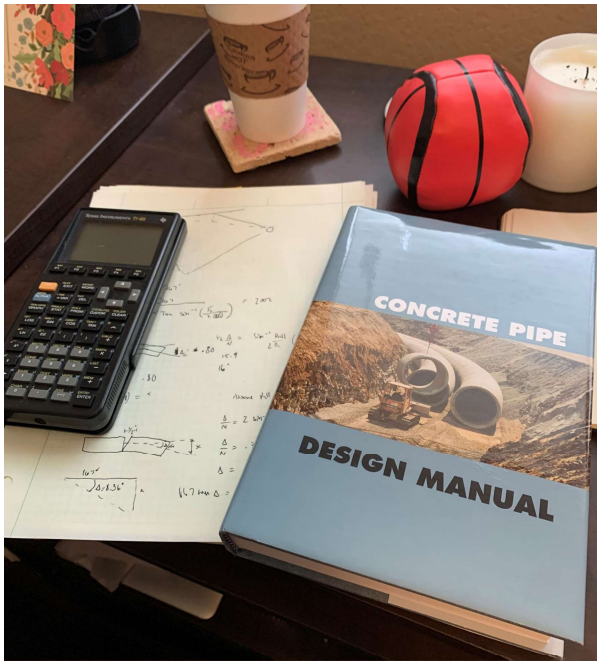
PipePac.org

We've got options to take your project from start to finish

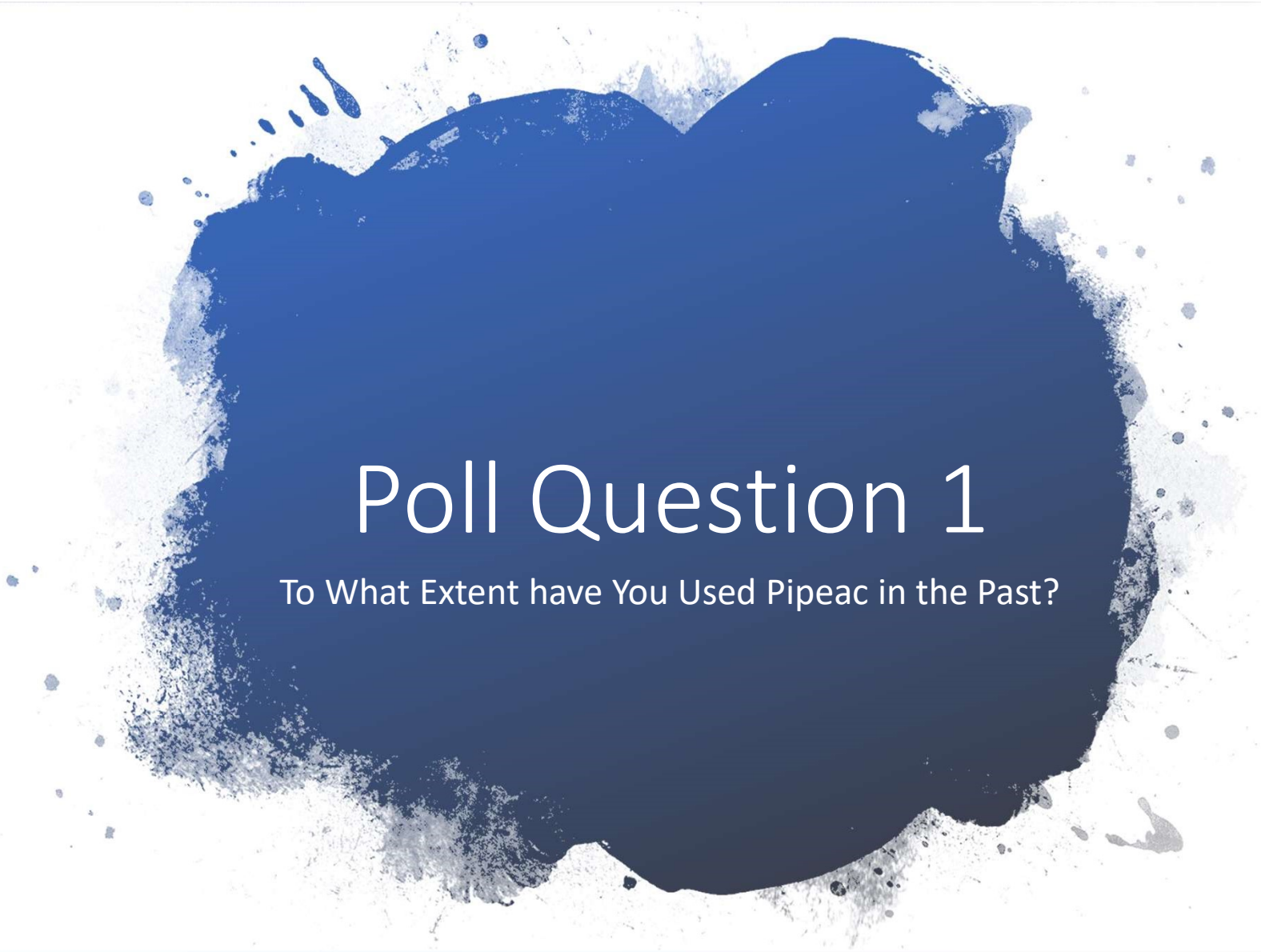
Three Edge Bearing Analysis (3EB)

Cost Analysis of Pipe Envelope (CAPE)

Life Cycle Analysis (LCA)



