

PLUTO JACKS

Complete Construction Print Package

NAU ASCE Concrete Canoe 2026

Design A: 216" x 32" x 18.5" x 0.5" Wall

Source Geometry: SolidWorks 19-Station Lines Plan

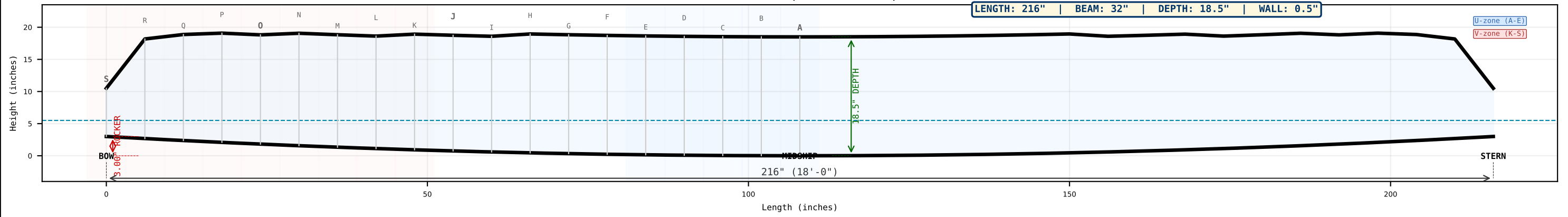
Print this document. Bring it to the shop.

SECTION 1

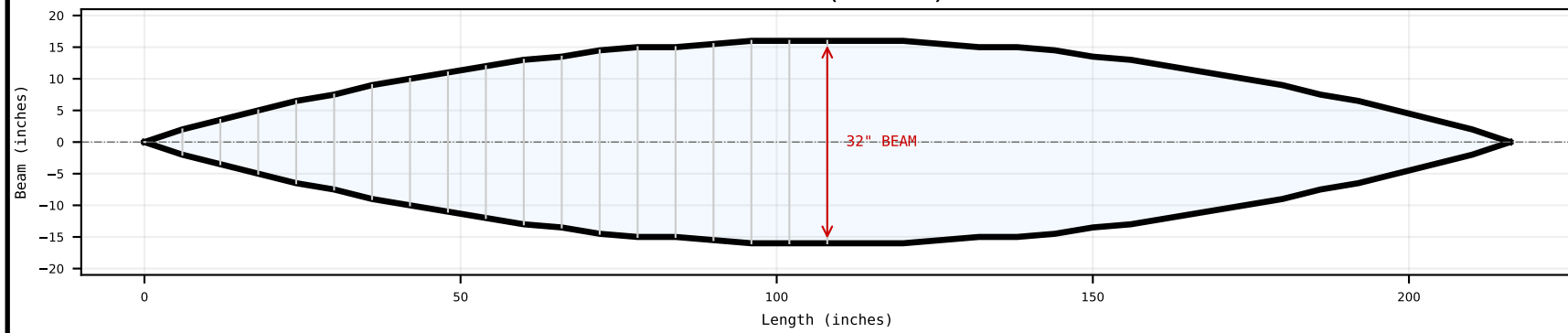
Construction Drawings — Body Plan & Station Details

22 pages follow

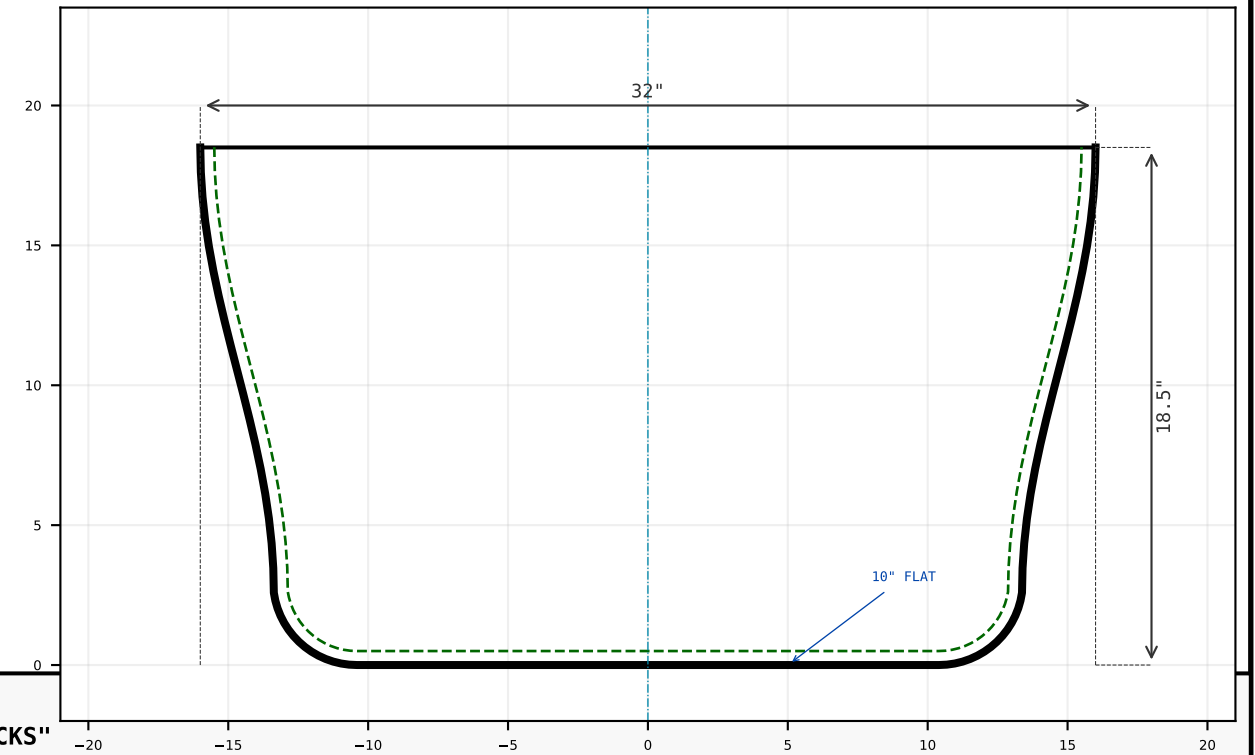
PROFILE VIEW (SIDE ELEVATION)



PLAN VIEW (TOP DOWN)



MIDSHIP SECTION (STA. A)



UNITS: INCHES

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | HULL OVERVIEW – THREE VIEWS

WALL: 0.5" UNIFORM

SHEET 1/22

J: 24.0"x18.0"

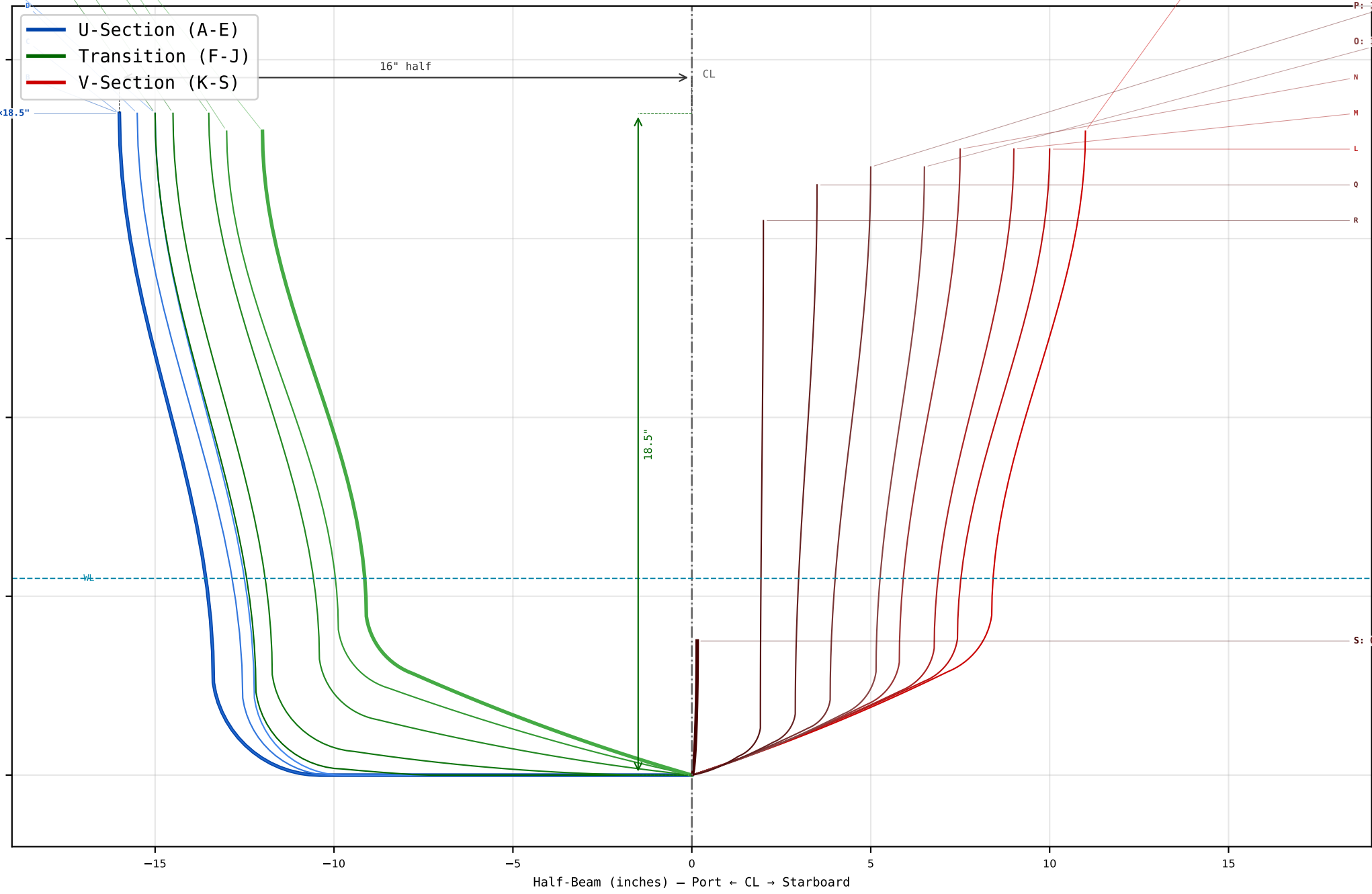
E: 30.0"x18.5"

A: 32.0"x18.5"

Depth (inches)

BODY PLAN

- U-Section (A-E)
- Transition (F-J)
- V-Section (K-S)



STATION DIMENSIONS

STA	BEAM	DEPTH	DIST
A	32.0"	18.5"	0"
B	32.0"	18.5"	6"
C	32.0"	18.5"	12"
D	31.0"	18.5"	18"
E	30.0"	18.5"	24"
F	30.0"	18.5"	30"
G	29.0"	18.5"	36"
H	27.0"	18.5"	42"
I	26.0"	18.0"	48"
J	24.0"	18.0"	54"
K	22.0"	18.0"	60"
L	20.0"	17.5"	66"
M	18.0"	17.5"	72"
N	15.0"	17.5"	78"
O	13.0"	17.0"	84"
P	10.0"	17.0"	90"
Q	7.0"	16.5"	96"
R	4.0"	15.5"	102"
S	0.0"	7.5"	108"

BEAM = full width
 DEPTH = keel to gunwale
 DIST = from midship (Sta A)

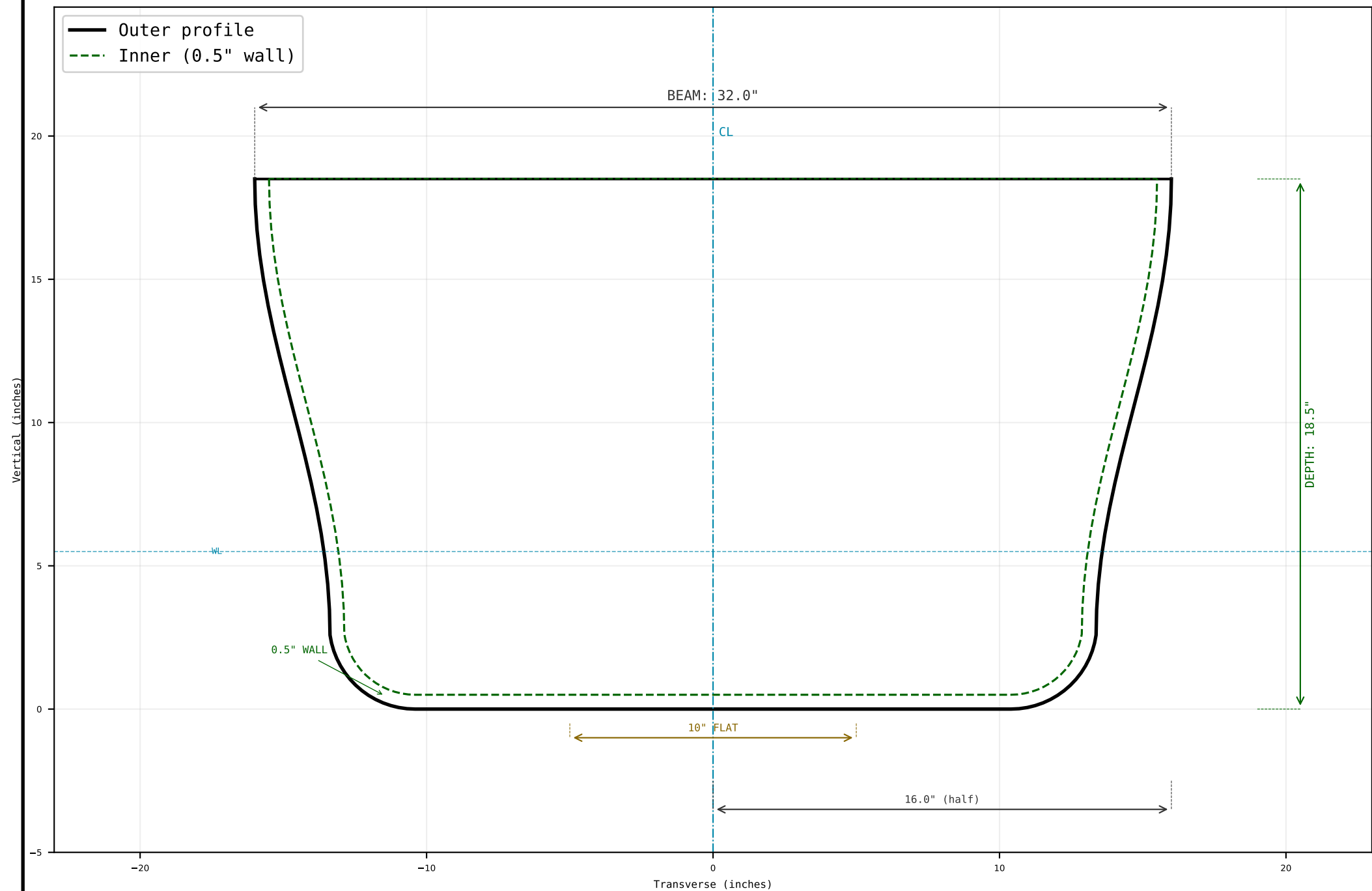
UNITS: INCHES

 WALL: 0.5" UNIFORM

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | BODY PLAN – ALL 19 STATIONS (DIMENSIONED)

LEFT: Stern/Midship (A-J) | RIGHT: Bow (K-S) | Dims: BEAM x DEPTH at each station



STATION A

Section Type: U-SECTION

Full Beam: 32.0"
 Half-Beam: 16.0"
 Depth: 18.5"
 Wall: 0.5"

Flat Bottom: 10.0"
 Deadrise: 0°
 Bilge Radius: 3.0"
 Rocker: 0.00"

Offset from
 Midship: 0"

Mold Position:
 From Bow: 108"
 (+ 3" flange)

CUT METHOD:
 Bottom: Utility knife
 Bilge: Bread knife
 Sides: Utility knife

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 18.50)
- (5.36, 18.50)
- (9.68, 18.50)
- (12.85, 17.23)
- (14.24, 9.73)
- (16.00, 0.00)

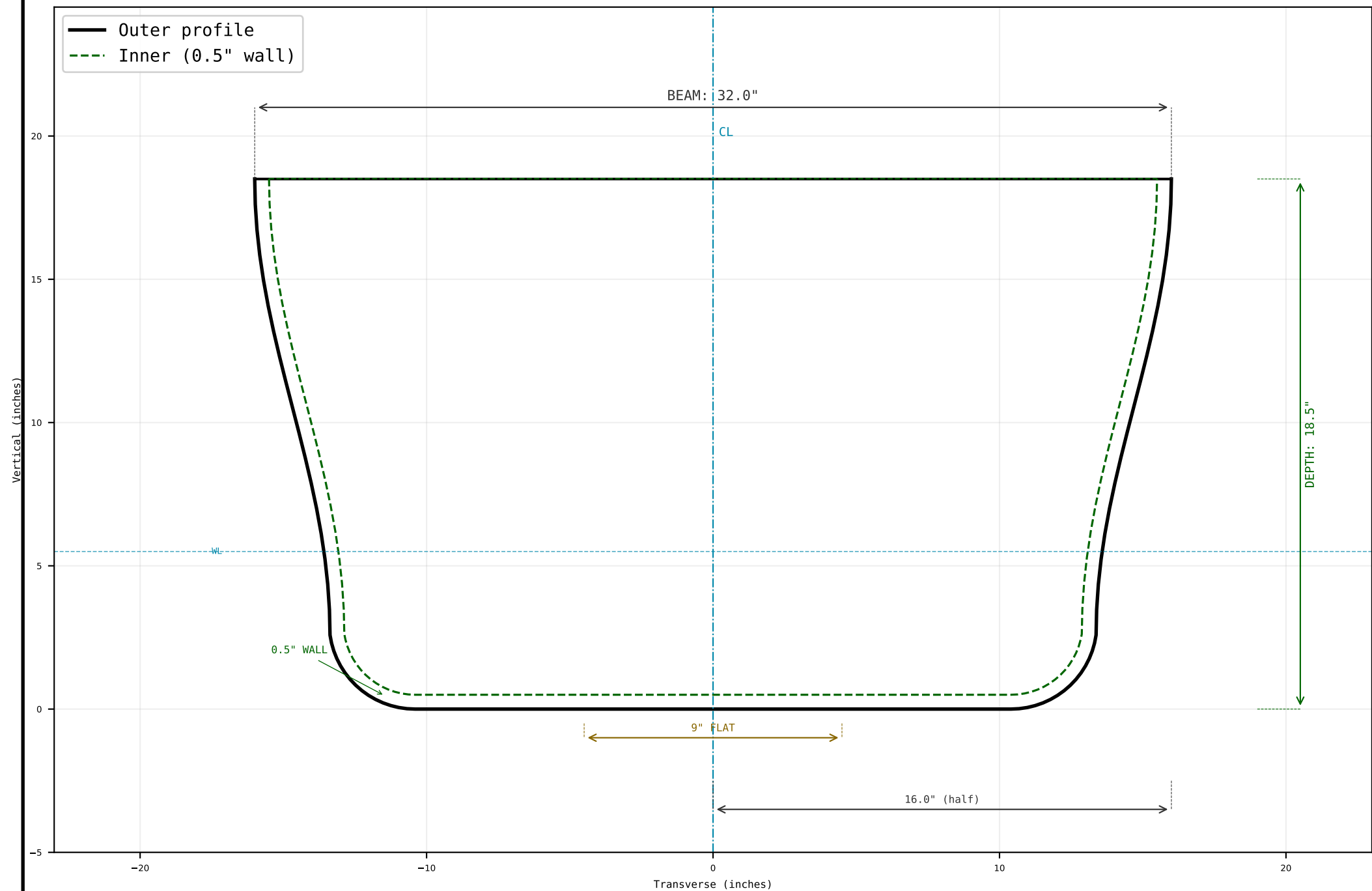
UNITS: INCHES

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION A – U-SECTION

Offset: 0" from midship | Beam: 32.0" | Depth: 18.5" | Deadrise: 0° | Rocker: 0.00"

WALL: 0.5" UNIFORM



STATION B

Section Type: U-SECTION

Full Beam: 32.0"
 Half-Beam: 16.0"
 Depth: 18.5"
 Wall: 0.5"

Flat Bottom: 9.0"
 Deadrise: 0°
 Bilge Radius: 3.0"
 Rocker: 0.01"

Offset from
 Midship: 6"

Mold Position:
 From Bow: 102"
 (+ 3" flange)

CUT METHOD:
 Bottom: Utility knife
 Bilge: Bread knife
 Sides: Utility knife

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 18.50)
- (4.89, 18.50)
- (9.61, 18.50)
- (12.85, 17.23)
- (14.24, 9.73)
- (16.00, 0.00)

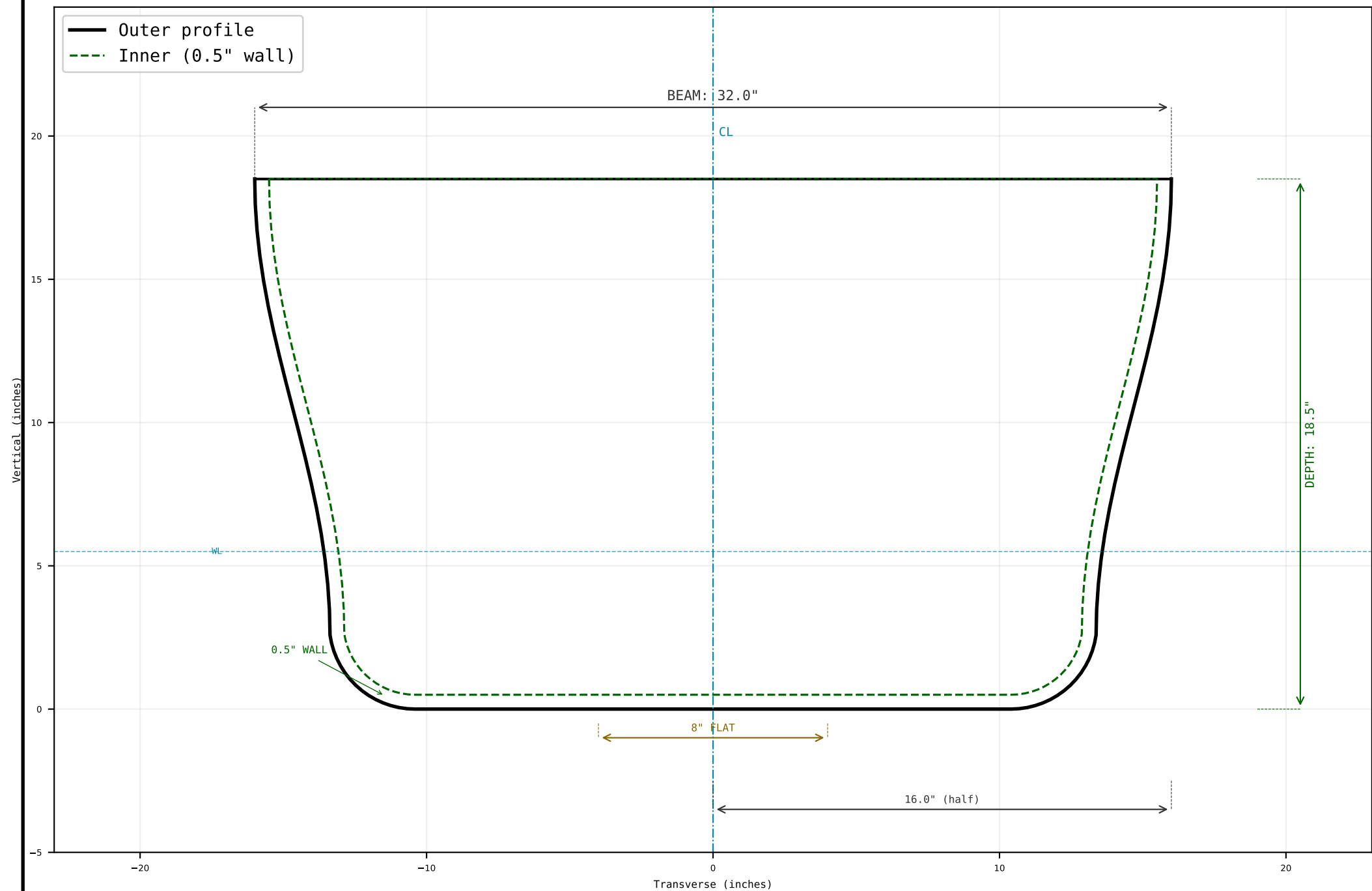
UNITS: INCHES

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION B – U-SECTION

Offset: 6" from midship | Beam: 32.0" | Depth: 18.5" | Deadrise: 0° | Rocker: 0.01"

