Easy Dig 4’ diameter Circular Trench Cage Tabulated Data

Soil Type	Maximum Depth		Pressure Rating		Certified By:
A25	28’ 8”	8.74m	720 PSF	34.47 kPa	ProForma Engineering
B45	16”	4.87m	720 PSF	34.47 kPa	
C60	12’	3.66m	720 PSF	34.47 kPa	
C80	9’	2.74m	720 PSF	34.47 kPa	

SOIL TYPE CLASSIFICATIONS			
Type A-25	**Type B-45**	**Type C-60**	**Type C-80**
Cohesive soil. 25 PSF (1.20 kPa) per 1 foot (0.30m) of depth	Medium cohesive to granular soil. 45 PSF (2.15 kPa) per 1 foot (0.30m) of depth	Soft cohesive to submerged soil. 60 PSF (2.87 kPa) per 1 foot (0.30m) of depth.	Soft cohesive to submerged soil. 80 PSF (3.83 kPa) per 1 foot (0.30m) of depth.
Clay with unconfined compressive strength greater than 1.5 TSF (144 kPa). Clay, silty clay, sandy clay, and clay loam.	Clay with unconfined compressive strength greater than .5 TSF (48 kPa) but less than 1.5 TSF (144 kPa). Cohesionless gravel, silt, silt loam, or sandy loam.	Soft cohesive soil unconfined compression strength less than .5 TSF (48 kPa). Gravel, sand and loamy sand; submerged soil or pock that is not stable.	Soft cohesive soil unconfined compression strength less than .5 TSF(48 kPa). Gravel, sand, and loamy sand; submerged soil or pock that is not stable.

MAXIMUM DEPTH
Maximum depth as to which the shoring can be used based on specified soil conditions.
Pressure Rating
Maximum lateral earth pressure capacity at trench bottom.
Reference *OSHA: 29CFR, Part 1926, Subpart P- Excavations and Australian Standard: AS4744.1-2000*

Tabulated Data

1. Easy Dig’s circular trench cages are certified by a registered engineer. They are designed to align with OSHA safety standards (OSHA: 29CFR, Part 1926, Subpart P- Excavations, Section 1926.652) and Australian Standards (AS4744.1-2000).
2. EasyDig trench cages shall be installed as per OSHA Installation and Removal Requirements for Protective Systems 1926.652(e) or similar governing standard in the region the shoring is utilized within.
3. The shoring shall be within 2 ft or less of the bottom of the excavation.
4. Easy Dig’s circular 4’ Trench Cage is engineered to 720psf/34.47kPa with a safety factor of 2 and a buckling safety factor of 4.13.
5. This data shall be utilized by a competent person only to select maximum allowable trench cage depth.
6. The competent person must classify the soil type correctly according to OSHA Appendix A, Soil Classification.

7. Soil conditions outside of the above tabulated data shall require site specific engineered designs.

8. This Tabulated Data is only valid if installed in the ground with an all around evenly distributed pressure.
9. Tabulated Data is invalid if Easy Dig 4’ Diameter Circular Trench Cage is in any way altered or damaged.
10. This Tabulated Data applies only to Easy Dig’s 4’ Diameter Circular Trench Cage
11. Perform certified condition assessment on EasyDig Shoring on a yearly basis or as required by local laws.

Change Record

1. *May 1, 2022: Updated version of EasyDig Shoring released. Shoring with a manufacture date prior to this date shall follow version 1 of tabulated data.*

PROFORMA
ENGINEERING

PROJECT:	Trench Cage
CLIENT:	Easy Dig
DOCUMENT TITLE:	Finite Element Analysis of Trench Cage
DOCUMENT NUMBER:	22-J1677-FEA-R1
CLIENT NUMBER:	RT - 266
JOB NUMBER:	22-J1677

REVISION	PREPARED BY:	CHECKED BY:
	DATE	DATE
0. Issued Report	K. Navitka	R. Swain
	10-May-2022	10-May-2022

Reviewed By:

Neil Evenson, P.Eng

PROVINCE OF MANITOBA
10 May 2022
N. J. EVENSON
Member
30128
REGISTERED PROFESSIONAL ENGINEER

APEGM
Certificate of Authorization
Proforma Engineering Limited
No. 5648 Date: 10 May 2022

1. Scope & Summary

This report covers the finite element analysis (FEA) of the Trench Cage for Easy Dig. The design was supplied and ProForma Engineering was tasked with evaluating the design through FEA.