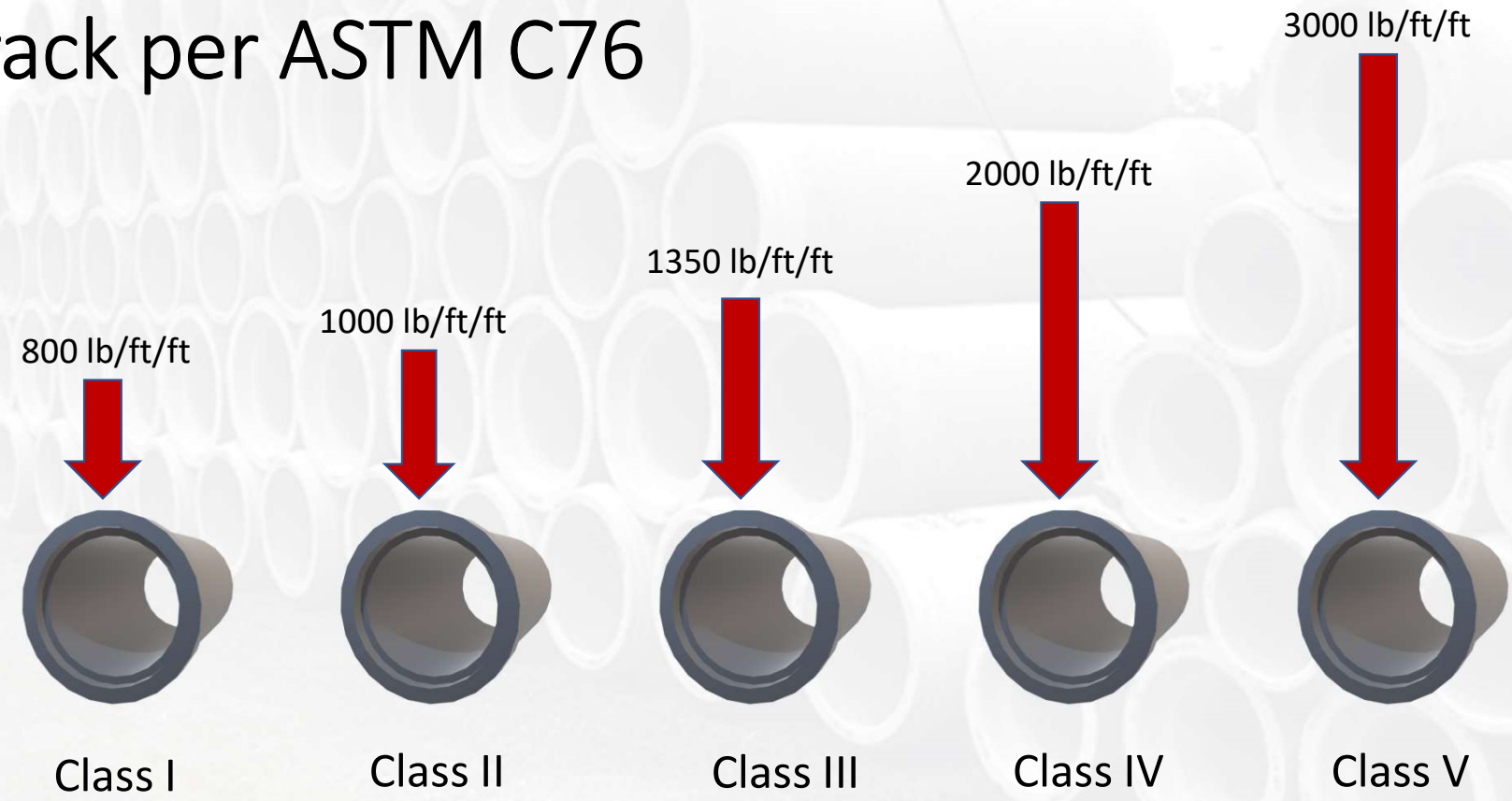
Indirect Design Tiers


Poll Question 1
To What Extent have You Used Pipeac in the Past?

Applications

- Indirect Design of new Culverts, Storm and Sanitary Sewers
- Value Design for projects
- Analyze existing projects with expected changes in loading

RCP Pipe Classes for 0.01” Crack per ASTM C76



Pipe Information

Load/Installation

Factor of Safety

Results

Pipe Information

Three Edge Bearing

Alternative Ref.: 60 Standard: ASTM (AASHTO) Units: US Units

Pipe Information | Load / Installation | Factor of Safety | Results

Pipe Shape

- Circular
- Vertical Elliptical
- Horizontal Elliptical
- Arch

Pipe Type

- Reinforced
- Non-Reinforced

Wall Thickness (in.)