WALL: 0.5" UNIFORM



STATION C

Section Type: U-SECTION

Full Beam: 32.0"
 Half-Beam: 16.0"
 Depth: 18.5"
 Wall: 0.5"

Flat Bottom: 8.0"
 Deadrise: 0°
 Bilge Radius: 3.0"
 Rocker: 0.04"

Offset from
 Midship: 12"

Mold Position:
 From Bow: 96"
 (+ 3" flange)

CUT METHOD:
 Bottom: Utility knife
 Bilge: Bread knife
 Sides: Utility knife

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 18.50)
- (4.43, 18.50)
- (9.55, 18.50)
- (12.85, 17.23)
- (14.24, 9.73)
- (16.00, 0.00)

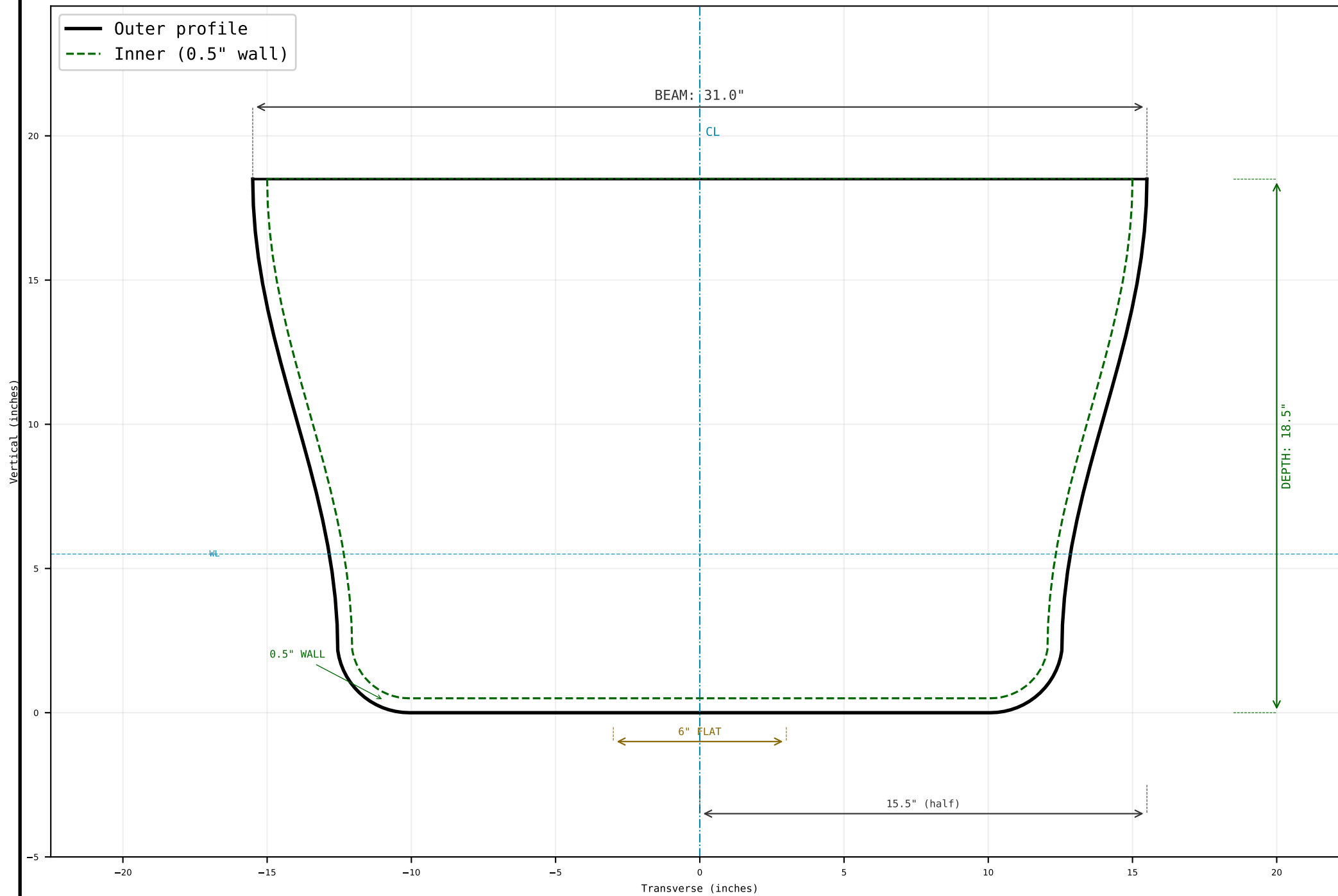
UNITS: INCHES

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION C – U-SECTION

Offset: 12" from midship | Beam: 32.0" | Depth: 18.5" | Deadrise: 0° | Rocker: 0.04"

WALL: 0.5" UNIFORM



STATION D

Section Type: U-SECTION

Full Beam: 31.0"
 Half-Beam: 15.5"
 Depth: 18.5"
 Wall: 0.5"

Flat Bottom: 6.0"
 Deadrise: 0°
 Bilge Radius: 2.5"
 Rocker: 0.08"

Offset from
 Midship: 18"

Mold Position:
 From Bow: 90"
 (+ 3" flange)

CUT METHOD:
 Bottom: Utility knife
 Bilge: Bread knife
 Sides: Utility knife

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 18.50)
- (3.47, 18.50)
- (9.13, 18.50)
- (12.11, 17.45)
- (13.52, 9.99)
- (15.50, 0.00)

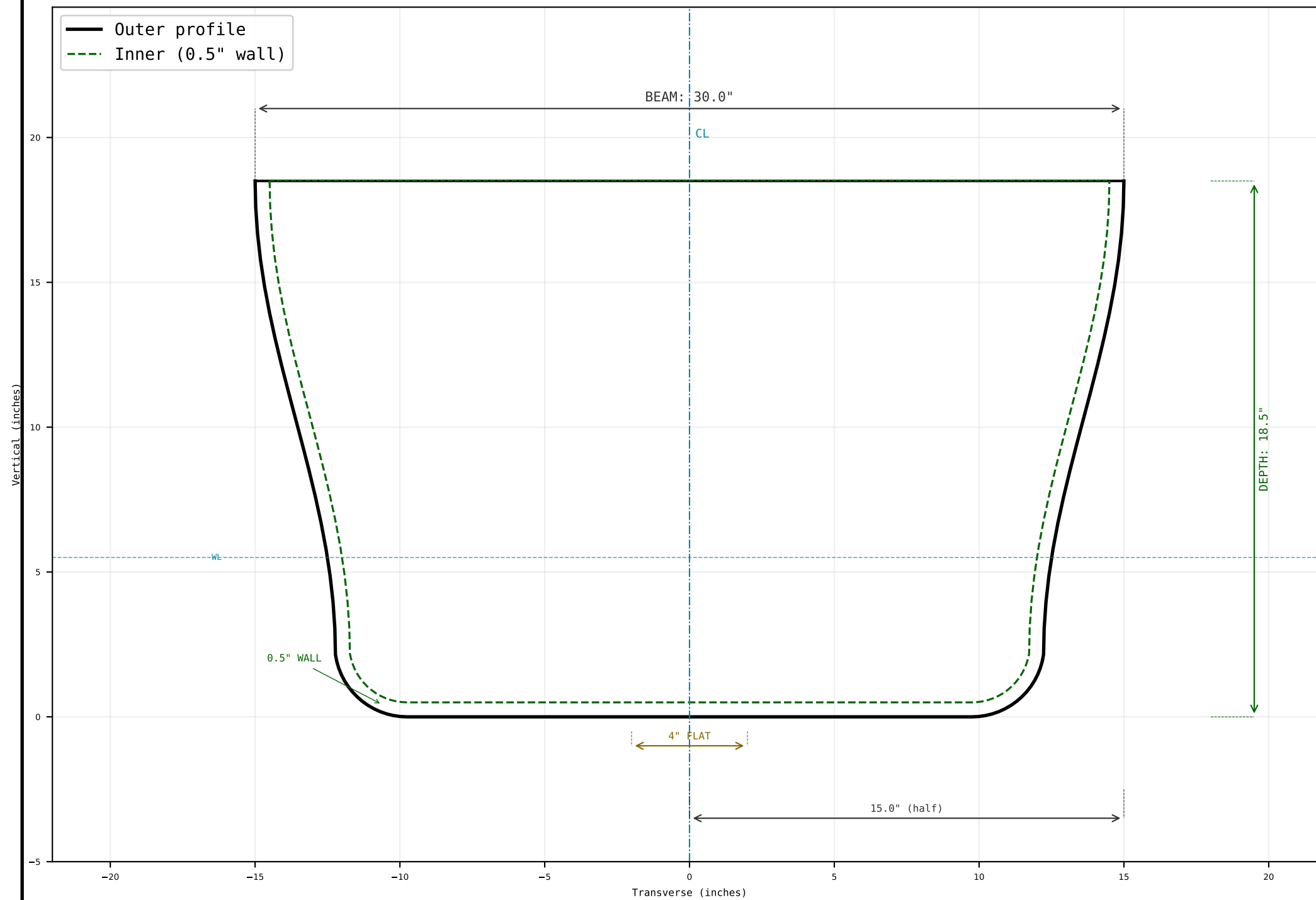
UNITS: INCHES

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION D – U-SECTION

Offset: 18" from midship | Beam: 31.0" | Depth: 18.5" | Deadrise: 0° | Rocker: 0.08"

WALL: 0.5" UNIFORM



STATION E

Section Type: U-SECTION

Full Beam: 30.0"
 Half-Beam: 15.0"
 Depth: 18.5"
 Wall: 0.5"

Flat Bottom: 4.0"
 Deadrise: 0°
 Bilge Radius: 2.5"
 Rocker: 0.15"

Offset from
 Midship: 24"

Mold Position:
 From Bow: 84"
 (+ 3" flange)

CUT METHOD:
 Bottom: Hot wire
 Sides: Utility knife

PANEL LAYOUT:
 48"W × 24"H × 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 18.50)
- (2.52, 18.50)
- (8.72, 18.50)
- (11.79, 17.45)
- (13.14, 9.99)
- (15.00, 0.00)

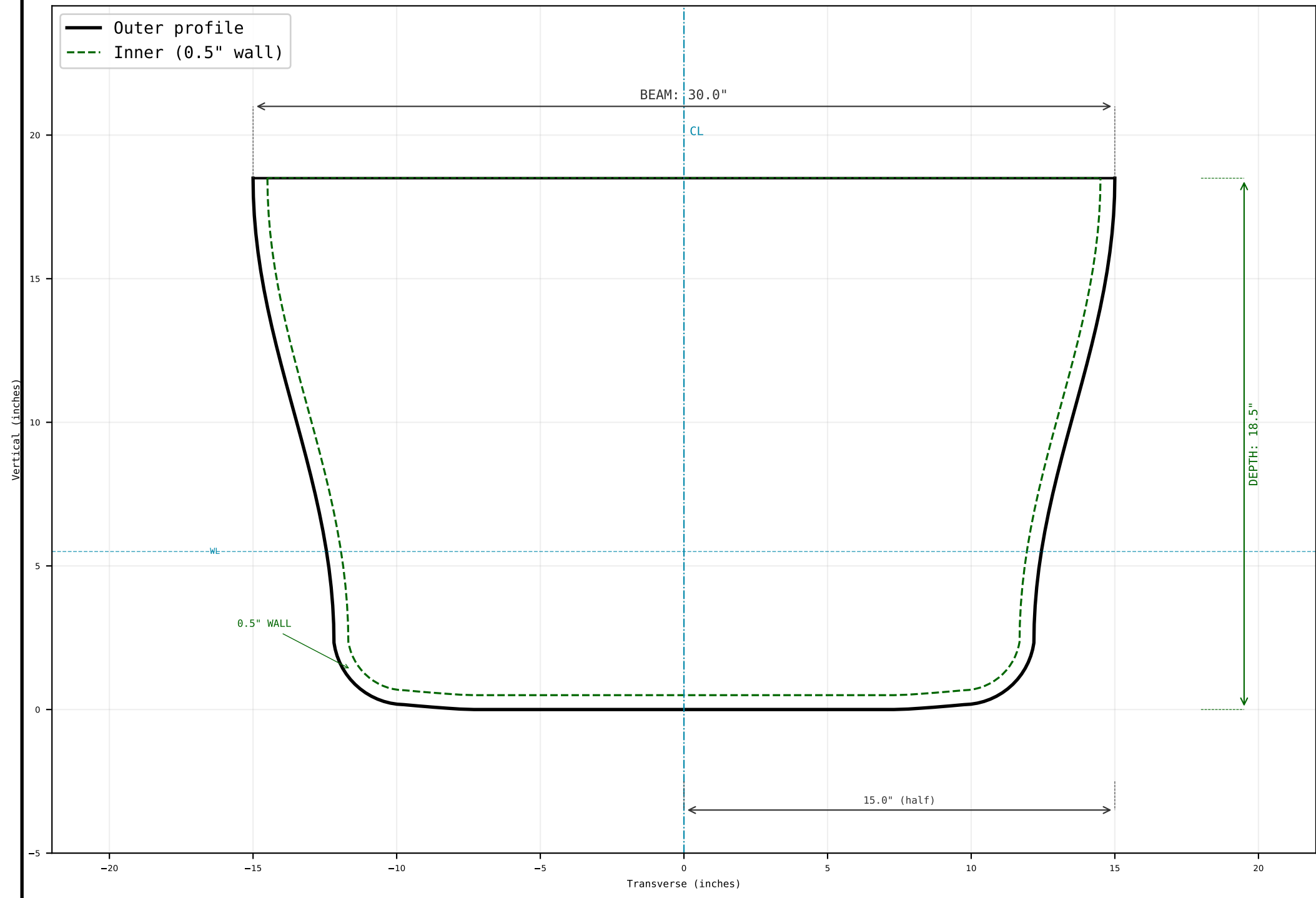
UNITS: INCHES

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" × 32" × 18.5" × 0.5" WALL | STATION E – U-SECTION

Offset: 24" from midship | Beam: 30.0" | Depth: 18.5" | Deadrise: 0° | Rocker: 0.15"

WALL: 0.5" UNIFORM



STATION F

Section Type: TRANSITION

Full Beam: 30.0"
 Half-Beam: 15.0"
 Depth: 18.5"
 Wall: 0.5"

Flat Bottom: 1.0"
 Deadrise: 1°
 Bilge Radius: 2.5"
 Rocker: 0.23"

Offset from
 Midship: 30"

Mold Position:
 From Bow: 78"
 (+ 3" flange)

CUT METHOD:
 Bottom: Hot wire
 Sides: Utility knife

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 18.50)
- (5.85, 18.50)
- (10.67, 18.14)
- (12.19, 15.53)
- (13.68, 7.77)
- (15.00, 0.00)

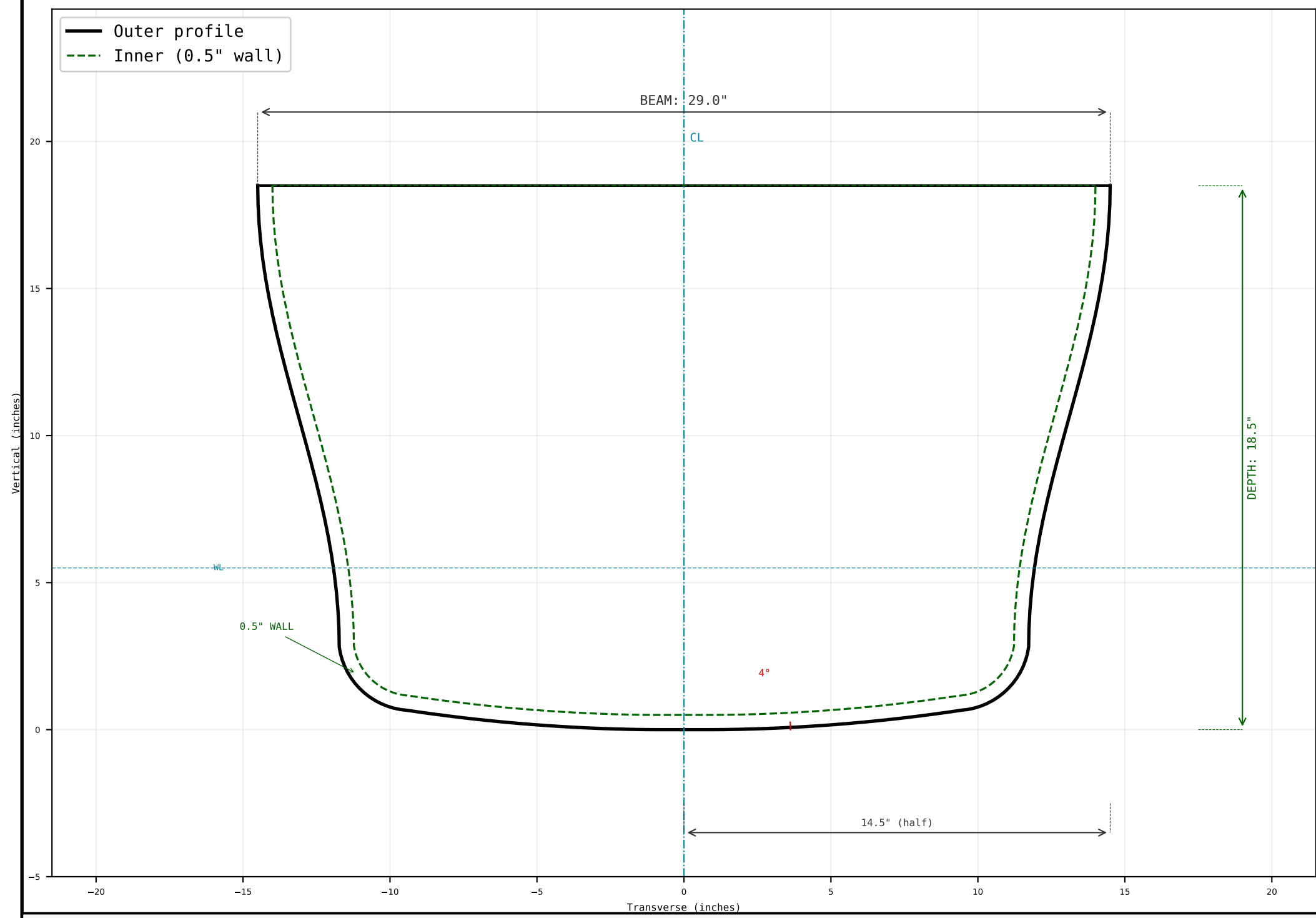
UNITS: INCHES

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION F – TRANSITION

WALL: 0.5" UNIFORM

Offset: 30" from midship | Beam: 30.0" | Depth: 18.5" | Deadrise: 1° | Rocker: 0.23"



STATION G

Section Type: TRANSITION

Full Beam: 29.0"
 Half-Beam: 14.5"
 Depth: 18.5"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 4°
 Bilge Radius: 2.5"
 Rocker: 0.33"

Offset from
 Midship: 36"

Mold Position:
 From Bow: 72"
 (+ 3" flange)

CUT METHOD:
 Bottom: Hot wire
 Sides: Utility knife

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 18.50)
- (5.66, 18.28)
- (10.30, 17.62)
- (11.74, 15.07)
- (13.20, 7.53)
- (14.50, 0.00)

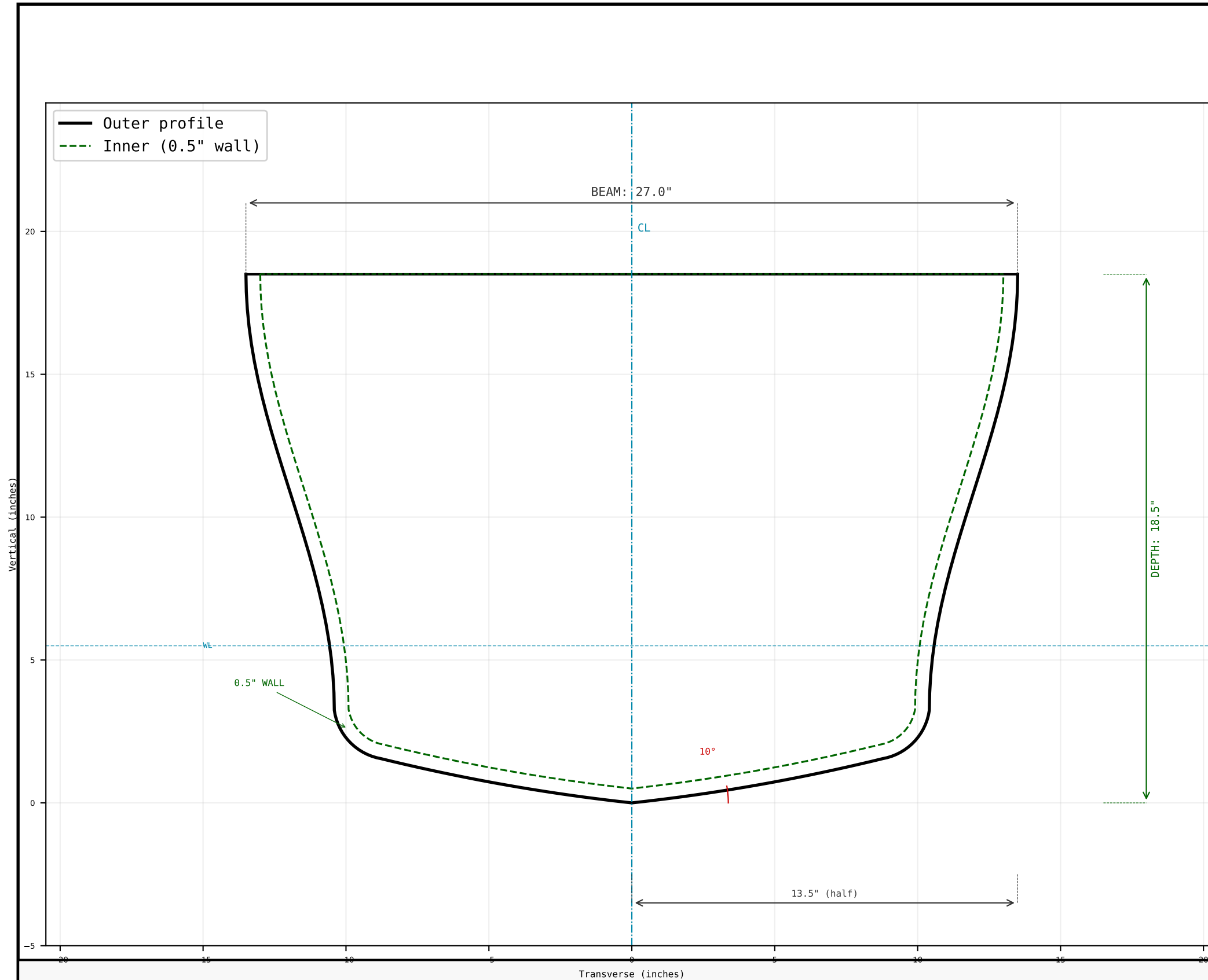
UNITS: INCHES

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION G – TRANSITION

WALL: 0.5" UNIFORM

Offset: 36" from midship | Beam: 29.0" | Depth: 18.5" | Deadrise: 4° | Rocker: 0.33"



STATION H

Section Type: TRANSITION

Full Beam: 27.0"
 Half-Beam: 13.5"
 Depth: 18.5"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 10°
 Bilge Radius: 2.0"
 Rocker: 0.45"

