KALARAMA FARM · KENTUCKY

HAUPT HYPERBOLIC HOBBIT HOME

Concept package for engineering review — rev 19 Nov 2026 (b)

Unstamped concept. Not a permit set. Not construction documents.

This mailing freezes one baseline so a structural engineer and other contributors can accept, resize, or reject it. Architecture and interiors come later. Structure first.

Field	Value
Date	11 September 2026 — revised 19 Nov 2026, rev b (current plans in §0)
Site	Kalarama Farm, Kentucky (Nov 2026 foundation concept assumes Bajo Chaco-type clay — site to be confirmed)
Owner / concept	Mark Haupt
Frozen baseline	**38 ft rise × 47.5 ft span × 60 ft length · ratio 0.80**
Soil cover at crown	10 ft at 120 pcf → 1,200 psf vertical soil load
Design shell	12 in shotcrete / gunite, #6 Grade 60 @ 5 in each way
Usable floor	6,062 sq ft (563.2 m^2) on three levels (0 / 10 / 20 ft above springline = 10 / 20 / 30 ft (3.05 / 6.10 / 9.14 m) above original grade on the 10 ft fill platform)
Quantity source	Haupt Hobbit Home V4 spreadsheet (live Drive file)

Drive sources

Spreadsheet: https://docs.google.com/spreadsheets/d/1LxNgPJWrnSWuSZxV4fPDwr1kBk8Zz-hgM4ch0WgCXkg/edit

Working notes (this document's parent draft):
https://docs.google.com/document/d/1wiuNttEjVzF1cge1siRKr1e2UcJAKCbvt5BMLDZi_K0/edit

> How to read numbers. The V4 sheet still holds comparison tables for other heights and ratios. The three quantity defects flagged in September (rib length 67.27 ft instead of 93.58 ft / 28.52 m; aluminum reuse credit; admixture on 277 cy instead of 308.85 cy / 236.1 m^3) are now fixed in the live sheet, and the brace count was corrected to 16 per arch on 19 Nov 2026; the live sheet totals $182,300.45 in materials. This package quotes the frozen 38 ft / 0.80 row everywhere. Section 0 (19 Nov 2026) states the current plans and governs where older sections differ.

0. Current plans — update 19 Nov 2026, rev b (read this first)

This revision brings the document up to the plans agreed with Mark Haupt (Kalarama Farm LLC) on 17–19 Nov 2026. The frozen shell baseline does not change: 38 ft (11.58 m) rise, 0.80 ratio, 47.5 ft (14.48 m) span, 60 ft (18.29 m) length, 12 in (305 mm) gunite with #6 Grade 60 @ 5 in (127 mm) each way, 31 ribs at 2 ft (0.61 m), 93.58 ft (28.52 m) developed arc per rib (not 67.27 ft / 20.50 m). Where an older section disagrees with this section, this section governs. Concept only — unstamped, not for construction; a licensed PE must verify every size.

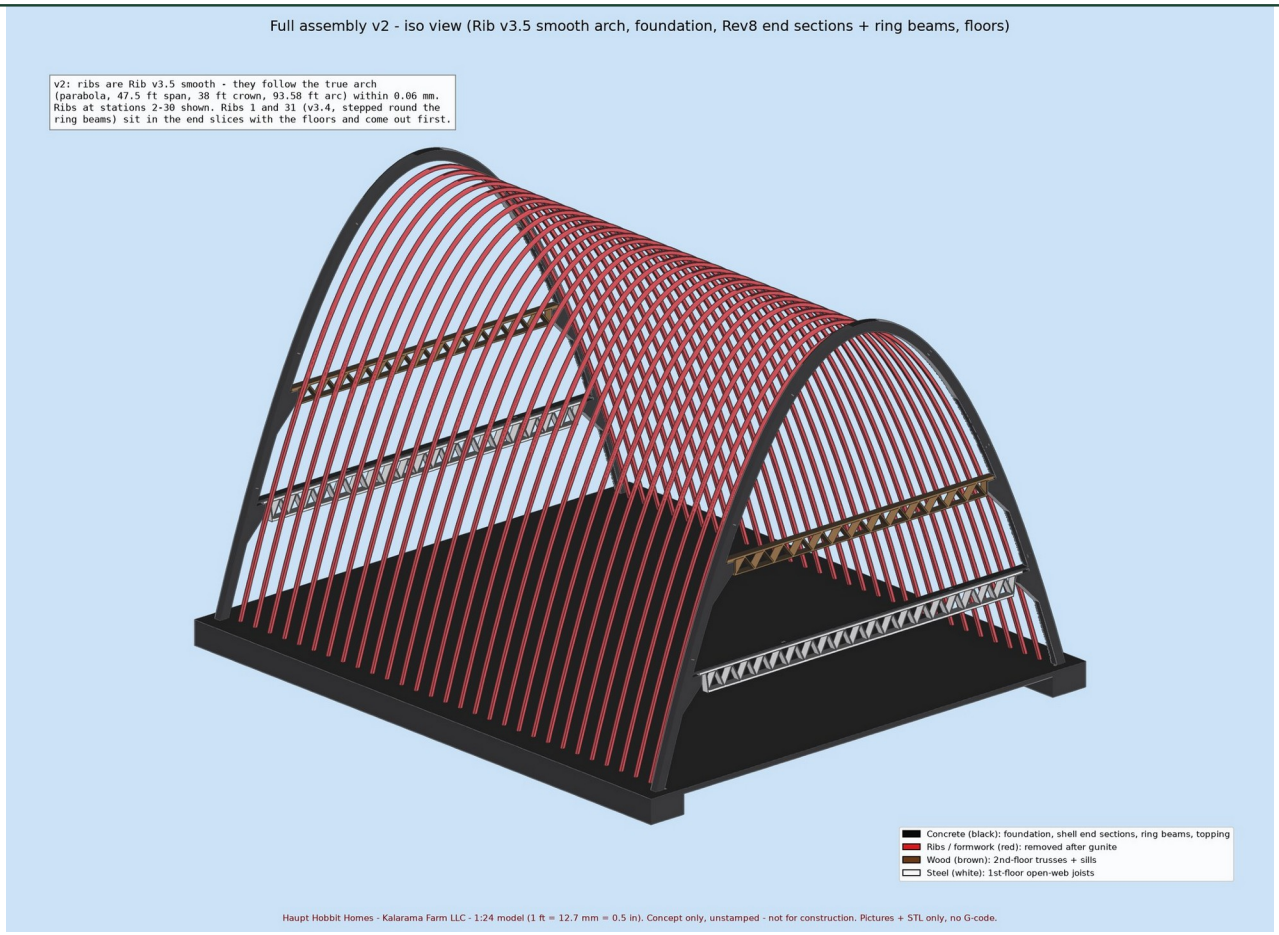


Figure 0.1 Overall assembly concept (pictured as the 1:24 model): concrete black, ribs red, wood brown, steel white. Folder: https://drive.google.com/drive/folders/1uUr1mO1w166g4oZtb0Z0-qPSAPdgWcLB

0.1 Site levels — 10 ft (3.05 m) fill platform (decided 19 Nov 2026)

The springline = ground floor = top of the compacted fill platform, 10 ft (3.05 m) above original grade. Height above original grade = 10 ft (3.05 m) + height above springline:

- Ground floor: 0 + 10 = 10 ft (3.05 m)
- 1st floor: 10 + 10 = 20 ft (6.10 m)
- 2nd floor: 20 + 10 = 30 ft (9.14 m)
- Lid: 33 + 10 = 43 ft (13.11 m)
- Crown: 38 + 10 = 48 ft (14.63 m)
- Top of soil cover ≈ 48 + 1 (shell) + 10 (cover) = 59 ft (17.98 m)

Shell geometry in this document is measured from the springline and does not change. Footing embedment and soil cover are now measured from the platform top. The platform is engineered fill: compaction, bearing capacity and settlement to be set by the geotechnical engineer / PE. SUPERSEDED: the +2 ft (0.61 m) pad raise of 3 Oct 2026 (floors 2 / 12 / 22 ft = 0.61 / 3.66 / 6.71 m and crown 40 ft / 12.19 m above original grade) no longer applies.

0.2 Ribs — one complete arch, cut out only at the ring beams; REUSABLE formwork

Each rib is 2.5 in (64 mm) square HSS, ONE complete continuous arch (93.58 ft / 28.52 m developed; 47.5 ft / 14.48 m wide × 38 ft / 11.58 m tall). A one-piece arch is far over the 8.5 ft (2.59 m) legal load width (a superload), so it is bent at or near the site, or shop-bent in pieces and CJP-welded into one arch in a site jig before erection. This replaces the earlier four- and six-piece bolted ribs; that text and those drawings are kept for history only. CNC files v4.0 (stations, cut / weld / bolt locations, shop drawing): https://drive.google.com/drive/folders/1YLvKUSfL7W1_T5GqTeJW_-O66NXJEFnc

Decided 19 Nov 2026: the rib is REUSABLE formwork. The galvanized aluminum substrate stays in place; the steel ribs are stripped after cure and reused.

At each ring beam (10 ft / 3.05 m and 20 ft / 6.10 m above springline, both sides: 4 places per rib, 124 for the house), on site:

1. Bottom support — same 2.5 in (64 mm) square tube, laid along the beam haunch / soffit (45°) and welded to the rib below the beam.

2. Vertical support — same tube, straight up the beam inner face and continuing past the floor line until it meets the rib above; top coped to the rib and welded.

3. Corner — the two supports are one length of tube: a 45° V-notch, 2.07 in (53 mm) wide at the inside face, is cut through the inside (concrete-side) face and both side walls; the tube is bent closed and the seam welded all round. One solid corner, no V gap.