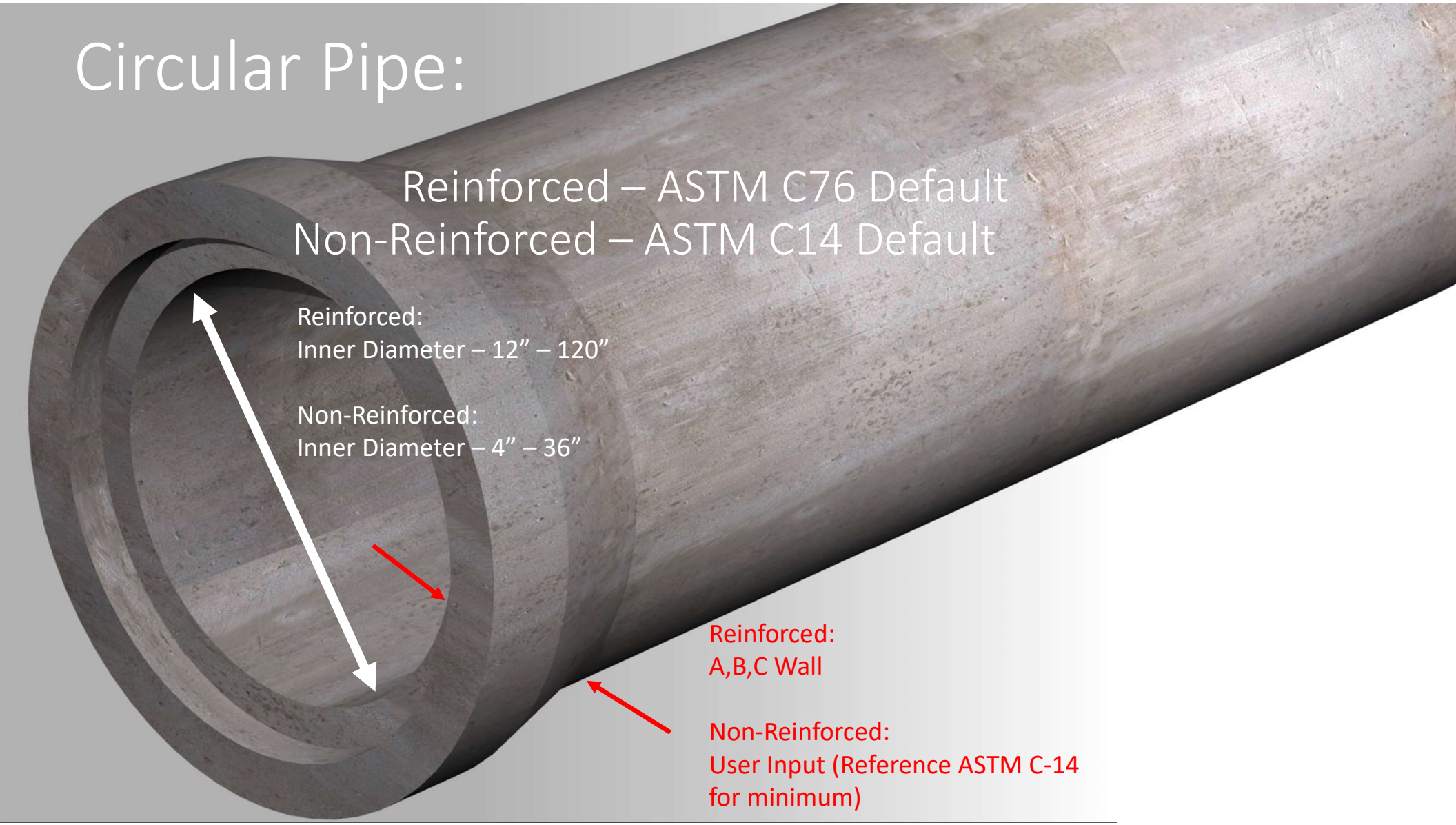
- A
- B
- C
- Other

Inner Diameter (in.)

Span (in.)

Rise (in.)

Circular Pipe:



Reinforced – ASTM C76 Default
Non-Reinforced – ASTM C14 Default

Reinforced:
Inner Diameter – 12” – 120”

Non-Reinforced:
Inner Diameter – 4” – 36”

Reinforced:
A,B,C Wall

Non-Reinforced:
User Input (Reference ASTM C-14 for minimum)

Other Pipe Shapes

- Vertical Elliptical – ASTM C507 (trench width limitations)
- Horizontal Elliptical - ASTM C507 (vertical clearance limitations)
- Arch – ASTM C506 vertical clearance limitations

Load/Installation

Three Edge Bearing

Alternative Ref.: 60 Standard: ASTM (AASHTO) Units: US Units

Pipe Information | Load / Installation | Factor of Safety | Results

Soil Type	Silty Sand
Soil Density (pcf)	120
Vertical Surcharge (psf)	0
Fluid Load	○ Yes ◉ No

Live Load Type

EDIT

○ AASHTO ○ CHBDC-ONT
○ Cooper ○ Other
○ Aircraft ○ None
○ CHBDC-CAN

Height of Fill (ft)

Minimum Fill	1.00
Maximum Fill	20.00
Incremental Fill	1.00
Selected Depth	10.0

Installation Type

EDIT

○ Trench
○ Positive Projection
○ Negative Projection
○ Jacked or Tunneled

Bedding Type

☐ 1 ☐ 4
☐ 2 ☐ B (Var)
☐ 3 ☐ C (Var)
☐ Grouted
☐ Non-Grouted
☐ Other - VAF (Vertical Arching Factor)

○ Constant ○ Variable

Fixed Bedding Factor

Fixed Arching Factor

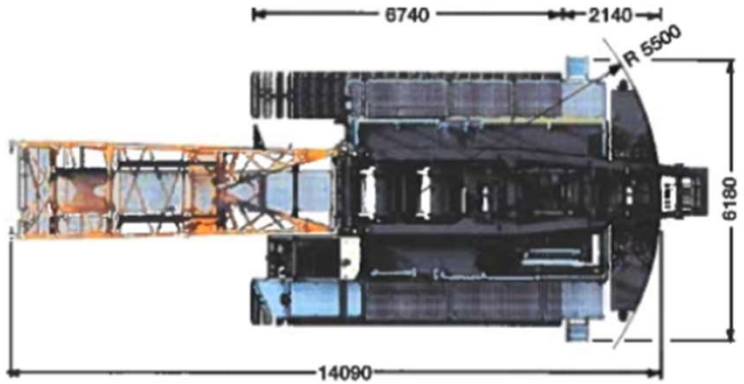
Vertical Surcharge Examples

16 PSI Ground bearing pressure

Construction Machine

HS 8130 HD

Litronic



Operating weight

The operating weight includes the basic machine with HD undercarriage, 2 main winches 350 kN including wire ropes (90 m), and 14 m main boom, consisting of A-frame, boom foot (7 m) and boom head (7 m), 29 t basic counterweight, 1000 mm 2-web grousers and 50 t hook block.