Offset from
 Midship: 42"

Mold Position:
 From Bow: 66"
 (+ 3" flange)

CUT METHOD:
 Bottom: Hot wire
 Sides: Utility knife

PANEL LAYOUT:
 48"W × 24"H × 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

(0.00, 18.50)
 (5.26, 17.72)
 (9.40, 16.73)
 (10.42, 14.65)
 (12.05, 7.33)
 (13.50, 0.00)

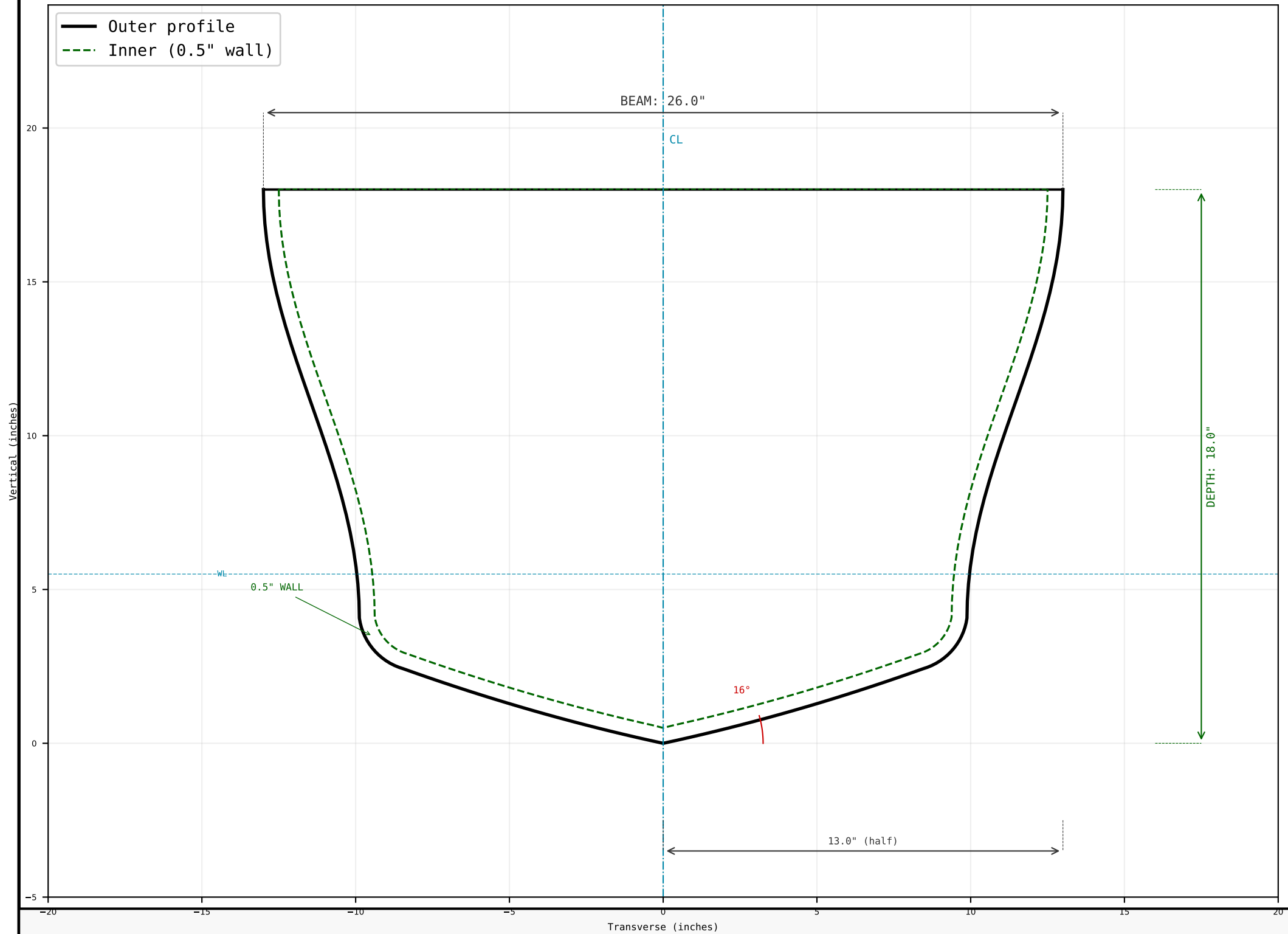
UNITS: INCHES

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" × 32" × 18.5" × 0.5" WALL | STATION H – TRANSITION

Offset: 42" from midship | Beam: 27.0" | Depth: 18.5" | Deadrise: 10° | Rocker: 0.45"

WALL: 0.5" UNIFORM



STATION I

Section Type: V-SECTION

Full Beam: 26.0"
 Half-Beam: 13.0"
 Depth: 18.0"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 16°
 Bilge Radius: 2.0"
 Rocker: 0.59"

Offset from
 Midship: 48"

Mold Position:
 From Bow: 60"
 (+ 3" flange)

CUT METHOD:
 Full profile: Bread
 knife (curved)

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 18.00)
- (5.07, 16.69)
- (9.01, 15.32)
- (9.89, 13.38)
- (11.54, 6.69)
- (13.00, 0.00)

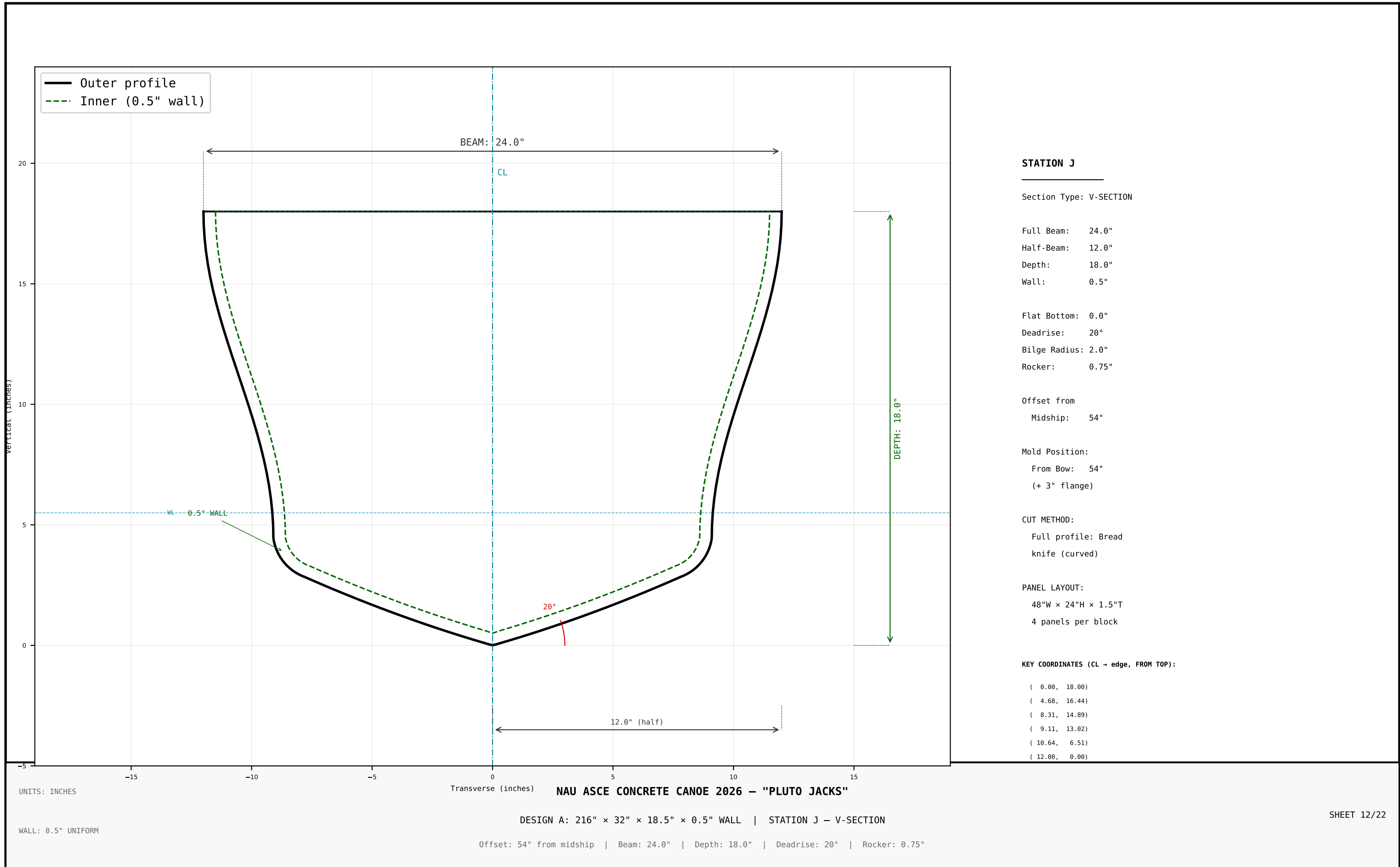
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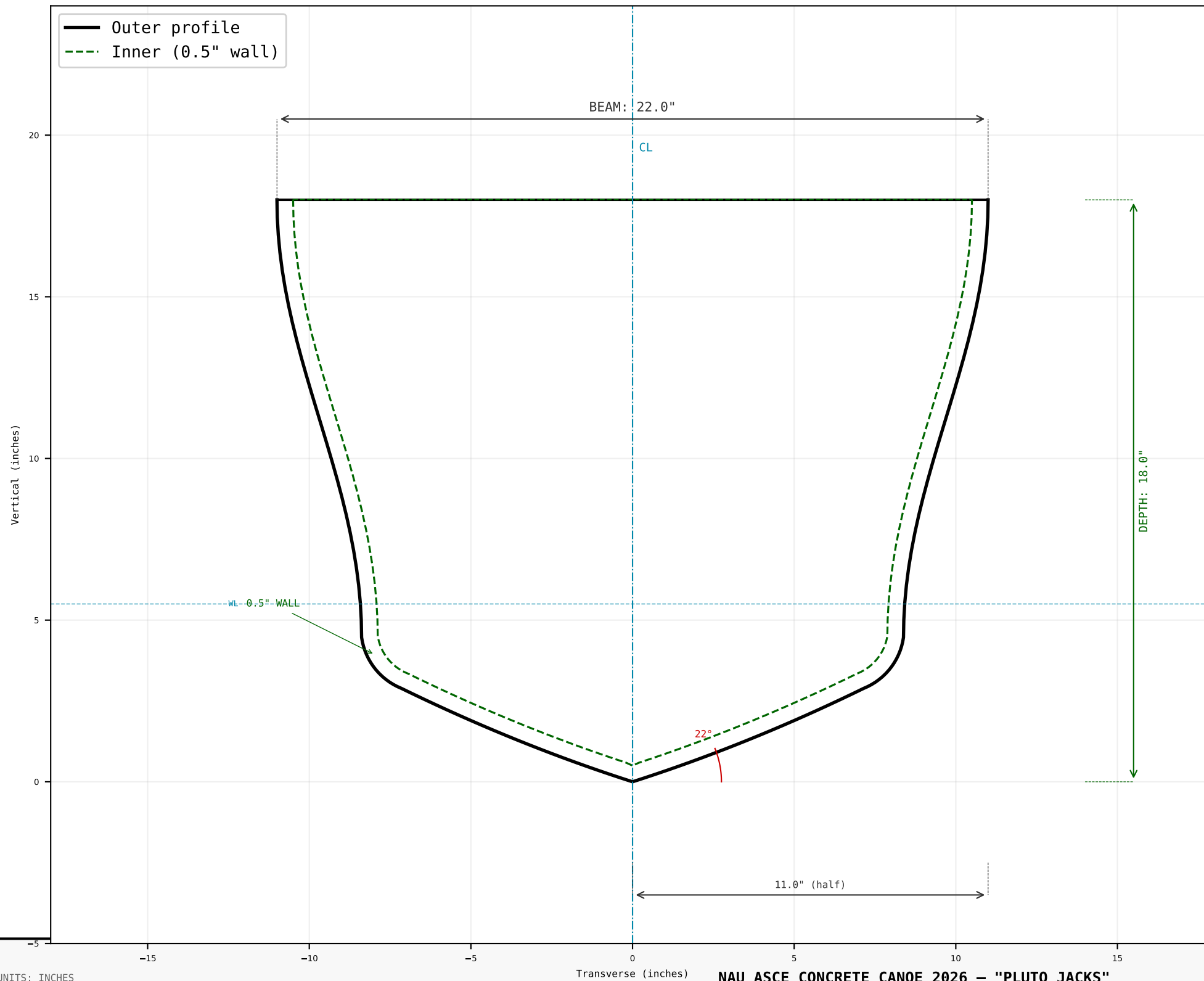
NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION I – V-SECTION

Offset: 48" from midship | Beam: 26.0" | Depth: 18.0" | Deadrise: 16° | Rocker: 0.59"

WALL: 0.5" UNIFORM





STATION K

Section Type: V-SECTION

Full Beam: 22.0"
 Half-Beam: 11.0"
 Depth: 18.0"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 22°
 Bilge Radius: 2.0"
 Rocker: 0.93"

Offset from
 Midship: 60"

Mold Position:
 From Bow: 48"
 (+ 3" flange)

CUT METHOD:
 Full profile: Bread
 knife (curved)

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 18.00)
- (4.29, 16.41)
- (7.63, 14.83)
- (8.39, 12.99)
- (9.77, 6.50)
- (11.00, 0.00)

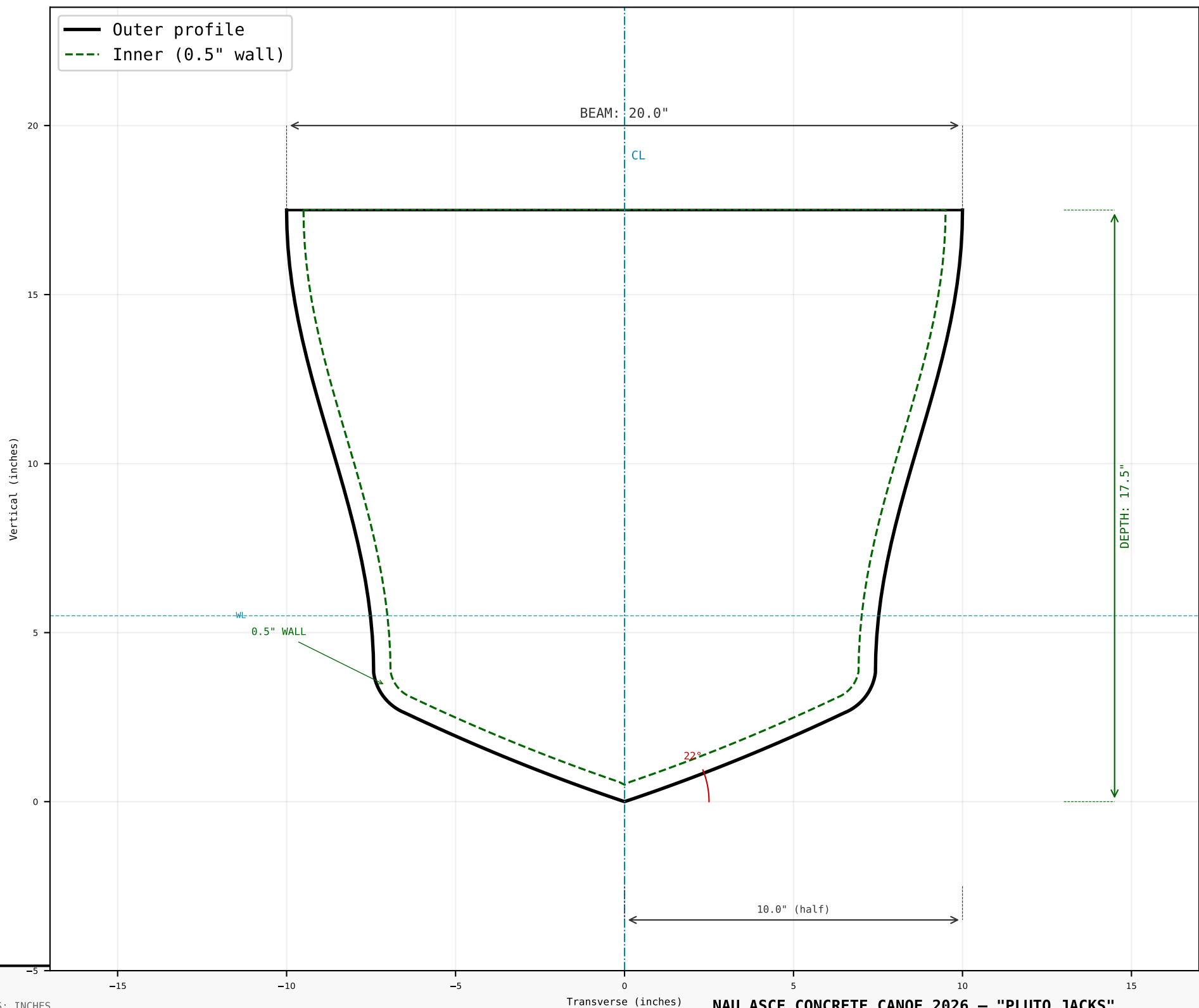
UNITS: INCHES

WALL: 0.5" UNIFORM

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION K – V-SECTION

Offset: 60" from midship | Beam: 22.0" | Depth: 18.0" | Deadrise: 22° | Rocker: 0.93"



STATION L

Section Type: V-SECTION

Full Beam: 20.0"
 Half-Beam: 10.0"
 Depth: 17.5"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 22°
 Bilge Radius: 1.5"
 Rocker: 1.12"

Offset from
 Midship: 66"

Mold Position:
 From Bow: 42"
 (+ 3" flange)

CUT METHOD:
 Full profile: Bread
 knife (curved)

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 17.50)
- (3.90, 16.03)
- (6.86, 14.67)
- (7.43, 13.14)
- (8.79, 6.57)
- (10.00, 0.00)

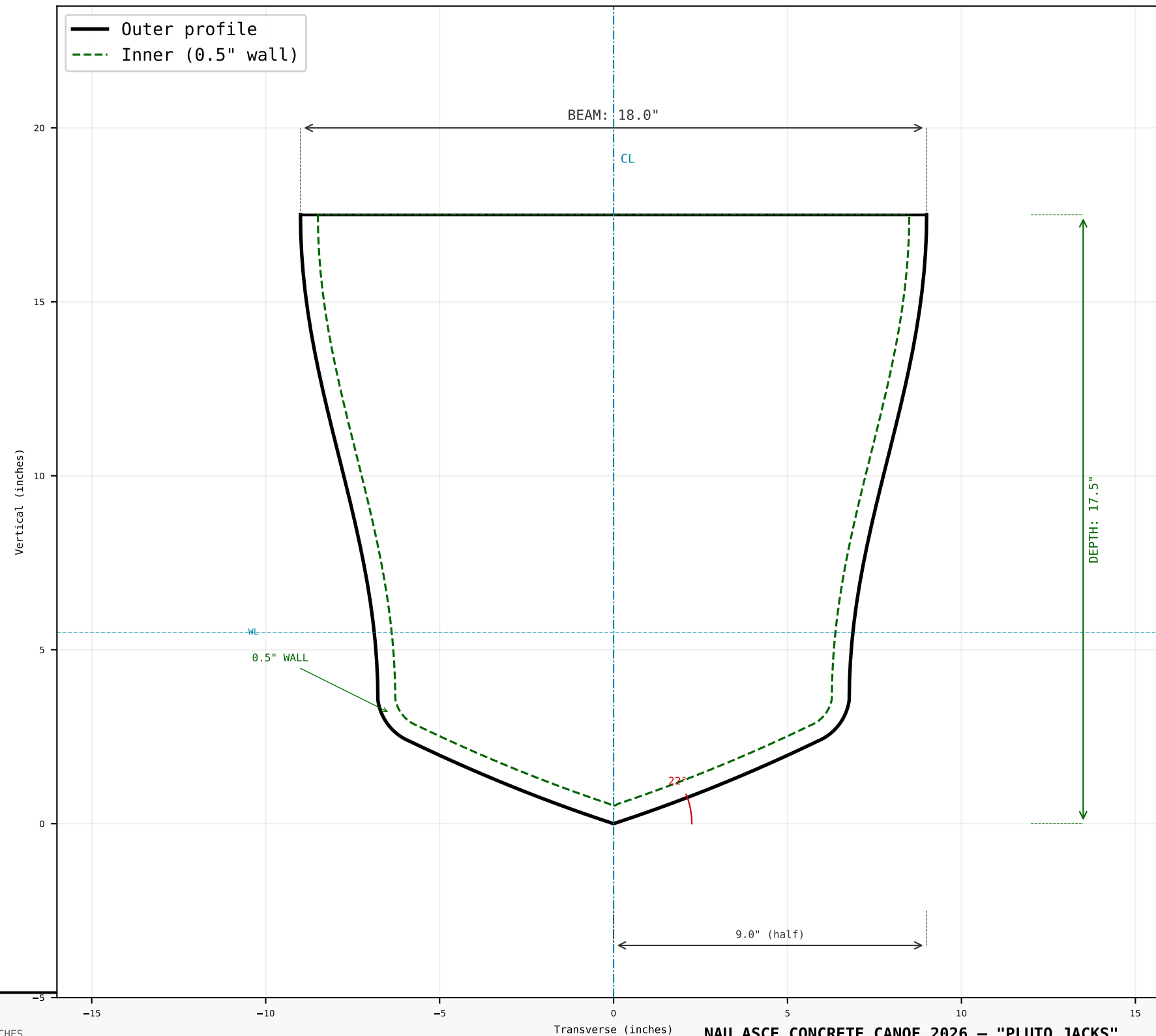
UNITS: INCHES

WALL: 0.5" UNIFORM

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION L – V-SECTION

Offset: 66" from midship | Beam: 20.0" | Depth: 17.5" | Deadrise: 22° | Rocker: 1.12"



STATION M

Section Type: V-SECTION

Full Beam: 18.0"
 Half-Beam: 9.0"
 Depth: 17.5"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 22°
 Bilge Radius: 1.5"
 Rocker: 1.33"

Offset from
 Midship: 72"

Mold Position:
 From Bow: 36"
 (+ 3" flange)

CUT METHOD:
 Full profile: Bread
 knife (curved)

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

(0.00, 17.50)
 (3.51, 16.19)
 (6.21, 14.93)
 (6.78, 13.40)
 (7.96, 6.70)
 (9.00, 0.00)

