P14416 P3 Arborloo Concrete Base Development
Strength/Safety Test Plan

Date Completed: 3/18/14

Performed By: Team

Summary: The following tests are designed to make sure the base is lightweight, strong, and durable. Tests included in this section are the weight of the heaviest piece assembled, number of people needed to move the heaviest assembled piece, load the base can support, and tripping hazards. Any notes or unusual/unique findings may be recorded in the comments sections. **Make sure the Hole Size Test Plan is done before starting the Strength/Safety Test Plan.**

Specifications Tested

Engr. Spec. #	Specification (description)	Unit of Measure	Marginal Value	Ideal Value	Pass/ Fail/ Margin
ES2	Load base can support (7 days)	lbs	270	450	Marginal
ES6	Tripping Hazards	in	~~X~~ 6	0	Pass
ES9	Weight of heaviest assembled piece	lbs	100	80	Pass
ES10	People needed to move heaviest assembled piece	qty	2	1	Pass
~~ES15~~	~~Pieces for available upgrade~~	qty	~~2~~	~~3~~	

Take out

Test Equipment

Check off	Equipment Description
✓	Concrete Base
✓	Scale
✓	Set of weights/ Known weights of objects
✓	Tape Measure
✓	At least 4 bricks
✓	Wood loading fixture
✓	Plywood circle (24" diameter)
✓	Mixing tray

Revision History

Revision	Description	Date
1	Created Document	12/5/13
2	Added Ideal Value, Pass/Fail Columns; Pass Fail Criteria	2/18/14
3	Updated equipment description, Load Test	3/8/14

Sections

Part I: Weight of Heaviest Assembled Piece Test
Part II: Number of People Needed to Move Heaviest Assembled Piece Test
Part III: Tripping Hazards Test
Part IV: Load the Base Can Support Test

Part I: Weight of Heaviest Assembled Piece Test
Date Completed: DNE 3/18/14

Performed By: Joe + Anthony

Procedure:

✓ **1.** Turn on the scale and tare it
✓ **2.** One person steps onto scale and record their weight
✓ **3.** The person steps off of scale and picks up concrete base and then steps back onto scale
✓ **4.** Record the weight of both the person and concrete base together
✓ **5.** Subtract the weight of the person from both the base and the person weight. This will be the weight of the base
✓ **6.** Record the weight of the concrete base

Comments:

Picture of "fully assembled" test:

Sign off on section completion before continuing: Joe Smithmyer

Part II: Number of People Needed to Move Heaviest Assembled Piece Test
Date Completed: 3/18/14

Performed By: Joe O. + Tony

Procedure:

✓ **1.** Take concrete base and lie flat on ground
✓ **2.** 1 person tries picking up base: if can't be picked up→add one more person until it is able to be picked up
✓ **3.** If able to be picked up, carry base to Innovation Center and back
✓ **4.** Record the number of people taken to move the base next to the base number and any comments the person(s) have about carrying the base (ex: I can do it, but it hurts my shoulder)

Comments:

Joe
Slab 2 - sharp edges hurts hands

Tony
Dome 2 - awkward, hurts hands, not two heavy

Picture of "fully assembled" test:

Sign off on section completion before continuing: Joe Smithmyer - Slab 2

Anthony Allen - Dome

Part III: Tripping Hazards Test

Date Completed: 3/18/14

Performed By: Evan + Mac

Procedure:

✓ **1.** Take concrete base and lie flat on ground
✓ **2.** Measure from ground the height to the highest point on the base
✓ **3.** Record this measurement in the Height column corresponding to the proper base number

Comments:

Picture of "fully assembled" test:

Sign off on section completion before continuing: Mac Kelly

Part IV: Load the Base Can Support Test

Date Completed: 3/18/14

Performed By: Victoria, Joe, Evan, Tony

Procedure:

✓ **1.** Lay bricks on the ground to create a "hole" template
✓ **2.** Place plywood with 22" diameter hole on top of the bricks
✓ **2.** Place concrete base on top of the plywood so the two holes are centered on each other
✓ **3.** Place 5 gallon bucket in hole after weighing on scale
✓ **5.** Place mixing tray (after weighing) upside down on top of 5 gallon bucket
✓ **4.** Place wood loading fixture (after weighing) on top of the upside down mixing tray
✓ **5.** Slowly place known weight in small (2-5 lbs) increments (maybe larger increments to start out until about 200 lbs) in the wood loading fixture
✓ **6.** After each weight is placed, inspect the base for any signs of cracking, debris, unique happenings, etc.
✓ **7.** Record any notes or unique findings in the comment section
✓ **8.** Failure is determined by large cracks in the base and record the amount of weight on the base that causes it to fail
✓ **9.** Load until 500lbs if able to and note any effects in the comment section.
___ **10.** If able to load to 500 lbs: Take 200lbs and drop from 6" above hole to simulate impact loading. ← failed before

Comments:

Slab 2 - 388.5 and 353.5 lbs - failed cracked down middle (one side completely, 2 cracks other side - Evan took picture

Dome 2 - 403 lbs + 200 lbs - failed - cracked on one side - Evan w/ picture

Picture of "fully assembled" test:

Sign off on section completion before continuing: Ian Bailey

Summary of Data

Base Number and Dome/Slab	Weight of Base (lbs)	Number of People Needed to Move (qty)	Height from ground to highest point of base (in)	Max Load Seat can Support (lbs)	Max Load Base can Support (lbs)
Slab 2	43.5	1	Avg. thicknesses		
		(need 2)			
Dome 2	31.02	1			

(2 people really light)