Total weight ..... approx. 116 t

Ground pressure

Ground bearing pressure ..... 1.06 kg/cm²

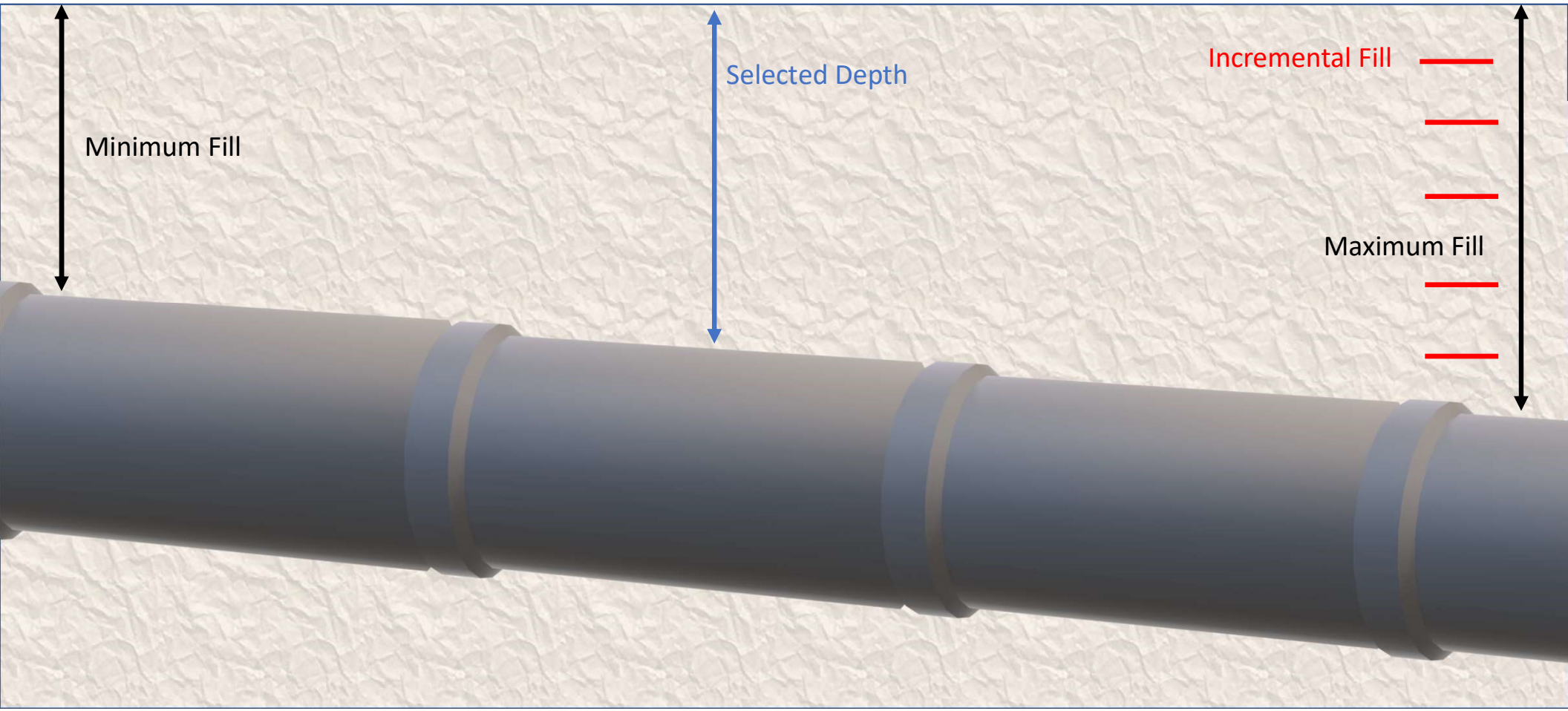
Remarks

1. Liebherr c
2. Designed
3. Machine s
4. The weigh etc.) must net lifting

Surcharge Load = 2304 psf

Height of Fill

Height of Fill (ft)	
Minimum Fill	1.00
Maximum Fill	20.00
Incremental Fill	1.00
Selected Depth	10.0



AASHTO

Cooper

Aircraft

CHBDC

Can

Ont

Other

None

Three Edge Bearing

Alternative Ref.: 60 Standard: ASTM (AASHTO) Units: US Units

Pipe Information | Load / Installation | Factor of Safety | Results

Live Load Parameters CLOSE DEFAULTS

Single Axle :

Load 32.00 kips = AASHTO HS 20

Double Axle :

Load Per Axle: 25.00 kips

Space between Axles: 4.00 ft

Live Load Distribution Factor: 1.15 (For AASHTO LRFD, Please use 1.15 or 1.0)

