413	+0.170	+1.333	+0.311	+0.129	+1.167
3	-0.207	+0.213	+1.500	-0.253	+0.170	+1.333	-0.272	+0.129	+1.167
4	-0.529	+1.500	-0.213	-0.447	+1.333	-0.170	-0.359	+1.167	-0.129
5	-0.422	+1.500	-0.213	-0.363	+1.333	-0.170	-0.295	+1.167	-0.129
6	-0.316	+1.500	-0.213	-0.278	+1.333	-0.170	-0.230	+1.167	-0.129
7	-0.209	+1.500	-0.213	-0.193	+1.333	-0.170	-0.166	+1.167	-0.129
8	-0.102	+1.500	-0.213	-0.108	+1.333	-0.170	-0.102	+1.167	-0.129
9	+0.104	-0.213	-0.667	+0.041	-0.170	-0.750	-0.020	-0.129	-0.857
10	+0.298	-0.213	-0.167	+0.259	-0.170	-0.188	+0.230	-0.129	-0.214
11	+0.326	-0.213	0	+0.291	-0.170	0	+0.266	-0.129	0

SHAPE G



POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+1.023	+0.327	+1.500	+0.862	+0.278	+1.333	+0.703	+0.225	+1.167
2	+0.551	+0.704	+1.364	+0.470	+0.613	+1.216	+0.385	+0.519	+1.069
3	+0.140	+1.033	+1.136	+0.128	+0.907	+1.016	+0.104	+0.778	+0.898
4	-0.183	+1.292	+0.829	-0.143	+1.139	+0.746	-0.119	+0.984	+0.666
5	-0.397	+1.463	+0.467	-0.323	+1.294	+0.426	-0.269	+1.123	+0.389
6	-0.486	+1.534	+0.072	-0.400	+1.360	+0.077	-0.337	+1.185	+0.085
7	-0.444	+1.500	-0.327	-0.370	+1.333	-0.278	-0.317	+1.167	-0.225
8	-0.362	+1.500	-0.327	-0.300	+1.333	-0.278	-0.261	+1.167	-0.225
9	-0.280	+1.500	-0.327	-0.231	+1.333	-0.278	-0.204	+1.167	-0.225
10	-0.176	+1.430	-0.559	-0.145	+1.269	-0.494	-0.136	+1.109	-0.426
11	-0.020	+1.324	-0.777	-0.012	+1.170	-0.698	-0.027	+1.017	-0.614
12	+0.128	-0.076	-0.820	+0.104	-0.008	-0.827	+0.053	+0.067	-0.833
13	+0.248	-0.260	-0.447	+0.226	-0.204	-0.465	+0.178	-0.142	-0.485
14	+0.312	-0.327	-0.167	+0.294	-0.278	-0.188	+0.248	-0.225	-0.214
15	+0.337	-0.327	-0.042	+0.321	-0.278	-0.047	+0.279	-0.225	-0.054
16	+0.340	-0.327	0	+0.325	-0.278	0	+0.283	-0.225	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

CONCENTRATED VERTICAL LOAD – TRIANGULAR FOUNDATION REACTION

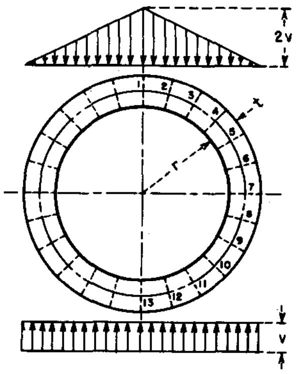
SHAPES CIRCULAR, SQUARE, AND G

REV. APR. 15, 1968

SEP. 28, 1964

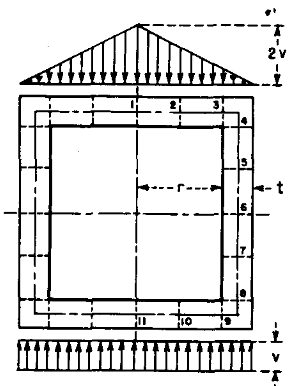
X-PEL-1058

CIRCULAR



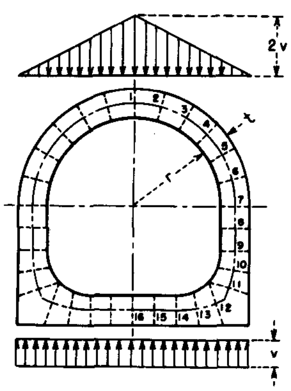
POINT	$t = \frac{r}{2}$ $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{3}$ $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$t = \frac{r}{6}$ $\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.530	+0.110	0	+0.464	+0.090	0	+0.397	+0.072	0
2	+0.441	+0.281	+0.625	+0.384	+0.243	+0.557	+0.328	+0.205	+0.489
3	+0.220	+0.658	+0.919	+0.191	+0.578	+0.821	+0.160	+0.500	+0.722
4	-0.047	+1.047	+0.892	-0.041	+0.926	+0.798	-0.038	+0.805	+0.704
5	-0.283	+1.331	+0.641	-0.243	+1.179	+0.577	-0.208	+1.028	+0.511
6	-0.430	+1.476	+0.282	-0.369	+1.310	+0.258	-0.313	+1.144	+0.232
7	-0.458	+1.500	-0.110	-0.394	+1.333	-0.090	-0.336	+1.167	-0.072
8	-0.372	+1.371	-0.481	-0.322	+1.221	-0.420	-0.277	+1.070	-0.361
9	-0.201	+1.070	-0.745	-0.175	+0.955	-0.655	-0.151	+0.839	-0.567
10	+0.014	+0.672	-0.828	+0.014	+0.603	-0.730	+0.011	+0.533	-0.634
11	+0.223	+0.280	-0.704	+0.197	+0.255	-0.622	+0.169	+0.230	-0.541
12	+0.374	-0.006	-0.403	+0.329	+0.002	-0.357	+0.283	+0.009	-0.310
13	+0.429	-0.110	0	+0.378	-0.090	0	+0.325	-0.072	0

SQUARE

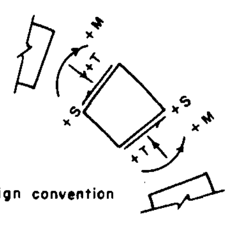


POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.734	+0.071	0	+0.636	+0.056	0	+0.539	+0.043	0
2	+0.512	+0.071	+0.833	+0.417	+0.056	+0.812	+0.324	+0.043	+0.786
3	-0.044	+0.071	+1.333	-0.114	+0.056	+1.250	-0.176	+0.043	+1.143
4	-0.373	+1.500	-0.071	-0.318	+1.333	-0.056	-0.268	+1.167	-0.043
5	-0.338	+1.500	-0.071	-0.290	+1.333	-0.056	-0.246	+1.167	-0.043
6	-0.302	+1.500	-0.071	-0.261	+1.333	-0.056	-0.225	+1.167	-0.043
7	-0.267	+1.500	-0.071	-0.233	+1.333	-0.056	-0.203	+1.167	-0.043
8	-0.231	+1.500	-0.071	-0.205	+1.333	-0.056	-0.182	+1.167	-0.043
9	+0.036	-0.071	-1.000	-0.029	-0.056	-1.000	-0.095	-0.043	-1.000
10	+0.411	-0.071	-0.500	+0.346	-0.056	-0.500	+0.280	-0.043	-0.500
11	+0.536	-0.071	0	+0.471	-0.056	0	+0.405	-0.043	0

SHAPE G



POINT	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$	$\frac{M}{vr^2}$	$\frac{T}{vr}$	$\frac{S}{vr}$
1	+0.525	+0.136	0	+0.461	+0.113	0	+0.397	+0.089	0
2	+0.437	+0.307	+0.618	+0.383	+0.265	+0.551	+0.328	+0.222	+0.485
3	+0.219	+0.681	+0.906	+0.192	+0.598	+0.810	+0.163	+0.515	+0.713
4	-0.043	+1.066	+0.873	-0.036	+0.942	+0.782	-0.032	+0.817	+0.691
5	-0.272	+1.344	+0.618	-0.232	+1.190	+0.557	-0.198	+1.037	+0.496
6	-0.411	+1.482	+0.256	-0.351	+1.316	+0.236	-0.299	+1.149	+0.210
7	-0.430	+1.500	-0.136	-0.370	+1.333	-0.113	-0.317	+1.167	-0.089
8	-0.396	+1.500	-0.136	-0.342	+1.333	-0.113	-0.294	+1.167	-0.089
9	-0.362	+1.500	-0.136	-0.314	+1.333	-0.113	-0.272	+1.167	-0.089
10	-0.302	+1.460	-0.371	-0.264	+1.296	-0.332	-0.232	+1.133	-0.292
11	-0.189	+1.383	-0.596	-0.167	+1.223	-0.542	-0.150	+1.064	-0.486
12	+0.026	+0.202	-1.055	-0.015	+0.226	-1.000	-0.057	+0.251	-0.940
13	+0.221	-0.013	-0.787	+0.167	+0.013	-0.761	+0.110	+0.040	-0.731
14	+0.366	-0.136	-0.500	+0.303	-0.113	-0.500	+0.238	-0.089	-0.500
15	+0.459	-0.136	-0.250	+0.397	-0.113	-0.250	+0.332	-0.089	-0.250
16	+0.490	-0.136	0	+0.428	-0.113	0	+0.363	-0.089	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

TRIANGULAR VERTICAL LOAD – UNIFORM FOUNDATION REACTION

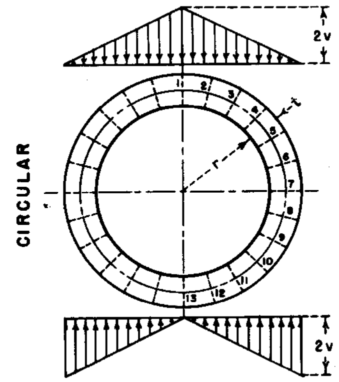
SHAPES CIRCULAR, SQUARE, AND G

REV. APR. 15, 1968

SEP. 28, 1964

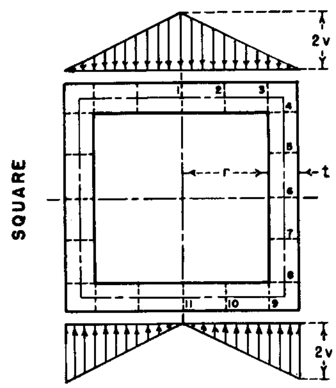
X-PEL-1059

CIRCULAR



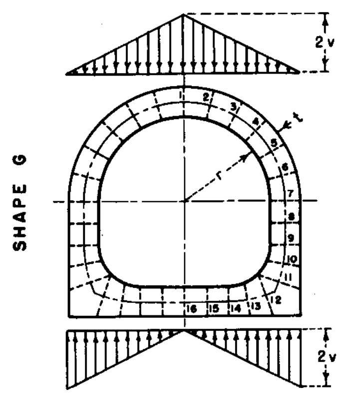
POINT	t = r/2: $\frac{M}{vr^2}$	t = r/2: $\frac{T}{vr}$	t = r/2: $\frac{S}{vr}$	t = r/3: $\frac{M}{vr^2}$	t = r/3: $\frac{T}{vr}$	t = r/3: $\frac{S}{vr}$	t = r/6: $\frac{M}{vr^2}$	t = r/6: $\frac{T}{vr}$	t = r/6: $\frac{S}{vr}$
1	+0.479	+0.220	0	+0.419	+0.180	0	+0.364	+0.143	0
2	+0.394	+0.387	+0.596	+0.343	+0.330	+0.534	+0.297	+0.274	+0.471
3	+0.187	+0.753	+0.865	+0.160	+0.656	+0.776	+0.138	+0.562	+0.686
4	-0.058	+1.125	+0.814	-0.055	+0.989	+0.734	-0.048	+0.855	+0.653
5	-0.266	+1.385	+0.546	-0.235	+1.224	+0.499	-0.202	+1.064	+0.449
6	-0.380	+1.504	+0.176	-0.335	+1.333	+0.171	-0.288	+1.163	+0.163
7	-0.372	+1.500	-0.220	-0.334	+1.333	-0.180	-0.291	+1.167	-0.143
8	-0.264	+1.295	-0.574	-0.243	+1.155	-0.496	-0.216	+1.014	-0.420
9	-0.103	+0.865	-0.753	-0.099	+0.776	-0.656	-0.089	+0.686	-0.562
10	+0.064	+0.375	-0.686	+0.055	+0.344	-0.599	+0.049	+0.311	-0.514
11	+0.194	-0.003	-0.435	+0.173	+0.011	-0.379	+0.155	+0.022	-0.324
12	+0.262	-0.186	-0.154	+0.234	-0.151	-0.133	+0.209	-0.118	-0.113
13	+0.277	-0.220	0	+0.247	-0.180	0	+0.221	-0.143	0