4. Cover plate — one small plate the same width as the tube, 2.5 in (64 mm) wide × 3/8 in (10 mm) thick (APPROVED 19 Nov 2026), on the OUTSIDE (shell-side) face of the rib, lapping 4 in (102 mm) above and below the cut with two 5/8 in (16 mm) bolts each end (approved). It sits in a slot through the beam and stays cast into the concrete permanently. It strengthens the rib across the cut (not the beam). It needs weld nuts or tapped holes so the bolts can be backed out from the room side (fabricator / PE).

5. Cut-out — the rib is cut from the beam tip (top of the beam at the shell) down to where the haunch meets the shell.

6. Cast the Rev7 ring beam and the shell. After cure: unbolt the rib stubs from the cover plate (the plate stays cast into the beam), cut the two supports free, and strip the rib for reuse. Because of the 4 cut-outs each rib comes off in 5 segments (2 legs, 2 middles, 1 crown), which must be re-joined and checked against the CNC stations before the next house. Each house needs 124 new cast-in plates and 124 new supports. In the 1:24 model the 4 demonstration cover plates print in white as loose pieces; the slot through the beam is described here only.

7. OPEN (found while making the CNC files): the bottom support's coped end lands on the rib mostly ABOVE the lower cut — only about 0.6 in (15 mm) of its contact is on the rib stub that stays, the rest is on the piece that is cut out. A fix is needed before fabrication, e.g. a short kicker tube from the support down onto the rib below the cut, or a bolted clip on the stub. Decision for Mark / PE.

Reuse and cost: the live sheet keeps the reuse factor at 0, so house #1 carries the full rib cost. Rib reuse is a saving for house #2 onward only, less refurbishment and re-joining, plus new plates and supports each house (proposed sheet line, not made).

Item (per rib, each side)	At 10 ft ring beam	At 20 ft ring beam
Cut-out along rib (beam tip to haunch-shell meet)	42.11 in (1,070 mm)	47.28 in (1,201 mm)
Haunch meets shell, below floor line	39.72 in (1,009 mm)	43.43 in (1,103 mm)
Bottom support along 45° haunch (concrete face)	39.20 in (996 mm)	44.44 in (1,129 mm)
Vertical support (beam bottom-inside corner to rib)	41.55 in (1,055 mm)	33.19 in (843 mm)
Vertical support meets rib, above floor line	29.55 in (750 mm)	21.19 in (538 mm)
Corner V-notch (45°) width at inside face	2.07 in (53 mm)	2.07 in (53 mm)
Cover plate (APPROVED 19 Nov 2026) — outside face, stays cast in; rib unbolts for reuse	2.5 × 3/8 in (64 × 10 mm), 4 in (102 mm) lap each end, 2 × 5/8 in (16 mm) bolts each end	same

Values are measured on the left-hand rib (right-hand is a mirror), full size, from the v2.3 pictures (19 Nov 2026 PM). Folder: https://drive.google.com/drive/folders/1qjvbKzCxU11SfZMLz_pfGfw1UW4Pb5bn

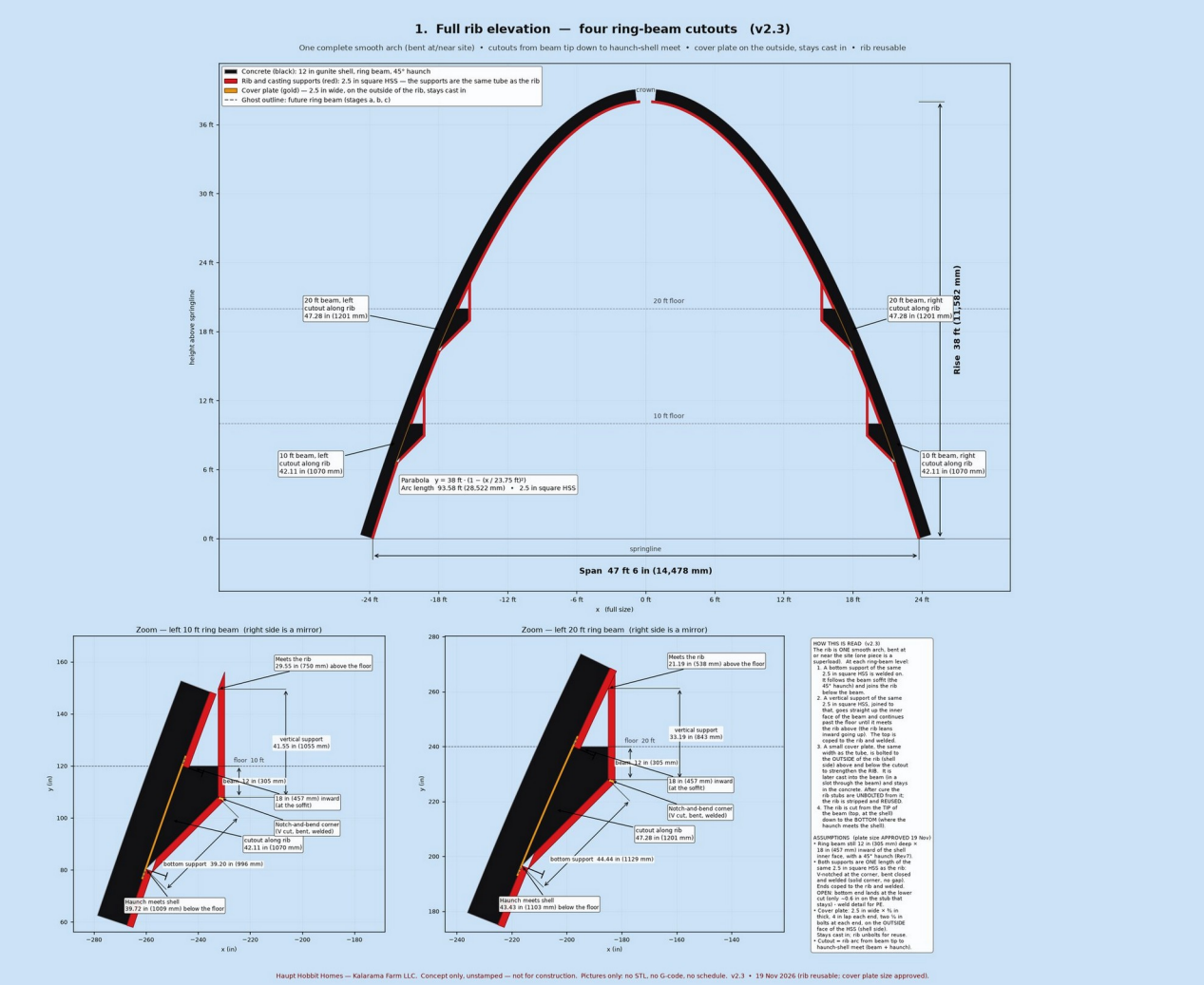


Figure 0.2 Full rib elevation with the four ring-beam cut-outs, plus 10 ft and 20 ft zooms (v2.3).

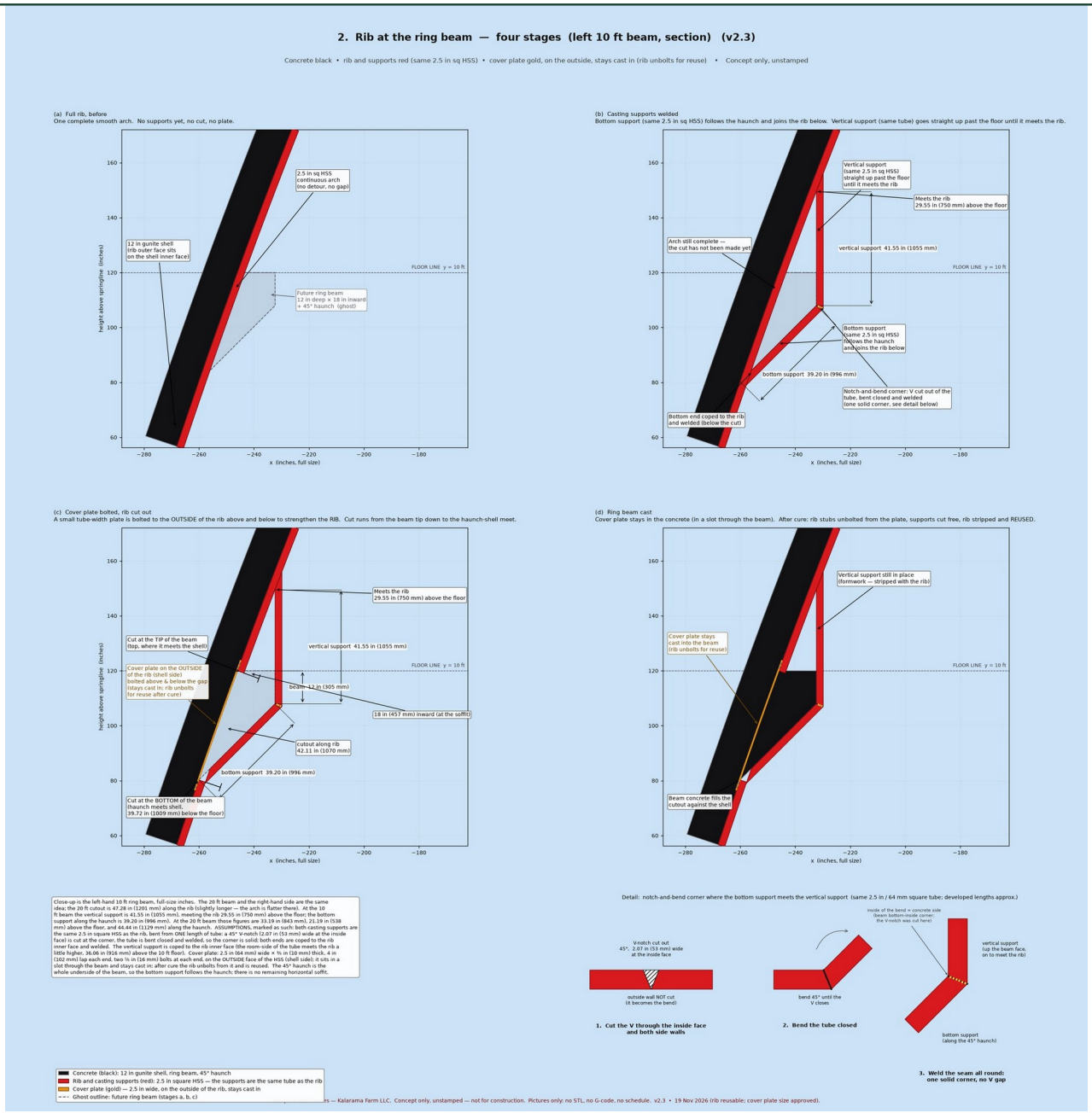


Figure 0.3 Rib at the 10 ft ring beam in four stages: (a) full rib, (b) supports welded, (c) cover plate bolted and rib cut, (d) beam cast — with the notch-and-bend corner detail (v2.3; after cure the rib is unbolted and reused).