UNITS: INCHES

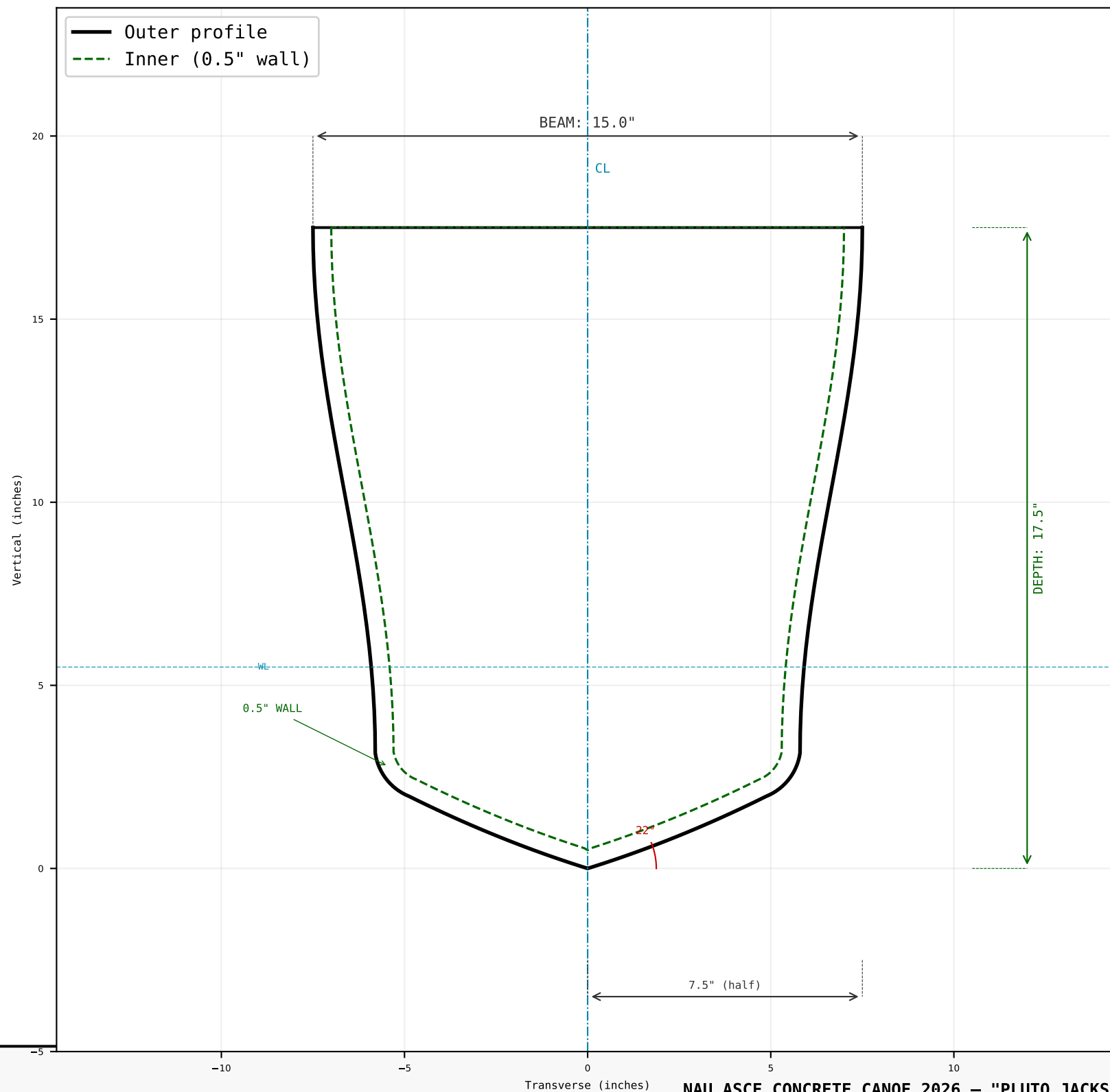
WALL: 0.5" UNIFORM

Transverse (inches)

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION M – V-SECTION

Offset: 72" from midship | Beam: 18.0" | Depth: 17.5" | Deadrise: 22° | Rocker: 1.33"



STATION N

Section Type: V-SECTION

Full Beam: 15.0"
 Half-Beam: 7.5"
 Depth: 17.5"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 22°
 Bilge Radius: 1.5"
 Rocker: 1.56"

Offset from
 Midship: 78"

Mold Position:
 From Bow: 30"
 (+ 3" flange)

CUT METHOD:
 Full profile: Bread
 knife (curved)

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 17.50)
- (2.92, 16.43)
- (5.24, 15.32)
- (5.81, 13.77)
- (6.70, 6.89)
- (7.50, 0.00)

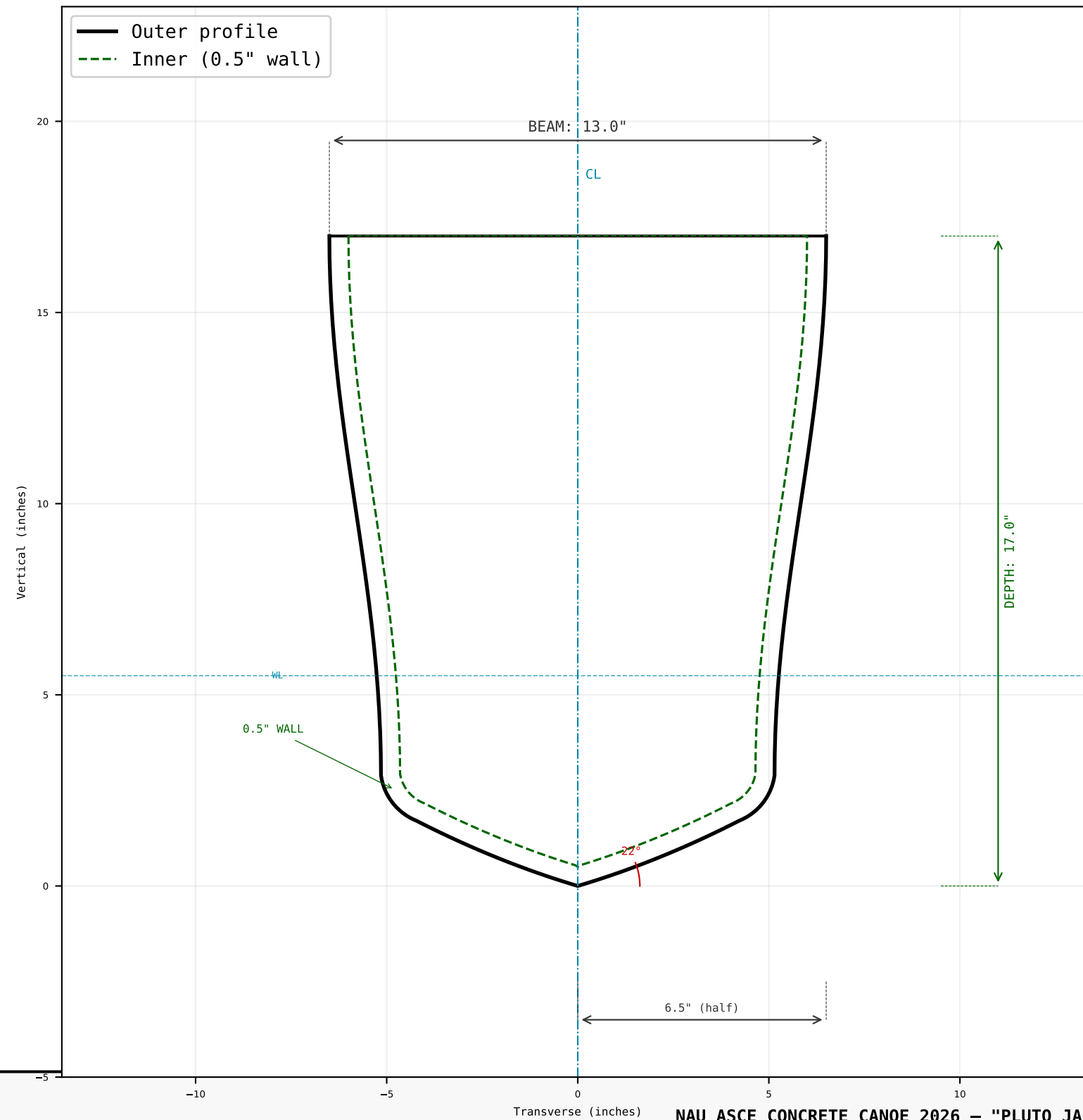
UNITS: INCHES

WALL: 0.5" UNIFORM

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION N – V-SECTION

Offset: 78" from midship | Beam: 15.0" | Depth: 17.5" | Deadrise: 22° | Rocker: 1.56"



STATION 0

Section Type: V-SECTION

Full Beam: 13.0"
 Half-Beam: 6.5"
 Depth: 17.0"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 22°
 Bilge Radius: 1.5"
 Rocker: 1.81"

Offset from
 Midship: 84"

Mold Position:
 From Bow: 24"
 (+ 3" flange)

CUT METHOD:
 Full profile: Bread
 knife (curved)

PANEL LAYOUT:
 48"W × 24"H × 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 17.00)
- (2.54, 16.08)
- (4.59, 15.08)
- (5.15, 13.55)
- (5.87, 6.77)
- (6.50, 0.00)

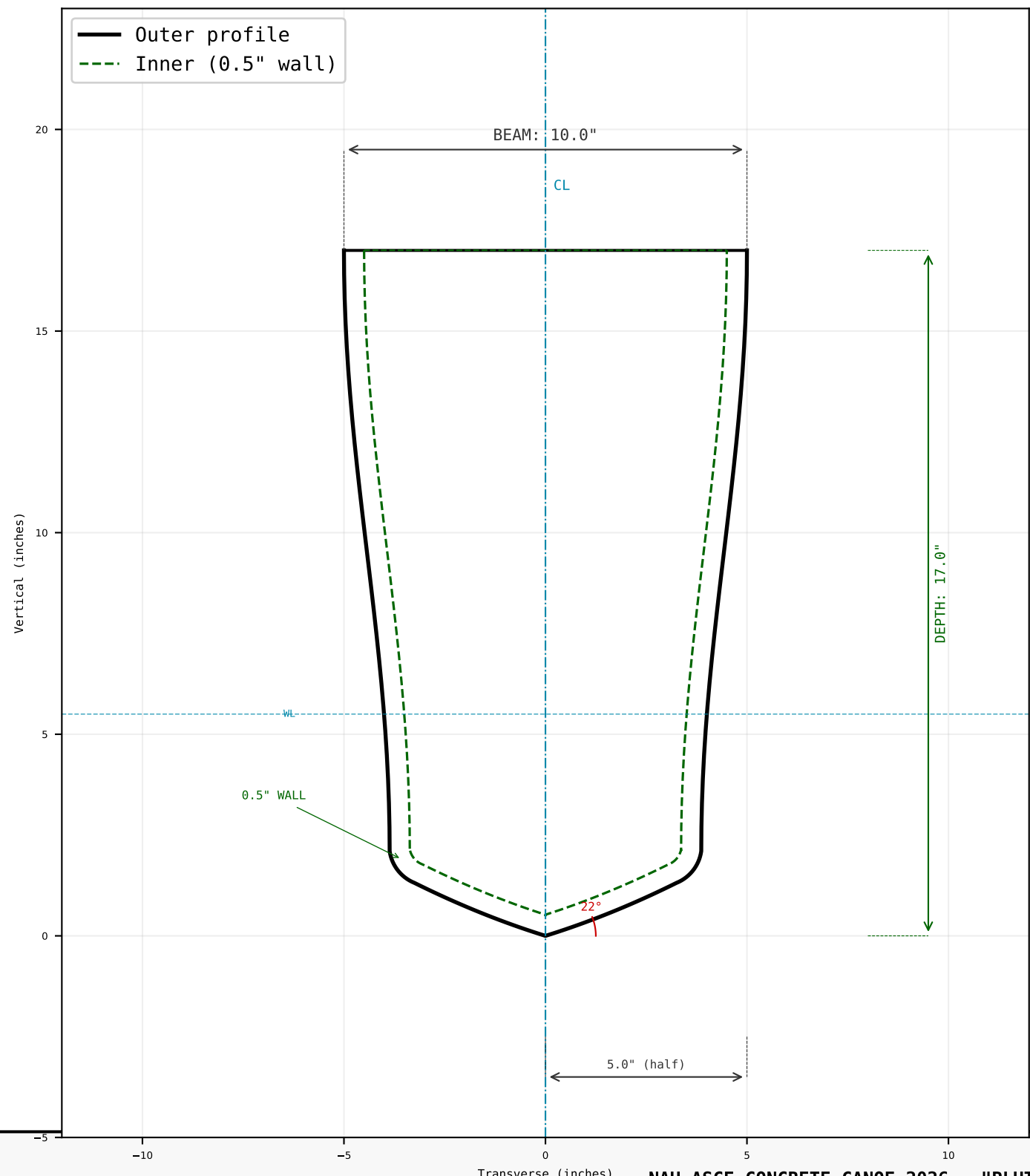
UNITS: INCHES

WALL: 0.5" UNIFORM

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" × 32" × 18.5" × 0.5" WALL | STATION 0 – V-SECTION

Offset: 84" from midship | Beam: 13.0" | Depth: 17.0" | Deadrise: 22° | Rocker: 1.81"



STATION P

Section Type: V-SECTION

Full Beam: 10.0"
 Half-Beam: 5.0"
 Depth: 17.0"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 22°
 Bilge Radius: 1.0"
 Rocker: 2.08"

Offset from
 Midship: 90"

Mold Position:
 From Bow: 18"
 (+ 3" flange)

CUT METHOD:
 Full profile: Bread
 knife (curved)

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 17.00)
- (1.95, 16.28)
- (3.49, 15.55)
- (3.87, 14.30)
- (4.47, 7.15)
- (5.00, 0.00)

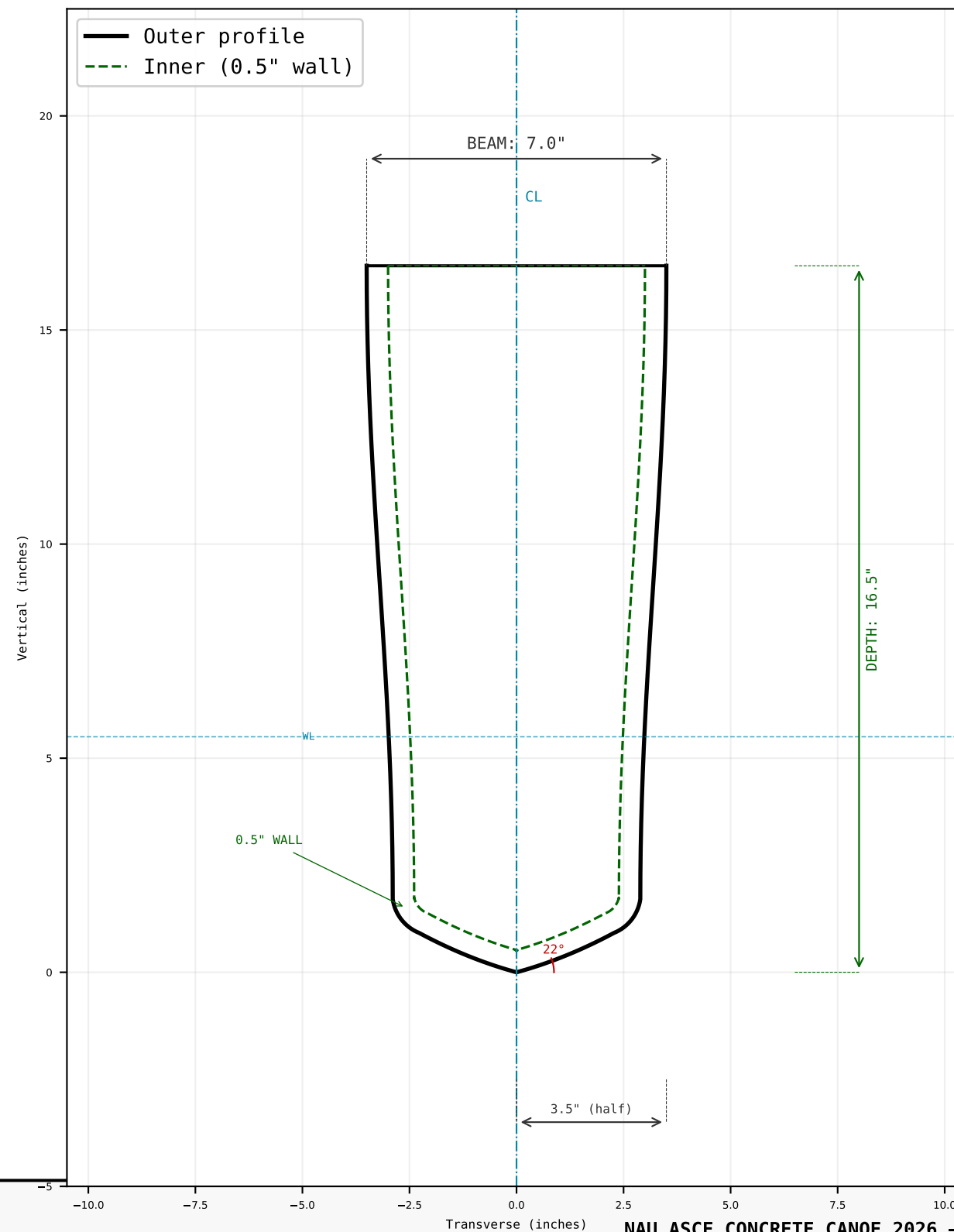
UNITS: INCHES

WALL: 0.5" UNIFORM

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION P – V-SECTION

Offset: 90" from midship | Beam: 10.0" | Depth: 17.0" | Deadrise: 22° | Rocker: 2.08"



STATION Q

Section Type: V-SECTION

Full Beam: 7.0"
 Half-Beam: 3.5"
 Depth: 16.5"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 22°
 Bilge Radius: 1.0"
 Rocker: 2.37"

Offset from
 Midship: 96"

Mold Position:
 From Bow: 12"
 (+ 3" flange)

CUT METHOD:
 Full profile: Bread
 knife (curved)

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 16.50)
- (1.36, 16.02)
- (2.52, 15.44)
- (2.89, 14.20)
- (3.21, 7.10)
- (3.50, 0.00)

UNITS: INCHES

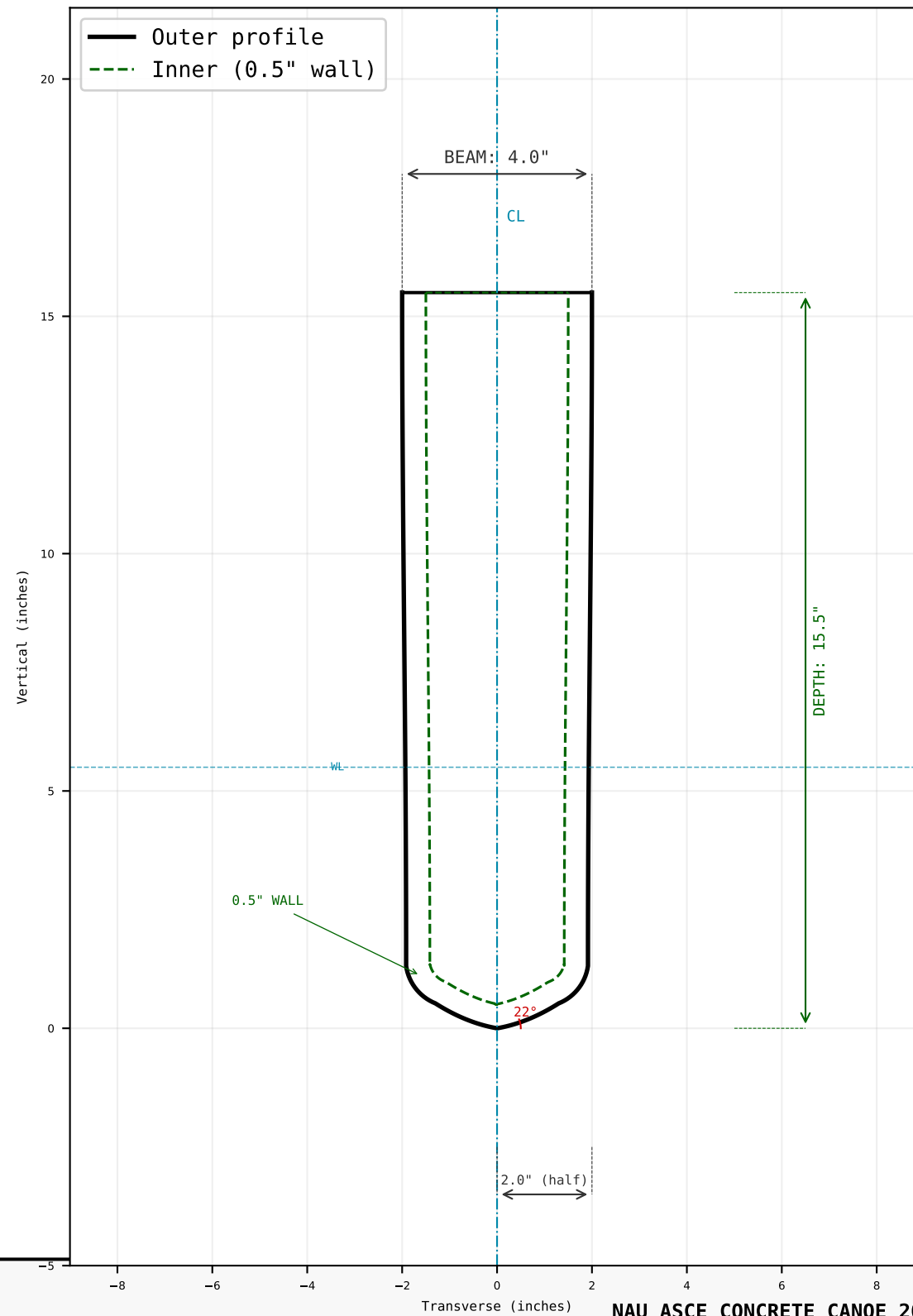
NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION Q – V-SECTION

Offset: 96" from midship | Beam: 7.0" | Depth: 16.5" | Deadrise: 22° | Rocker: 2.37"

WALL: 0.5" UNIFORM

SHEET 19/22



STATION R

Section Type: V-SECTION

Full Beam: 4.0"
 Half-Beam: 2.0"
 Depth: 15.5"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 22°
 Bilge Radius: 1.0"
 Rocker: 2.68"

Offset from
 Midship: 102"

Mold Position:
 From Bow: 6"
 (+ 3" flange)

CUT METHOD:
 Full profile: Bread
 knife (curved)

PANEL LAYOUT:
 48"W × 24"H × 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (0.00, 15.50)
- (0.78, 15.26)
- (1.54, 14.84)
- (1.92, 13.62)
- (1.96, 6.81)
- (2.00, 0.00)

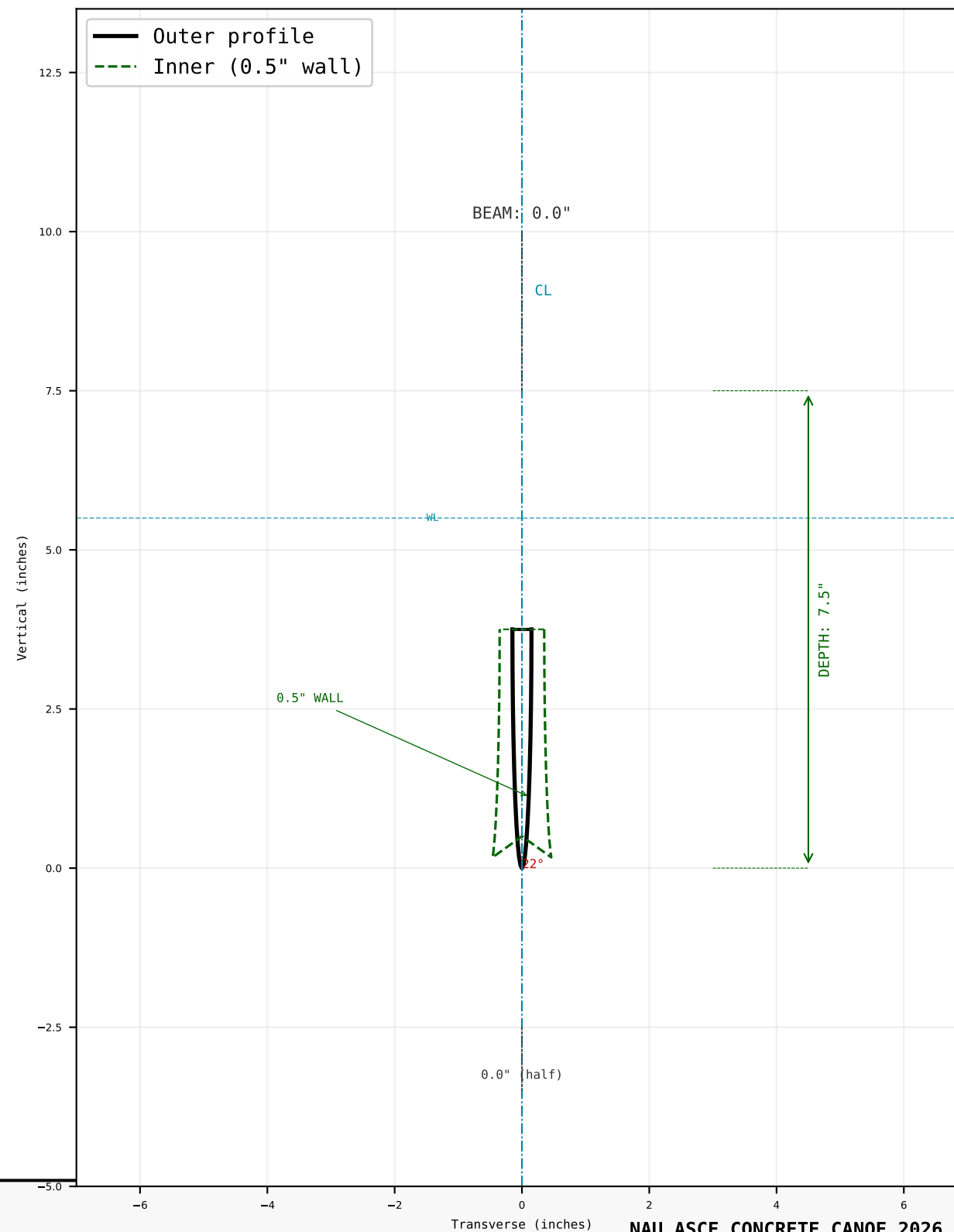
UNITS: INCHES

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" × 32" × 18.5" × 0.5" WALL | STATION R – V-SECTION