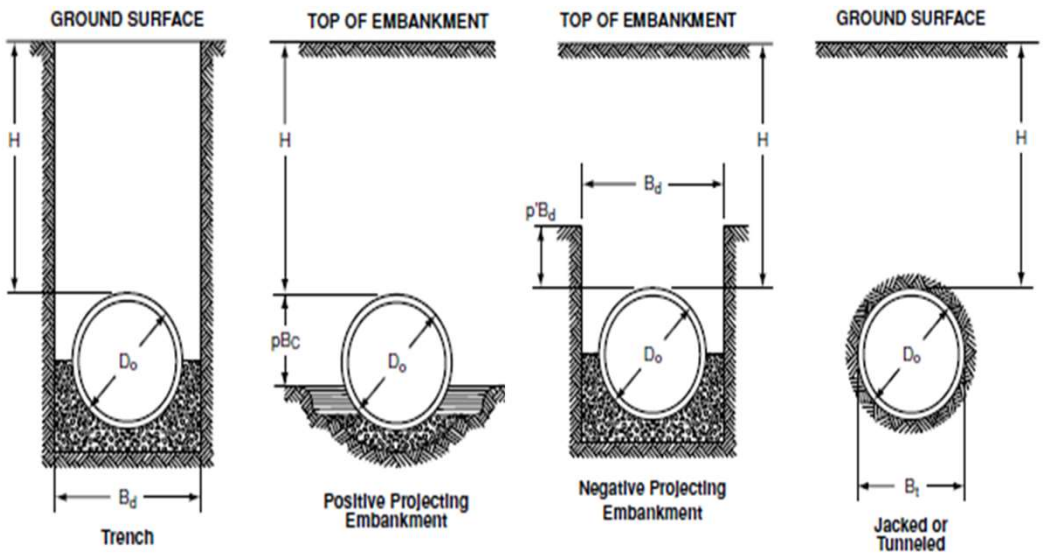
HL 93 Live Loading

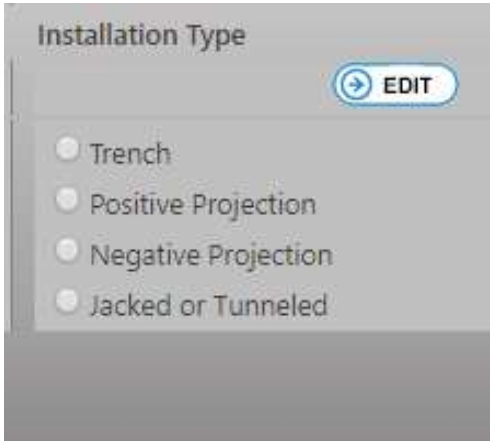
Default Impact Factors

At the surface: 0.33

Minimum Impact Factor: 0.00

Depth for Minimum: 8.00 ft

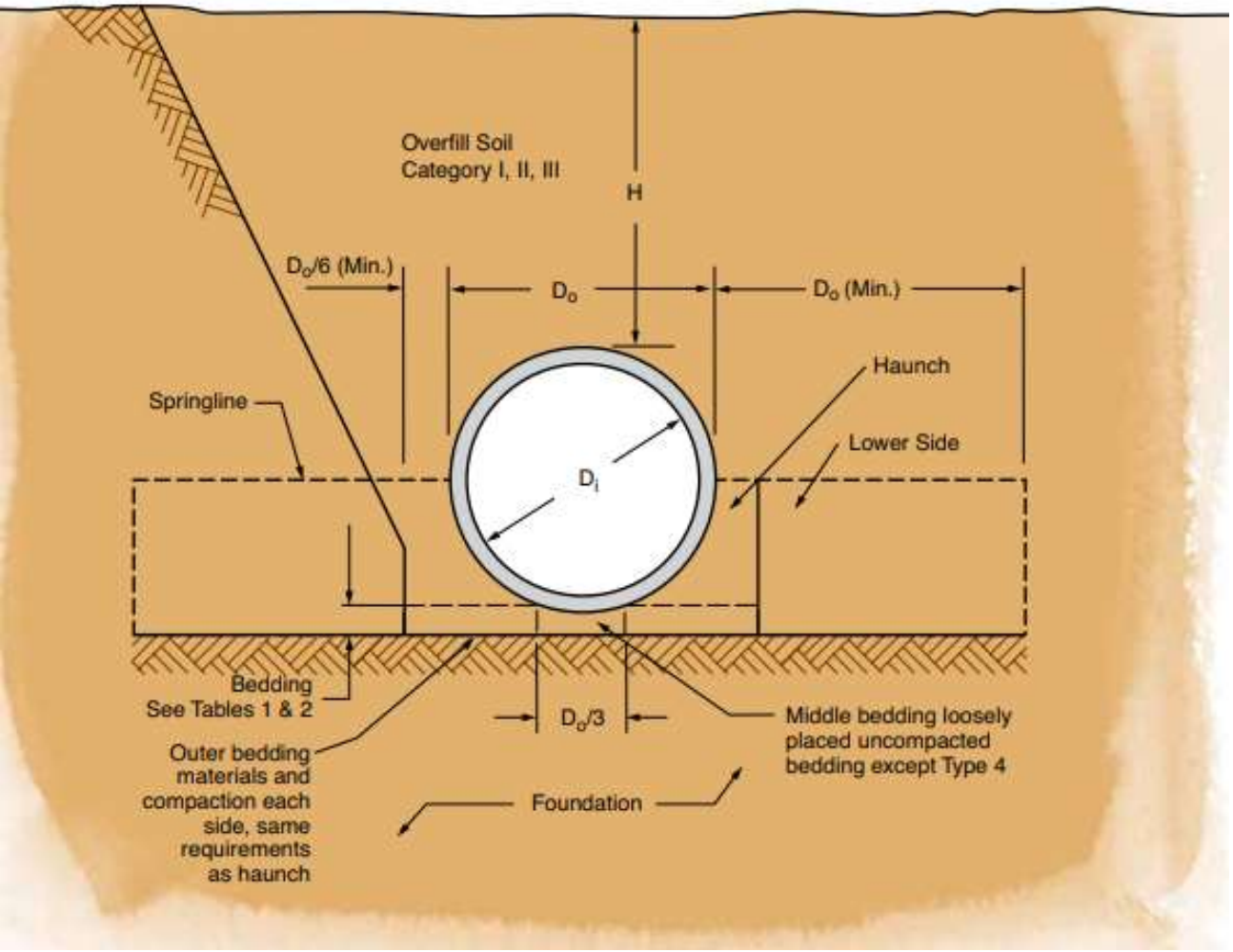




Installation Type

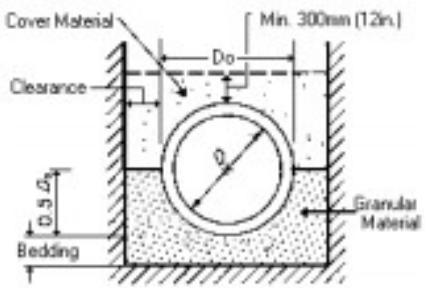
Standard Trench/Embankment Installation

Concrete pipe should be installed in accordance with the AASHTO LRFD Bridge Construction Specifications, Section 27 or ASTM C1479. Figure 1 shows the basic pipe and soil terminology.