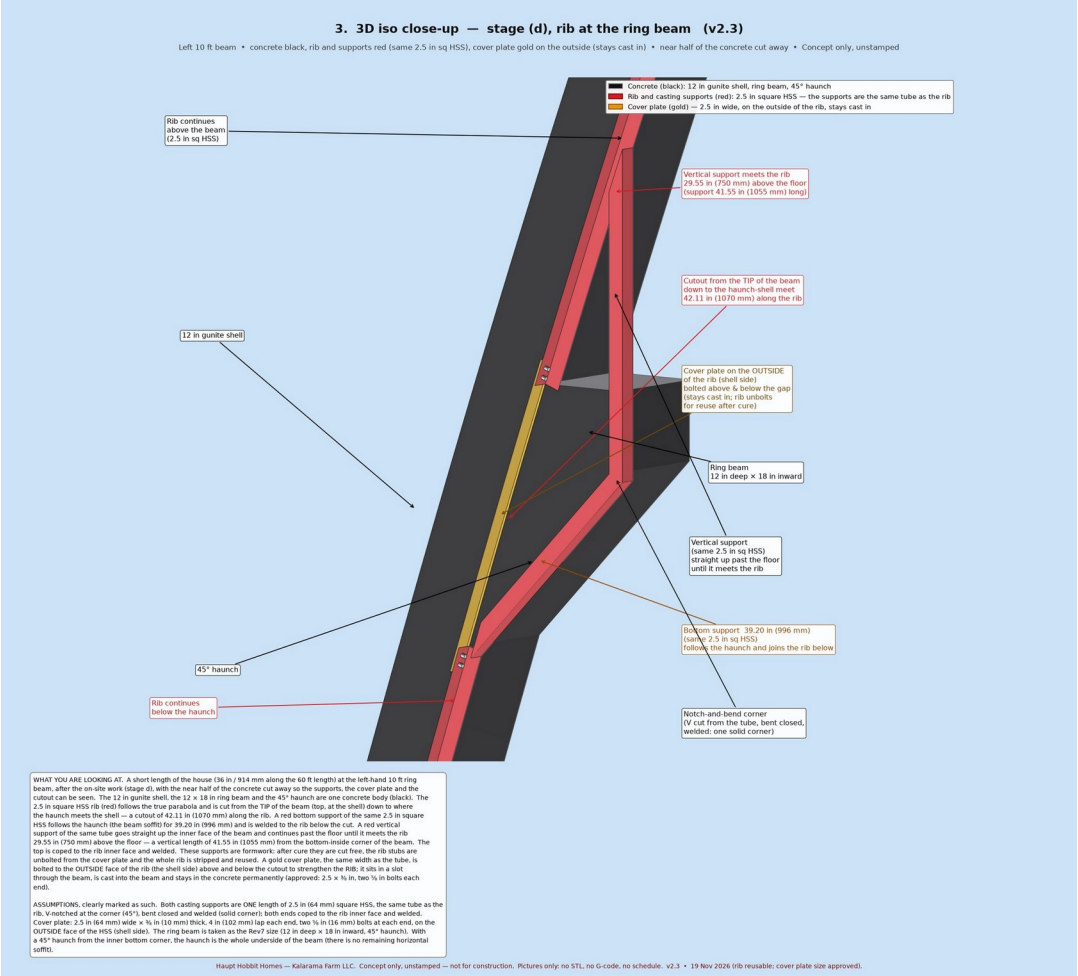


Figure 0.4 3D close-up, stage (d), near half of the concrete cut away (v2.3). Rib and both supports are the same 2.5 in (64 mm) square tube.

0.3 Ring beams (Rev7)

Ring beams at 10 ft (3.05 m) and 20 ft (6.10 m) above springline: 12 in (305 mm) deep × 18 in (457 mm) inward of the shell inner face, top at the floor line, with a 45° haunch that forms the whole underside. This replaces the 16 in (406 mm) / 14 in (356 mm) ring beams and the 14 ft (4.27 m) intermediate beams of the September package (placeholder until the PE sizes it for the floor line load and eccentricity).

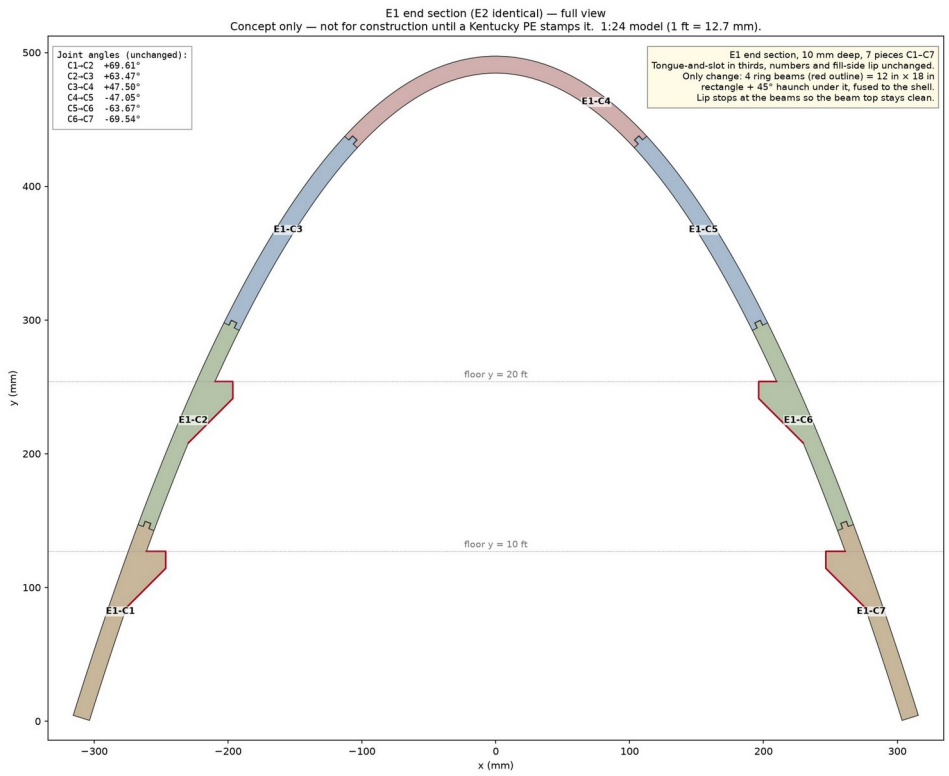


Figure 0.5 Rev7 end section with both ring beams and haunches (pictured as the 1:24 model section). Folder: https://drive.google.com/drive/folders/1VQpzMoruZ6vgz-1NL-kzqlZlOxfNMX5j

0.4 Floors — clear span, no columns

1st floor (10 ft / 3.05 m above springline; about 36.7 ft / 11.19 m clear): open-web steel joists about 26 in (660 mm) deep @ 24 in (610 mm), with 2.5 in (64 mm) concrete on form deck — about 29 in (735 mm) overall and about 40 psf (1.9 kPa).

2nd floor (20 ft / 6.10 m above springline; about 28.6 ft / 8.72 m clear): open-web wood floor trusses about 20 in (510 mm) deep @ 24 in (610 mm) with plywood / T&G subfloor.

Both are simple-span gravity members bearing on the ring beams: one end fixed, the other slotted, so they put no thrust on the shell. Headroom from the 1st finished floor to the underside of the 2nd-floor trusses is about 8 ft 1.5 in (2,476 mm). PE to run a vibration check on the 1st floor.