SQUARE

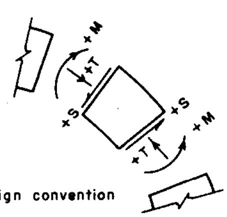


POINT	t = r/2: $\frac{M}{vr^2}$	t = r/2: $\frac{T}{vr}$	t = r/2: $\frac{S}{vr}$	t = r/3: $\frac{M}{vr^2}$	t = r/3: $\frac{T}{vr}$	t = r/3: $\frac{S}{vr}$	t = r/6: $\frac{M}{vr^2}$	t = r/6: $\frac{T}{vr}$	t = r/6: $\frac{S}{vr}$
1	+0.705	+0.142	0	+0.614	+0.113	0	+0.523	+0.086	0
2	+0.483	+0.142	+0.833	+0.395	+0.113	+0.812	+0.308	+0.086	+0.786
3	-0.072	+0.142	+1.333	-0.136	+0.113	+1.250	-0.192	+0.086	+1.143
4	-0.384	+1.500	-0.142	-0.330	+1.333	-0.113	-0.280	+1.167	-0.086
5	-0.313	+1.500	-0.142	-0.274	+1.333	-0.113	-0.237	+1.167	-0.086
6	-0.242	+1.500	-0.142	-0.217	+1.333	-0.113	-0.194	+1.167	-0.086
7	-0.171	+1.500	-0.142	-0.161	+1.333	-0.113	-0.151	+1.167	-0.086
8	-0.100	+1.500	-0.142	-0.104	+1.333	-0.113	-0.108	+1.167	-0.086
9	+0.088	-0.142	-0.667	+0.035	-0.113	-0.750	-0.030	-0.086	-0.857
10	+0.283	-0.142	-0.167	+0.253	-0.113	-0.188	+0.220	-0.086	-0.214
11	+0.311	-0.142	0	+0.285	-0.113	0	+0.256	-0.086	0

SHAPE G



POINT	t = r/2: $\frac{M}{vr^2}$	t = r/2: $\frac{T}{vr}$	t = r/2: $\frac{S}{vr}$	t = r/3: $\frac{M}{vr^2}$	t = r/3: $\frac{T}{vr}$	t = r/3: $\frac{S}{vr}$	t = r/6: $\frac{M}{vr^2}$	t = r/6: $\frac{T}{vr}$	t = r/6: $\frac{S}{vr}$
1	+0.479	+0.229	0	+0.423	+0.191	0	+0.366	+0.153	0
2	+0.395	+0.397	+0.594	+0.348	+0.340	+0.531	+0.300	+0.284	+0.468
3	+0.189	+0.761	+0.860	+0.166	+0.666	+0.770	+0.141	+0.570	+0.681
4	-0.055	+1.132	+0.807	-0.047	+0.997	+0.727	-0.042	+0.863	+0.646
5	-0.259	+1.390	+0.538	-0.224	+1.230	+0.489	-0.194	+1.069	+0.440
6	-0.370	+1.507	+0.166	-0.322	+1.336	+0.160	-0.278	+1.165	+0.154
7	-0.360	+1.500	-0.229	-0.317	+1.333	-0.191	-0.278	+1.167	-0.153
8	-0.302	+1.500	-0.229	-0.269	+1.333	-0.191	-0.239	+1.167	-0.153
9	-0.245	+1.500	-0.229	-0.221	+1.333	-0.191	-0.201	+1.167	-0.153
10	-0.164	+1.445	-0.463	-0.154	+1.283	-0.409	-0.148	+1.122	-0.356
11	-0.030	+1.354	-0.684	-0.040	+1.198	-0.616	-0.053	+1.042	-0.547
12	+0.097	+0.017	-0.790	+0.063	+0.074	-0.799	+0.020	+0.134	-0.808
13	+0.212	-0.163	-0.432	+0.180	-0.118	-0.450	+0.140	-0.072	-0.473
14	+0.274	-0.229	-0.167	+0.246	-0.191	-0.188	+0.209	-0.153	-0.214
15	+0.299	-0.229	-0.042	+0.273	-0.191	-0.047	+0.240	-0.153	-0.054
16	+0.302	-0.229	0	+0.277	-0.191	0	+0.245	-0.153	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

TRIANGULAR VERTICAL LOAD - TRIANGULAR FOUNDATION REACTION

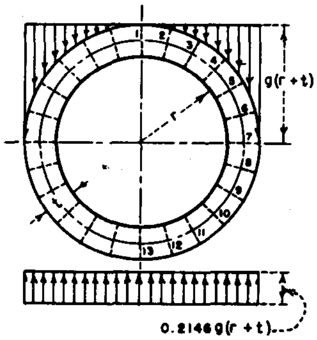
SHAPES CIRCULAR, SQUARE, AND G

REV. APR. 15, 1968

SEP. 28, 1964

X-PEL-1060

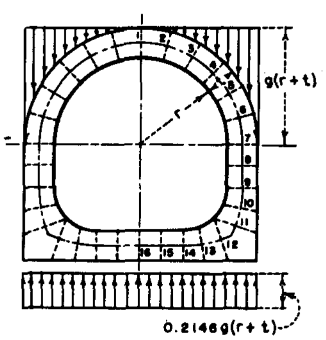
CIRCULAR



POINT	$t = \frac{r}{2}$: $\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$	$t = \frac{r}{3}$: $\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$	$t = \frac{r}{6}$: $\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$
1	+0.051	-0.066	0	+0.043	-0.048	0	+0.035	-0.033	0
2	+0.048	-0.062	+0.023	+0.041	-0.045	+0.017	+0.033	-0.031	+0.012
3	+0.037	-0.032	+0.075	+0.033	-0.022	+0.057	+0.027	-0.014	+0.042
4	+0.016	+0.056	+0.149	+0.014	+0.047	+0.115	+0.012	+0.039	+0.085
5	-0.015	+0.213	+0.199	-0.013	+0.170	+0.153	-0.012	+0.132	+0.114
6	-0.047	+0.388	+0.172	-0.042	+0.308	+0.132	-0.037	+0.237	+0.098
7	-0.072	+0.483	+0.066	-0.063	+0.382	+0.048	-0.053	+0.292	+0.033
8	-0.077	+0.468	-0.057	-0.064	+0.368	-0.049	-0.052	+0.281	-0.041
9	-0.053	+0.395	-0.152	-0.043	+0.310	-0.124	-0.034	+0.236	-0.098
10	-0.009	+0.288	-0.195	-0.007	+0.225	-0.157	-0.005	+0.169	-0.123
11	+0.038	+0.178	-0.176	+0.032	+0.137	-0.141	+0.026	+0.102	-0.110
12	+0.074	+0.096	-0.104	+0.062	+0.072	-0.083	+0.049	+0.052	-0.064
13	+0.087	+0.066	0	+0.072	+0.048	0	+0.057	+0.033	0

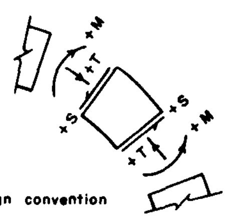
Note: No vertical arch load on square shape.

SHAPE G



NOTE: g represents the weight per unit volume of soil cover on the arch of the conduit section in units consistent with those of the radius r.

POINT	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$	$\frac{M}{gr^3}$	$\frac{T}{gr^2}$	$\frac{S}{gr^2}$
1	+0.048	-0.053	0	+0.042	-0.038	0	+0.035	-0.027	0
2	+0.045	-0.049	+0.020	+0.040	-0.036	+0.015	+0.033	-0.025	+0.011
3	+0.036	-0.021	+0.069	+0.033	-0.014	+0.053	+0.028	-0.008	+0.039
4	+0.017	+0.065	+0.140	+0.016	+0.054	+0.108	+0.014	+0.043	+0.081
5	-0.011	+0.219	+0.188	-0.009	+0.175	+0.145	-0.008	+0.135	+0.109
6	-0.039	+0.391	+0.160	-0.036	+0.310	+0.123	-0.032	+0.238	+0.091
7	-0.060	+0.483	+0.053	-0.053	+0.382	+0.038	-0.046	+0.292	+0.027
8	-0.073	+0.483	+0.053	-0.063	+0.382	+0.038	-0.053	+0.292	+0.027
9	-0.086	+0.483	+0.053	-0.072	+0.382	+0.038	-0.059	+0.292	+0.027
10	-0.090	+0.485	-0.024	-0.074	+0.383	-0.025	-0.059	+0.292	-0.025
11	-0.075	+0.475	-0.100	-0.061	+0.373	-0.088	-0.049	+0.283	-0.076
12	-0.027	+0.157	-0.309	-0.029	+0.131	-0.263	-0.030	+0.109	-0.218
13	+0.030	+0.092	-0.238	+0.020	+0.073	-0.206	+0.009	+0.058	-0.175
14	+0.075	+0.053	-0.161	+0.057	+0.038	-0.143	+0.040	+0.027	-0.125
15	+0.106	+0.053	-0.080	+0.084	+0.038	-0.072	+0.063	+0.027	-0.063
16	+0.116	+0.053	0	+0.093	+0.038	0	+0.071	+0.027	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