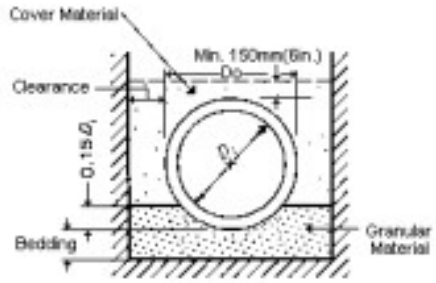


Bedding Type

1	4
2	B (Var)
3	C (Var)
Grouted	
Non-Grouted	
Other - VAF (Vertical Arching Factor)	

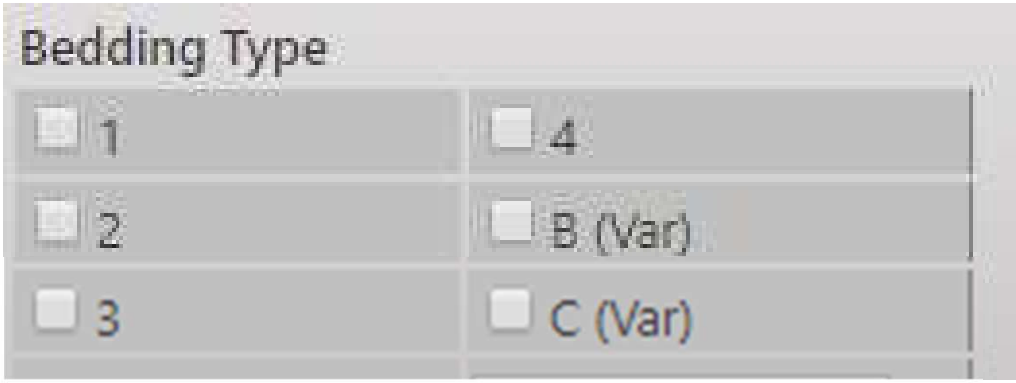


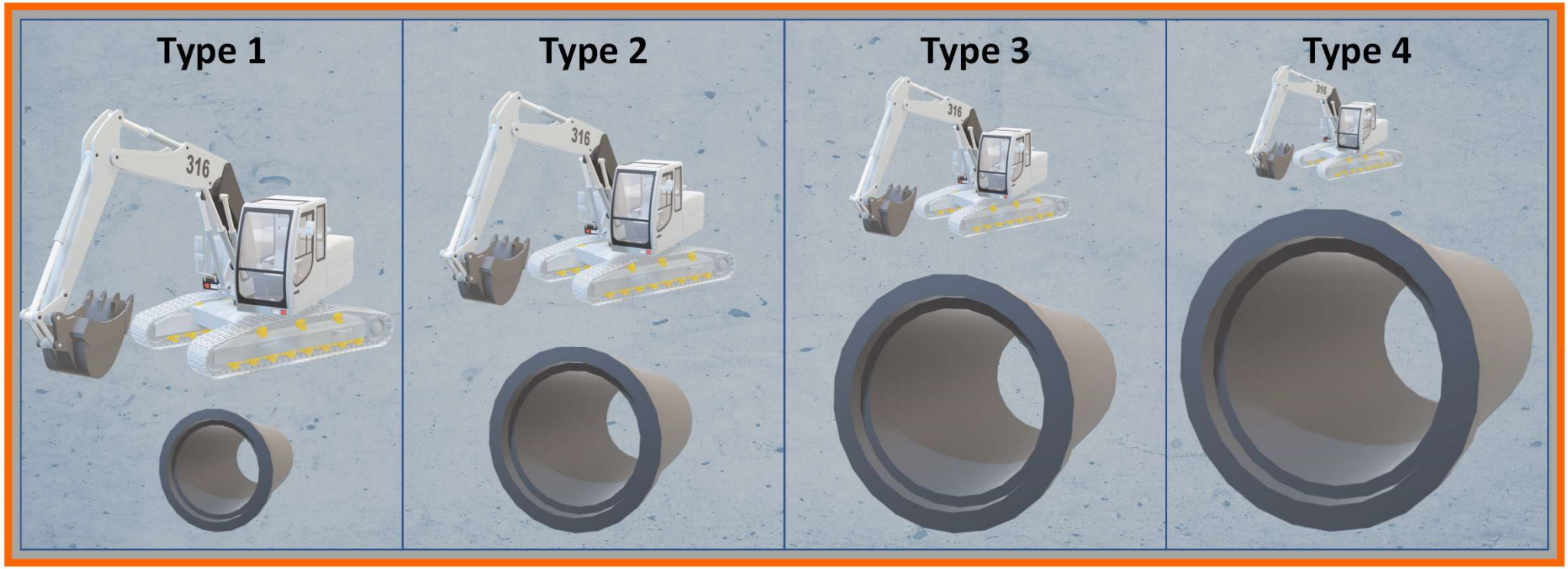
Class B



Class C

Bedding Types






Poll Question 2

Factor of Safety

Three Edge Bearing

Alternative Ref.: 60 Standard: ASTM (AASHTO) Units: US Units

Pipe Information | Load / Installation | Factor of Safety | Results

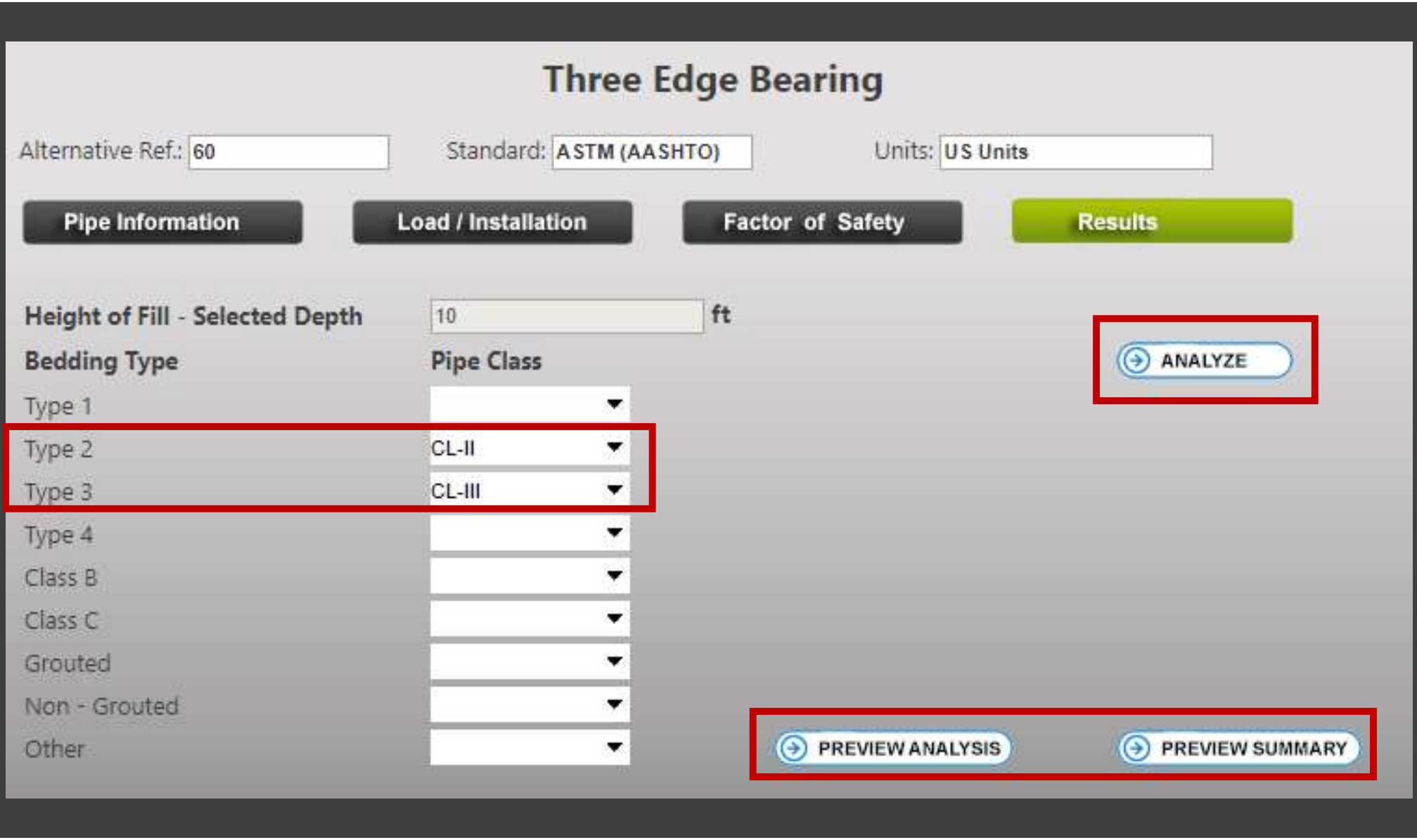
Factors of Safety for Dead and Live Loads

- (•) ASTM C 76 Standard
- ( ) User Specified

	Dead Load	Live Load
0.01 in. crack	1	1
Ultimate:		
DL.01 <= 2000 lb/ft/ft:	1.5	1.5
DL.01 >= 3000 lb/ft/ft:	1.25	1.25

Intermediate DL.01 is interpolated

Results


Three Edge Bearing
Alternative Ref.: 60
Standard: ASTM (AASHTO)
Units: US Units
Pipe Information
Load / Installation
Factor of Safety
Results
Height of Fill - Selected Depth
10
ft
Bedding Type
Pipe Class
Type 1
Type 2
CL-II
Type 3
CL-III
Type 4
Class B
Class C
Grouted
Non - Grouted
Other
ANALYZE
PREVIEW ANALYSIS
PREVIEW SUMMARY

Three Edge Bearing Analysis - Results

D-LOAD REQUIREMENTS FOR 60 in. DIAMETER CIRCULAR PIPE
Results of Analysis for Bedding Type 2