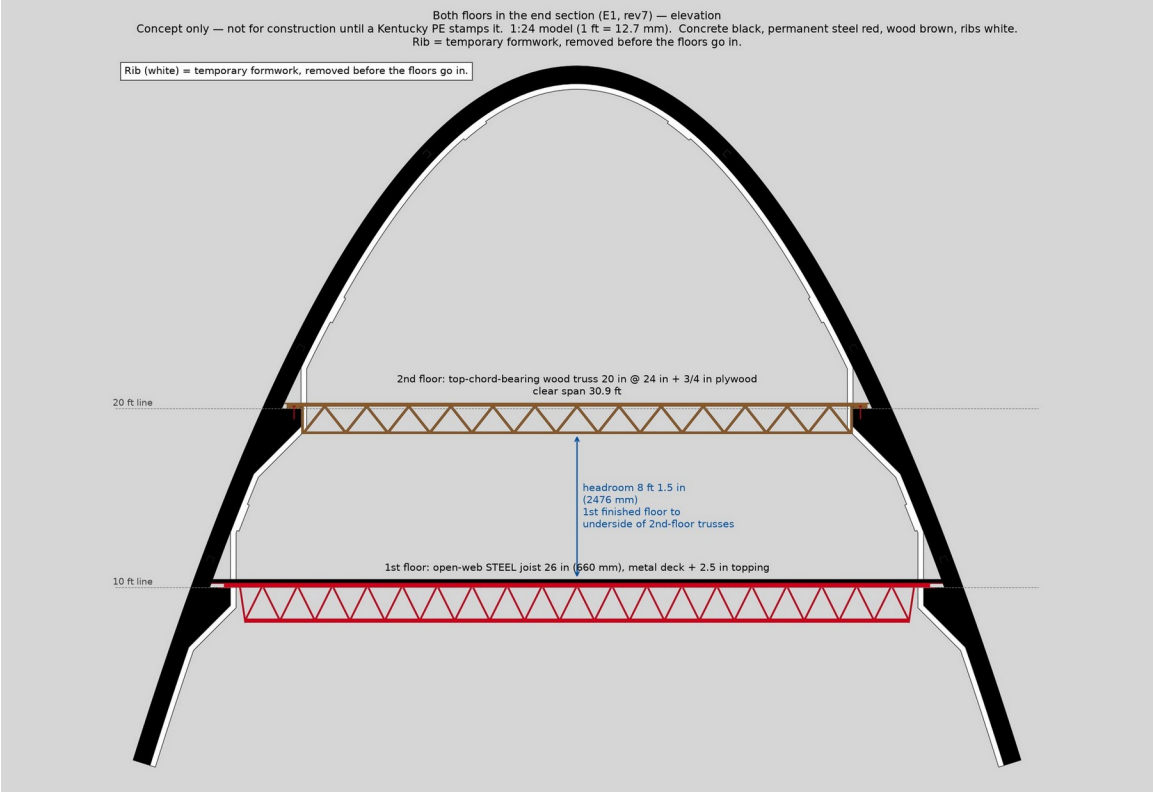


Figure 0.6 Both floors in the end section (concept). Folder: https://drive.google.com/drive/folders/1teXUJkXjC-zSP0RpfCPRFmekrzR1_K2m

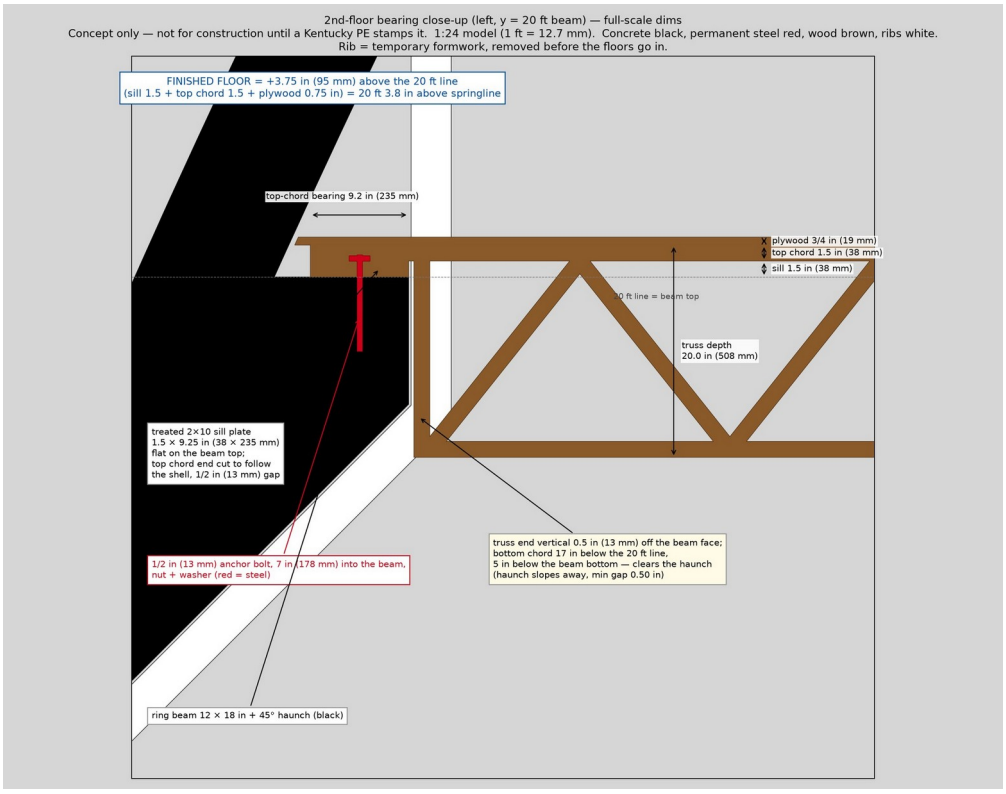


Figure 0.7 Floor bearing on the ring beam (concept).

0.5 Foundation concept (18 Nov 2026)

Continuous strip footing under each long shell edge (full 60 ft / 18.29 m length); ground slab cast monolithic with both footings so the floor also ties the arch thrust; gravel drainage layer under the slab. The house sits on a compacted fill platform 10 ft (3.05 m) high, about 170 × 170 ft (52 × 52 m), placed in about 8 in (200 mm) lifts with edges contoured at 30°, over native Bajo Chaco-type clay. Soil test needed; all sizes by the PE after the soil report.

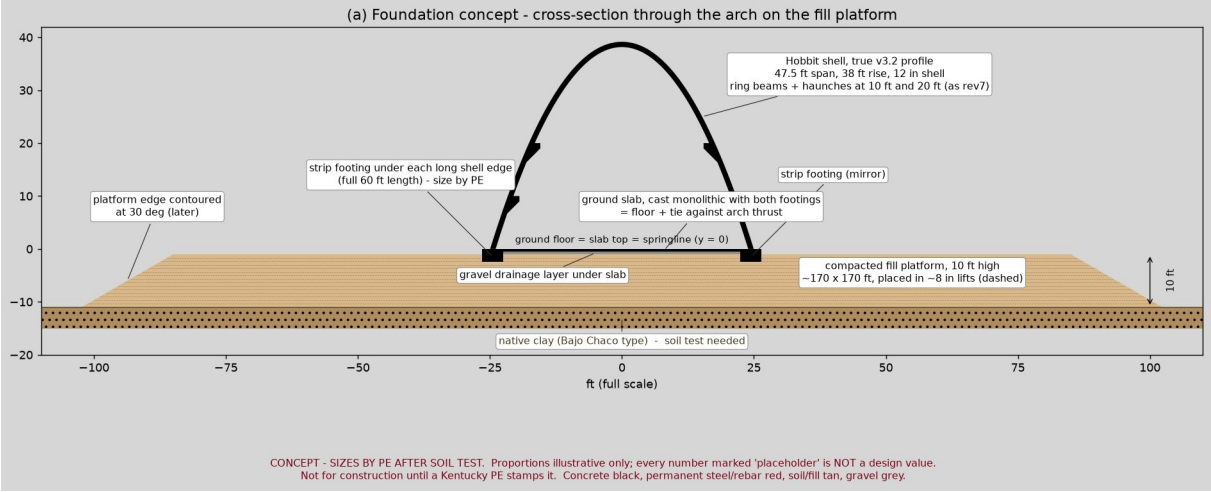


Figure 0.8 Foundation concept: cross-section through the arch on the fill platform. Folder: https://drive.google.com/drive/folders/1QSntiKK7rjnv0FYsG-83EFKh6H7F05Cf

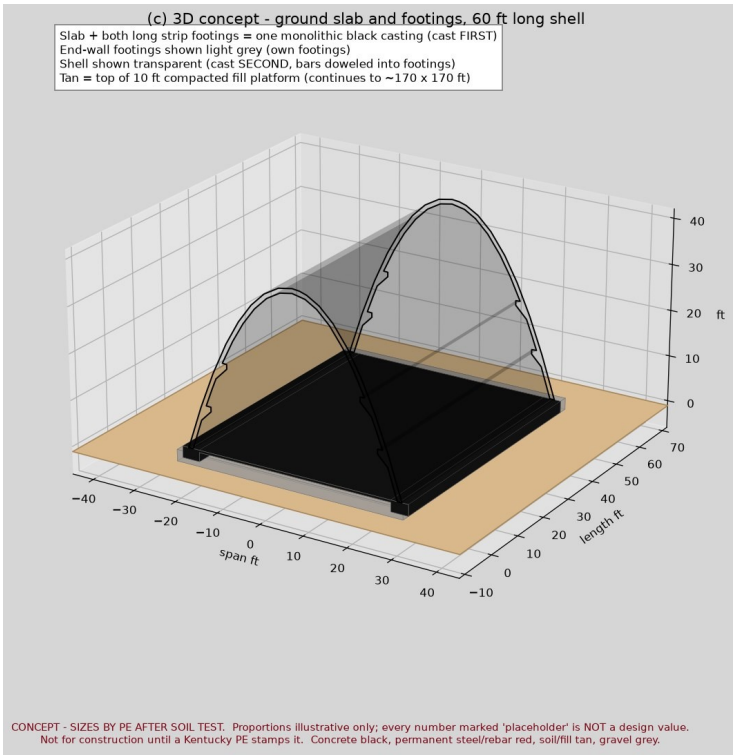


Figure 0.9 Foundation concept in 3D: ground slab and footings, 10 ft (3.05 m) platform.