VERTICAL ARCH LOAD - UNIFORM FOUNDATION REACTION

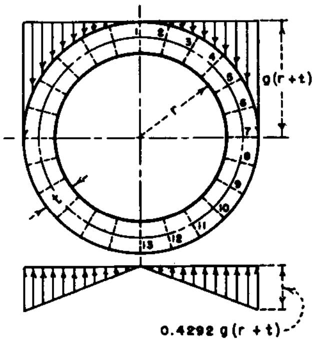
SHAPES CIRCULAR, SQUARE, AND G

REV. APR. 15, 1968

SEP. 28, 1964

X-PEL-1061

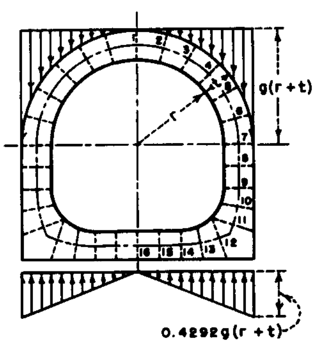
CIRCULAR



POINT	$t = \frac{r}{2}$ $\frac{M}{gr^3}$	$t = \frac{r}{2}$ $\frac{T}{gr^2}$	$t = \frac{r}{2}$ $\frac{S}{gr^2}$	$t = \frac{r}{3}$ $\frac{M}{gr^3}$	$t = \frac{r}{3}$ $\frac{T}{gr^2}$	$t = \frac{r}{3}$ $\frac{S}{gr^2}$	$t = \frac{r}{6}$ $\frac{M}{gr^3}$	$t = \frac{r}{6}$ $\frac{T}{gr^2}$	$t = \frac{r}{6}$ $\frac{S}{gr^2}$
1	+0.035	-0.030	0	+0.031	-0.022	0	+0.027	-0.015	0
2	+0.033	-0.028	+0.014	+0.029	-0.020	+0.011	+0.026	-0.014	+0.008
3	+0.027	-0.002	+0.057	+0.024	+0.000	+0.044	+0.021	+0.002	+0.033
4	+0.012	+0.081	+0.124	+0.010	+0.065	+0.097	+0.009	+0.051	+0.073
5	-0.010	+0.230	+0.168	-0.011	+0.183	+0.131	-9.010	+0.141	+0.099
6	-0.031	+0.397	+0.138	-0.033	+0.314	+0.107	-0.030	+0.241	+0.080
7	-0.044	+0.483	+0.030	-0.045	+0.382	+0.022	-0.042	+0.292	+0.015
8	-0.042	+0.443	-0.087	-0.041	+0.350	-0.071	-0.037	+0.267	-0.056
9	-0.021	+0.329	-0.155	-0.021	+0.259	-0.124	-0.019	+0.197	-0.096
10	+0.007	+0.192	-0.149	+0.005	+0.150	-0.119	+0.004	+0.114	-0.093
11	+0.028	+0.087	-0.089	+0.025	+0.067	-0.072	+0.022	+0.050	-0.056
12	+0.038	+0.038	-0.023	+0.034	+0.028	-0.019	+0.030	+0.020	-0.015
13	+0.038	+0.030	0	+0.035	+0.022	0	+0.031	+0.015	0

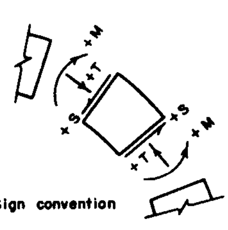
Note: No vertical arch load on square shape.

SHAPE G



NOTE: g represents the weight per unit volume of soil cover on the arch of the conduit section in units consistent with those of the radius r.

POINT	$t = \frac{r}{2}$ $\frac{M}{gr^3}$	$t = \frac{r}{2}$ $\frac{T}{gr^2}$	$t = \frac{r}{2}$ $\frac{S}{gr^2}$	$t = \frac{r}{3}$ $\frac{M}{gr^3}$	$t = \frac{r}{3}$ $\frac{T}{gr^2}$	$t = \frac{r}{3}$ $\frac{S}{gr^2}$	$t = \frac{r}{6}$ $\frac{M}{gr^3}$	$t = \frac{r}{6}$ $\frac{T}{gr^2}$	$t = \frac{r}{6}$ $\frac{S}{gr^2}$
1	+0.033	-0.023	0	+0.031	-0.016	0	+0.027	-0.010	0
2	+0.032	-0.021	+0.012	+0.030	-0.014	+0.009	+0.026	-0.009	+0.007
3	+0.026	+0.004	+0.054	+0.025	+0.006	+0.041	+0.022	+0.006	+0.031
4	+0.013	+0.086	+0.119	+0.013	+0.070	+0.092	+0.011	+0.055	+0.069
5	-0.007	+0.234	+0.162	-0.007	+0.186	+0.126	-0.007	+0.143	+0.095
6	-0.026	+0.399	+0.131	-0.027	+0.316	+0.101	-0.026	+0.242	+0.076
7	-0.037	+0.483	+0.023	-0.038	+0.382	+0.016	-0.036	+0.292	+0.010
8	-0.043	+0.483	+0.023	-0.042	+0.382	+0.016	-0.039	+0.292	+0.010
9	-0.048	+0.483	+0.023	-0.046	+0.382	+0.016	-0.042	+0.292	+0.010
10	-0.045	+0.480	-0.053	-0.042	+0.379	-0.047	-0.038	+0.289	-0.041
11	-0.024	+0.466	-0.128	-0.025	+0.366	-0.110	-0.024	+0.278	-0.091
12	-0.004	+0.098	-0.224	-0.006	+0.088	-0.206	-0.011	+0.079	-0.185
13	+0.028	+0.043	-0.124	+0.023	+0.036	-0.117	+0.016	+0.030	-0.110
14	+0.046	+0.023	-0.054	+0.041	+0.016	-0.054	+0.033	+0.010	-0.054
15	+0.054	+0.023	-0.013	+0.049	+0.016	-0.013	+0.040	+0.010	-0.013
16	+0.055	+0.023	0	+0.050	+0.016	0	+0.042	+0.010	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

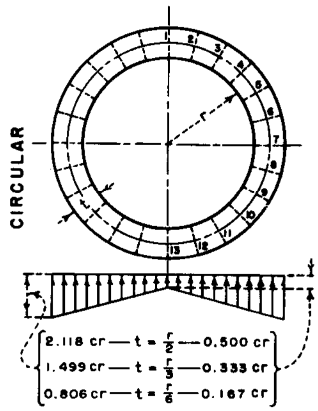
VERTICAL ARCH LOAD – TRIANGULAR FOUNDATION REACTION

SHAPES CIRCULAR, SQUARE, AND G

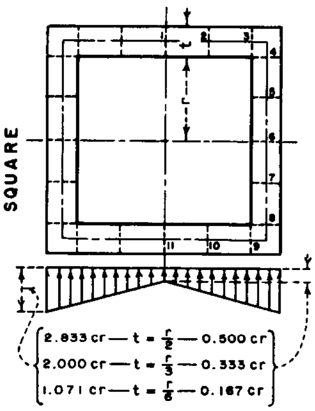
REV. APR. 15, 1966

SEP. 28, 1964

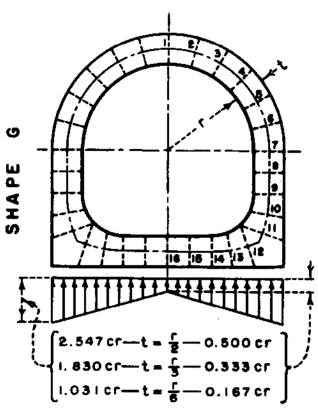
X-PEL-1062



POINT	$t = \frac{r}{2}$: $\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$t = \frac{r}{3}$: $\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$t = \frac{r}{6}$: $\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$
1	+0.180	+0.064	0	+0.111	+0.024	0	+0.054	+0.002	0
2	+0.156	+0.104	+0.141	+0.097	+0.049	+0.092	+0.047	+0.015	+0.045
3	+0.092	+0.219	+0.251	+0.057	+0.122	+0.165	+0.029	+0.049	+0.081
4	+0.001	+0.392	+0.302	+0.001	+0.233	+0.199	+0.003	+0.102	+0.099
5	-0.093	+0.599	+0.272	-0.058	+0.364	+0.183	-0.024	+0.165	+0.092
6	-0.162	+0.807	+0.150	-0.103	+0.498	+0.109	-0.046	+0.229	+0.059
7	-0.175	+0.982	-0.064	-0.117	+0.611	-0.024	-0.055	+0.284	-0.002
8	-0.134	+0.987	-0.331	-0.095	+0.617	-0.190	-0.046	+0.288	-0.080
9	-0.058	+0.752	-0.508	-0.045	+0.474	-0.301	-0.021	+0.223	-0.132
10	+0.031	+0.412	-0.502	+0.015	+0.264	-0.298	+0.009	+0.127	-0.130
11	+0.104	+0.120	-0.336	+0.064	+0.086	-0.196	+0.034	+0.046	-0.084
12	+0.141	-0.033	-0.124	+0.088	-0.006	-0.069	+0.046	+0.005	-0.028
13	+0.148	-0.064	0	+0.093	-0.024	0	+0.048	-0.002	0

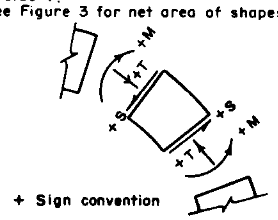


POINT	$t = \frac{r}{2}$: $\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$t = \frac{r}{3}$: $\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$t = \frac{r}{6}$: $\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$
1	+0.262	-0.021	0	+0.162	-0.027	0	+0.073	-0.019	0
2	+0.199	-0.021	+0.250	+0.120	-0.027	+0.167	+0.052	-0.019	+0.083
3	+0.012	-0.021	+0.500	-0.005	-0.027	+0.333	-0.010	-0.019	+0.167
4	-0.118	+0.750	+0.021	-0.065	+0.444	+0.027	-0.026	+0.194	+0.019
5	-0.129	+1.000	+0.021	-0.078	+0.611	+0.027	-0.035	+0.278	+0.019
6	-0.140	+1.250	+0.021	-0.092	+0.778	+0.027	-0.045	+0.361	+0.019
7	-0.150	+1.500	+0.021	-0.105	+0.944	+0.027	-0.054	+0.444	+0.019
8	-0.161	+1.750	+0.021	-0.118	+1.111	+0.027	-0.064	+0.528	+0.019
9	+0.012	+0.021	-0.778	-0.023	+0.027	-0.625	-0.033	+0.019	-0.388
10	+0.239	+0.021	-0.194	+0.160	+0.027	-0.156	+0.080	+0.019	-0.097
11	+0.271	+0.021	0	+0.186	+0.027	0	+0.096	+0.019	0



POINT	$t = \frac{r}{2}$: $\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$t = \frac{r}{3}$: $\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$	$t = \frac{r}{6}$: $\frac{M}{cr^3}$	$\frac{T}{cr^2}$	$\frac{S}{cr^2}$
1	+0.188	+0.033	0	+0.122	+0.003	0	+0.063	-0.010	0
2	+0.163	+0.074	+0.150	+0.107	+0.029	+0.098	+0.056	+0.003	+0.048
3	+0.095	+0.192	+0.267	+0.065	+0.104	+0.175	+0.037	+0.039	+0.087
4	-0.002	+0.370	+0.324	+0.005	+0.218	+0.214	+0.009	+0.093	+0.107
5	-0.105	+0.583	+0.299	-0.059	+0.354	+0.201	-0.022	+0.159	+0.103
6	-0.183	+0.799	+0.180	-0.111	+0.492	+0.129	-0.047	+0.226	+0.070
7	-0.207	+0.982	-0.033	-0.131	+0.611	-0.003	-0.059	+0.284	+0.010
8	-0.199	+1.107	-0.033	-0.130	+0.694	-0.003	-0.061	+0.325	+0.010
9	-0.191	+1.232	-0.033	-0.129	+0.778	-0.003	-0.063	+0.367	+0.010
10	-0.157	+1.330	-0.245	-0.113	+0.843	-0.144	-0.058	+0.400	-0.061
11	-0.069	+1.409	-0.495	-0.062	+0.898	-0.313	-0.036	+0.435	-0.150
12	+0.008	+0.216	-0.766	-0.012	+0.188	-0.551	-0.014	+0.124	-0.309
13	+0.110	+0.035	-0.428	+0.065	+0.051	-0.321	+0.031	+0.044	-0.191
14	+0.170	-0.033	-0.171	+0.111	-0.003	-0.140	+0.059	+0.010	-0.093
15	+0.195	-0.033	-0.043	+0.132	-0.003	-0.035	+0.073	+0.010	-0.023
16	+0.198	-0.033	0	+0.135	-0.003	0	+0.074	+0.010	0

NOTES: c represents the weight per unit volume of concrete or other material in units consistent with those of the radius r.
See Figure 3 for net area of shapes.