Offset: 102" from midship | Beam: 4.0" | Depth: 15.5" | Deadrise: 22° | Rocker: 2.68"

WALL: 0.5" UNIFORM



STATION S

Section Type: V-SECTION

Full Beam: 0.0"
 Half-Beam: 0.0"
 Depth: 7.5"
 Wall: 0.5"

Flat Bottom: 0.0"
 Deadrise: 22°
 Bilge Radius: 0.9"
 Rocker: 3.00"

Offset from
 Midship: 108"

Mold Position:
 From Bow: 0"
 (+ 3" flange)

CUT METHOD:
 Full profile: Bread
 knife (curved)

PANEL LAYOUT:
 48"W x 24"H x 1.5"T
 4 panels per block

KEY COORDINATES (CL → edge, FROM TOP):

- (-0.00, 7.50)
- (0.05, 7.32)
- (0.09, 6.78)
- (0.12, 5.95)
- (0.14, 4.91)
- (0.15, 3.75)

UNITS: INCHES

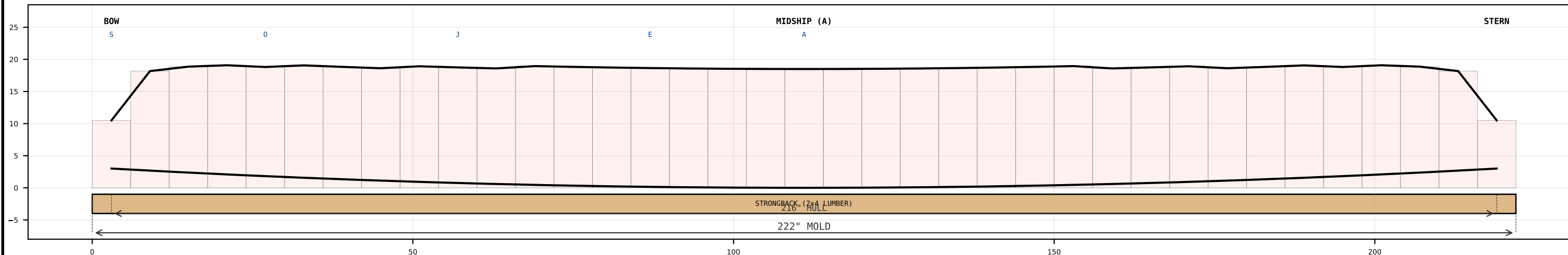
NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | STATION S – V-SECTION

Offset: 108" from midship | Beam: 0.0" | Depth: 7.5" | Deadrise: 22° | Rocker: 3.00"

WALL: 0.5" UNIFORM

MOLD SIDE VIEW



BILL OF MATERIALS

ITEM	QTY	DESCRIPTION
1	40	EPS Foam Sheets 48"x24"x1.5"
2	37	Foam Blocks (4 panels each, 148 total)
3	12	Spare Panels
4	2	Strongback 2x4x20' Lumber
5	4	Cross-braces 2x4x36"
6	1 gal	PL Premium adhesive
7	1 roll	Basalt mesh reinforcement
8	~2.5 ft ³	Concrete mix (58.6 PCF = 153 lbs)
9	1 can	Mold release / plastic wrap
10	As needed	Sandpaper (80, 120, 220 grit)

CONSTRUCTION NOTES

1. Cut foam blocks per station templates (Sheets 3-21)
2. Glue 4 panels per block with PL Premium
3. Allow 24h cure before handling
4. Mount blocks on strongback at 6" spacing
5. FAIR between stations with long sanding board
 - Use 80-grit for bulk removal
 - Finish with 120-grit
6. Check profile templates at each station
7. Apply mold release or plastic wrap
8. Concrete Lift 1: 0.20" base layer
9. Place basalt mesh (centered in wall)
10. Concrete Lift 2: 0.30" top layer
11. Total wall: 0.50" (check with depth gauge)
12. C0: cure for accelerated strength

~~CRITICAL: Keep seats Low (4-5" above keel)~~
to maintain GM ≥ 6.0" stability margin.

UNITS: INCHES

NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A: 216" x 32" x 18.5" x 0.5" WALL | MOLD ASSEMBLY – STRONGBACK & STATION LAYOUT

WALL: 0.5" UNIFORM

37 stations x 6" spacing = 222" mold (+ 3" flanges each end)

SECTION 2

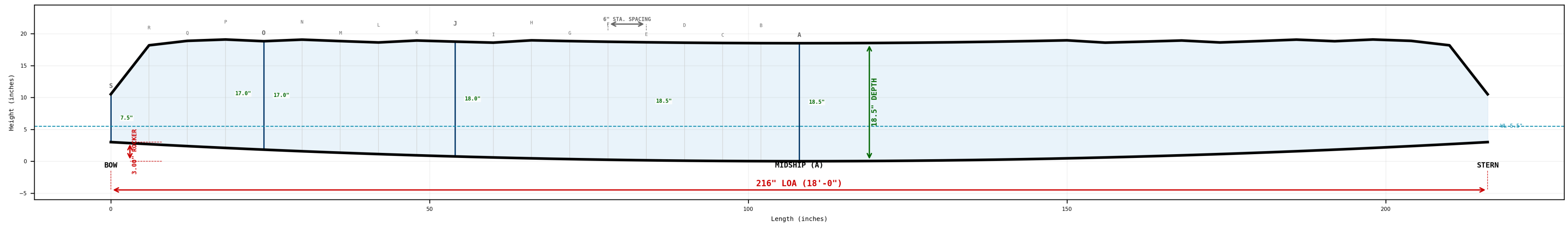
Hull Dimensions Sheet — All Dims on One Drawing

1 pages follow

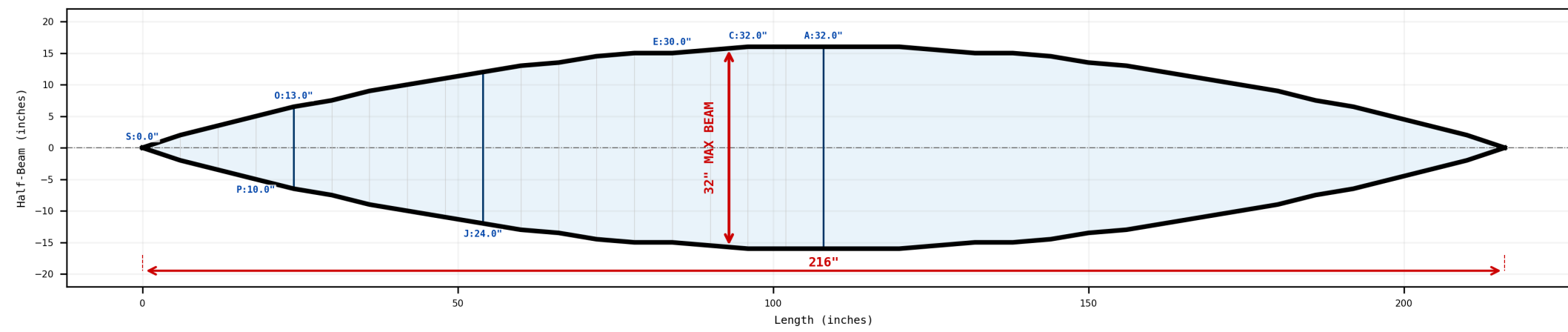
NAU ASCE CONCRETE CANOE 2026 – "PLUTO JACKS"

DESIGN A – FULLY DIMENSIONED HULL | 216" × 32" × 18.5" × 0.5" WALL

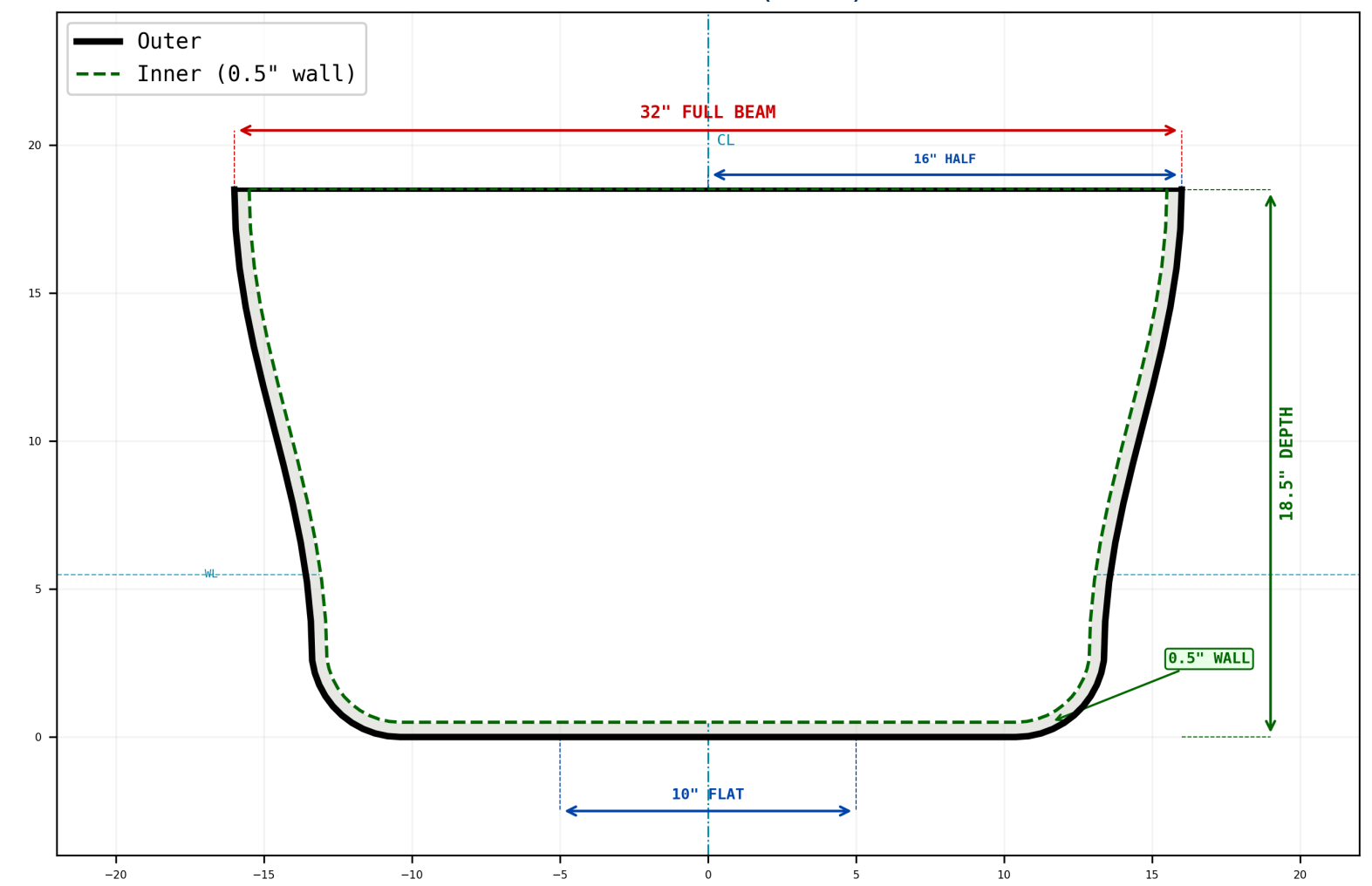
PROFILE VIEW (SIDE ELEVATION)



PLAN VIEW (TOP DOWN)



MIDSHIP SECTION (STA. A)



SECTION 3

Station Cutting Sheets — Per-Station Templates

21 pages follow

STATION A

Wide U, flattest bottom

Position: MIDSHIP (center of canoe)
 Prepare: 4 panels total (4/block x 1 block)

△ NEARLY IDENTICAL TO: B, C, D, E

Some template works - trim beam by 2 1/2" per station

CUT 4 PANELS (1 block, midship)

DIMENSIONS

Full Beam: 32.00"
 Depth at CL: 18.50"
 Half-Breadth: 16.00"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.00" from bottom
 Spare (bottom): 5.0" below keel
 Spare (width): 8.0" each side
 Block: 6" (4 panels)

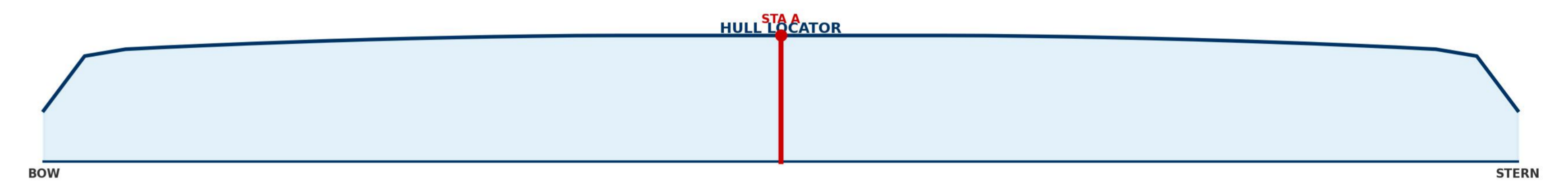
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
4.00"	1.50"
8.00"	3.00"
12.00"	5.75"
16.00"	18.50" (gunwale)

Full coords on template

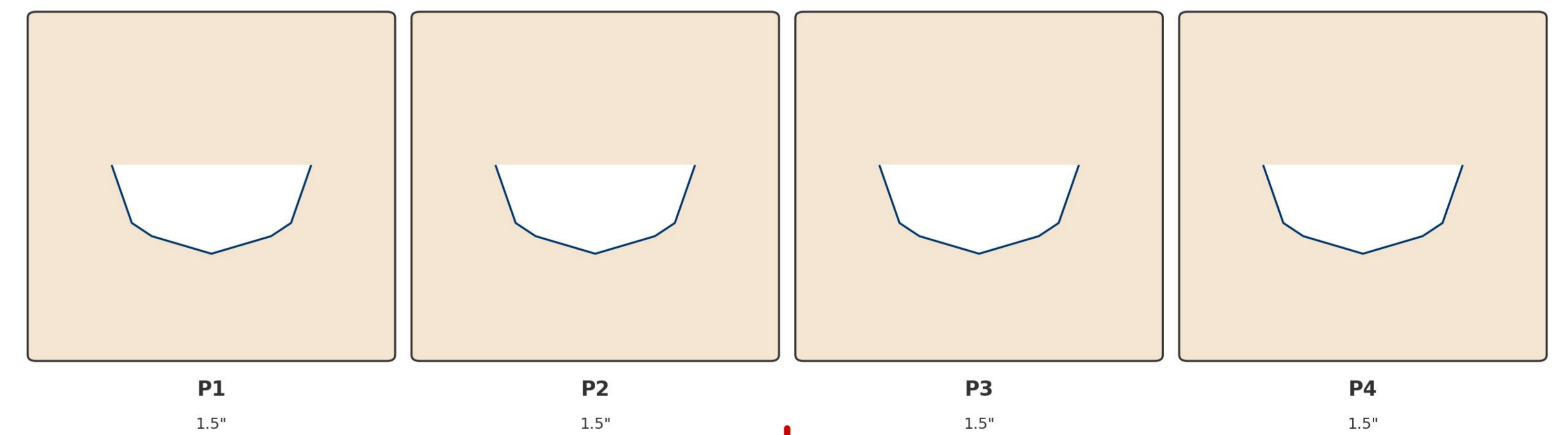
CUTTING METHOD

FLAT BOTTOM (Wide U)
 Score straight lines down both sides with utility knife. Bread knife for the curved bottom. Bottom is nearly flat -- follow template closely.

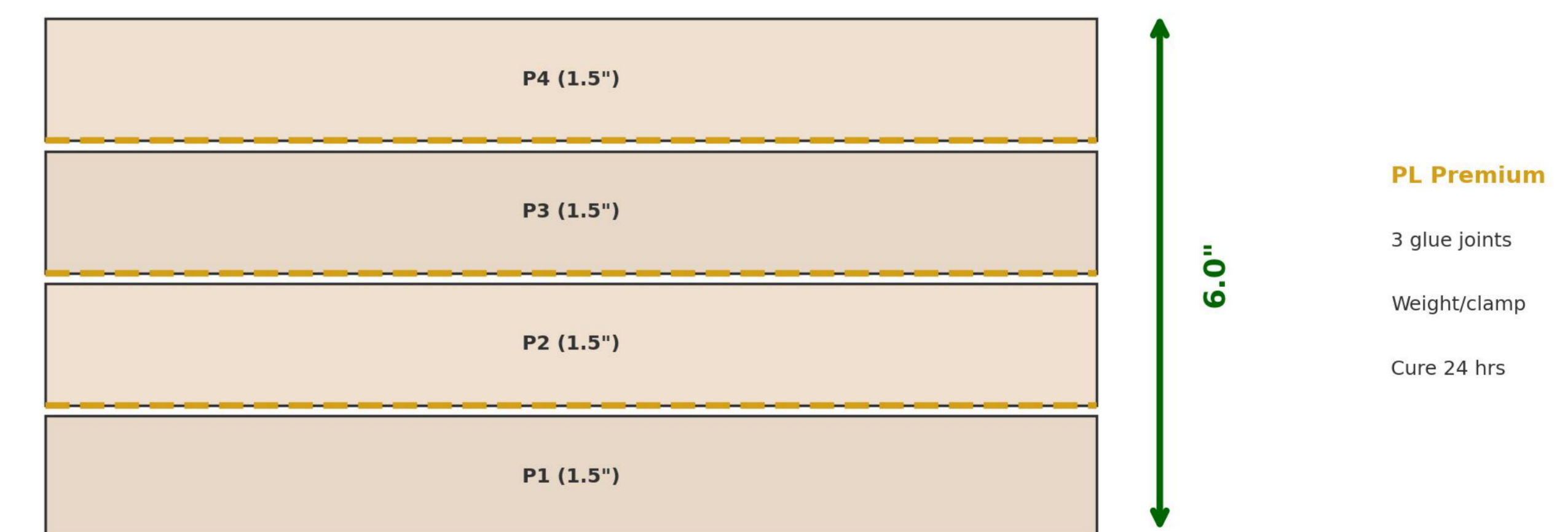


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife

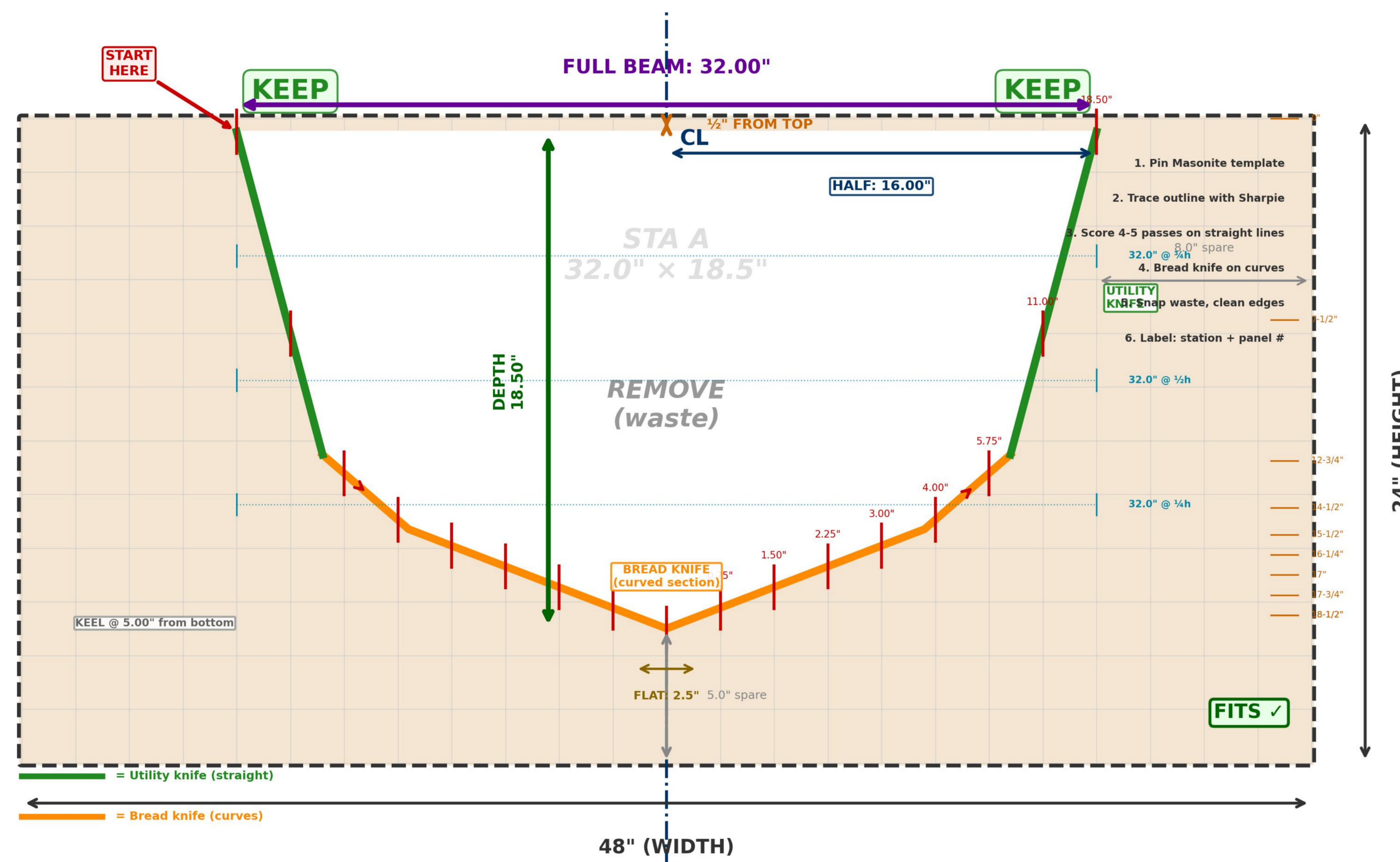


Step 2: Glue face-to-face → 6" block



PL Premium
 3 glue joints
 Weight/clamp
 Cure 24 hrs

= 1 BLOCK (Station A)



STATION B

Nearly identical to midship

Position: 6" from midship (204" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

△ NEARLY IDENTICAL TO: A, C, D, E

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 32.00"
 Depth at CL: 18.50"
 Half-Breadth: 16.00"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.00" from bottom
 Spare (bottom): 5.0" below keel
 Spare (width): 8.1" each side
 Block: 6" (4 panels)

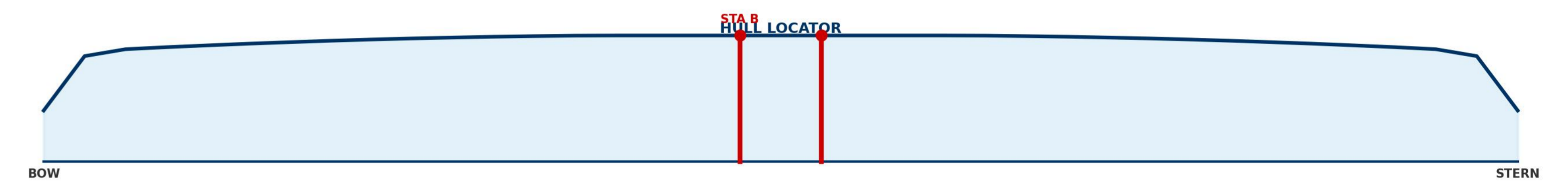
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
4.00"	1.50"
8.00"	3.00"
12.00"	5.75"
16.00"	18.50" (gunwale)

Full coords on template

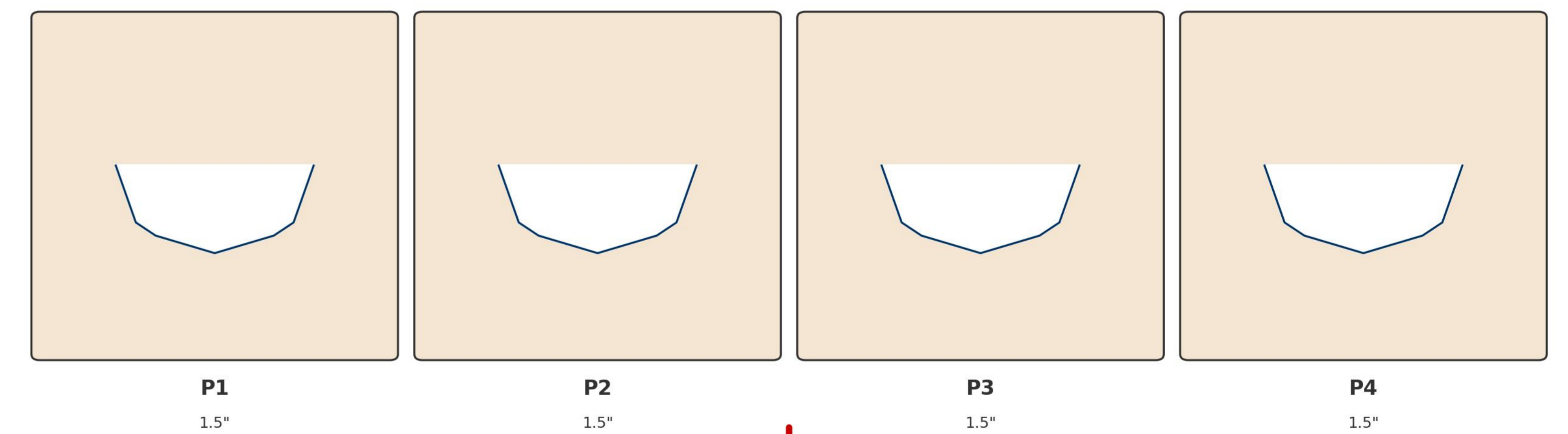
CUTTING METHOD

FLAT BOTTOM (Wide U)
 Score straight lines down both sides with utility knife. Bread knife for the curved bottom. Bottom is nearly flat -- follow template closely.