0.6 Ends — Combo 1 (locked)

Both ends are Combo 1 (C1 + C1): hybrid horizontal daylight bands with 35–45% open / glazed area per end face (aim about 40%, about 480 sq ft / 44.6 m² of the about 1,203 sq ft / 111.8 m² face), solid piers 4.0 + 3.0 + 3.0 + 4.0 ft (1.22 + 0.91 + 0.91 + 1.22 m), ring beams continuous through the solid zones. The ends are NOT full glass. Portal stays

unlocked. Details: Combo 1 Opening Schedule
https://docs.google.com/document/d/1lDTAK6wjMdaHj1edd7WkyQpRSi4UOZNyMY2LYxCrX4Q/edit

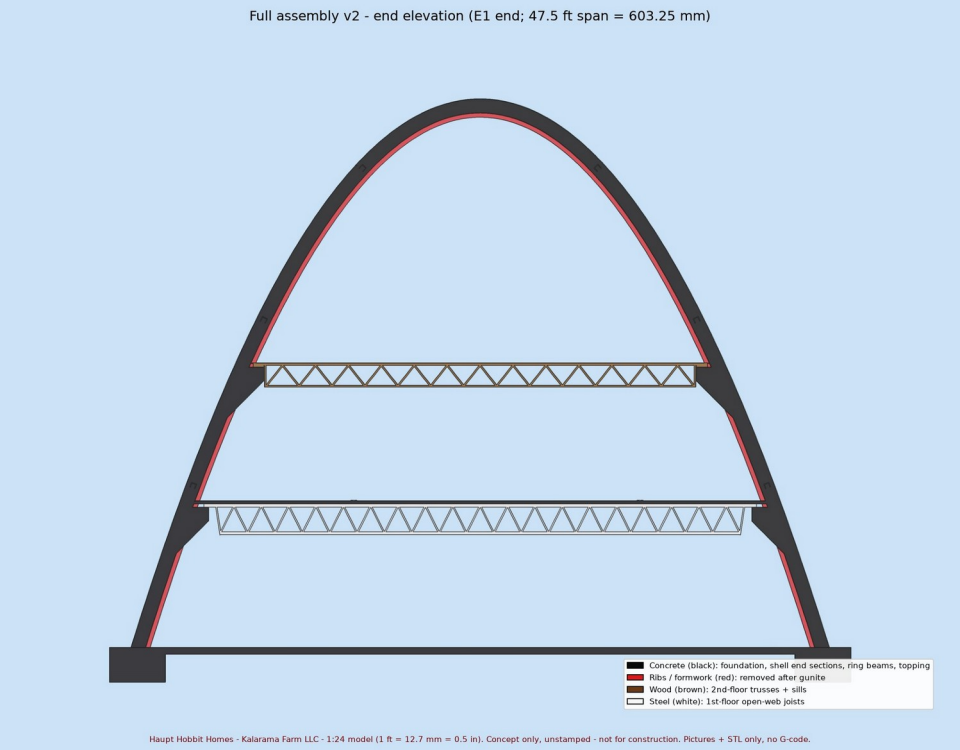


Figure 0.10 End elevation of the assembly concept (pictured as the 1:24 model; glazing layout per the Opening Schedule).

0.7 Live V4 cost sheet status (read 19 Nov 2026)

Live V4 sheet line (19 Nov 2026)	Value	Status
Length of each arch rib	93.58 ft (28.52 m)	Fixed (was 67.27 ft / 20.50 m)
Total rib tubing, 31 ribs	2,900.98 ft (884.22 m) → $14,504.90	Fixed (was 2,085.27 ft / 635.59 m)
Aluminum reuse credit	$0	Fixed (was −$6,054)
Waterproofing admixture	309 cu yd (236.1 m^3) → $46,327	Fixed (was 277 cu yd / 211.8 m^3)
Horizontal braces	16 per arch, 960 ft (292.6 m) → $1,920	Fixed 19 Nov 2026 (Mark approved; was 23 / 1,380 ft / $2,760)
Formwork & substrate total	$31,050.90	Fixed (was $31,890.90). Reuse factor stays 0: house #1 carries the full rib cost
Envelope & moisture total	$68,592.32	—
Materials total (materials only)	$182,300.45 ($30.07 / usable sq ft; $323.70 / m^2)	Floors/beams lines still price RC slabs + 16/14 in rings — not yet re-priced for joists/trusses and Rev7 beams

Sheet: https://docs.google.com/spreadsheets/d/1LxNgPJWrnSWuSZxV4fPDwr1kBk8Zz-hgM4ch0WgCXkg/edit — the only sheet change was the brace formula (16 per arch, approved by Mark 19 Nov 2026); other proposed sheet changes are listed for Mark.

1. Ask of the engineer

Please review this concept and answer in writing:

1. Can a parabolic gunite shell of this size carry 10 ft of soil plus ordinary farm surface loads (grass, horses, light tractor)?
2. Is 12 in shell thickness with a #6 @ 5 in two-way mat a reasonable starting design, or what thickness and bar would you use instead?

3. Are 12 in × 18 in (305 × 457 mm) Rev7 ring beams with a 45° haunch, carrying clear-span steel joists (1st floor) and wood trusses (2nd floor), the right way to hang two upper floors from the shell? (Replaces the September ring + 14 ft intermediate beam scheme.)
4. What must the strip footings and monolithic slab tie be to take vertical load and outward arch thrust on a 10 ft (3.05 m) compacted fill platform over clay?
5. What is missing before anyone bids formwork or shotcrete: borings, end walls, portal, stairs, sleeves, code items?

We are not asking you to invent the architecture. We are asking you to confirm or reject the structure.

2. What this building is

An earth-sheltered house cut into a Kentucky hillside. The structure is a parabolic concrete arch shot over stay-in-place galvanized aluminum carried on reusable square-tube steel ribs (the ribs are stripped after cure and reused, §0.2). After curing, the hill is put back. The only thing that should read from the farm is a front portal that follows the slope. Grass, horses, and a tractor can run over the top.

Why this shape

- Almost no heating or cooling. Ground temperature holds the interior near 55–65°F.
- Almost no exterior maintenance. There is no conventional roof to replace.
- Utilities run in the leftover crescent between the curved shell and the straight interior walls. They stay reachable.
- The arch carries dirt in compression. That is the point of the shape.

The three problems that still decide whether it works are the same as any buried building: water, air, and light.

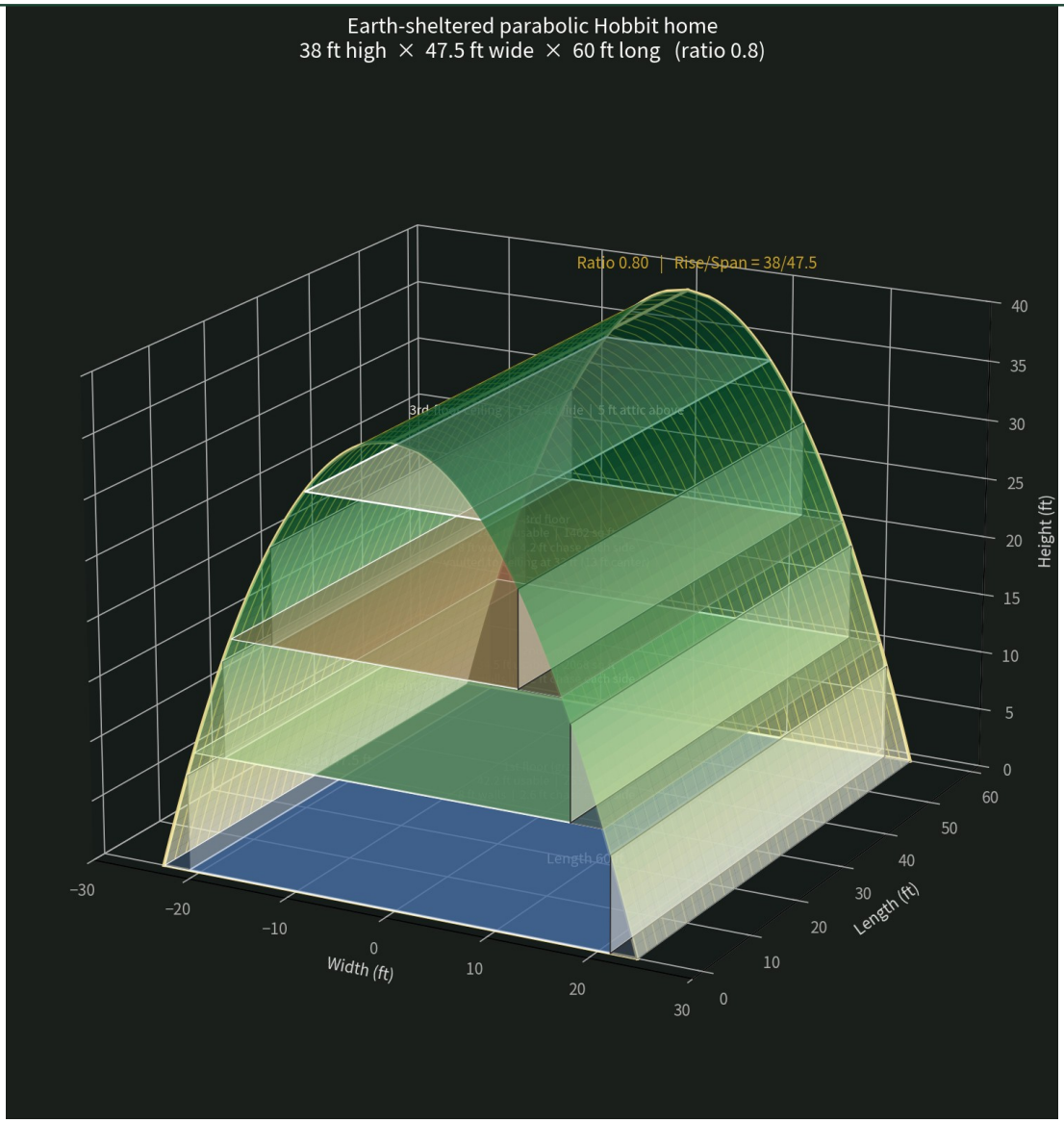


Figure 1. Occupied volume of the frozen baseline. Three floor plates at 0 / 10 / 20 ft. Interior walls stop at the 8 ft usable-height line; the leftover crescent is the utility chase. Third-floor ceiling is a light lid at 33 ft with 5 ft of attic under the crown.

Baseline building: 38 ft rise × 47.5 ft span × 60 ft long. Three floor plates. Interior walls sit at the 8 ft usable-height line. Third-floor ceiling is a flat lid 5 ft below the crown. Rooms in the House tab (2,276 sq ft of named program) have not been assigned to floors — that list is a program, not the calculated floor area.