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

DEAD WEIGHT OF CONDUIT

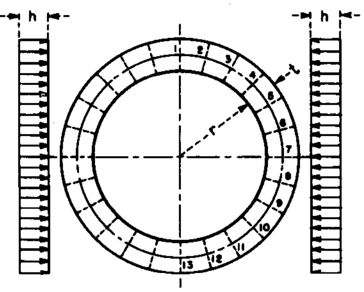
SHAPES CIRCULAR, SQUARE, AND G

REV. APR. 15, 1968

SEP. 28, 1964

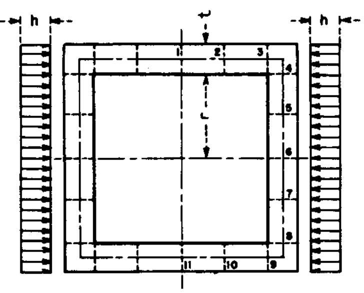
X-PEL-1063

CIRCULAR



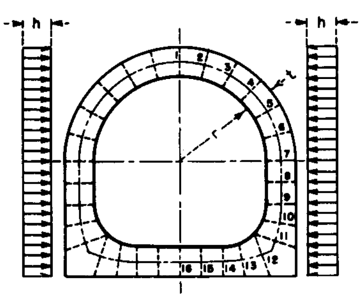
POINT	t = r/2 $\frac{M}{hr^2}$	t = r/2 $\frac{T}{hr}$	t = r/2 $\frac{S}{hr}$	t = r/3 $\frac{M}{hr^2}$	t = r/3 $\frac{T}{hr}$	t = r/3 $\frac{S}{hr}$	t = r/6 $\frac{M}{hr^2}$	t = r/6 $\frac{T}{hr}$	t = r/6 $\frac{S}{hr}$
1	-0.375	+1.500	0	-0.333	+1.333	0	-0.292	+1.167	0
2	-0.325	+1.400	-0.375	-0.289	+1.244	-0.333	-0.253	+1.089	-0.292
3	-0.188	+1.125	-0.650	-0.167	+1.000	-0.577	-0.146	+0.875	-0.505
4	0	+0.750	-0.750	0	+0.667	-0.667	0	+0.583	-0.583
5	+0.188	+0.375	-0.650	+0.167	+0.333	-0.577	+0.146	+0.292	-0.505
6	+0.325	+0.100	-0.375	+0.289	+0.089	-0.333	+0.253	+0.078	-0.292
7	+0.375	0	0	+0.333	0	0	+0.292	0	0
8	+0.325	+0.100	+0.375	+0.289	+0.089	+0.333	+0.253	+0.078	+0.292
9	+0.188	+0.375	+0.650	+0.167	+0.333	+0.577	+0.146	+0.292	+0.505
10	0	+0.750	+0.750	0	+0.667	+0.667	0	+0.583	+0.583
11	-0.188	+1.125	+0.650	-0.167	+1.000	+0.577	-0.146	+0.875	+0.505
12	-0.325	+1.400	+0.375	-0.289	+1.244	+0.333	-0.253	+1.089	+0.292
13	-0.375	+1.500	0	-0.333	+1.333	0	-0.292	+1.167	0

SQUARE

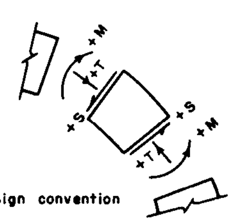


POINT	t = r/2 $\frac{M}{hr^2}$	t = r/2 $\frac{T}{hr}$	t = r/2 $\frac{S}{hr}$	t = r/3 $\frac{M}{hr^2}$	t = r/3 $\frac{T}{hr}$	t = r/3 $\frac{S}{hr}$	t = r/6 $\frac{M}{hr^2}$	t = r/6 $\frac{T}{hr}$	t = r/6 $\frac{S}{hr}$
1	-0.245	+1.500	0	-0.220	+1.333	0	-0.194	+1.167	0
2	-0.245	+1.500	0	-0.220	+1.333	0	-0.194	+1.167	0
3	-0.245	+1.500	0	-0.220	+1.333	0	-0.194	+1.167	0
4	+0.005	0	-1.000	-0.053	0	-1.000	-0.111	0	-1.000
5	+0.380	0	-0.500	+0.322	0	-0.500	+0.264	0	-0.500
6	+0.505	0	0	+0.447	0	0	+0.389	0	0
7	+0.380	0	+0.500	+0.322	0	+0.500	+0.264	0	+0.500
8	+0.005	0	+1.000	-0.053	0	+1.000	-0.111	0	+1.000
9	-0.245	+1.500	0	-0.220	+1.333	0	-0.194	+1.167	0
10	-0.245	+1.500	0	-0.220	+1.333	0	-0.194	+1.167	0
11	-0.245	+1.500	0	-0.220	+1.333	0	-0.194	+1.167	0

SHAPE G



POINT	t = r/2 $\frac{M}{hr^2}$	t = r/2 $\frac{T}{hr}$	t = r/2 $\frac{S}{hr}$	t = r/3 $\frac{M}{hr^2}$	t = r/3 $\frac{T}{hr}$	t = r/3 $\frac{S}{hr}$	t = r/6 $\frac{M}{hr^2}$	t = r/6 $\frac{T}{hr}$	t = r/6 $\frac{S}{hr}$
1	-0.394	+1.541	0	-0.354	+1.374	0	-0.310	+1.205	0
2	-0.342	+1.439	-0.386	-0.307	+1.284	-0.344	-0.270	+1.125	-0.302
3	-0.200	+1.160	-0.670	-0.180	+1.036	-0.598	-0.159	+0.908	-0.524
4	-0.004	+0.779	-0.779	-0.006	+0.696	-0.696	-0.006	+0.610	-0.610
5	+0.194	+0.395	-0.685	+0.170	+0.354	-0.613	+0.148	+0.311	-0.538
6	+0.343	+0.111	-0.414	+0.304	+0.100	-0.373	+0.265	+0.088	-0.328
7	+0.406	0	-0.041	+0.361	0	-0.041	+0.314	0	-0.038
8	+0.385	0	+0.209	+0.340	0	+0.209	+0.293	0	+0.212
9	+0.302	0	+0.459	+0.256	0	+0.459	+0.209	0	+0.462
10	+0.169	+0.116	+0.726	+0.131	+0.118	+0.702	+0.090	+0.121	+0.678
11	-0.009	+0.319	+0.974	-0.036	+0.319	+0.925	-0.064	+0.321	+0.873
12	-0.186	+1.387	+0.454	-0.163	+1.222	+0.422	-0.145	+1.059	+0.390
13	-0.266	+1.441	+0.230	-0.234	+1.275	+0.214	-0.207	+1.111	+0.198
14	-0.293	+1.459	0	-0.258	+1.292	0	-0.228	+1.129	0
15	-0.293	+1.459	0	-0.258	+1.292	0	-0.228	+1.129	0
16	-0.293	+1.459	0	-0.258	+1.292	0	-0.228	+1.129	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

UNIFORM HORIZONTAL LOAD – BOTH SIDES

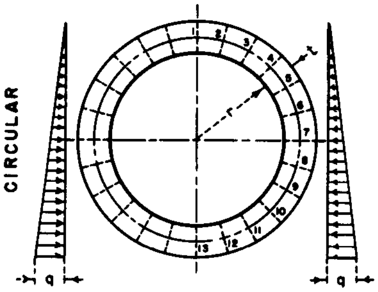
SHAPES CIRCULAR, SQUARE, AND G

REV. APR. 15, 1968

SEP. 28, 1964

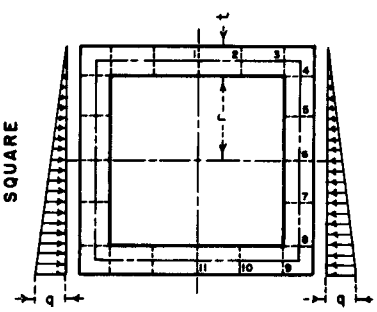
X-PEL-1064

CIRCULAR



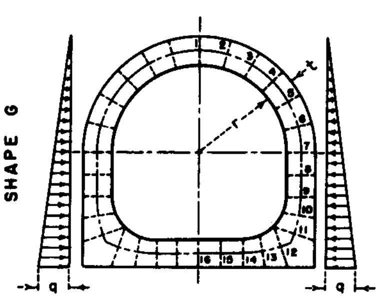
POINT	$t = \frac{r}{2}$ $\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	$t = \frac{r}{3}$ $\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	$t = \frac{r}{6}$ $\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$
1	-0.169	+0.435	0	-0.147	+0.395	0	-0.125	+0.352	0
2	-0.150	+0.420	-0.112	-0.132	+0.381	-0.102	-0.112	+0.340	-0.091
3	-0.098	+0.371	-0.214	-0.087	+0.336	-0.194	-0.074	+0.300	-0.173
4	-0.020	+0.285	-0.285	-0.020	+0.259	-0.259	-0.017	+0.231	-0.231
5	+0.068	+0.171	-0.295	+0.057	+0.156	-0.270	+0.049	+0.140	-0.242
6	+0.144	+0.059	-0.221	+0.126	+0.055	-0.204	+0.108	+0.050	-0.185
7	+0.187	0	-0.060	+0.165	0	-0.061	+0.143	0	-0.061
8	+0.180	+0.041	+0.154	+0.159	+0.035	+0.129	+0.139	+0.028	+0.106
9	+0.119	+0.204	+0.354	+0.106	+0.178	+0.308	+0.092	+0.152	+0.263
10	+0.019	+0.465	+0.465	+0.016	+0.408	+0.408	+0.012	+0.352	+0.352
11	-0.090	+0.754	+0.435	-0.083	+0.664	+0.383	-0.077	+0.575	+0.332
12	-0.175	+0.980	+0.263	-0.161	+0.863	+0.231	-0.146	+0.749	+0.201
13	-0.207	+1.065	0	-0.190	+0.939	0	-0.172	+0.814	0

SQUARE

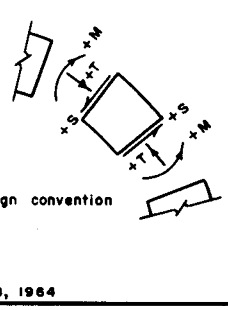


POINT	$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$
1	-0.117	+0.444	0	-0.103	+0.404	0	-0.089	+0.362	0
2	-0.117	+0.444	0	-0.103	+0.404	0	-0.089	+0.362	0
3	-0.117	+0.444	0	-0.103	+0.404	0	-0.089	+0.362	0
4	-0.013	0	-0.402	-0.038	0	-0.383	-0.059	0	-0.356
5	+0.160	0	-0.277	+0.130	0	-0.274	+0.101	0	-0.267
6	+0.250	0	-0.069	+0.220	0	-0.071	+0.190	0	-0.071
7	+0.215	0	+0.223	+0.185	0	+0.226	+0.154	0	+0.233
8	+0.013	0	+0.598	-0.022	0	+0.617	-0.061	0	+0.644
9	-0.133	+1.056	0	-0.123	+0.929	0	-0.114	+0.804	0
10	-0.133	+1.056	0	-0.123	+0.929	0	-0.114	+0.804	0
11	-0.133	+1.056	0	-0.123	+0.929	0	-0.114	+0.804	0