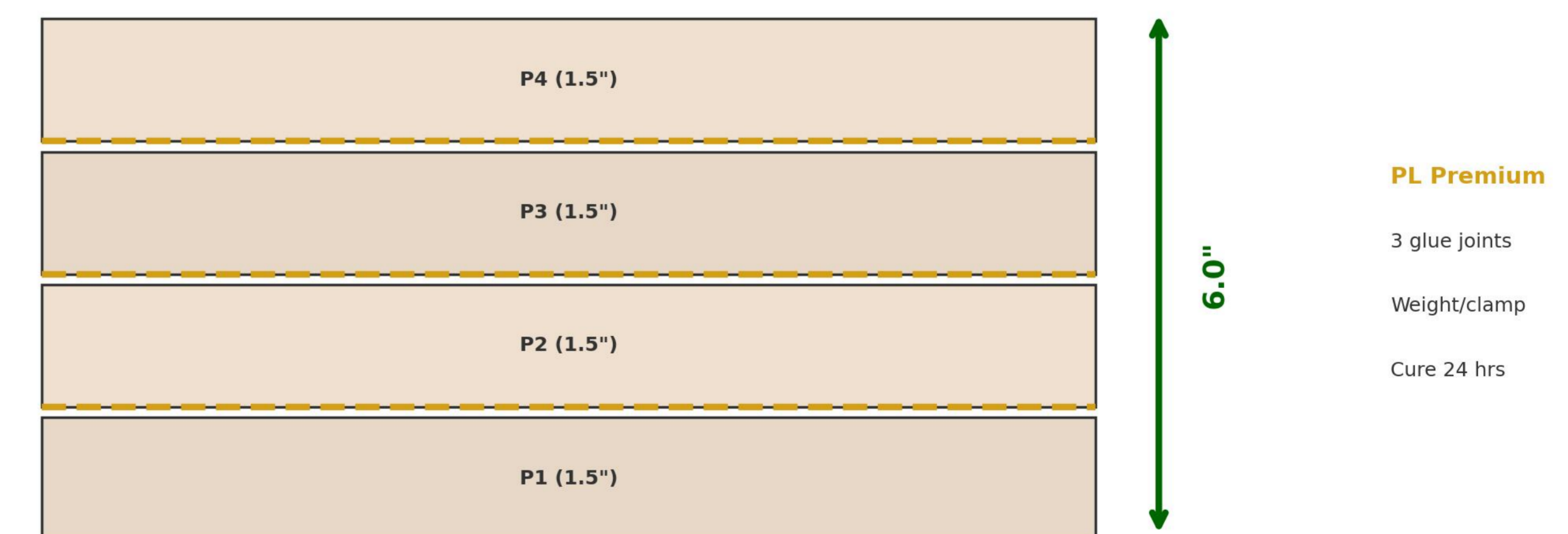


4-PANEL ASSEMBLY

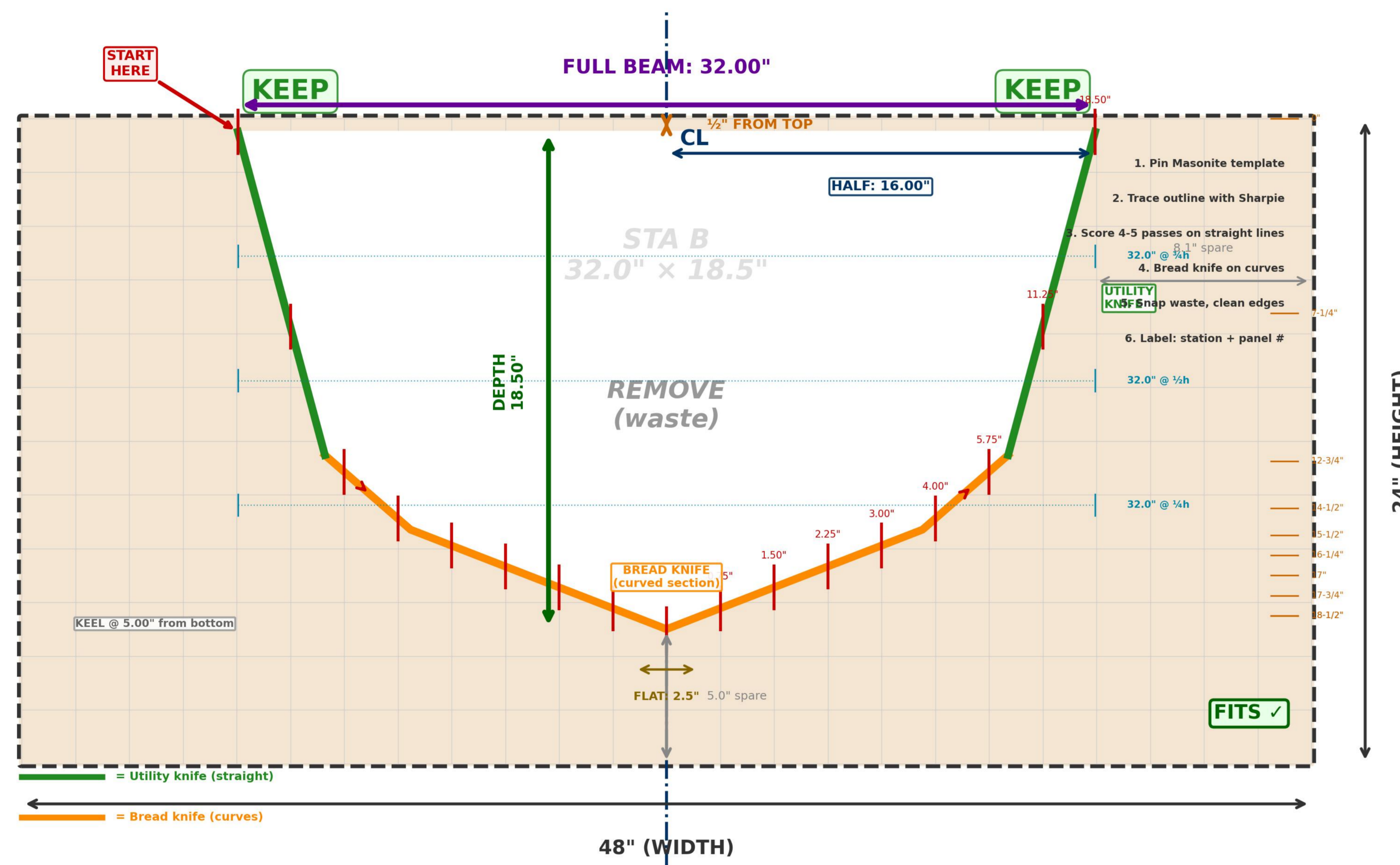
Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 6" block



= 1 BLOCK (Station B)



STATION C

Slight narrowing

Position: 12" from midship (192" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

△ NEARLY IDENTICAL TO: A, B, D, E

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 31.50"
 Depth at CL: 18.50"
 Half-Breadth: 15.75"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.00" from bottom
 Spare (bottom): 5.0" below keel
 Spare (width): 8.2" each side
 Block: 6" (4 panels)

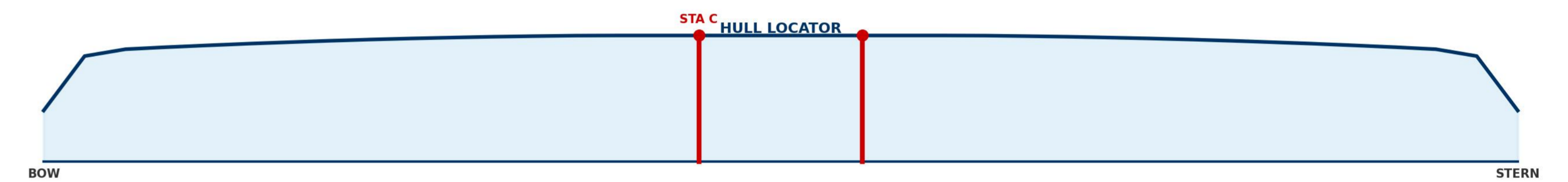
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
4.00"	1.50"
8.00"	3.25"
12.00"	6.00"
15.75"	18.50" (gunwale)

Full coords on template

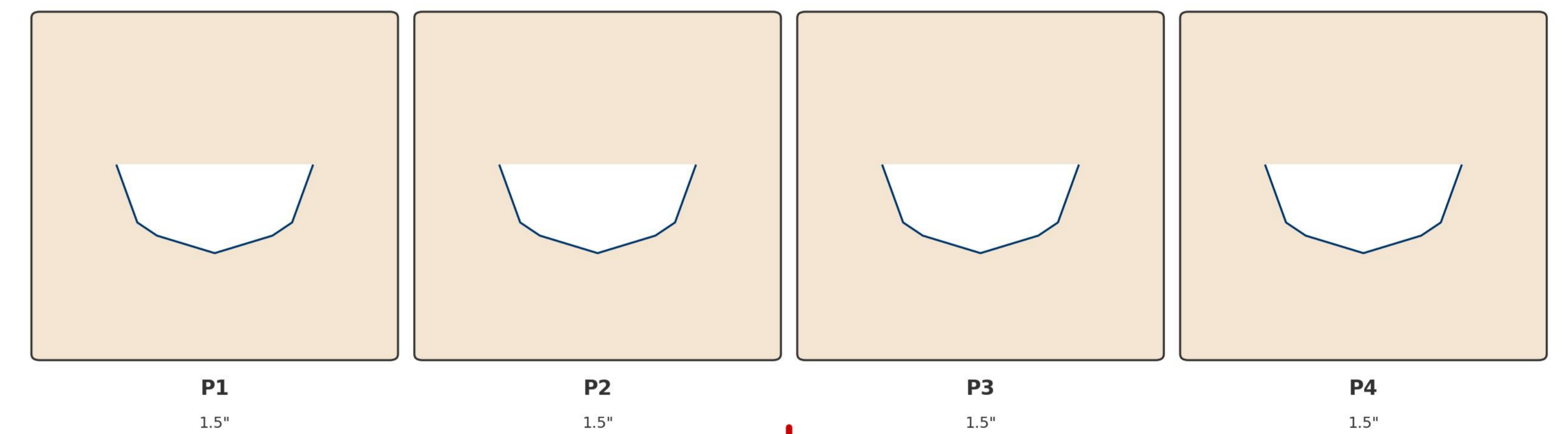
CUTTING METHOD

FLAT BOTTOM (Wide U)
 Score straight lines down both sides with utility knife. Bread knife for the curved bottom. Bottom is nearly flat -- follow template closely.

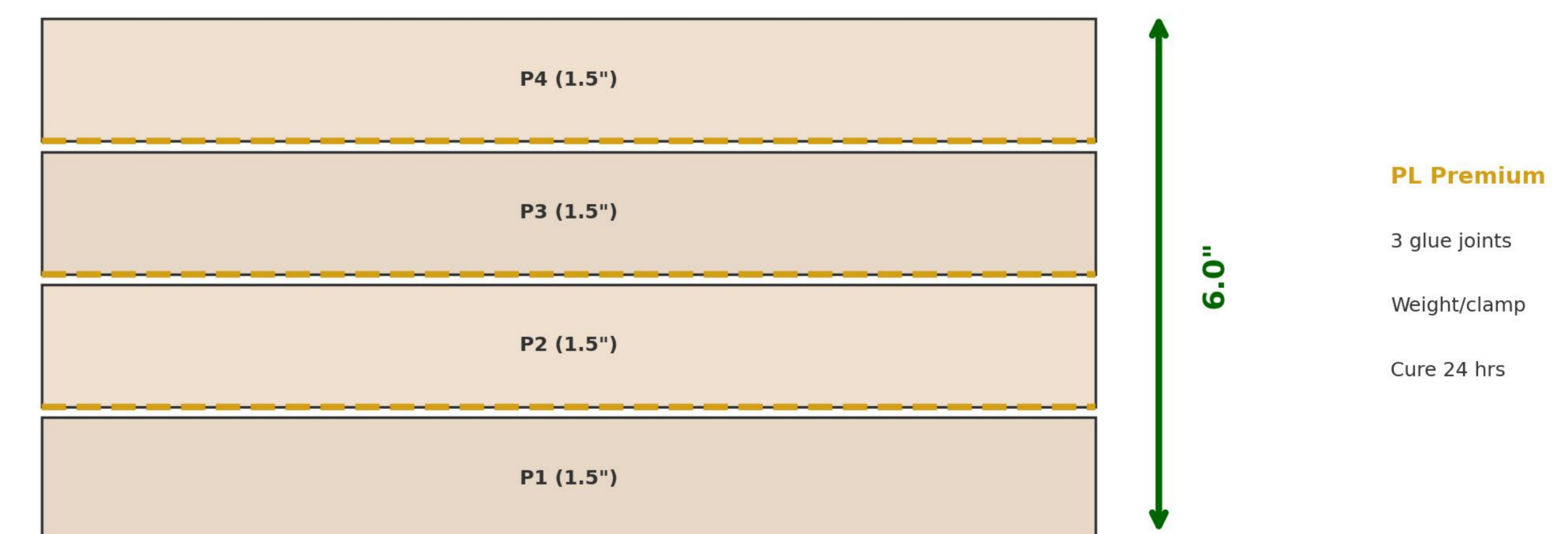


4-PANEL ASSEMBLY

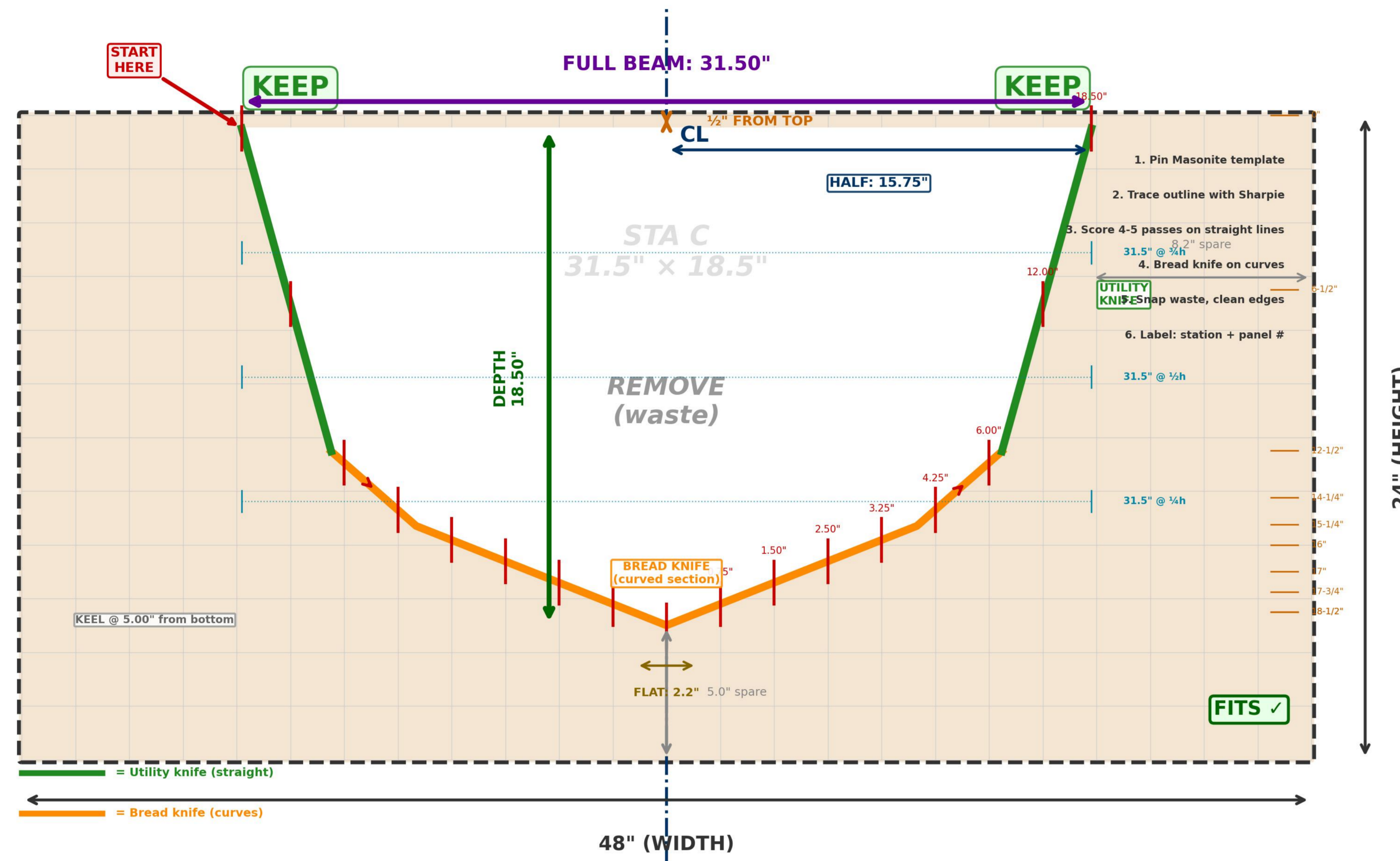
Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 6" block



= 1 BLOCK (Station C)



STATION D

Gentle taper begins

Position: 18" from midship (180" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

△ NEARLY IDENTICAL TO: A, B, C, E

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 31.25"
 Depth at CL: 18.50"
 Half-Breadth: 15.50"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.00" from bottom
 Spare (bottom): 5.0" below keel
 Spare (width): 8.4" each side
 Block: 6" (4 panels)

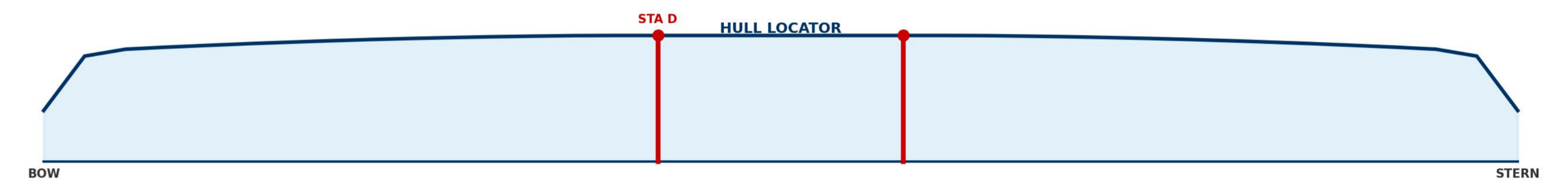
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
4.00"	1.75"
8.00"	3.25"
12.00"	6.50"
15.50"	18.50" (gunwale)

Full coords on template

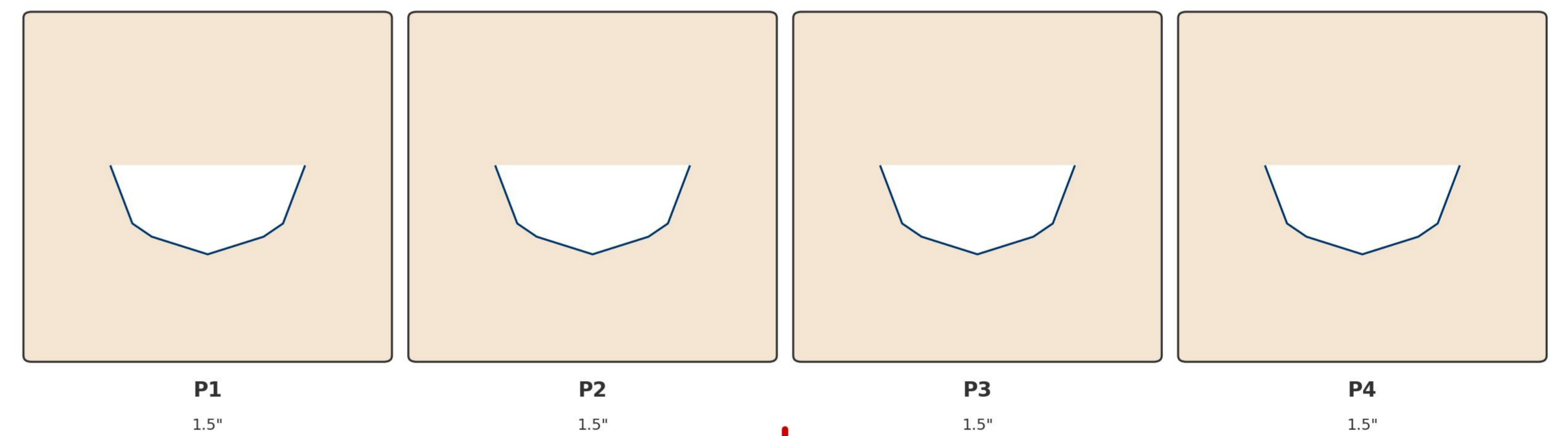
CUTTING METHOD

FLAT BOTTOM (Wide U)
 Score straight lines down both sides with utility knife. Bread knife for the curved bottom. Bottom is nearly flat -- follow template closely.