3. Frozen baseline

Use these numbers everywhere. Do not mix them with older 24 ft or 30 ft tables still sitting in the sheet or in previous drafts.

Item	Frozen value
Shape	Parabola (called hyperbolic in the project name; the modeled curve is a parabola)
Rise / height	38 ft
Rise-to-span ratio	0.80
Span	47.5 ft

Item	Frozen value
Length	60 ft
Soil cover at crown	10 ft
Soil density	120 pcf
Vertical soil load	1,200 psf
Clear ceiling target	10 ft
Usable-height cutoff	8 ft (walls stop here; chase is outside the wall)
Third-floor lid	5 ft below crown (ceiling at 33 ft)
Floor levels	0 ft, 10 ft, 20 ft above springline (10 / 20 / 30 ft = 3.05 / 6.10 / 9.14 m above original grade on the 10 ft fill platform; crown 48 ft / 14.63 m)
Arch rib spacing	2 ft on center → 31 ribs
Intermediate floor beams	Superseded 19 Nov 2026: none — clear-span joists / trusses @ 24 in (610 mm) on Rev7 ring beams (§0.4)
Design shell thickness	**12 in (not the 7.3 in Ratio Cost figure)**
Design shell rebar	**#6 Grade 60 @ 5 in o.c. each way**
Usable floor area	6,062 sq ft
Gross floor area	7,258 sq ft
Sheet materials total (as modeled)	$182,300.45 live sheet 19 Nov 2026 (~$30.07 / usable sq ft; $323.70 / m²). Was $167,418 on 11 Sep 2026.
Corrected materials (see §10)	**Rib length, reuse, admixture and brace-count fixes are now in the sheet (§0.7)**

Assumptions tab (live sheet, 11 Sep 2026)

Fixed parameter	Value
Soil weight	120 pcf
Soil covering	10 ft
Default length	60 ft
Default height	**38 ft**
Default ratio	0.80
Default ceiling height	10 ft
Default usable height	8 ft
Intermediate beam spacing	14 ft (sheet) — superseded by clear-span floors (§0.4)

The height-38 assumption is now correct on the live sheet. That item from the earlier defect list is closed.

Named room program (House tab) — not a floor plan

Room	Qty	Width ft	Length ft	Area sq ft
Foyer	1	10	10	100
Living	1	15	20	300
Dining	1	15	15	225
Kitchen	1	15	15	225
Mud room	1	15	10	150
Bathroom	3	10	8	240
Half bath	2	6	8	96
Main bedroom	1	15	20	300
Guest bedroom	2	16	20	640
Program total	**13 rooms**	**—**	**—**	**2,276**

2,276 sq ft is a room wish-list. The 38 ft shell has 6,062 usable sq ft. Rooms have not been assigned to floors. Do not design structure around this list.

4. Why 0.80, not 0.50

A flatter arch (ratio 0.50) gives more floor per foot of height. A taller arch (0.80–1.00) is stronger in compression, thrusts less for a given rise, and stacks three floors inside one shell. This first house is a multi-story earth-covered shell, not a wide one-story bunker. That is why the project baseline is 0.80 at 38 ft, not the older "0.50–0.55 for maximum single-level floor."

Ratio Analysis tab — comparison only

Ratio	Span ft	Rel. bending	Rel. thrust	Est. thk in*	GF usable w	SF usable area	2-level usable
0.50	76.0	1.000	1.000	11.7	67.5	3,308	7,868
0.66	57.6	0.574	0.758	8.9	51.2	2,506	5,961
0.75	50.7	0.444	0.667	7.8	45.0	2,205	5,245
0.80	**47.5**	**0.391**	**0.625**	**7.3***	**42.2**	**2,068**	**4,918**
0.85	44.7	0.346	0.588	6.9	39.7	1,946	4,628
1.00	38.0	0.250	0.500	5.9	33.8	1,654	3,934

Estimated thickness on this tab is a relative soil-cover study. It is not the budget thickness. Budget and design thickness live on Shell Design and are 12 in at 38 ft because the shell also hangs two upper floors. Do not quote the 7.3 in / $26,277 Ratio Cost row as the project shell. Project shell materials are $44,688.

Usable floor space vs height at ratio 0.80 (Floor Space tab)

Height	Span	1st usable	2nd usable	3rd usable	4th usable	Total usable	% usable
24	30.0	1,470	900	—	—	2,370	75%
30	37.5	1,927	1,423	581	—	3,931	73%
36	45.0	2,381	1,909	1,273	—	5,563	82%
38	**47.5**	**2,532**	**2,068**	**1,462**	**—**	**6,062**	**84%**
40	50.0	2,683	2,225	1,643	671	7,222	78%
44	55.0	2,985	2,537	1,990	1,219	8,730	83%

The 38 ft row is the project: 2,532 + 2,068 + 1,462 = 6,062 usable sq ft. Gross plates at the same row are 2,850 + 2,446 + 1,962 = 7,258 sq ft.

5. Geometry the bender and the engineer both need

Centerline of the arch, feet, crown at x = 0, y = 38:

$$y = 38 \times \left(1 - (2x / 47.5)^2\right)$$

Width at height y:

$$w(y) = 47.5 \times \sqrt{\left(1 - y/38\right)}$$

Exact centerline arc length of one rib: 93.58 ft (1,122.9 in). The live Formwork tab now uses 93.58 ft (28.52 m); the old 67.27 ft figure is retired. For fabrication and tube takeoff, use 93.58 ft.

This is not a constant-radius roll. Radius is tightest at the crown (7.42 ft / 89 in) and almost straight at the feet (279.68 ft / 3,356 in). Confirm a 2.5 in square HSS can take that crown bend before ordering.

Usable interior walls stand vertical at the width where the curve still has 8 ft of headroom above that floor. The leftover crescent between wall and shell is the utility chase (power, water, waste, ventilation).