SHAPE G



POINT	$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$	$\frac{M}{qr^2}$	$\frac{T}{qr}$	$\frac{S}{qr}$
1	-0.184	+0.458	0	-0.155	+0.418	0	-0.138	+0.378	0
2	-0.164	+0.442	-0.118	-0.139	+0.404	-0.108	-0.124	+0.365	-0.098
3	-0.109	+0.391	-0.226	-0.091	+0.357	-0.206	-0.084	+0.323	-0.186
4	-0.026	+0.301	-0.301	-0.020	+0.276	-0.276	-0.023	+0.249	-0.249
5	+0.068	+0.182	-0.316	+0.063	+0.167	-0.290	+0.049	+0.152	-0.264
6	+0.151	+0.065	-0.244	+0.138	+0.061	-0.227	+0.115	+0.056	-0.210
7	+0.202	0	-0.083	+0.184	0	-0.085	+0.158	0	-0.086
8	+0.206	0	+0.052	+0.189	0	+0.052	+0.162	0	+0.052
9	+0.174	0	+0.209	+0.157	0	+0.212	+0.129	0	+0.217
10	+0.107	+0.064	+0.400	+0.093	+0.066	+0.392	+0.068	+0.068	+0.385
11	+0.007	+0.199	+0.607	-0.004	+0.202	+0.586	-0.024	+0.207	+0.563
12	-0.087	+0.990	+0.324	-0.075	+0.865	+0.299	-0.072	+0.740	+0.272
13	-0.144	+1.029	+0.164	-0.126	+0.902	+0.151	-0.115	+0.777	+0.138
14	-0.163	+1.042	0	-0.142	+0.915	0	-0.130	+0.789	0
15	-0.163	+1.042	0	-0.142	+0.915	0	-0.130	+0.789	0
16	-0.163	+1.042	0	-0.142	+0.915	0	-0.130	+0.789	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

TRIANGULAR HORIZONTAL LOAD - BOTH SIDES

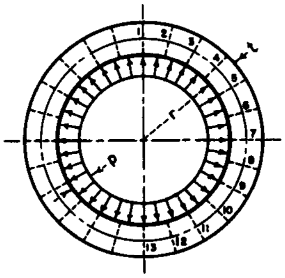
SHAPES CIRCULAR, SQUARE, AND G

REV. APR. 15, 1968

SEP. 28, 1964

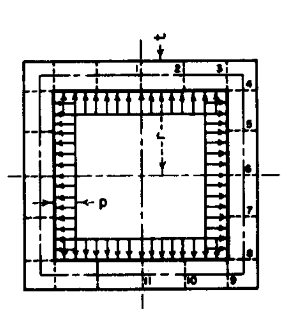
X-PEL-1065

CIRCULAR



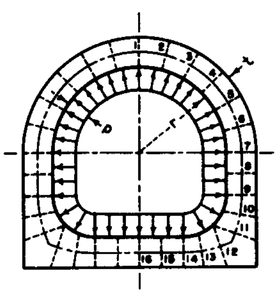
POINT	t = r/2 $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	t = r/3 $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	t = r/6 $\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$
1	0	-1.000	0	0	-1.000	0	0	-1.000	0
2	0	-1.000	0	0	-1.000	0	0	-1.000	0
3	0	-1.000	0	0	-1.000	0	0	-1.000	0
4	0	-1.000	0	0	-1.000	0	0	-1.000	0
5	0	-1.000	0	0	-1.000	0	0	-1.000	0
6	0	-1.000	0	0	-1.000	0	0	-1.000	0
7	0	-1.000	0	0	-1.000	0	0	-1.000	0
8	0	-1.000	0	0	-1.000	0	0	-1.000	0
9	0	-1.000	0	0	-1.000	0	0	-1.000	0
10	0	-1.000	0	0	-1.000	0	0	-1.000	0
11	0	-1.000	0	0	-1.000	0	0	-1.000	0
12	0	-1.000	0	0	-1.000	0	0	-1.000	0
13	0	-1.000	0	0	-1.000	0	0	-1.000	0

SQUARE

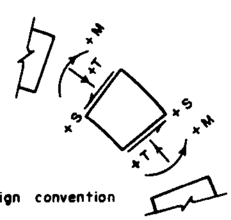


POINT	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$
1	-0.260	-1.000	0	-0.227	-1.000	0	-0.196	-1.000	0
2	-0.135	-1.000	-0.500	-0.102	-1.000	-0.500	-0.071	-1.000	-0.500
3	+0.240	-1.000	-1.000	+0.273	-1.000	-1.000	+0.304	-1.000	-1.000
4	+0.240	-1.000	+1.000	+0.273	-1.000	+1.000	+0.304	-1.000	+1.000
5	-0.135	-1.000	+0.500	-0.102	-1.000	+0.500	-0.071	-1.000	+0.500
6	-0.260	-1.000	0	-0.227	-1.000	0	-0.196	-1.000	0
7	-0.135	-1.000	-0.500	-C.102	-1.000	-0.500	-0.071	-1.000	-0.500
8	+0.240	-1.000	-1.000	+0.273	-1.000	-1.000	+0.304	-1.000	-1.000
9	+0.240	-1.000	+1.000	+0.273	-1.000	+1.000	+0.304	-1.000	+1.000
10	-0.135	-1.000	+0.500	-0.102	-1.000	+0.500	-0.071	-1.000	+0.500
11	-0.260	-1.000	0	-0.227	-1.000	0	-0.196	-1.000	0

SHAPE G



POINT	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$	$\frac{M}{pr^2}$	$\frac{T}{pr}$	$\frac{S}{pr}$
1	+0.027	-1.072	0	+0.024	-1.067	0	+0.019	-1.059	0
2	+0.024	-1.069	+0.019	+0.021	-1.065	+0.017	+0.017	-1.057	+0.015
3	+0.015	-1.062	+0.036	+0.013	-1.058	+0.034	+0.010	-1.051	+0.030
4	+0.000	-1.051	+0.051	+0.001	-1.048	+0.048	+0.000	-1.042	+0.042
5	-0.018	-1.036	+0.062	-0.016	-1.034	+0.058	-0.013	-1.030	+0.051
6	-0.040	-1.019	+0.069	-0.035	-1.017	+0.065	-0.028	-1.015	+0.057
7	-0.063	-1.000	+0.072	-0.055	-1.000	+0.067	-0.045	-1.000	+0.059
8	-0.049	-1.000	-0.178	-0.041	-1.000	-0.183	-0.029	-1.000	-0.191
9	+0.026	-1.000	-0.428	+0.036	-1.000	-0.433	+0.050	-1.000	-0.441
10	+0.124	-1.048	-0.459	+0.131	-1.052	-0.455	+0.143	-1.058	-0.453
11	+0.213	-1.054	-0.478	+0.219	-1.063	-0.464	+0.229	-1.075	-0.451
12	+0.198	-1.009	+0.568	+0.209	-1.022	+0.550	+0.223	-1.040	+0.527
13	+0.089	-0.988	+0.541	+0.102	-0.997	+0.532	+0.122	-1.010	+0.521
14	-0.027	-0.928	+0.500	-0.009	-0.933	+0.500	+0.016	-0.941	+0.500
15	-0.121	-0.928	+0.250	-0.102	-0.933	+0.250	-0.078	-0.941	+0.250
16	-0.152	-0.928	0	-0.134	-0.933	0	-0.109	-0.941	0



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

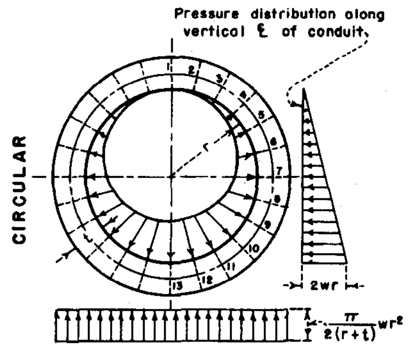
UNIFORM INTERNAL RADIAL LOAD

SHAPES CIRCULAR, SQUARE, AND G

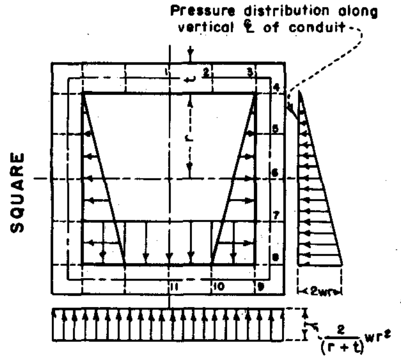
REV. APR. 15, 1968

SEP. 28, 1964

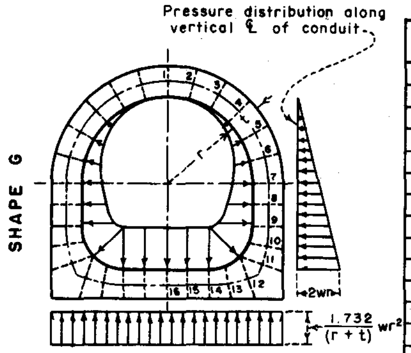
X-PEL-1066



POINT	$t = \frac{r}{2}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t = \frac{r}{3}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$t = \frac{r}{6}$ $\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.192	-0.522	0	+0.188	-0.539	0	+0.180	-0.558	0
2	+0.170	-0.505	+0.132	+0.166	-0.521	+0.137	+0.159	-0.539	+0.142
3	+0.108	-0.455	+0.238	+0.107	-0.470	+0.246	+0.102	-0.487	+0.256
4	+0.020	-0.384	+0.293	+0.021	-0.397	+0.306	+0.019	-0.410	+0.319
5	-0.076	-0.308	+0.281	-0.073	-0.316	+0.296	-0.072	-0.326	+0.312
6	-0.155	-0.244	+0.191	-0.152	-0.249	+0.208	-0.150	-0.253	+0.226
7	-0.192	-0.215	+0.022	-0.191	-0.215	+0.039	-0.193	-0.215	+0.058
8	-0.177	-0.290	-0.202	-0.179	-0.286	-0.185	-0.182	-0.281	-0.167
9	-0.112	-0.514	-0.399	-0.114	-0.506	-0.384	-0.117	-0.496	-0.368
10	-0.012	-0.830	-0.492	-0.011	-0.818	-0.480	-0.012	-0.805	-0.467
11	+0.096	-1.152	-0.442	+0.099	-1.137	-0.434	+0.102	-1.121	-0.424
12	+0.178	-1.390	-0.261	+0.184	-1.374	-0.256	+0.188	-1.355	-0.251
13	+0.208	-1.478	0	+0.215	-1.461	0	+0.220	-1.442	0