A static structural analysis and an eigenvalue buckling analysis were run to simulate the trench cage being installed in the ground with an all-around evenly distributed normal pressure of 720 psf. The analysis results show that the stresses in trench cage are below material (Aluminum 6061-T6) yield values with a safety factor of at least two (2). The first buckling mode has a safety factor of 4.13. The maximum deflection is 0.3".

Any modifications, changes, material substitutions, or deviations from the models and materials provided may invalidate the results from this analysis and shall be brought to the attention of the reviewing engineer.

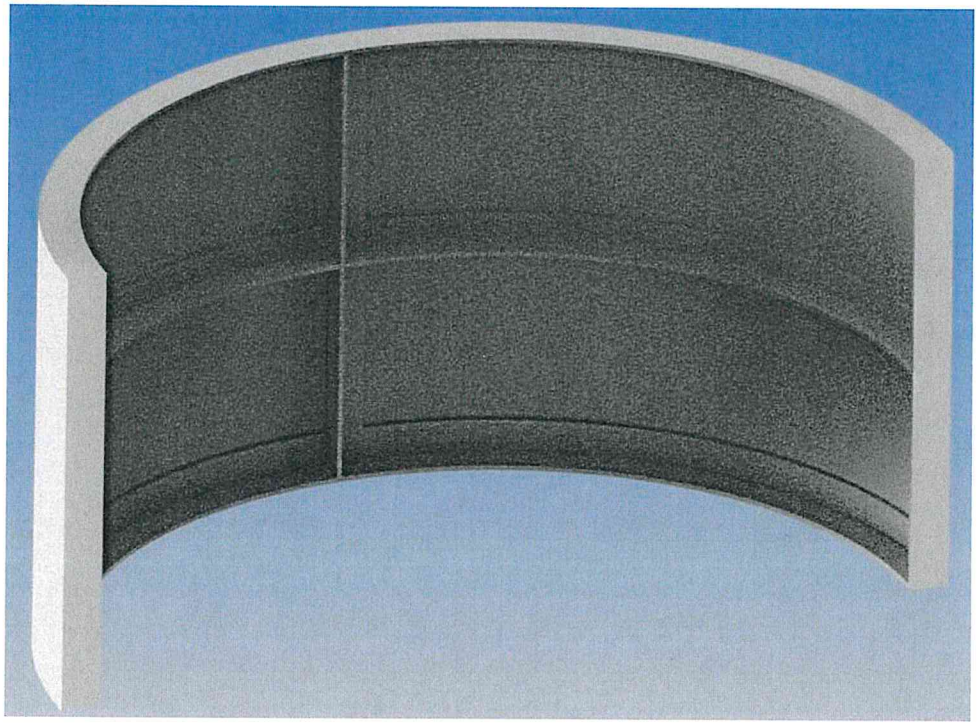

Figure 1: Model of Trench Cage

2. Results

This section shows the analysis result plots. Total deformation, equivalent stress, and the first two buckling modes are shown.