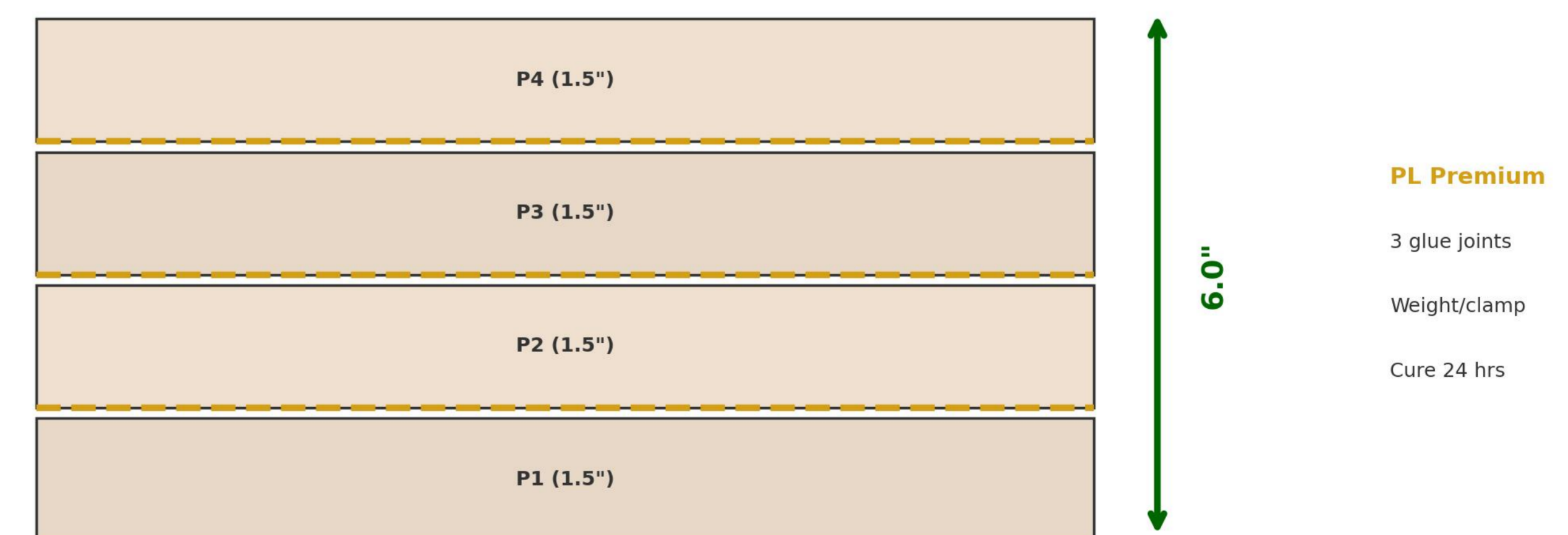


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife

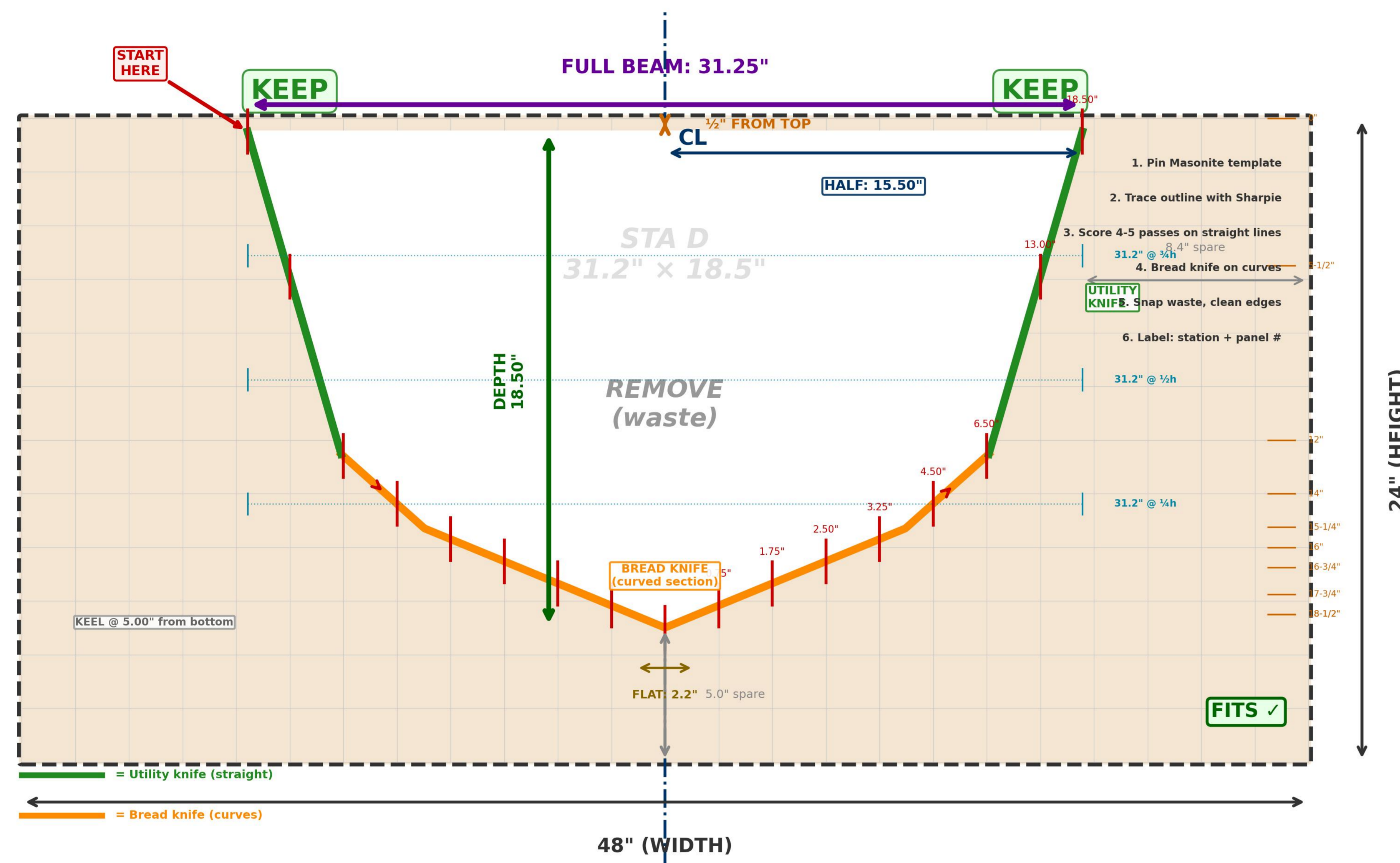


Step 2: Glue face-to-face → 6" block



PL Premium
 3 glue joints
 Weight/clamp
 Cure 24 hrs

= 1 BLOCK (Station D)



STATION E

Continued taper

Position: 24" from midship (168" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

△ NEARLY IDENTICAL TO: A, B, C, D

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 30.50"
 Depth at CL: 18.50"
 Half-Breadth: 15.25"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.00" from bottom
 Spare (bottom): 5.0" below keel
 Spare (width): 8.8" each side
 Block: 6" (4 panels)

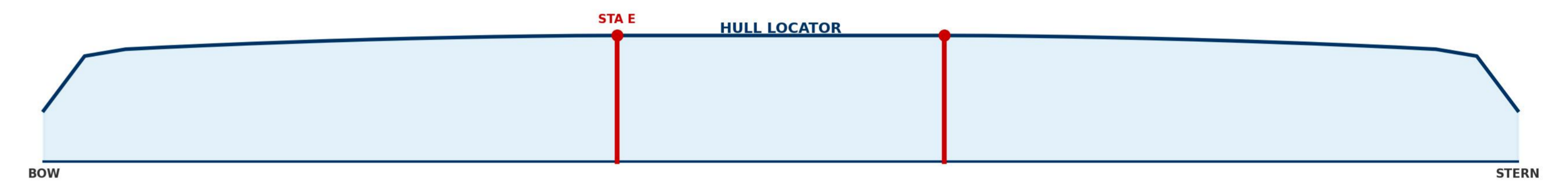
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
4.00"	1.75"
8.00"	3.50"
12.00"	8.00"
15.25"	18.50" (gunwale)

Full coords on template

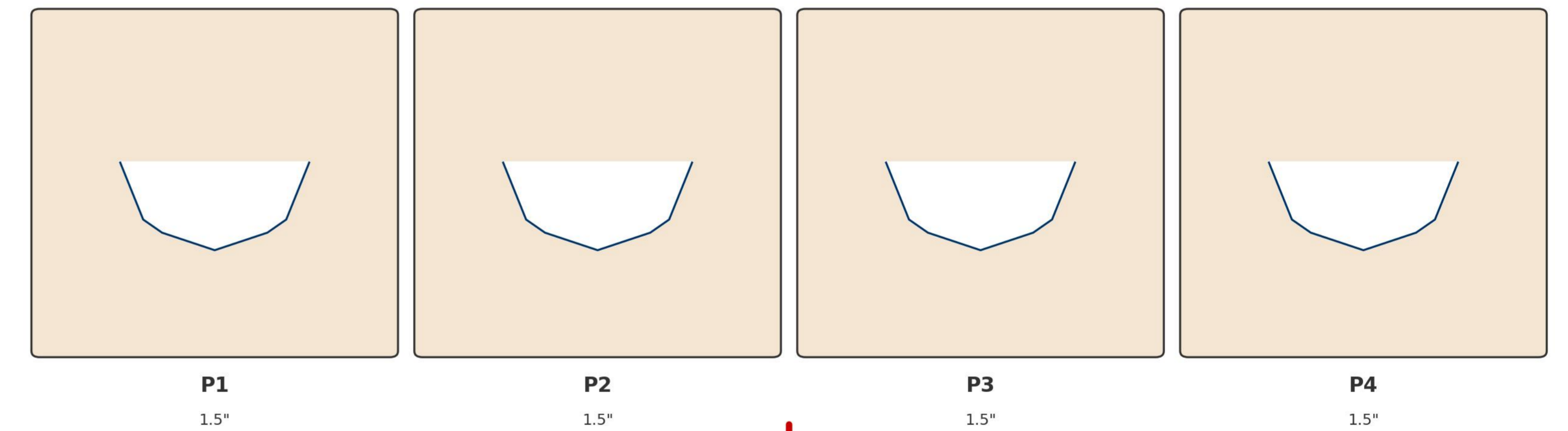
CUTTING METHOD

FLAT BOTTOM (Wide U)
 Score straight lines down both sides with utility knife. Bread knife for the curved bottom. Bottom is nearly flat -- follow template closely.

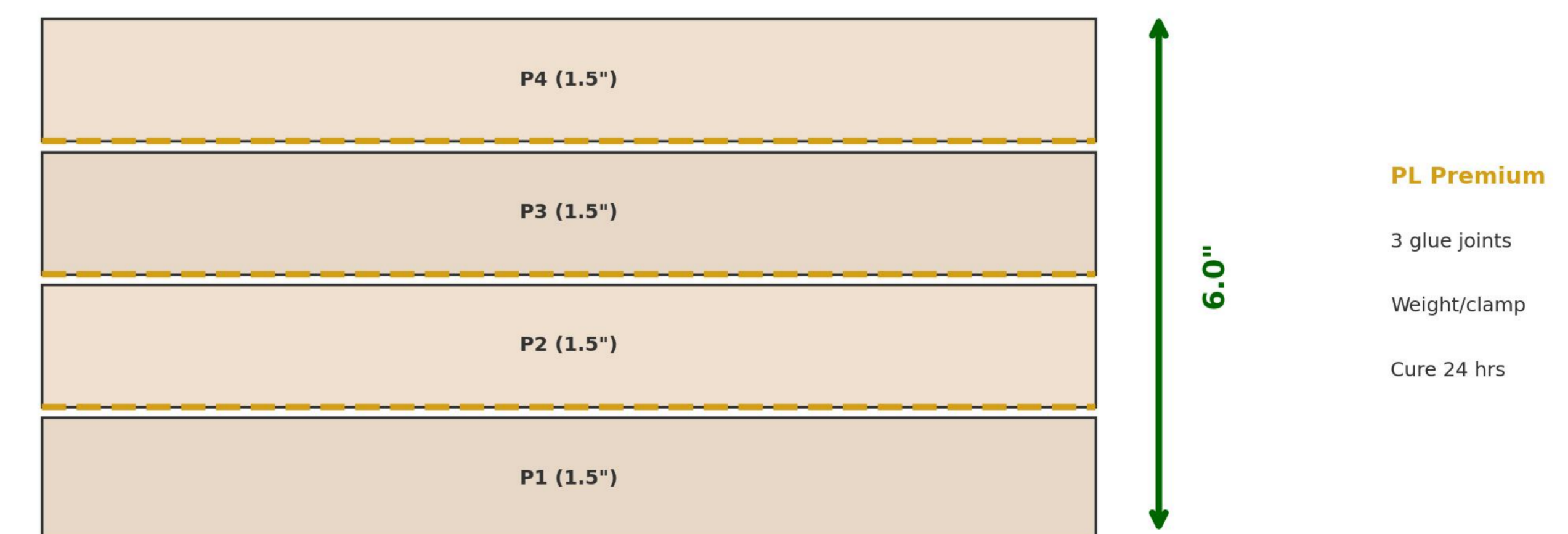


4-PANEL ASSEMBLY

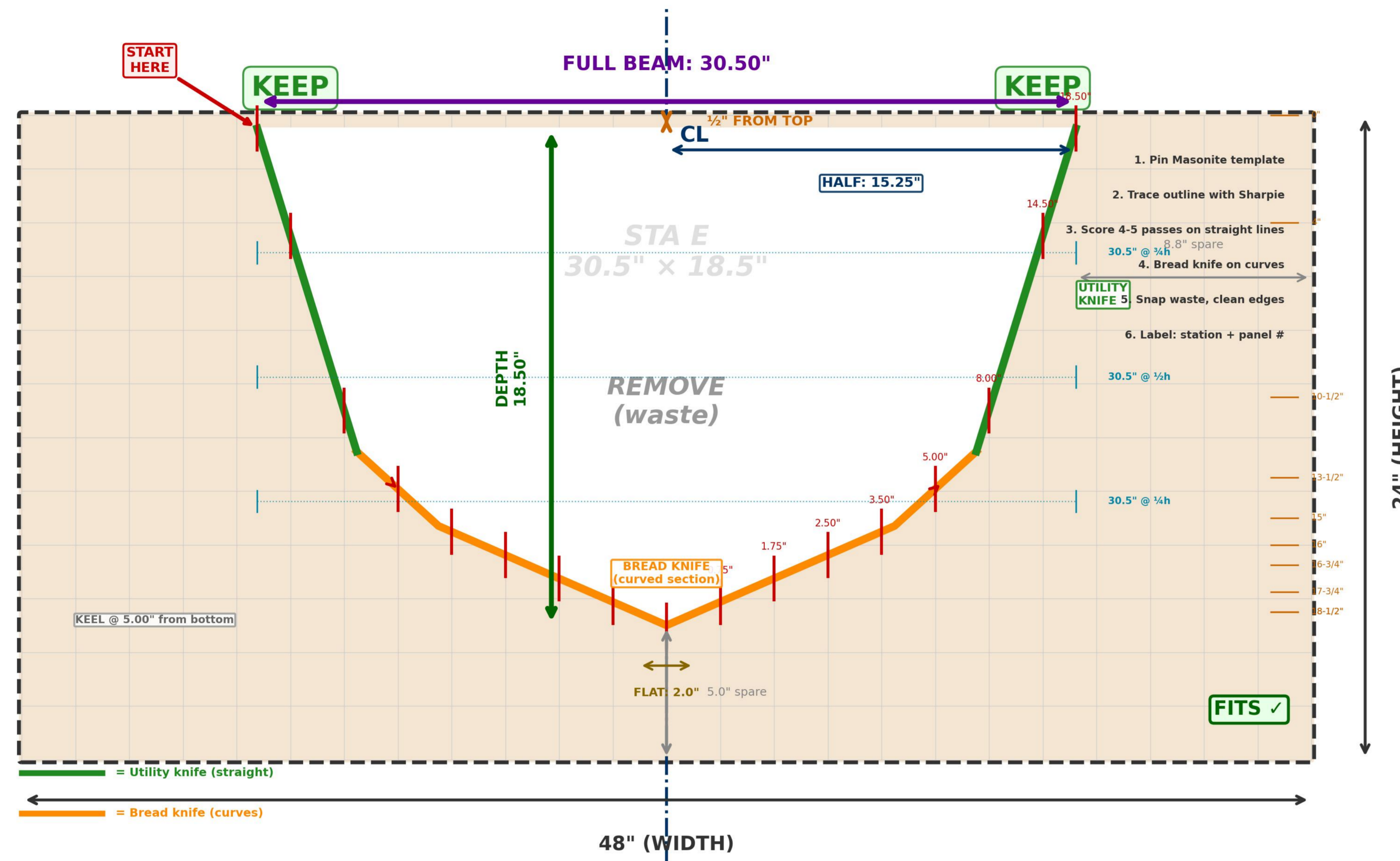
Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 6" block



= 1 BLOCK (Station E)



STATION F

Depth starts decreasing

Position: 30" from midship (156" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 29.50"
 Depth at CL: 18.50"
 Half-Breadth: 14.75"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.02" from bottom
 Spare (bottom): 5.0" below keel
 Spare (width): 9.2" each side
 Block: 6" (4 panels)

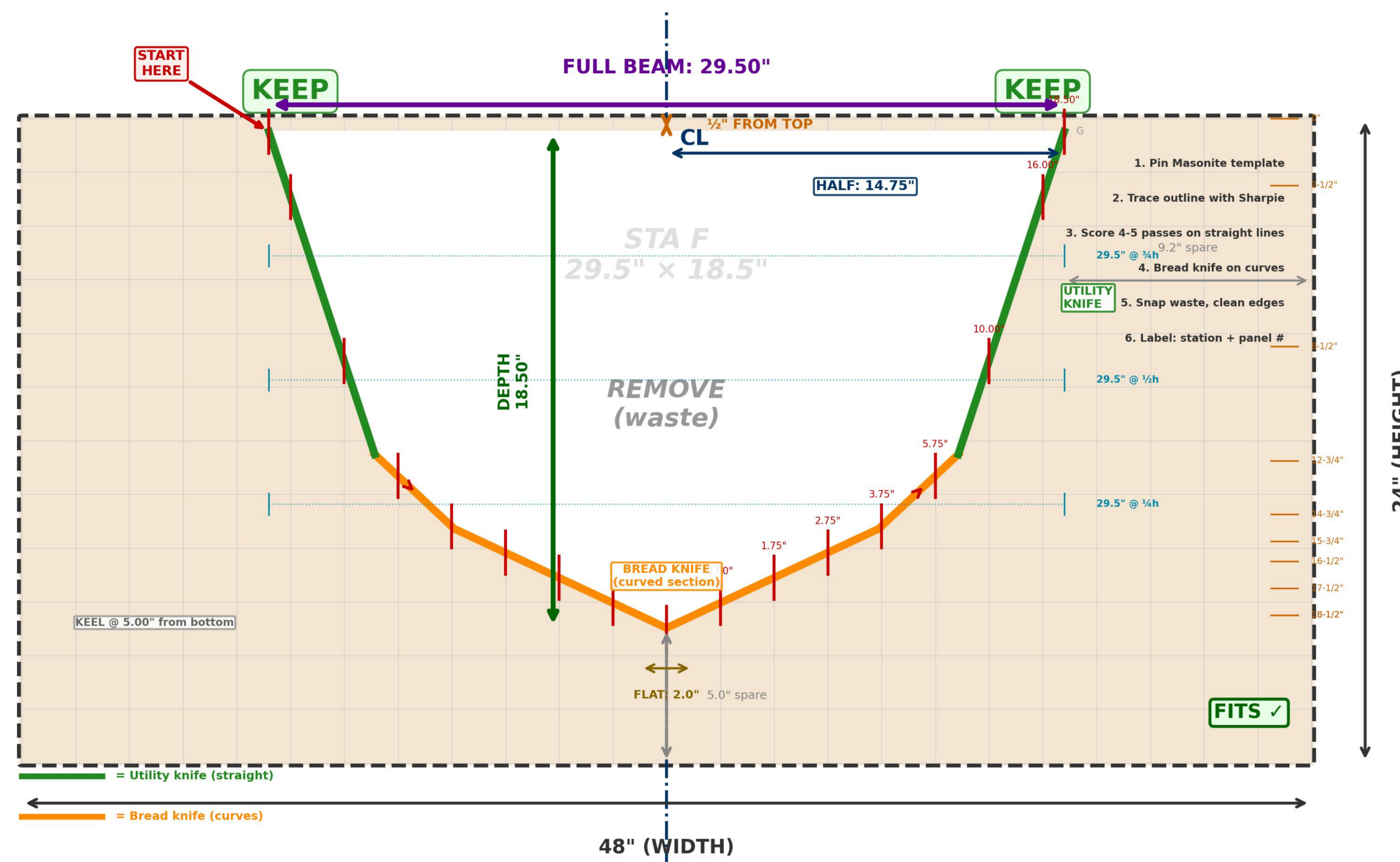
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
4.00"	1.75"
8.00"	3.75"
12.00"	10.00"
14.75"	18.50" (gunwale)

Full coords on template

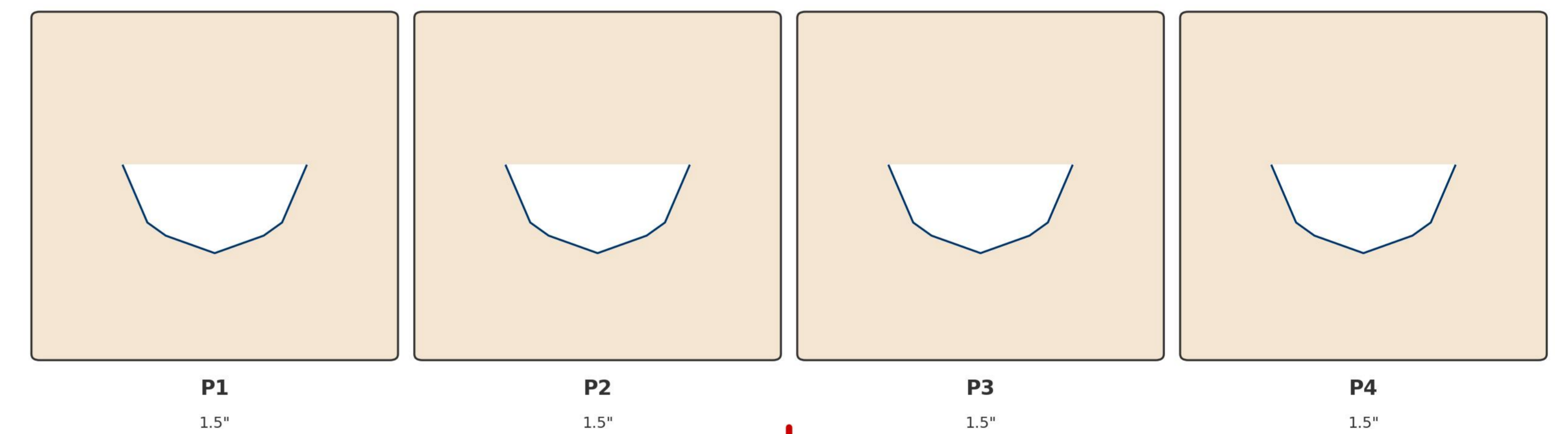
CUTTING METHOD

U-TO-V TRANSITION
 Sides still straight (utility knife).
 Bottom developing V shape -- bread knife needed.
 needed. Angle changes here.