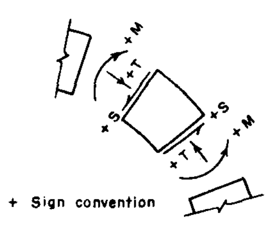


POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.179	-0.605	0	+0.171	-0.619	0	+0.158	-0.629	0
2	+0.179	-0.605	0	+0.171	-0.619	0	+0.158	-0.629	0
3	+0.179	-0.605	0	+0.171	-0.619	0	+0.158	-0.629	0
4	+0.028	0	+0.605	+0.068	0	+0.619	+0.106	0	+0.629
5	-0.254	0	+0.480	-0.220	0	+0.494	-0.188	0	+0.504
6	-0.411	0	+0.105	-0.384	0	+0.119	-0.356	0	+0.129
7	-0.317	0	-0.520	-0.297	0	-0.506	-0.275	0	-0.496
8	+0.151	0	-1.395	+0.164	0	-1.381	+0.181	0	-1.371
9	+0.334	-1.395	+0.667	+0.311	-1.381	+0.500	+0.272	-1.371	+0.286
10	+0.084	-1.395	+0.333	+0.123	-1.381	+0.250	+0.165	-1.371	+0.143
11	+0.000	-1.395	0	+0.061	-1.381	0	+0.129	-1.371	0



POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.230	-0.613	0	+0.216	-0.622	0	+0.213	-0.637	0
2	+0.204	-0.592	+0.156	+0.192	-0.601	+0.158	+0.190	-0.615	+0.162
3	+0.131	-0.534	+0.283	+0.122	-0.542	+0.288	+0.124	-0.554	+0.295
4	+0.024	-0.449	+0.358	+0.021	-0.455	+0.364	+0.027	-0.465	+0.374
5	-0.095	-0.353	+0.360	-0.092	-0.357	+0.367	-0.082	-0.365	+0.380
6	-0.202	-0.268	+0.278	-0.194	-0.270	+0.287	-0.180	-0.274	+0.301
7	-0.268	-0.215	+0.113	-0.259	-0.215	+0.122	-0.244	-0.215	+0.137
8	-0.263	-0.215	-0.168	-0.256	-0.215	-0.159	-0.245	-0.215	-0.145
9	-0.179	-0.215	-0.512	-0.174	-0.215	-0.503	-0.167	-0.215	-0.488
10	-0.038	-0.280	-0.780	-0.039	-0.285	-0.770	-0.040	-0.290	-0.753
11	+0.140	-0.305	-1.063	+0.137	-0.319	-1.049	+0.132	-0.335	-1.029
12	+0.227	-1.194	+0.095	+0.218	-1.156	-0.011	+0.197	-1.102	-0.136
13	+0.199	-1.373	+0.269	+0.207	-1.352	+0.179	+0.207	-1.321	+0.069
14	+0.123	-1.387	+0.423	+0.151	-1.378	+0.351	+0.174	-1.363	+0.258
15	+0.044	-1.387	+0.211	+0.085	-1.378	+0.175	+0.125	-1.363	+0.129
16	+0.017	-1.387	0	+0.063	-1.378	0	+0.109	-1.363	0

NOTE: w represents the weight per unit volume of water in units consistent with those of the radius r.



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

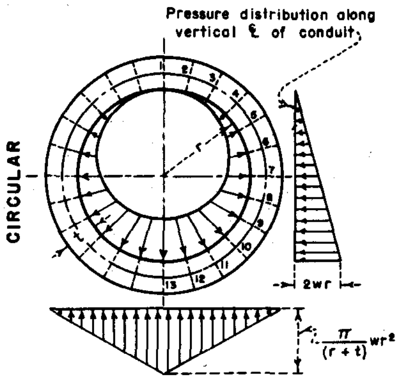
TRIANGULAR INTERNAL RADIAL LOAD – UNIFORM FOUNDATION REACTION

SHAPES CIRCULAR, SQUARE, AND G

REV APR. 15, 1968

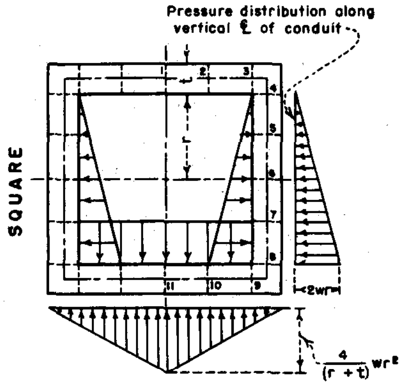
SEP. 28, 1964 X-PEL-1067

CIRCULAR



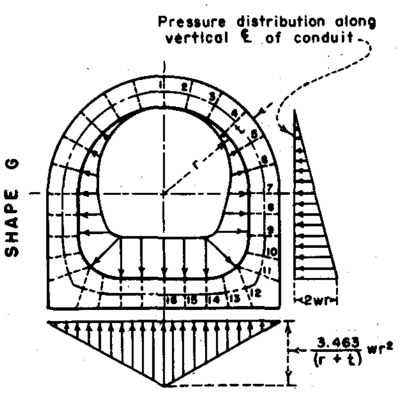
POINT	t = r/2: $\frac{M}{wr^3}$	t = r/2: $\frac{T}{wr^2}$	t = r/2: $\frac{S}{wr^2}$	t = r/3: $\frac{M}{wr^3}$	t = r/3: $\frac{T}{wr^2}$	t = r/3: $\frac{S}{wr^2}$	t = r/6: $\frac{M}{wr^3}$	t = r/6: $\frac{T}{wr^2}$	t = r/6: $\frac{S}{wr^2}$
1	+0.264	-0.637	0	+0.256	-0.646	0	+0.248	-0.655	0
2	+0.237	-0.616	+0.162	+0.231	-0.624	+0.164	+0.224	-0.633	+0.166
3	+0.161	-0.555	+0.295	+0.159	-0.562	+0.300	+0.156	-0.570	+0.304
4	+0.050	-0.466	+0.375	+0.053	-0.472	+0.381	+0.057	-0.478	+0.387
5	-0.076	-0.365	+0.381	-0.066	-0.369	+0.388	-0.056	-0.374	+0.396
6	-0.190	-0.274	+0.302	-0.175	-0.276	+0.310	-0.160	-0.278	+0.319
7	-0.264	-0.215	+0.137	-0.247	-0.215	+0.146	-0.229	-0.215	+0.155
8	-0.272	-0.211	-0.104	-0.256	-0.208	-0.096	-0.240	-0.206	-0.087
9	-0.197	-0.299	-0.391	-0.188	-0.295	-0.383	-0.177	-0.290	-0.376
10	-0.047	-0.519	-0.641	-0.044	-0.513	-0.635	-0.039	-0.506	-0.628
11	+0.145	-0.856	-0.725	+0.144	-0.849	-0.721	+0.144	-0.841	-0.716
12	+0.314	-1.201	-0.522	+0.312	-1.193	-0.520	+0.312	-1.184	-0.517
13	+0.386	-1.363	0	+0.385	-1.354	0	+0.385	-1.345	0

SQUARE



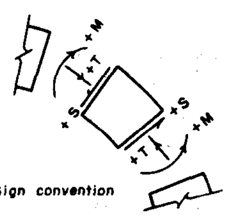
POINT	t = r/2: $\frac{M}{wr^3}$	t = r/2: $\frac{T}{wr^2}$	t = r/2: $\frac{S}{wr^2}$	t = r/3: $\frac{M}{wr^3}$	t = r/3: $\frac{T}{wr^2}$	t = r/3: $\frac{S}{wr^2}$	t = r/6: $\frac{M}{wr^3}$	t = r/6: $\frac{T}{wr^2}$	t = r/6: $\frac{S}{wr^2}$
1	+0.241	-0.699	0	+0.222	-0.703	0	+0.206	-0.703	0
2	+0.241	-0.699	0	+0.222	-0.703	0	+0.206	-0.703	0
3	+0.241	-0.699	0	+0.222	-0.703	0	+0.206	-0.703	0
4	+0.066	0	+0.699	+0.105	0	+0.703	+0.148	0	+0.703
5	-0.263	0	+0.574	-0.226	0	+0.578	-0.183	0	+0.578
6	-0.467	0	+0.199	-0.432	0	+0.203	-0.388	0	+0.203
7	-0.421	0	-0.426	-0.388	0	-0.422	-0.344	0	-0.422
8	+0.001	0	-1.301	+0.031	0	-1.297	+0.076	0	-1.297
9	+0.289	-1.301	+0.222	+0.234	-1.297	+0.125	+0.181	-1.297	+0.041
10	+0.279	-1.301	-0.111	+0.280	-1.297	-0.219	+0.289	-1.297	-0.347
11	+0.326	-1.301	0	+0.359	-1.297	0	+0.406	-1.297	0

SHAPE G



POINT	t = r/2: $\frac{M}{wr^3}$	t = r/2: $\frac{T}{wr^2}$	t = r/2: $\frac{S}{wr^2}$	t = r/3: $\frac{M}{wr^3}$	t = r/3: $\frac{T}{wr^2}$	t = r/3: $\frac{S}{wr^2}$	t = r/6: $\frac{M}{wr^3}$	t = r/6: $\frac{T}{wr^2}$	t = r/6: $\frac{S}{wr^2}$
1	+0.301	-0.720	0	+0.282	-0.723	0	+0.260	-0.732	0
2	+0.271	-0.696	+0.183	+0.253	-0.699	+0.184	+0.233	-0.707	+0.186
3	+0.184	-0.627	+0.337	+0.172	-0.630	+0.338	+0.157	-0.637	+0.343
4	+0.056	-0.525	+0.434	+0.052	-0.527	+0.436	+0.044	-0.524	+0.442
5	-0.091	-0.407	+0.453	-0.086	-0.408	+0.455	-0.086	-0.413	+0.463
6	-0.230	-0.295	+0.382	-0.217	-0.296	+0.385	-0.210	-0.298	+0.394
7	-0.331	-0.215	+0.220	-0.312	-0.215	+0.223	-0.300	-0.215	+0.232
8	-0.352	-0.215	-0.061	-0.334	-0.215	-0.058	-0.325	-0.215	-0.049
9	-0.295	-0.215	-0.405	-0.278	-0.215	-0.402	-0.271	-0.215	-0.393
10	-0.179	-0.263	-0.674	-0.165	-0.268	-0.670	-0.164	-0.273	-0.659
11	-0.026	-0.271	-0.961	-0.011	-0.286	-0.953	-0.011	-0.302	-0.939
12	+0.163	-0.981	-0.210	+0.134	-0.958	-0.272	+0.084	-0.928	-0.332
13	+0.228	-1.198	-0.141	+0.206	-1.182	-0.224	+0.164	-1.156	-0.315
14	+0.247	-1.280	+0.038	+0.243	-1.277	-0.055	+0.218	-1.268	-0.166
15	+0.248	-1.280	-0.029	+0.263	-1.277	-0.089	+0.263	-1.268	-0.163
16	+0.253	-1.280	0	+0.277	-1.277	0	+0.286	-1.268	0

NOTE: w represents the weight per unit volume of water in units consistent with those of the radius r.