2.1 Total Deformation

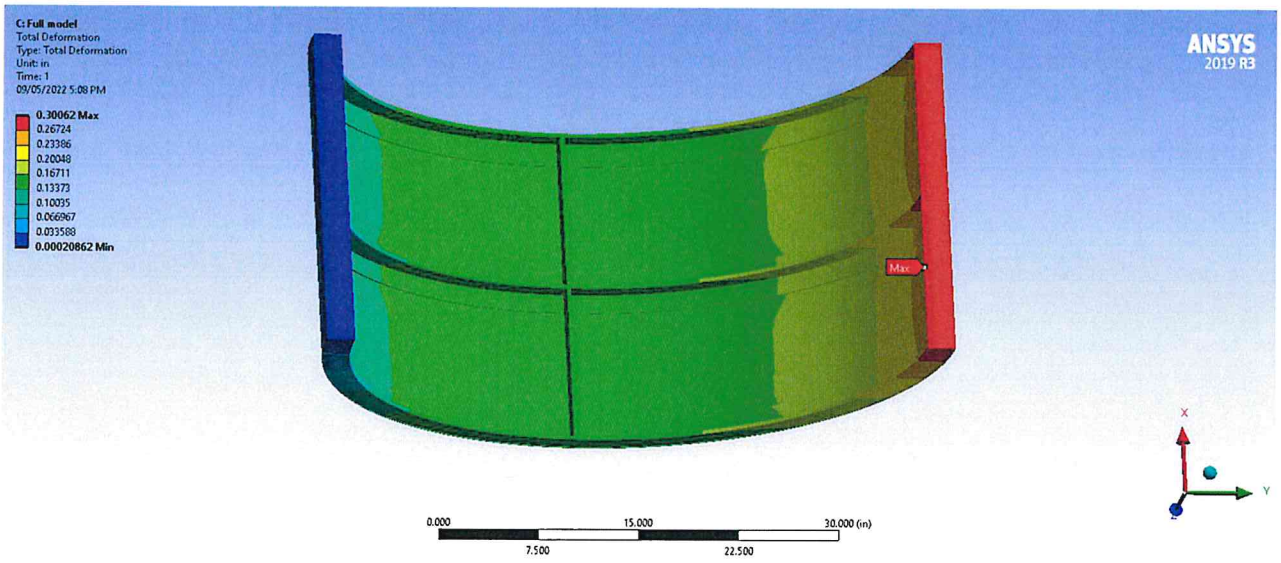

Figure 2: Total Deformation

2.2 Equivalent Stress

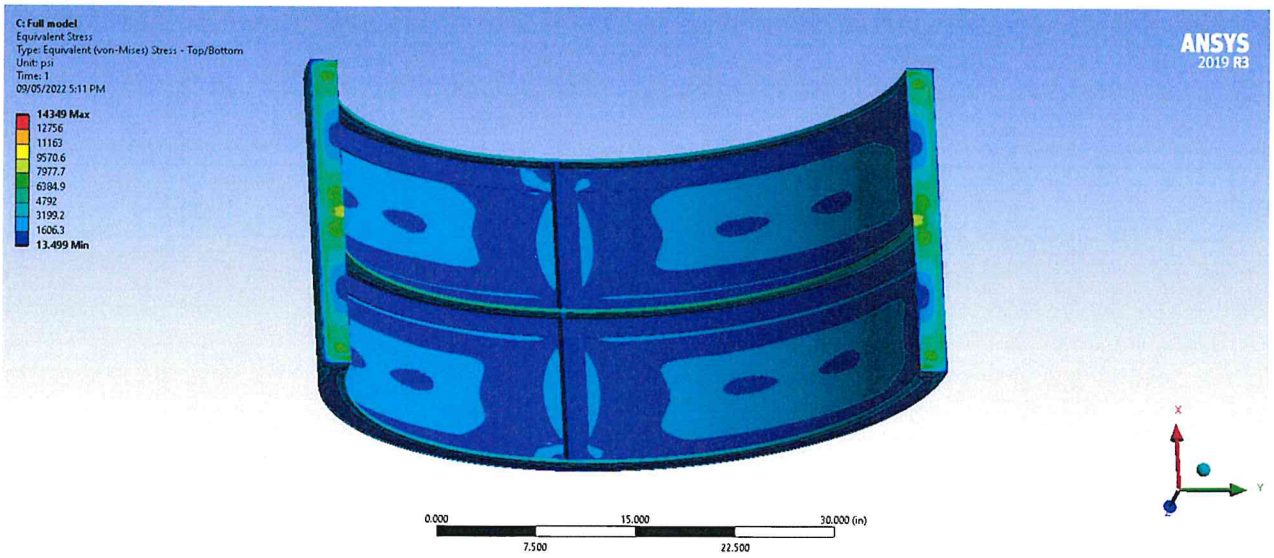

Figure 3: Equivalent Stress

2.3 Buckling