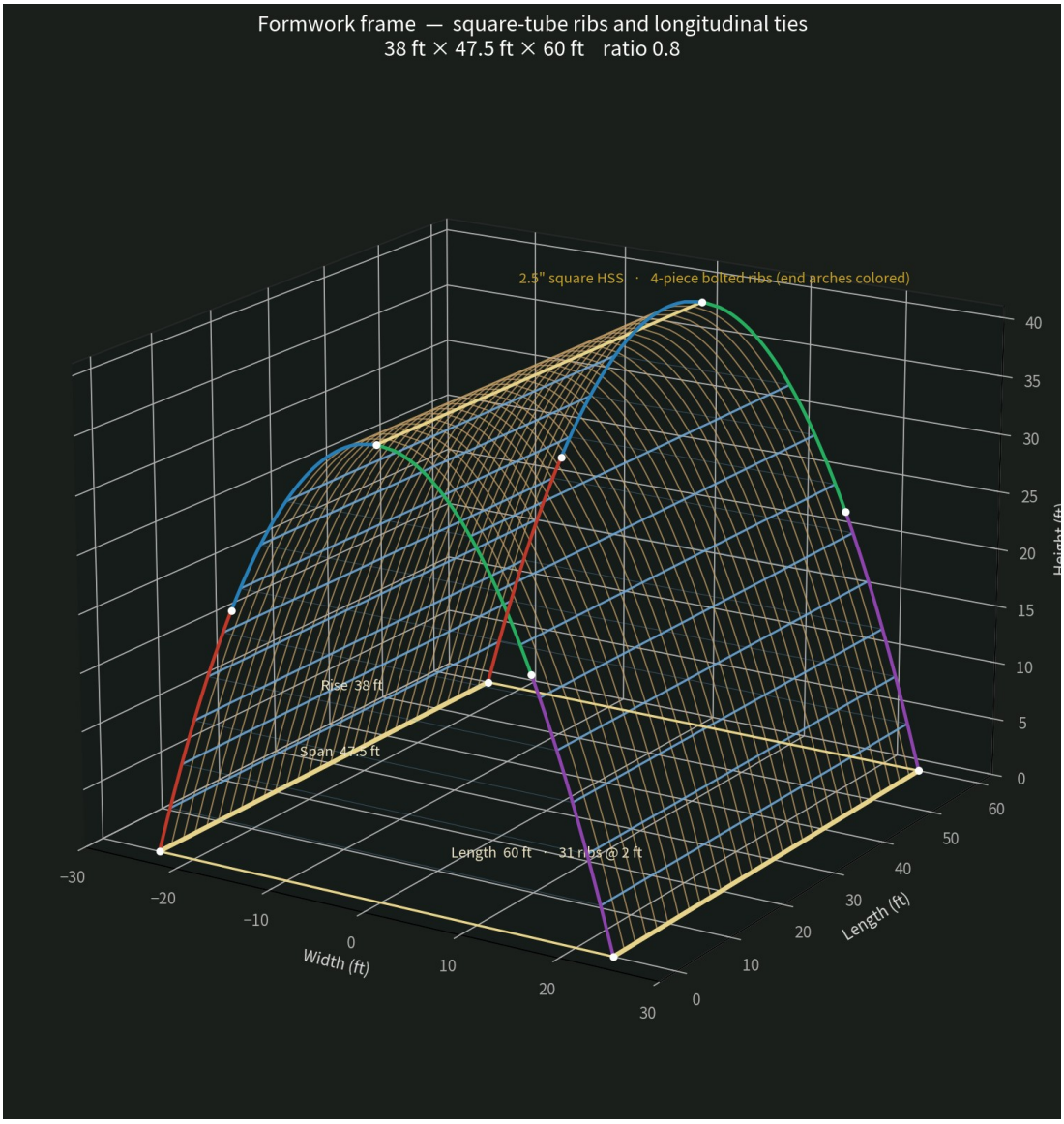


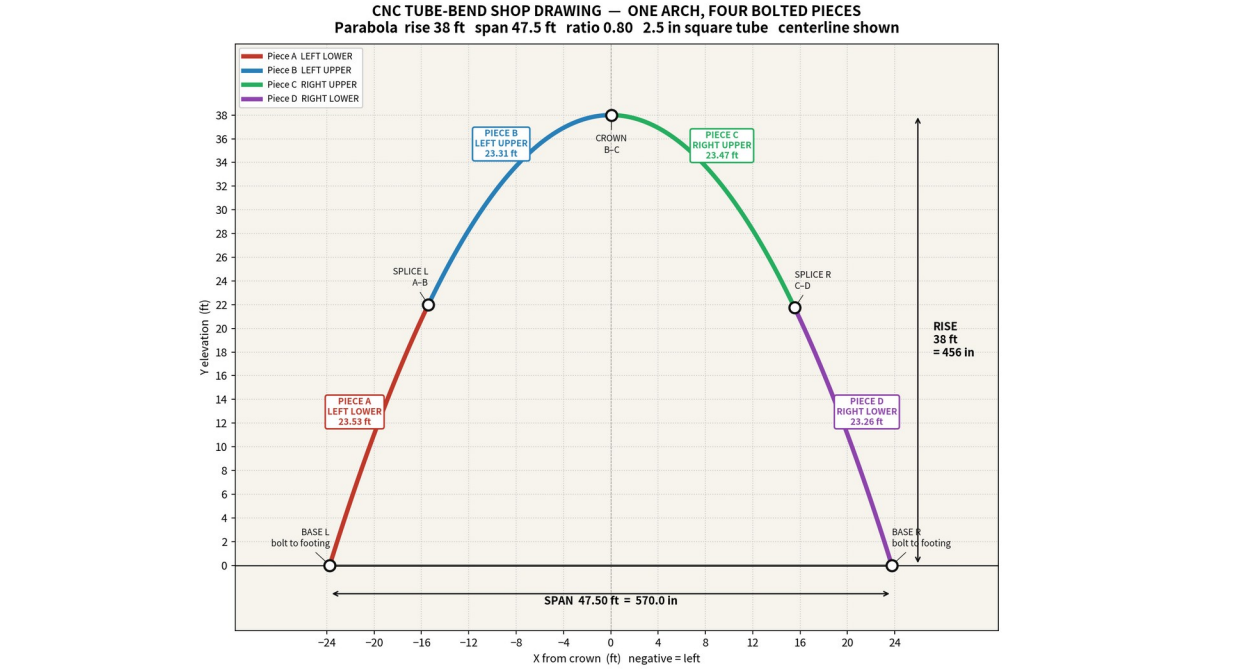
Figure 2. Formwork cage (the galvanized aluminum stays in place; the steel ribs are reusable and stripped after cure, §0.2). 31 ribs at 2 ft centers. Eight longitudinal ties each side at 4, 8, 12, 16, 20, 24, 28, and 32 ft. Base rails on both footings. Crown rail. End ribs shown as four bolted pieces (red / blue / green / purple) — superseded 19 Nov 2026: each rib is now one complete shop-made arch (§0.2).

6. Formwork and CNC tube work

SUPERSEDED 19 Nov 2026 — each rib is now ONE complete arch, cut out only at the ring beams (see §0.2). Kept for history: each rib was four pieces that bolt together. A and D are mirrors. B and C are mirrors. Two CNC programs, four pieces per arch, 31 arches. The CNC coordinates still describe the single arch centerline.

Piece	Role	Developed length	Joints
A	Left lower	23.53 ft	Footing → left splice
B	Left upper	23.31 ft	Left splice → crown

Piece	Role	Developed length	Joints
C	Right upper	23.47 ft	Crown → right splice
D	Right lower	23.26 ft	Right splice → footing
Sum	**One rib centerline**	**93.58 ft**	**Do not use 67.27 ft**



BEND PROFILE
Centerline is a parabola: $y = 38 \cdot (1 - (2x / 47.5)^2)$ with x, y in feet.
This is NOT a constant-radius roll. Radius is tightest at the crown and opens toward the feet.
Crown radius = 7.42 ft (89 in). Base radius = 279.68 ft (3356 in).
Total centerline arc = 93.58 ft (1122.9 in). Four pieces split at equal arc length (quarter points) plus the crown.

FABRICATION
Tube: 2.5 in square HSS, bent in the plane of this drawing.
Make TWO of profile LOWER (A and D are mirrors) and TWO of profile UPPER (B and C are mirrors).
Sample the curve every 6 in of developed length — see arch_cnc_coordinates.csv.
Ends: cut square to the tangent. Weld a 6×6×3/8 in splice plate, four 5/8 in bolts,
plate plane perpendicular to the tube centerline. Match-drill A to B and C to D in the shop if possible.
Base plates bolt to the strip footing with starter dowels. Do not skip the crown splice — that is how
the four pieces become one arch. Rib stand 2.0 on center along the 60 ft building length.

Joint	X ft	Y ft	X in	Y in	Tangent from horiz	Local R
BASE L	-23.750	0.000	-285.00	0.00	+72.65°	279.68 ft
SPLICE L (A–B)	-15.417	21.988	-185.00	263.86	+64.29°	90.94 ft
CROWN (B–C)	+0.060	38.000	+0.71	456.00	-0.46°	7.42 ft
SPLICE R (C–D)	+15.536	21.740	+186.43	260.88	-64.46°	92.66 ft
BASE R	+23.750	0.000	+285.00	0.00	-72.65°	279.68 ft

Figure 3 (history — four-piece rib superseded 19 Nov 2026). CNC shop drawing for one four-piece rib. Crown radius 7.42 ft. Base radius 279.68 ft. Suggested splice: ends cut square to the tangent; 6×6×¾ in plate; four ⅝ in bolts; match-drill pairs in the shop. Base plates bolt to the strip footing. Do not skip the crown splice. Coordinate file: Hobbit Home CNC arch coordinates.csv (points every 6 in of developed length).

Formwork & Gunite Substrate tab — as modeled vs corrected

Item	Sheet 11 Sep 2026	Live sheet 19 Nov 2026	Notes
Arch spacing	2 ft	2 ft	Unchanged
Number of arches	31	31	ROUNDUP(60/2)+1
Length of each arch	**67.27 ft**	**93.58 ft (28.52 m)**	**Fixed in live sheet**
Tube size	2.5 in sq HSS	2.5 in sq HSS	Bent in plane of front elevation
Total rib stock	2,085 ft	2,900.98 ft (884.22 m)	31 × 93.58 — fixed; $14,504.90
Ties / braces	960 ft	960 ft (292.6 m)	Fixed 19 Nov 2026: 16 braces per arch = 960 ft (292.6 m), $1,920 (was 23 / 1,380 ft)
Galvalume area	4,036 sq ft	4,036 sq ft (375 m²)	Aluminum stays in place (no

Item	Sheet 11 Sep 2026	Live sheet 19 Nov 2026	Notes
			credit). Steel ribs are reusable — credit house #2+ only.
Gauge	1/8 in	1/8 in	Back form for gunite
Reuse factor in sheet	**−$6,054 on aluminum**	**$0**	**Fixed in live sheet (0). Ribs are reusable formwork (19 Nov 2026) — credit them on house #2+ only**
Sheet formwork total	$20,918	$31,050.90	Braces fixed 19 Nov 2026 (was $31,890.90)

Unit rates used on that tab: tube + bending $5 / ft, ties $2 / ft, galvalume $3 / sq ft, optional wire mesh $0.50 / sq ft, scaffolding lump $500.

7. Foundation and shell

Continuous reinforced strip footings under both feet of the arch, with starter dowels that develop into the shell. The footing must take vertical load and outward thrust. Size is an engineer item; the sheet does not design it. Nov 2026 concept: strip footings + ground slab cast monolithic as a thrust tie, on a 10 ft (3.05 m) compacted fill platform (§0.5).

Shotcrete is placed in lifts, not one 12 in pass. Keep the #6 mat toward the inner third of the wall so there is cover on the soil side. Galvalume stays in place as the back form.

Ring-beam bands (Rev7, §0.3): leave a 12 in (305 mm) strip of the inner face without aluminum (thin board you can break out). Dowels from the shell turn inward into the ring beam so the floor system is tied to the shell, not merely bearing on it.

Recommended shell bar (Shell Design tab)

Shell thickness	Recommended rebar	Spacing
10 in	#5	6 in
12 in ← project	**#6**	**5 in**
13 in	#7	5 in

Shell measurements — highlight the 38 ft row

Height ft	Span ft	Thickness in	Surface sq ft	Concrete cy
24	30.0	10	2,549	82.3
30	37.5	12	3,186	114.1
36	45.0	12	3,823	141.0
38	**47.5**	**12**	**4,036**	**150.2**
40	50.0	13	4,248	170.1
44	55.0	13	4,673	190.4

Shell rebar and cost at 38 ft

Item	Value
Thickness	12 in
Concrete	4,000+ psi shotcrete / gunite
Volume	150.2 cy
Rebar	#6 @ 5 in each way

Item	Value
Rebar length	19,371 ft
Concrete cost @ $175/cy	$26,285
Rebar cost @ $0.95/ft	$18,402
Shell materials	**$44,688 ($7.37 / usable sq ft)**

8. Floors and ring beams

SUPERSEDED 19 Nov 2026 — current plan (§0.3–0.4): Rev7 ring beams 12 in × 18 in (305 × 457 mm) with a 45° haunch; 1st floor open-web steel joists ~26 in (660 mm) @ 24 in (610 mm) + 2.5 in (64 mm) concrete on deck; 2nd floor open-web wood trusses ~20 in (510 mm) @ 24 in (610 mm); no intermediate beams. September text kept for history: each upper level had a perimeter ring beam cast against the inside of the shell, intermediate beams at 14 ft along the 60 ft length, and a slab on that grid. The tables below still match the live sheet, which has not been re-priced for the new floors.

Leave sleeved openings in the ring beams for stairs, waste, water, and electrical before the pour. Do not core them later if you can avoid it.

Third-floor ceiling is a light flat lid at 33 ft (10.06 m) above springline, not another earth-loaded slab. The 5 ft above it is attic / chase under the crown.