- sharp edges hurts han

Pass/Fail Criteria

Rqmt #	Engr. Requirement (metric)	Customer Req	Unit of Measure	Marginal Value	Ideal Value	Pass/Fail Criteria
S1	Purchase Cost for base	1	$	25	25	Fails if purchase cost >$25
S2	Load it can support (7 days)	3	lbs	270	450	Fails if load < 270 lbs
S3	Hole diameter it covers	2	in	18	20	Fails if clearance between outer edge of concrete base and diameter of plywood hole < 2"
S4	Squat hole widest point	3	in	9	10	Passes if diameter is between 9"-11"
S5	Static coefficient of friction against ground	3	-	0.5	0.6	Use scale to measure force it takes to move
S6	Tripping hazards	3	qty	0	0	N/A
S7	Time to assemble	5	hours	2	1	Fails if assembly time > 2 hours
S8	Hand tools needed to assemble	1.5	qty	3	0	Fails if tools needed quantity > 3
S9	Weight of heaviest assembled piece	4.5	lbs	100	80	Fails if weight of heaviest piece is > 100 lbs
S10	People needed to move heaviest assembled piece	5	qty	2	1	Fails if number of people > 2
S11	90% of Users find easy to clean	4.5	survey	90%	100%	Passes if within ± 5% of 90%
S12	Lifecycle	1.8	years	TBD	TBD	TBD
S13	90% of Users find comfortable	6	survey	90%	100%	Passes if within ± 5% of 90%
S14	90% of Users find visually appealing	7	survey	90%	100%	Passes if within ± 5% of 90%
S15	Pieces for available upgrade	9	qty	2	3	N/A

6"

	Customer Requirements
1	Affordable
2	Covers Hole
3	Safe to Use
4	Moveable
5	Simple to Setup
6	Comfortable
7	"Modern" Aesthetics
8	Servicability
9	Allows Financing in Parts

2-Slab-43.5 lbs → plastic sticking to mold + base, wet weight didn't include to, layer

Dome 2 - 31.02 lbs

P14416 P3 Arborloo Concrete Base Development
Hole Size Test Plan

Date Completed: 3/18/14

Performed By: Team

Summary: The following tests are designed to make sure the hole sizes for the base are the proper size. The sections consist of determining the squat hole diameter size and how well the base covers the arborloo hole. Make any notes or record any unusual/unique findings in the comments section. **This should be the second set of tests performed on the concrete bases.**

Specifications Tested

Engr. Spec. #	Specification (description)	Unit of Measure	Marginal Value	Ideal Value	Pass/Fail/ Marginal
ES3	Size of arborloo hole(diameter)	in	18	20	Pass
ES4	Squat hole (diameter)- using a 5 gallon bucket to create this hole in the mold	in	9	10	Pass

Test Equipment

Check off	Equipment Description
	Concrete Base
	Tape measure
	Piece of plywood with 22" diameter hole

Revision History

Revision	Description	Date
1	Created Document	12/5/13
2	Added Ideal Value, Pass/Fail Columns; Pass Fail Criteria	2/18/14
3	Changed procedure of Part I	3/8/14

Sections

Part I: Size of Hole Arborloo Covers Test
Part II: Squat Hole Test

Part I: Size of Hole Arborloo Covers Test

Date Completed: 3/18/14

Performed By: Evan Burley + Mac Keehfus + Tony DeLeo

Procedure:

✓ **1.** Use tape measure to get dimensions of concrete base (OD, ID, inside thickness, outside thickness, height, width, plywood hole diameter) and record these dimensions

✓ **2.** Set up sheet of plywood with 22" diameter hole in the center

✓ **3.** Place and center concrete base over the center of the circle in plywood

✓ **4.** Take a pencil and mark the outer diameter in 6 spots (roughly 60 degrees apart) on the plywood

✓ **5.** Measure and record the distance from outer diameter of concrete base to the diameter of the 22" plywood circle

✓ **6.** Record these measurements below

✓ **7.** Once the measurements are recorded, erase the pencil marks on the plywood

Summary of Data

Base Number and Dome/Slab	Hole in Ground Diameter (in)	Squat Hole Diameter or ID (in)	Outside Diameter (in)	Height (in)	Width (in)	Inside Thickness (in)	Outside Thickness (in)	Distance from OD of Base to OD of plywood hole (in)
Dome 2	22	10.5, 10.5, 10.5, 10.5, 10.5, 10	30, 30.25, 30, 30.25, 29, 30.25	4, 3.75, 3 7/8, 3 7/8, 3 7/8, 4	10.25, 9.75, 10.5, 10, 9.5, 10	1, 1.25, 1.25, 1.5, 1.25, 1.5	N/A	N/A
Slab 2	22	~~10 1/8~~, 10.25, 10.25, 10.125, 10.25, 10.5, 10.125	29.125, 29.5, 31, 29.5, 29, 30.125	Avg. thickness N/A	8 7/8, 9, 10, 10.25, 10, 10	1.5, 1.5, 1.75, 1 3/8, 1.25, 1.5	1 3/8, 1 3/8, 1.25, 1 3/8, 1.75, 1.5	2 5/8, 4.25, 4.25, 4.5, 4 3/8, 3.5

Comments: width = ID to OD

Picture of "fully assembled" test:

Sign off on section completion before continuing: Mac Kelly

Part II: Squat Hole Test

Date Completed: 3/18/14

Performed By: Evan + Mac + Tony

Procedure:

✓ **1.** Take concrete base and lie flat on ground

✓ **2.** Use tape measure to obtain diameter of squat hole

✓ **3.** Take 6 diameter measurements (roughly 60 degrees apart)

✓ **4.** Record squat hole diameters in Summary of Data Table

Comments:

Picture of "fully assembled" test:

Sign off on section completion before continuing: Max Wahl

Pass/Fail Criteria

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