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMÈTER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

TRIANGULAR INTERNAL RADIAL LOAD – TRIANGULAR FOUNDATION REACTION

SHAPES CIRCULAR, SQUARE, AND G

REV. APR. 15, 1968

SEP. 28, 1964

X-PEL-1068

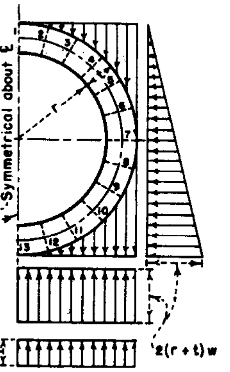
CIRCULAR

Dead weight of one-half of conduit

$t = \frac{r}{2}$, 4.720 wr^2

$t = \frac{r}{3}$, 2.937 wr^2

$t = \frac{r}{6}$, 1.364 wr^2



$t = \frac{r}{2}$, 0.791 wr

$t = \frac{r}{3}$, 0.108 wr

* $t = \frac{r}{6}$, −0.664 wr

2(r + t)w

POINT	$t = \frac{r}{2}$ $\frac{M}{wr^3}$	$t = \frac{r}{2}$ $\frac{T}{wr^2}$	$t = \frac{r}{2}$ $\frac{S}{wr^2}$	$t = \frac{r}{3}$ $\frac{M}{wr^3}$	$t = \frac{r}{3}$ $\frac{T}{wr^2}$	$t = \frac{r}{3}$ $\frac{S}{wr^2}$	*$t = \frac{r}{6}$ $\frac{M}{wr^3}$	*$t = \frac{r}{6}$ $\frac{T}{wr^2}$	*$t = \frac{r}{6}$ $\frac{S}{wr^2}$
1	+0.106	+1.114	0	+0.004	+0.885	0	−0.088	+0.707	0
2	+0.090	+1.178	+0.098	+0.002	+0.919	+0.013	−0.078	+0.712	−0.069
3	+0.047	+1.365	+0.177	−0.002	+1.017	+0.023	−0.050	+0.730	−0.125
4	−0.015	+1.656	+0.218	−0.009	+1.172	+0.028	−0.009	+0.761	−0.155
5	−0.081	+2.024	+0.207	−0.016	+1.373	+0.027	+0.035	+0.810	−0.152
6	−0.133	+2.433	+0.139	−0.021	+1.605	+0.019	+0.073	+0.880	−0.109
7	−0.153	+2.843	+0.011	−0.023	+1.850	+0.003	+0.094	+0.974	−0.026
8	−0.133	+3.173	−0.158	−0.020	+2.085	−0.017	+0.088	+1.120	+0.085
9	−0.076	+3.365	−0.306	−0.012	+2.291	−0.035	+0.055	+1.331	+0.184
10	+0.006	+3.437	−0.375	−0.001	+2.456	−0.044	+0.003	+1.574	+0.232
11	+0.093	+3.432	−0.337	+0.010	+2.575	−0.040	−0.053	+1.799	+0.211
12	+0.158	+3.401	−0.198	+0.019	+2.646	−0.024	−0.096	+1.958	+0.125
13	+0.182	+3.386	0	+0.022	+2.670	0	−0.112	+2.016	0

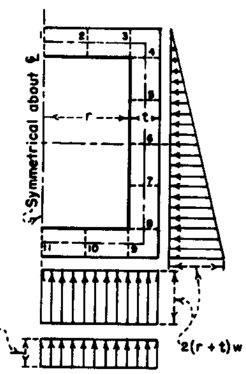
SQUARE

Dead weight of one-half of conduit

$t = \frac{r}{2}$, 6.010 wr^2

$t = \frac{r}{3}$, 3.740 wr^2

$t = \frac{r}{6}$, 1.736 wr^2



$t = \frac{r}{2}$, 1.007 wr

$t = \frac{r}{3}$, 0.138 wr

* $t = \frac{r}{6}$, −0.845 wr

2(r + t)w

POINT	$t = \frac{r}{2}$ $\frac{M}{wr^3}$	$t = \frac{r}{2}$ $\frac{T}{wr^2}$	$t = \frac{r}{2}$ $\frac{S}{wr^2}$	$t = \frac{r}{3}$ $\frac{M}{wr^3}$	$t = \frac{r}{3}$ $\frac{T}{wr^2}$	$t = \frac{r}{3}$ $\frac{S}{wr^2}$	*$t = \frac{r}{6}$ $\frac{M}{wr^3}$	*$t = \frac{r}{6}$ $\frac{T}{wr^2}$	*$t = \frac{r}{6}$ $\frac{S}{wr^2}$
1	+0.358	+1.081	0	+0.157	+0.900	0	−0.015	+0.753	0
2	+0.208	+1.081	+0.601	+0.057	+0.900	+0.401	−0.065	+0.753	+0.200
3	−0.243	+1.081	+1.202	−0.244	+0.900	+0.801	−0.215	+0.753	+0.401
4	−0.294	+1.803	−0.956	−0.233	+1.068	−0.845	−0.186	+0.467	−0.614
5	+0.101	+2.404	−0.581	+0.127	+1.469	−0.553	+0.142	+0.668	−0.531
6	+0.245	+3.005	+0.044	+0.278	+1.870	−0.011	+0.303	+0.868	−0.072
7	+0.015	+3.606	+0.919	+0.096	+2.270	+0.780	+0.172	+1.068	+0.636
8	−0.715	+4.207	+2.044	−0.544	+2.671	+1.822	−0.375	+1.269	+1.594
9	−0.515	+3.419	−2.805	−0.511	+2.655	−2.003	−0.417	+1.969	−1.088
10	+0.537	+3.419	−1.402	+0.241	+2.655	−1.002	−0.009	+1.969	−0.544
11	+0.888	+3.419	0	+0.491	+2.655	0	+0.127	+1.969	0

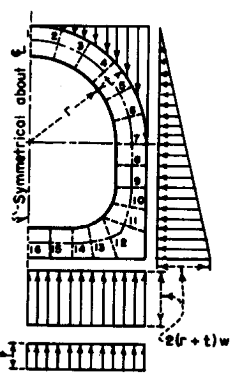
SHAPE G

Dead weight of one-half of conduit

$t = \frac{r}{2}$, 5.494 wr^2

$t = \frac{r}{3}$, 3.467 wr^2

$t = \frac{r}{6}$, 1.679 wr^2



$t = \frac{r}{2}$, 0.985 wr

$t = \frac{r}{3}$, 0.220 wr

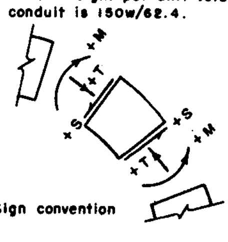
* $t = \frac{r}{6}$, −0.644 wr

2(r + t)w

POINT	$t = \frac{r}{2}$ $\frac{M}{wr^3}$	$t = \frac{r}{2}$ $\frac{T}{wr^2}$	$t = \frac{r}{2}$ $\frac{S}{wr^2}$	$t = \frac{r}{3}$ $\frac{M}{wr^3}$	$t = \frac{r}{3}$ $\frac{T}{wr^2}$	$t = \frac{r}{3}$ $\frac{S}{wr^2}$	*$t = \frac{r}{6}$ $\frac{M}{wr^3}$	*$t = \frac{r}{6}$ $\frac{T}{wr^2}$	*$t = \frac{r}{6}$ $\frac{S}{wr^2}$
1	+0.061	+1.171	0	−0.012	+0.943	0	−0.104	+0.765	0
2	+0.048	+1.233	+0.084	−0.011	+0.974	−0.002	−0.092	+0.768	−0.084
3	+0.012	+1.414	+0.148	−0.009	+1.067	−0.006	−0.058	+0.780	−0.154
4	−0.039	+1.696	+0.177	−0.005	+1.213	−0.013	−0.007	+0.803	−0.196
5	−0.090	+2.053	+0.158	+0.002	+1.402	−0.023	+0.050	+0.839	−0.202
6	−0.125	+2.448	+0.084	+0.013	+1.620	−0.037	+0.104	+0.895	−0.165
7	−0.126	+2.843	−0.046	+0.028	+1.850	−0.054	+0.140	+0.974	−0.084
8	−0.164	+3.143	+0.361	−0.003	+2.050	+0.311	+0.122	+1.074	+0.239
9	−0.312	+3.444	+0.829	−0.132	+2.251	+0.738	+0.016	+1.174	+0.624
10	−0.487	+3.910	+0.813	−0.296	+2.607	+0.812	−0.129	+1.426	+0.790
11	−0.613	+4.529	+0.748	−0.447	+3.118	+0.854	−0.293	+1.835	+0.939
12	−0.443	+4.102	−1.830	−0.397	+3.163	−1.155	−0.313	+2.256	−0.462
13	−0.116	+3.634	−1.648	−0.183	+2.839	−1.131	−0.217	+2.091	−0.579
14	+0.217	+3.329	−1.391	+0.049	+2.613	−1.043	−0.091	+1.957	−0.644
15	+0.478	+3.329	−0.696	+0.245	+2.613	−0.521	+0.029	+1.957	−0.322
16	+0.565	+3.329	0	+0.310	+2.613	0	+0.070	+1.957	0

NOTES: w represents the weight per unit volume of water in units consistent with those of the radius r. The assumed weight per unit volume of the conduit is 150w/62.4.

* Tension is assumed to develop at the foundation. For the assumption that the conduits float see Figure 49.



+ Sign convention

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
TRIANGULAR EXTERNAL HYDROSTATIC LOAD INCLUDING DEAD LOAD
SHAPES CIRCULAR, SQUARE, AND G

REV. APR. 15, 1968

SEP. 28, 1964

X-PEL-1069

SHAPE A

POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.057	+0.728	0
2	+0.049	+0.772	+0.069
3	+0.027	+0.892	+0.114
4	-0.001	+1.065	+0.117
5	-0.024	+1.253	+0.079
6	-0.032	+1.423	+0.014
7	-0.025	+1.549	-0.048
8	-0.048	+1.689	+0.224
9	-0.154	+1.913	+0.561
10	-0.356	+2.266	+0.954
11	-0.323	+2.281	-1.172
12	-0.072	+2.127	-0.829
13	+0.123	+2.028	-0.429
14	+0.098	+1.994	0

SHAPE B

POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.019	+0.679	0
2	+0.015	+0.710	+0.029
3	+0.007	+0.797	+0.047
4	-0.003	+0.924	+0.046
5	-0.010	+1.070	+0.030
6	-0.012	+1.213	+0.009
7	-0.012	+1.338	+0.002
8	-0.035	+1.489	+0.192
9	-0.106	+1.770	+0.421
10	-0.216	+2.256	+0.660
11	-0.194	+2.452	-0.696
12	-0.067	+2.238	-0.537
13	+0.031	+2.094	-0.291
14	+0.067	+2.043	0

SHAPE C

POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.080	+0.687	0
2	+0.068	+0.737	+0.099
3	+0.034	+0.876	+0.167
4	-0.010	+1.073	+0.184
5	-0.051	+1.289	+0.147
6	-0.078	+1.483	+0.073
7	-0.085	+1.625	-0.007
8	-0.102	+1.785	+0.157
9	-0.162	+2.094	+0.363
10	-0.148	+2.099	-0.576
11	-0.025	+2.025	-0.376
12	+0.041	+2.015	-0.105
13	+0.062	+2.030	-0.057
14	+0.070	+2.035	0

SHAPE E

POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.061	+0.907	0
2	+0.049	+0.964	+0.099
3	+0.018	+1.123	+0.156
4	-0.017	+1.343	+0.143
5	-0.038	+1.570	+0.056
6	-0.028	+1.753	-0.082
7	+0.019	+1.854	-0.226
8	+0.023	+1.988	+0.218
9	-0.139	+2.121	+0.774
10	-0.505	+2.255	+1.441
11	-0.464	+1.816	-1.933
12	+0.073	+1.816	-1.288
13	+0.395	+1.816	-0.644
14	+0.503	+1.816	0