Recommended beam bar

Beam depth	Recommended rebar	Used on
12 in	#5	Shallower comparison rows
14 in	#6	3rd-floor ring at 38 ft
16 in	**#6**	**2nd-floor ring at 38 ft**
18 in	#7	Taller comparison rows only

Beam Design tab — 38 ft building

Item	2nd floor (at 10 ft)	3rd floor (at 20 ft)
Width used in takeoff	40.77 ft	32.69 ft
Ring beam depth	16 in	14 in
Ring beam rebar	#6	#6
Ring beam length	365 ft	316 ft
Intermediate beams	4 (+ 2 end beams)	same grid
Beam concrete (both levels)	**31.67 cy combined**	**—**

Floor plates used in the rollup

Level	Width used	Ring depth	Slab thickness	Slab rebar
Ground (0 ft)	47.5 ft	— slab on grade	5.5 in	#4
2nd (10 ft)	**~41 ft**	**16 in / #6**	**6.0 in**	**#5**
3rd (20 ft)	~33 ft	14 in / #6	5.5 in	#4

Floor-slab concrete in the rollup: 126.98 cy. Beam concrete: 31.67 cy. Floor rebar in the rollup: #4 9,623 ft + #5 4,893 ft.

9. Water, air, and light

Water

Assume the hill wants in. Stack the barriers:

1. Slope and drain the backfill. No ponding on the crown.
2. Dimpled drainage board over the whole shell, to a perimeter pipe.
3. Sheet membrane on the cured exterior.
4. Crystalline admixture in all structural concrete (shell + beams + slabs).
5. 15-mil vapor barrier under the ground slab.
6. Dual French drain around the footing, 215 ft in the current takeoff.

Envelope & Moisture Protection tab

Item	Unit	Qty in sheet	Unit cost	Sheet total
Exterior membrane	sq ft	4,036	$1.50	$6,054
Protection / drain board	sq ft	4,036	$1.00	$4,036
Waterproofing admixture	**cy**	**277.18 ← short**	**$150**	**$41,577**
Under-slab vapor barrier	sq ft	2,850	$0.50	$1,425
Perimeter drain pipe	lin ft	215	$50	$10,750
Sheet envelope total				$63,842

> Admixture is shown on 277.18 cy. Total structural concrete in the rollup is 308.85 cy (shell 150.2 + beams 31.67 + floors 126.98). Use 308.85 so beams and slabs are included. That adds about $4,750.

Air

This is an earth-covered tube. It needs designed supply and exhaust, not hope. HVAC and ERV are not sized. That is a mechanical item after the PE confirms volume and openings.

Light and egress

Ends: Combo 1 is locked for both ends — hybrid daylight bands with 35–45% glazing per end face, solid piers 4 + 3 + 3 + 4 ft (1.22 + 0.91 + 0.91 + 1.22 m), ring beams continuous (§0.6 and the Combo 1 Opening Schedule). Not full-glass ends. Portal geometry, end-wall structure, doors and a second means of egress still need PE / architect design before a permit.

10. Cost — what the materials total is and is not (live sheet 19 Nov 2026: $182,300)

Total Building Cost tab, as modeled on 11 Sep 2026 (history — live total now $182,300.45, see §0.7)

Category	Amount	$ / usable sf	Source
Shell (shotcrete + rebar)	$44,687	$7.37	Shell Design
Ring + intermediate beams	$6,189	$1.02	Beam Design
Floor slabs	$31,781	$5.24	Floor Design
Formwork + substrate (net)	$20,918	$3.45	Formwork tab, uncorrected

Category	Amount	$ / usable sf	Source
Envelope + moisture	$63,842	$10.53	Envelope tab, admixture short
Total materials in model	**$167,418**	**$27.62**	**6,062 usable sf**

Material rollup behind that total

Material	Shell	Beams	Floors	Total qty	Cost
Concrete cy	150.2	31.67	126.98	308.85	$54,049
Rebar #4 ft	—	—	9,623	9,623	$6,428
Rebar #5 ft	—	—	4,893	4,893	$3,131
Rebar #6 ft	19,371	681	—	20,052	$19,049

Unit rates (Pricing tab)

Component	Unit	Price
Rebar #4	ft	$0.668
Rebar #5	ft	$0.64
Rebar #6	ft	$0.95
Rebar #7	ft	$1.35
Concrete	cy	$175
Exterior membrane	sq ft	$1.50
Drain board	sq ft	$1.00
Waterproofing admixture	cy	$150
Under-slab vapor barrier	sq ft	$0.50
Perimeter drain pipe	lin ft	$50

Corrected materials if the three sheet defects are fixed (done — live sheet now $182,300.45 after the 19 Nov 2026 brace fix)

Adjustment	Effect
As-modeled materials	$167,418
Rib stock 2,085 → 2,901 ft @ $5	+ ~$4,080
Drop aluminum reuse credit of −$6,054	+ $6,054
Admixture 277.18 → 308.85 cy @ $150	+ ~$4,751
Corrected materials (still materials only)	**~$182,300 (~$30 / usable sf)**

Included: concrete, rebar, form steel and skin as modeled, membrane, drain board, admixture, slab barrier, perimeter drain.

Not included: excavation, access, labor, gunite crew, equipment, footings and fill platform beyond the slab model, joist / truss floors (not yet priced in the sheet), end walls, portal, stairs, insulation, MEP, interiors, septic, well, permits, engineering, contingency.

11. Suggested construction sequence

1. Geotechnical borings on the footprint. Water table, bearing, rock.
2. Bench the hillside. Temporary interceptor swales.

3. Build the compacted fill platform in ~8 in (200 mm) lifts. Strip footings with thrust steel and starter dowels; ground slab cast monolithic as the thrust tie, with 15-mil (0.38 mm) barrier.
4. Stand the 31 one-piece ribs (each a complete arch, bent or welded up at / near the site). 2 ft (0.61 m) spacing. Ribs are reusable formwork. Ties at the eight elevations. Plumb and guy.
5. Hang galvalume. Leave break-out bands at ring-beam levels.
6. Tie the #6 mat. Chairs for cover. Inward dowels at ring-beam bands.
7. Shoot gunite in lifts to 12 in. Moist cure.
8. Membrane + drain board + geotextile.
9. At each ring beam: weld the bottom and vertical supports (notch-and-bend corner), bolt the cover plate, cut the rib out from beam tip to haunch-shell meet, cast the Rev7 ring beam (sleeve openings first). Then set steel joists + deck slab (1st floor) and wood trusses (2nd floor).
10. Portal and end walls (design pending).
11. Perimeter drain in washed rock. Backfill in thin compacted lifts. Restore the hill.
12. Interior walls on the 8 ft line, MEP in the chases, finishes.

12. What this package does not decide

An engineer or later consultant still owns:

- Footing width, depth, and reinforcing
- End-wall structure and connection to the arch
- Portal geometry and slope match
- Stairs and openings through ring beams
- Exact sleeve schedule
- Compaction spec and drainage details
- Kentucky residential code: egress, ventilation, fire, energy
- Insulation strategy
- Mechanical, electrical, plumbing
- Room layout on the three floors

13. What we want back

From the structural engineer, in writing:

1. Accept, thicken, or reject the 12 in / #6 @ 5 in shell under 10 ft of cover plus two hanging floors.
2. Accept or resize the Rev7 12 in × 18 in (305 × 457 mm) ring beams with 45° haunch, the rib cut-out with cast-in cover plate, and the clear-span joist / truss floors; confirm the rib can be unbolted from the cast-in plates and stripped for reuse after cure, and fix the bottom-support weld at the lower cut (§0.2 item 7).
3. A first footing concept.
4. A list of calculations and drawings required for a permit set.
5. Anything in this concept that is unsafe or naive.

From other contributors: fabricator capability for the 7.4 ft (2.26 m) crown radius and for bending / assembling one-piece 47.5 × 38 ft (14.48 × 11.58 m) ribs at or near the site (a one-piece rib is a superload on public roads); a shotcrete contractor who will work against stay-in-place metal on a curve; civil input on drain and backfill.

Appendix A — File list

File	Use
Haupt Hobbit Home V4 spreadsheet	Live quantities and formulas
3D usable-floors PNG (Figure 1)	How the house is occupied
Formwork cage PNG (Figure 2)	How the cage stands
CNC shop-drawing PNG (Figure 3)	History — four-piece rib superseded; current CNC files v4.0 (one-piece rib) in the CNC folder
CNC coordinates CSV	Points every 6 in for the bender
This Word package	What to send the engineer

Appendix B — Sheet defects (status 19 Nov 2026)

#	Defect	Status 19 Nov 2026
1	**Formwork arch length 67.27 → 93.58 ft**	**Closed — live sheet uses 93.58 ft (28.52 m)**
2	Reuse credit is on aluminum; aluminum stays in the wall. Ribs are reusable (19 Nov 2026) — credit ribs on house #2+ only.	Closed — reuse credit $0
3	Envelope admixture 277 cy → 308.85 cy	Closed — 309 cy (236.1 m^3), $46,327
4	Ratio Cost 7.3 in shell must not be quoted as the project shell	Still a trap on that tab; this package uses 12 in / $44,688
5	Assumptions tab should show height 38, not leftover 30	Closed. Live sheet now shows 38.

Items 1–3 are fixed in the live sheet. Item 6 (brace count) was fixed on 19 Nov 2026: 16 braces per arch, 960 ft (292.6 m), $1,920; materials total $182,300.45. New item 7: floors / beams lines still price RC slabs on 16 / 14 in rings, not the Rev7 beams and joist / truss floors.

Prepared for Mark Haupt / Kalarama Farm LLC from the live V4 sheet and the September 2026 drawings. Unstamped concept. Revised 19 Nov 2026, rev b (§0, current plans; pictures from the 17–19 Nov 2026 concept sets, rib pictures v2.3).