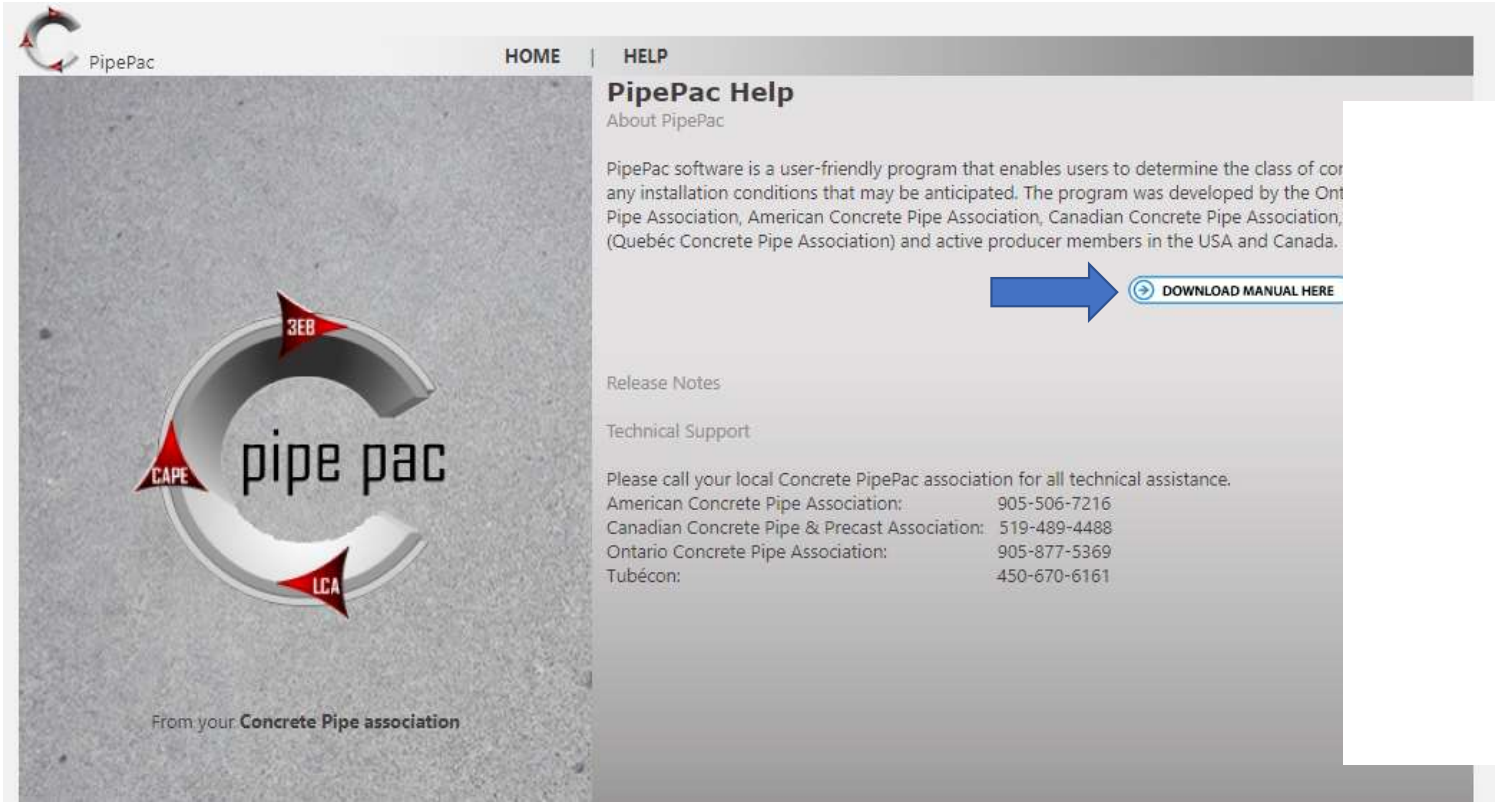
Pipe Depth	Arching Factor	>Trans	Earth Load (lb/ft)	Live Load (lb/ft)	Surch Load (lb/ft)	Total Load (lb/ft)	Bed Fact DL	Bed Fact LL	Required D-Load 0.01 in. (lb/ft/ft)
1.00	**1.32**	**N**	**1560**	**0**	**0**	**2786**	**2.29**	**1.40**	**243 (CL-I)**
2.00	1.37	N	2613	0	0	3838	2.47	1.80	310 (CL-I)
3.00	1.38	N	3623	0	0	4848	2.56	2.20	379 (CL-I)
4.00	1.37	N	4592	0	0	5817	2.60	2.20	447 (CL-I)
5.00	1.36	N	5522	0	0	6747	2.62	2.20	516 (CL-I)
6.00	1.34	N	6414	0	0	7640	2.62	2.20	584 (CL-I)
7.00	1.32	N	7271	0	0	8496	2.61	2.20	651 (CL-I)
8.00	1.30	N	8093	0	0	9318	2.60	2.20	717 (CL-I)
9.00	1.28	N	8881	0	0	10106	2.59	2.20	781 (CL-I)
10.00	**1.26**	**N**	**9638**	**0**	**0**	**10863**	**2.57**	**2.20**	**844 (CL-II)**
11.00	1.24	N	10364	0	0	11589	2.56	2.20	906 (CL-II)
12.00	1.22	N	11061	0	0	12286	2.54	2.20	966 (CL-II)
13.00	**1.19**	**N**	**11730**	**0**	**0**	**12955**	**2.53**	**2.20**	**1024 (CL-III)**
14.00	1.17	N	12371	0	0	13596	2.52	2.20	1081 (CL-III)
15.00	1.15	N	12987	0	0	14212	2.50	2.20	1136 (CL-III)
16.00	1.13	N	13578	0	0	14803	2.49	2.20	1190 (CL-III)
17.00	1.11	N	14145	0	0	15370	2.48	2.20	1242 (CL-III)
18.00	1.09	N	14689	0	0	15914	2.46	2.20	1292 (CL-III)
19.00	1.08	N	15211	0	0	16436	2.45	2.20	1341 (CL-III)
20.00	**1.06**	**N**	**15712**	**0**	**0**	**16937**	**2.44**	**2.20**	**1389 (CL-IV)**

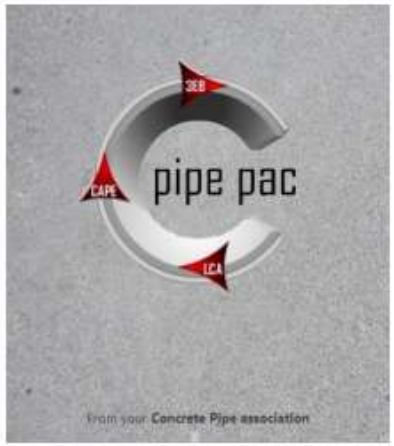
Three Edge Bearing Analysis - Summary

D-LOAD REQUIREMENTS FOR A 60 (in) DIAMETER CIRCULAR PIPE
Comparison of required D-Load Values for Selected Bedding Types

Pipe Depth (ft)	Type 1	Type 2	Type 3	Type 4	Type B	Type C
1.00		243 (CL-I)	290 (CL-I)			
2.00		310 (CL-I)	379 (CL-I)			
3.00		379 (CL-I)	467 (CL-I)			
4.00		447 (CL-I)	554 (CL-I)			
5.00		516 (CL-I)	640 (CL-I)			
6.00		584 (CL-I)	724 (CL-I)			
7.00		651 (CL-I)	807 (CL-II)			
8.00		717 (CL-I)	887 (CL-II)			
9.00		781 (CL-I)	966 (CL-II)			
10.00		**844 (CL-II)**	**1042 (CL-III)**			
11.00		906 (CL-II)	1116 (CL-III)			
12.00		966 (CL-II)	1188 (CL-III)			
13.00		1024 (CL-III)	1258 (CL-III)			
14.00		1081 (CL-III)	1325 (CL-III)			
15.00		1136 (CL-III)	1391 (CL-IV)			
16.00		1190 (CL-III)	1454 (CL-IV)			
17.00		1242 (CL-III)	1515 (CL-IV)			
18.00		1292 (CL-III)	1574 (CL-IV)			
19.00		1341 (CL-III)	1632 (CL-IV)			
20.00		1389 (CL-IV)	1687 (CL-IV)			

PipePac Help Menu





Version 4

User Manual

Projec
Inform

With the given parameters, can we value engineer this Class V RCP?

Pipe Information

- 60” RCP
- B-Wall

Factor of Safety

- Follow ASTM C76

www.pipepac.org

Additional Resources

- Design Data 1
- Design Data 9
- Concrete Pipe Design Manual
- Design and Installation Webinars on YouTube

Industry Innovations

Precast Concrete Pipe & Structures

August Webinar

Innovation in Concrete Pipe