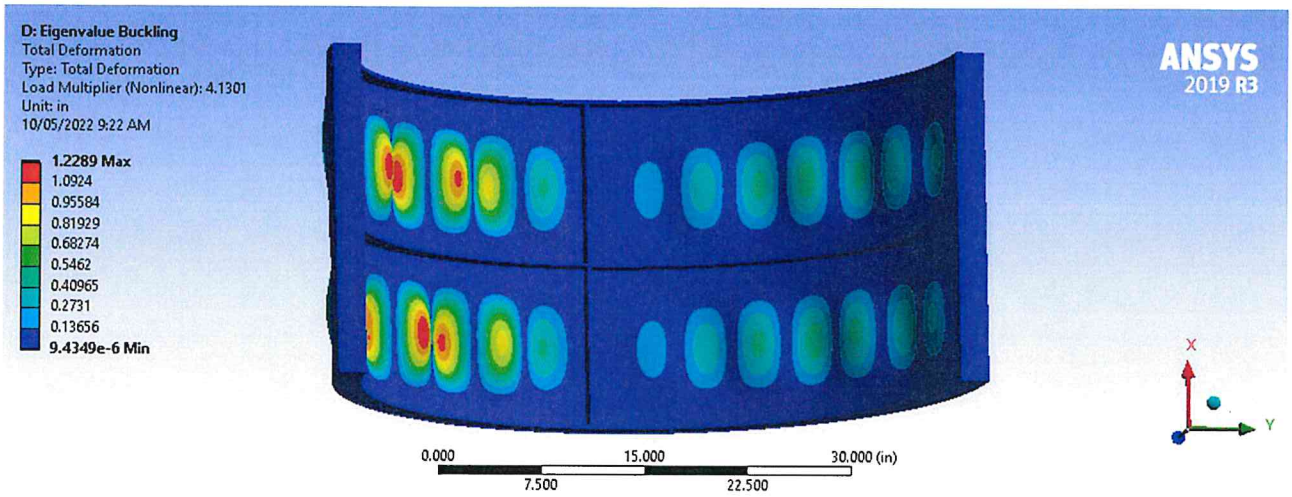

Figure 4: Buckling Mode 1

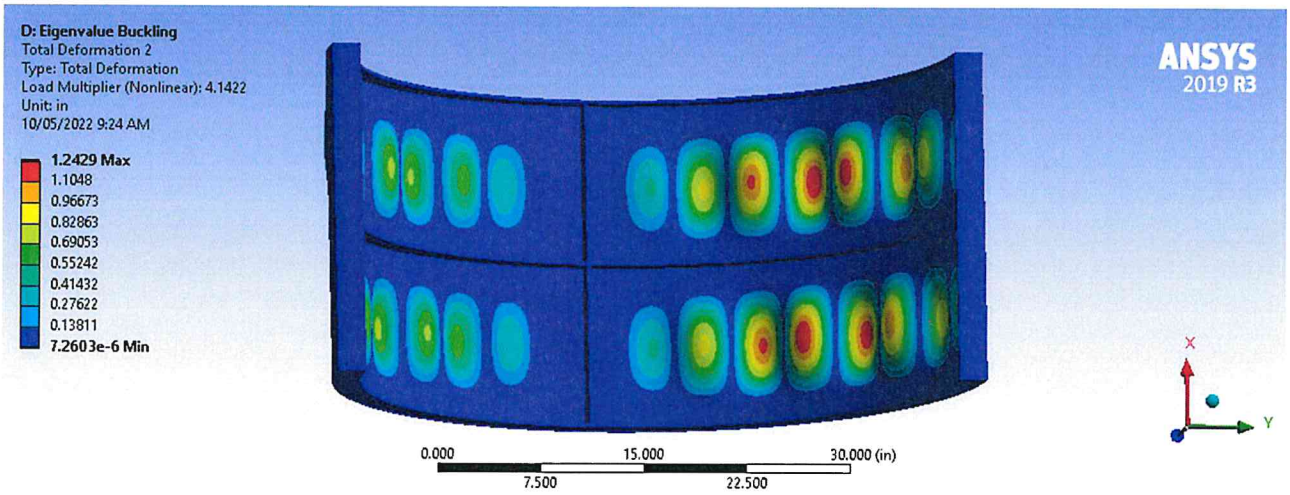

Figure 5: Buckling Mode 2

3. Loads and Constraints

This section shows the loads and constraints that were used in the analysis.