SHAPE F

POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.103	+0.775	0
2	+0.088	+0.834	+0.121
3	+0.047	+0.997	+0.201
4	-0.005	+1.226	+0.212
5	-0.049	+1.469	+0.150
6	-0.069	+1.674	+0.033
7	-0.057	+1.806	-0.094
8	-0.047	+1.919	+0.038
9	-0.085	+2.053	+0.230
10	-0.188	+2.212	+0.475
11	-0.174	+2.071	-0.898
12	+0.051	+2.004	-0.623
13	+0.190	+1.962	-0.319
14	+0.237	+1.947	0

SHAPE G

POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.083	+0.778	0
2	+0.071	+0.832	+0.100
3	+0.038	+0.980	+0.165
4	-0.003	+1.188	+0.170
5	-0.037	+1.410	+0.112
6	-0.049	+1.599	+0.010
7	-0.033	+1.725	-0.098
8	-0.048	+1.825	+0.225
9	-0.151	+1.925	+0.611
10	-0.279	+2.163	+0.645
11	-0.400	+2.535	+0.667
12	-0.364	+2.458	-1.052
13	-0.163	+2.160	-1.042
14	+0.045	+1.944	-0.966
15	+0.226	+1.944	-0.483
16	+0.286	+1.944	0

CIRCULAR

POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.106	+0.707	0
2	+0.090	+0.764	+0.125
3	+0.047	+0.923	+0.211
4	-0.009	+1.149	+0.232
5	-0.062	+1.391	+0.184
6	-0.094	+1.603	+0.085
7	-0.100	+1.748	-0.026
8	-0.080	+1.842	-0.109
9	-0.042	+1.912	-0.152
10	+0.003	+1.961	-0.155
11	+0.043	+1.993	-0.125
12	+0.071	+2.010	-0.069
13	+0.081	+2.016	0

SQUARE

POINT	$\frac{M}{wr^3}$	$\frac{T}{wr^2}$	$\frac{S}{wr^2}$
1	+0.315	+0.753	0
2	+0.159	+0.753	+0.623
3	-0.308	+0.753	+1.246
4	-0.350	+1.453	-0.614
5	-0.022	+1.654	-0.531
6	+0.139	+1.854	-0.072
7	+0.009	+2.054	+0.636
8	-0.539	+2.255	+1.594
9	-0.510	+1.969	-1.933
10	+0.215	+1.969	-0.966
11	+0.456	+1.969	0

Top reaction is assumed to be of uniform intensity, v.

SHAPE	$\frac{v}{wr}$
A	+0.493
B	+0.312
C	+0.558
E	+0.754
F	+0.713
G	+0.644
Circular	+0.664
Square	+0.845

For loading diagram, + sign convention, and the assumption that the conduits do not float see Figures 18, 33, and 48.

Note: Shape D does not float.

SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS

COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR

TRIANGULAR EXTERNAL HYDROSTATIC LOAD
INCLUDING DEAD LOAD

CONDUITS ASSUMED TO FLOAT

ALL SHAPES

$t = \frac{r}{6}$

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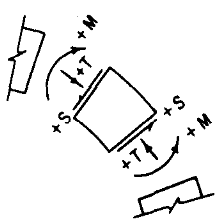
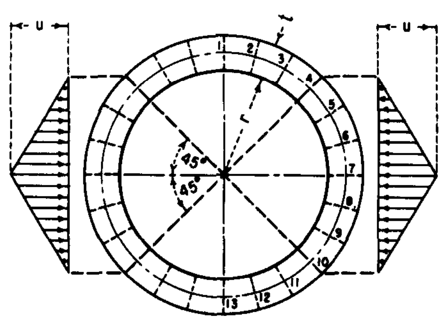
POINT	t = r/2: $\frac{M}{ur^2}$	t = r/2: $\frac{T}{ur}$	t = r/2: $\frac{S}{ur}$	t = r/3: $\frac{M}{ur^2}$	t = r/3: $\frac{T}{ur}$	t = r/3: $\frac{S}{ur}$	t = r/6: $\frac{M}{ur^2}$	t = r/6: $\frac{T}{ur}$	t = r/6: $\frac{S}{ur}$
1	-0.218	+0.530	0	-0.183	+0.471	0	-0.150	+0.412	0
2	-0.196	+0.512	-0.137	-0.164	+0.455	-0.122	-0.135	+0.398	-0.107
3	-0.130	+0.459	-0.265	-0.109	+0.408	-0.236	-0.090	+0.357	-0.206
4	-0.024	+0.375	-0.375	-0.021	+0.333	-0.333	-0.019	+0.292	-0.292
5	+0.103	+0.242	-0.420	+0.085	+0.215	-0.373	+0.069	+0.189	-0.327
6	+0.211	+0.082	-0.306	+0.179	+0.073	-0.272	+0.149	+0.064	-0.238
7	+0.257	0	0	+0.219	0	0	+0.183	0	0
8	+0.211	+0.082	+0.306	+0.179	+0.073	+0.272	+0.149	+0.064	+0.238
9	+0.103	+0.242	+0.420	+0.085	+0.215	+0.373	+0.069	+0.189	+0.327
10	-0.024	+0.375	+0.375	-0.021	+0.333	+0.333	-0.019	+0.292	+0.292
11	-0.130	+0.459	+0.265	-0.109	+0.408	+0.236	-0.090	+0.357	+0.206
12	-0.196	+0.512	+0.137	-0.164	+0.455	+0.122	-0.135	+0.398	+0.107
13	-0.218	+0.530	0	-0.183	+0.471	0	-0.150	+0.412	0



+ Sign convention



SINGLE BARREL CONDUIT
BEGGS DEFORMETER STRESS ANALYSIS
COEFFICIENTS FOR MOMENT, THRUST, AND SHEAR
HORIZONTAL PASSIVE PRESSURE

CIRCULAR SHAPE

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APPENDIX: THE BEGGS DEFORMETER

This study has been made using the Beggs Deformeter apparatus [4 5 6] (figure 51). The basis of the method is a direct application of Maxwell's Theorem of Reciprocal Deflections, which states that for any two points on a structure, the ratio of the displacement at the first point to the load causing it, applied at the second point, is equal to the ratio of the displacement at the second point to the load causing it, applied at the first point. Displacements are measured in the load directions.

In the general application of this method of stress analysis, an elastic scale model of the structure under consideration is deformed at a cut in the model by use of a special set of gage blocks and plugs. Three sets of plugs are used to apply a rotational, a normal, and a shearing displacement at the gage block. Microscopes equipped with filar eyepieces are used to measure the model deflections at points corresponding to the load points of the actual structure. Deflections are measured in the direction of the prototype loads. No loads are applied to the model. Deflections of the model are read at prototype load points for displacements applied at the gage block. The difference in microscope readings is a measure of the model deflection induced by the change at the gage block from the first position of the plugs to the second position of the plugs.

From Maxwell's Theorem the following equations may be written for the redundant reactions at the cut section:

For a concentrated load	For a distributed load
$M_1=P\frac{e_M}{d_M}n$	$M_1=\frac{n}{d_M}\int pe_M dl$
$S_1=P\frac{e_S}{d_S}$	$S_1=\frac{1}{d_S}\int pe_S\,dl$
$T_1=P\frac{e_T}{d_T}$	$T_1=\frac{1}{d_T}\int pe_T\,dl$

where

- d_M is the angular rotation applied at the cut by the moment plugs
- d_S is the displacement applied at the cut by the shear plugs
- d_T is the displacement applied at the cut by the thrust plugs
- e_M is the measured deflection at a load point, in the direction of the load, due to d_M
- e_S is the measured deflection at a load point, in the direction of the load, due to d_S
- e_T is the measured deflection at a load point, in the direction of the load, due to d_T
- l is the load length
- M_1 is the redundant moment reaction at the cut
- n is the scale factor (prototype to model)
- P is a load acting at a point on the prototype
- p is the load intensity on the prototype at the deflection point
- S_1 is the redundant shear reaction at the cut
- T_1 is the redundant thrust reaction at the cut.

The only unknowns in these equations are M_1, T_1, and S_1.

In the actual operation of the Beggs Deformeter the arithmetic is simplified by the use of calibration factors based on the plug dimensions and the eyepiece scales. An influence line through points obtained by multiplying the deflection ordinates by the proper calibration factor gives directly the magnitude of the moment, thrust, or shear at the gage block position for a unit traveling load.

It should be pointed out that the Beggs Deformeter method automatically takes into account the strain energy in a structure due to moment, thrust, and shear as well as haunch effects and other shape changes.

[4] Beggs, G. E., "An Accurate Solution of Statically Indeterminate Structures by Paper Models and Special Gages," *Proceedings* ACI, vol. XVIII, 1922, pp. 58–78.
[5] McCullough, C. B., and Thayer, E. S., *Elastic Arch Bridges*, John Wiley and Sons, New York, 1931, pp. 282–300.
[6] Phillips, H. B., and Allen, I. E., "The Beggs Deformeter Theory and Technique," Bureau of Reclamation, Denver, Colo., July 1965.

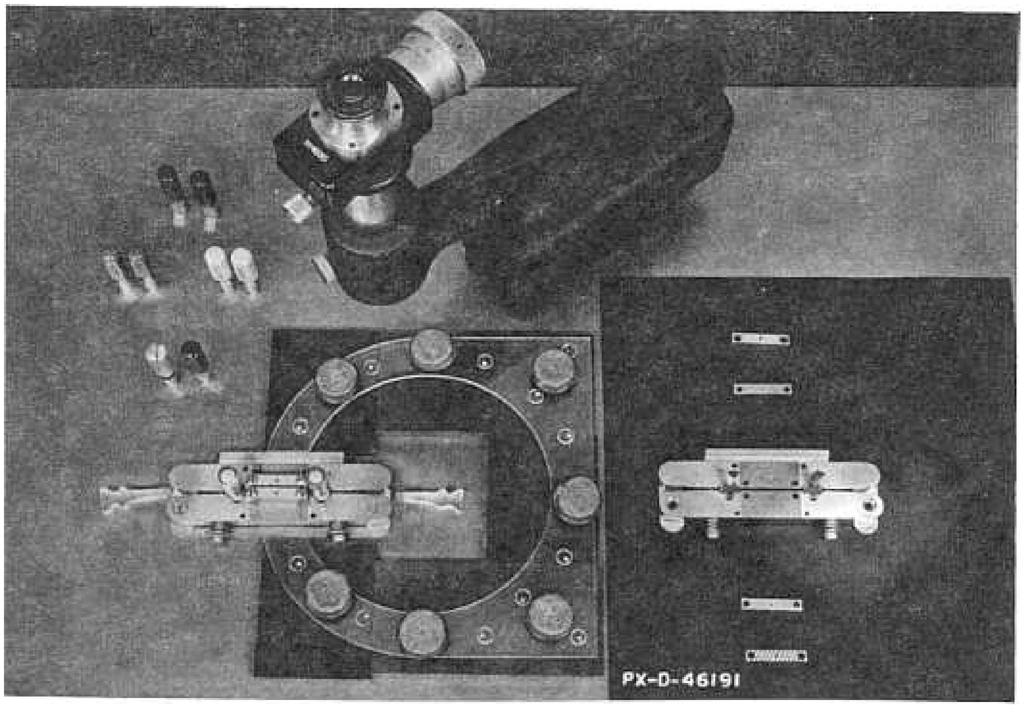

FIGURE 51. -*Beggs Deformeter apparatus and shape B conduit model.*

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