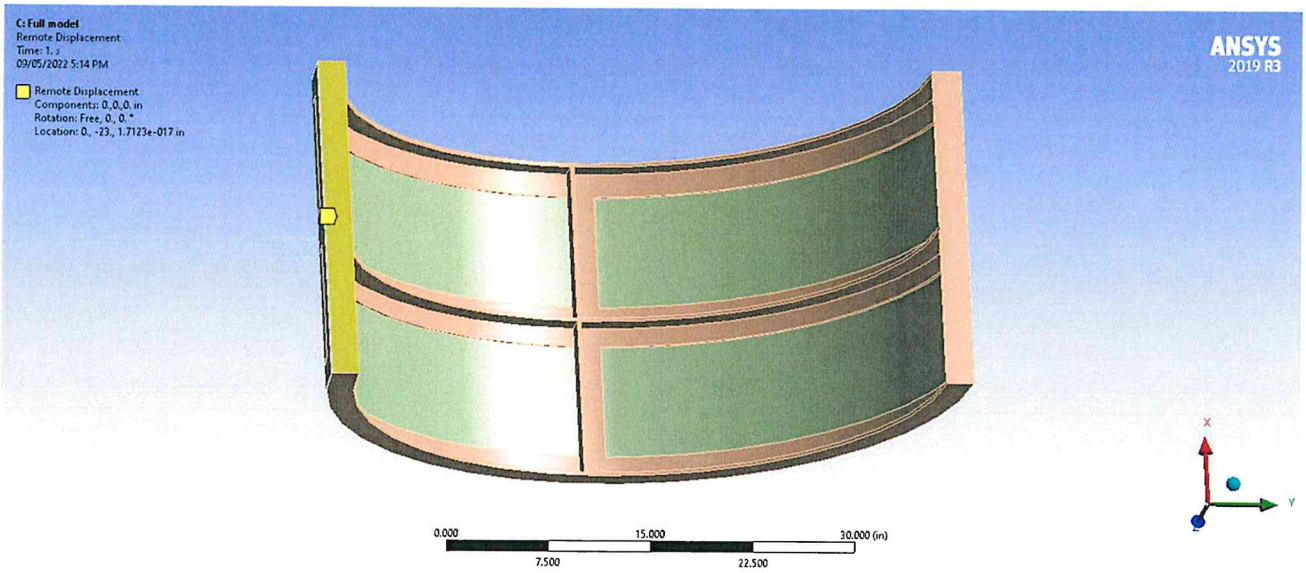

Figure 6: Remote Displacement 1

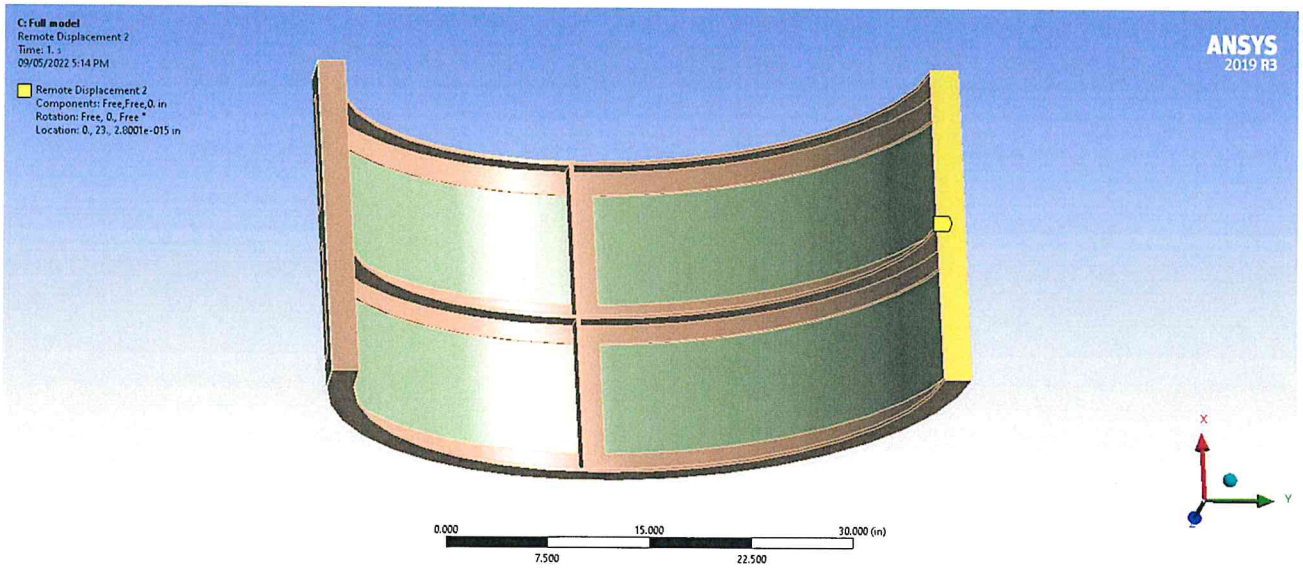

Figure 7: Remote Displacement 2

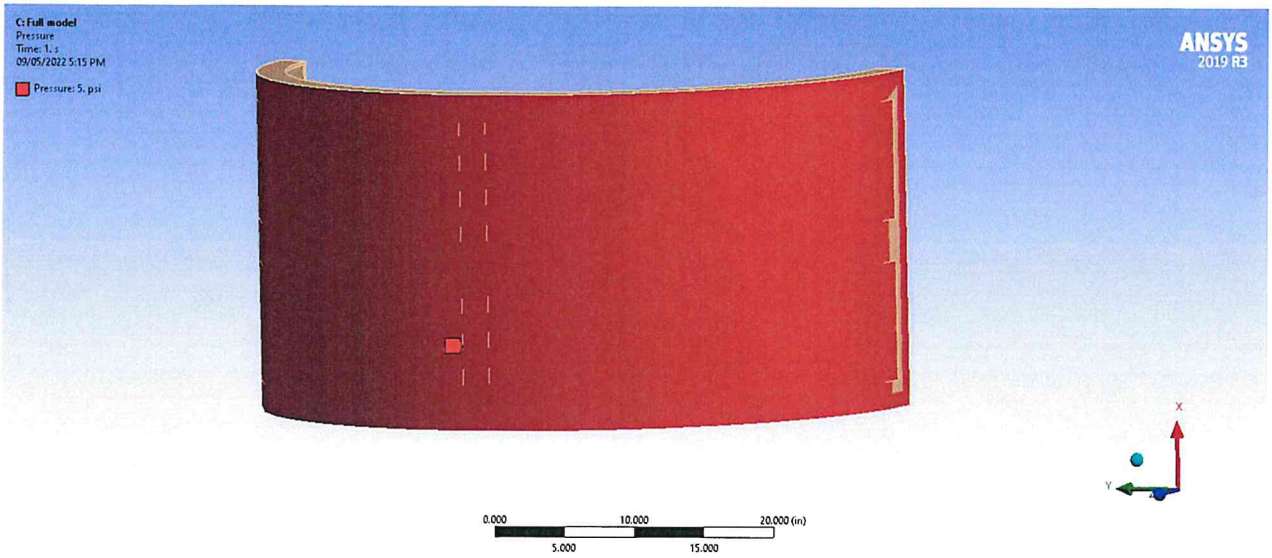

Figure 8: Pressure

4. Analysis Details

4.1 Material Model

The material model used in the analyses is a linear elastic model with Young's Modulus and Poisson's ratio for aluminum alloy (10,000 ksi and 0.33 respectively).

4.2 Mesh & Contacts

A fine mesh of size 0.120" was used in all locations.

All contacts between separate geometry components are bonded as appropriate to simulate the connections between the parts.

5. Geometry

To reduce the complexity of the analysis model, a separate CAD model was created with simplified geometry. The modifications are listed below:

- The shell component was remodelled as mid surface plane with individual relative thickness applied to increase the analysis run time efficiency.
- Framing components were modeled as one part to reduce connections and increase analysis run time efficiency.
- Rivets were not included in the analysis as it is assumed external pressures maintain contact between external shell and structural frame members.

6. Analysis Software

ANSYS Static Structural 2019 R3 was utilized for the finite element analysis.