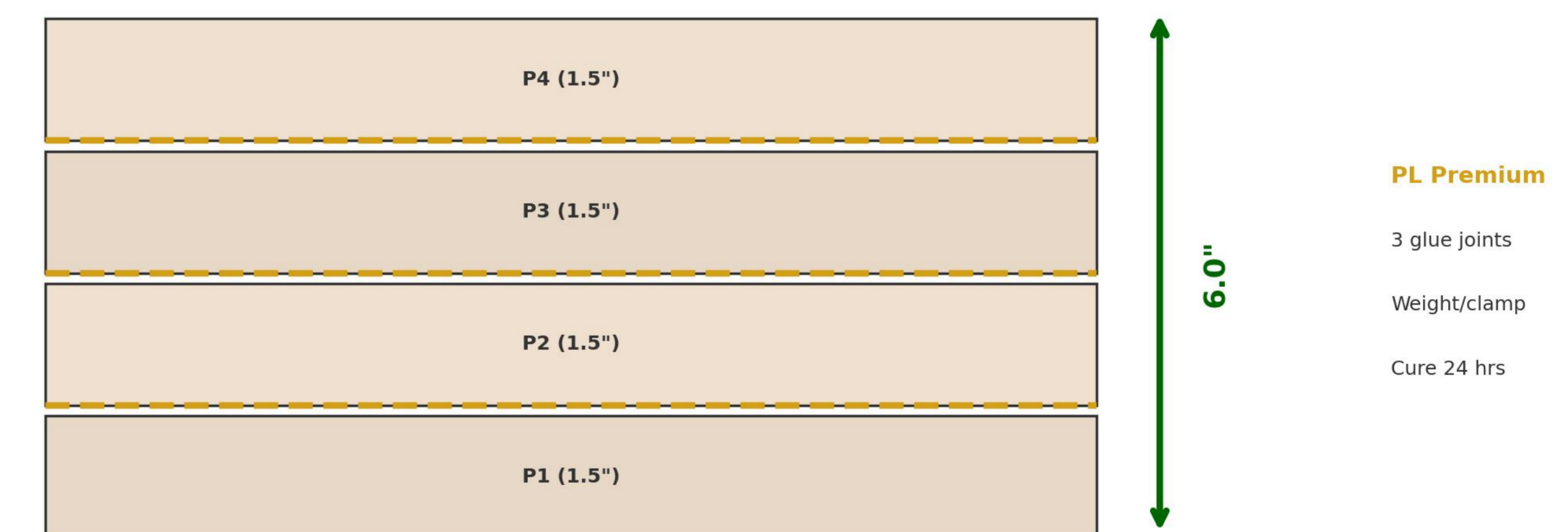


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 6" block



= 1 BLOCK (Station F)

STATION G

V-shape developing

Position: 36" from midship (144" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 28.50"
 Depth at CL: 18.50"
 Half-Breadth: 14.25"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.09" from bottom
 Spare (bottom): 5.1" below keel
 Spare (width): 9.7" each side
 Block: 6" (4 panels)

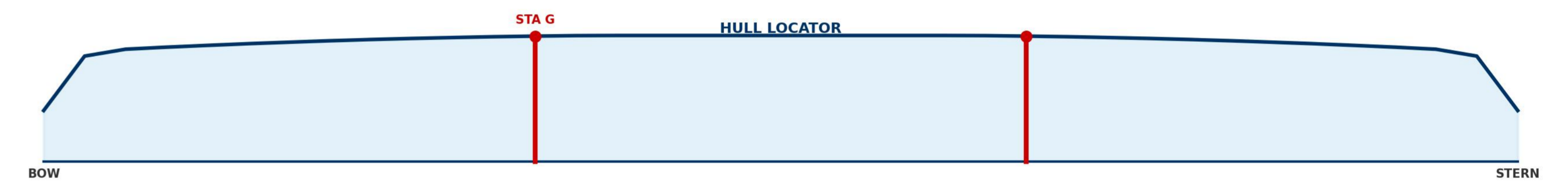
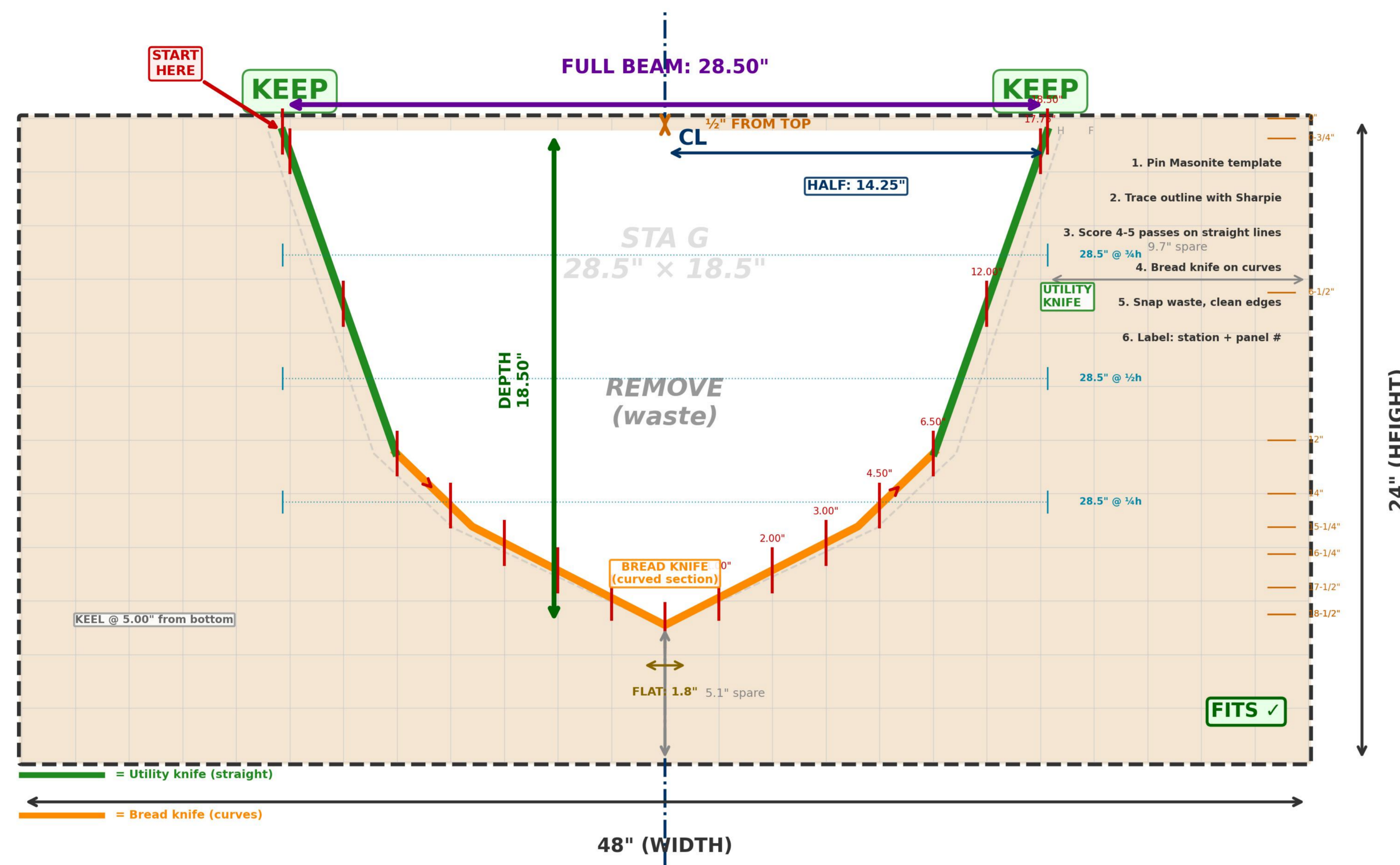
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
4.00"	2.00"
8.00"	4.50"
12.00"	12.00"
14.25"	18.50" (gunwale)

Full coords on template

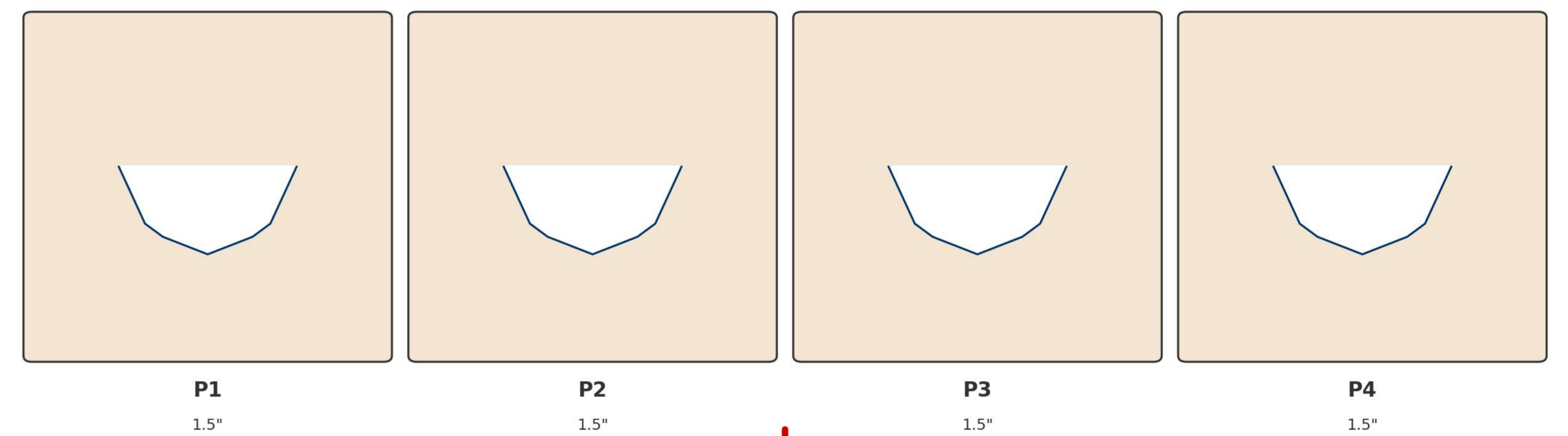
CUTTING METHOD

U-TO-V TRANSITION
 Sides still straight (utility knife).
 Bottom developing V shape -- bread knife needed. Angle changes here.

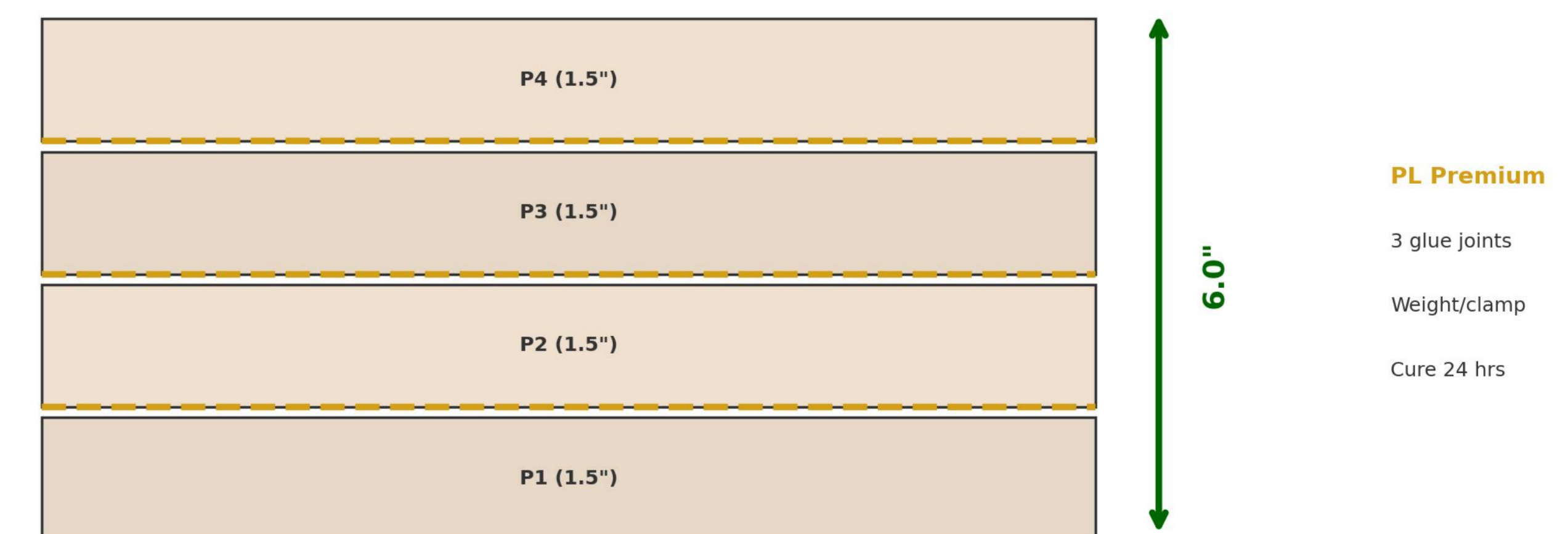


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face -> 6" block



= 1 BLOCK (Station G)

STATION H

Clear V-bottom emerging

Position: 42" from midship (132" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 27.25"
 Depth at CL: 18.25"
 Half-Breadth: 13.75"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.18" from bottom
 Spare (bottom): 5.2" below keel
 Spare (width): 10.4" each side
 Block: 6" (4 panels)

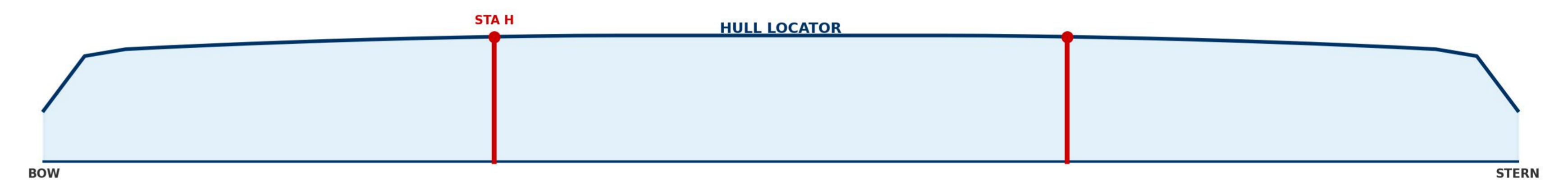
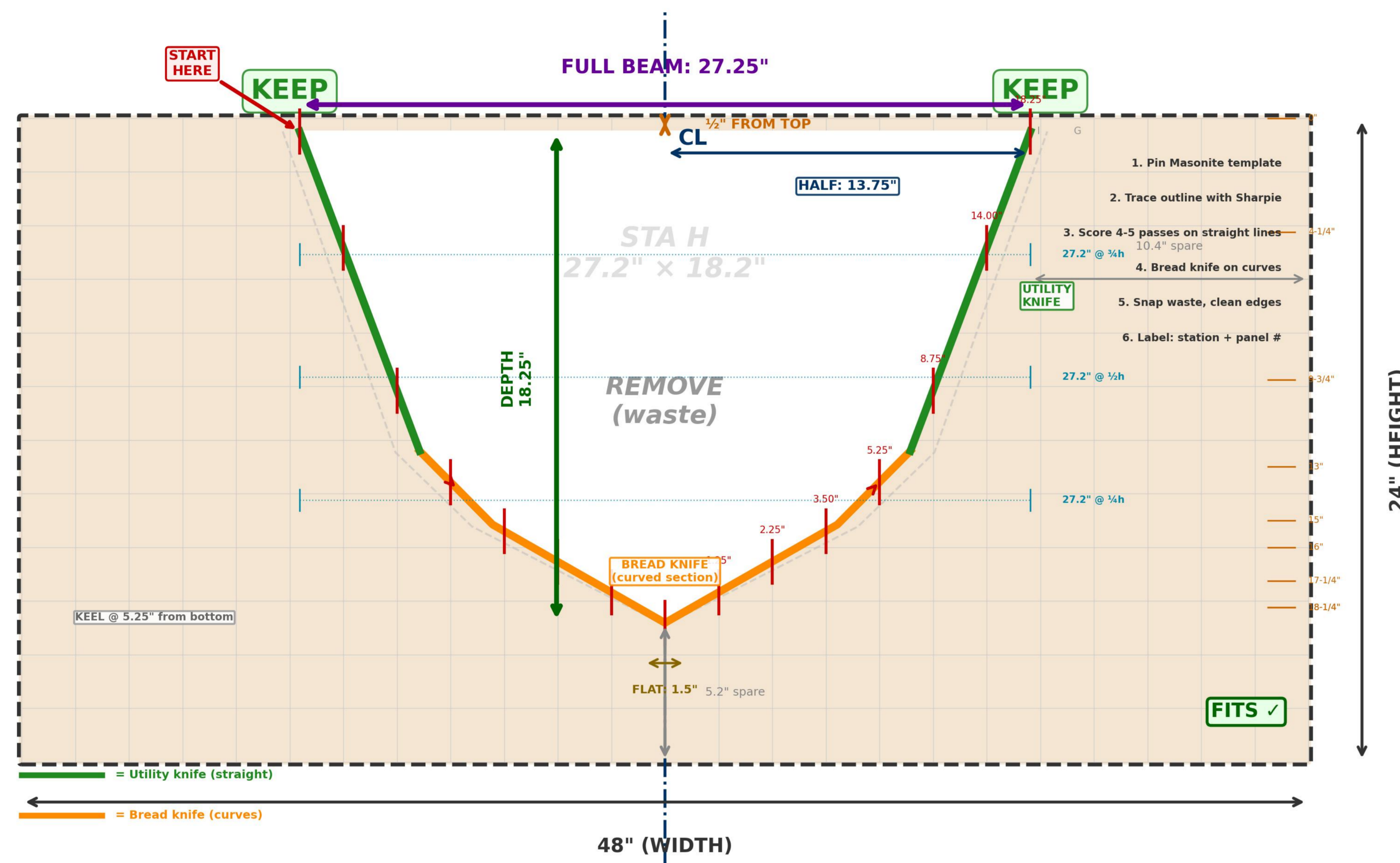
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
4.00"	2.25"
8.00"	5.25"
12.00"	14.00"
13.75"	18.25" (gunwale)

Full coords on template

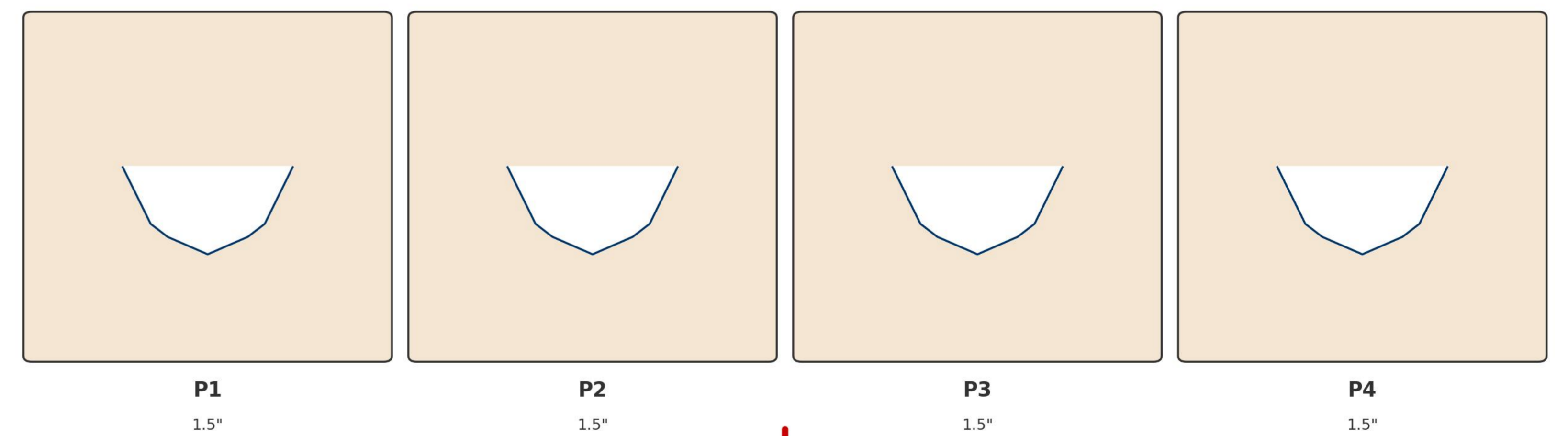
CUTTING METHOD

U-TO-V TRANSITION
 Sides still straight (utility knife).
 Bottom developing V shape -- bread knife needed. Angle changes here.



4-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face -> 6" block



= 1 BLOCK (Station H)

STATION I

Transitional U-to-V

Position: 48" from midship (120" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 25.75"
 Depth at CL: 18.25"
 Half-Breadth: 13.00"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.30" from bottom
 Spare (bottom): 5.3" below keel
 Spare (width): 11.1" each side
 Block: 6" (4 panels)

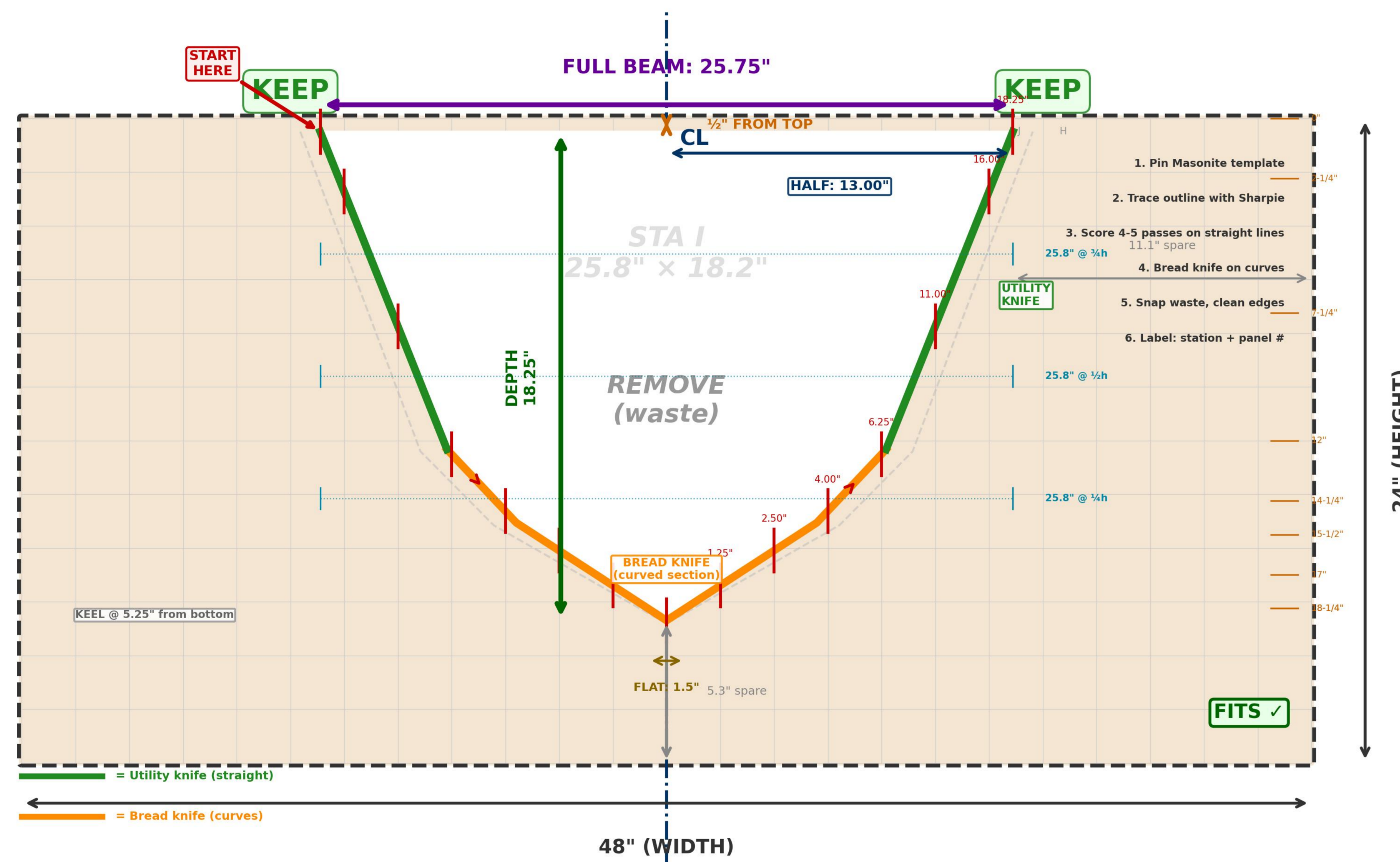
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
4.00"	2.50"
8.00"	6.25"
12.00"	16.00"
13.00"	18.25" (gunwale)

Full coords on template

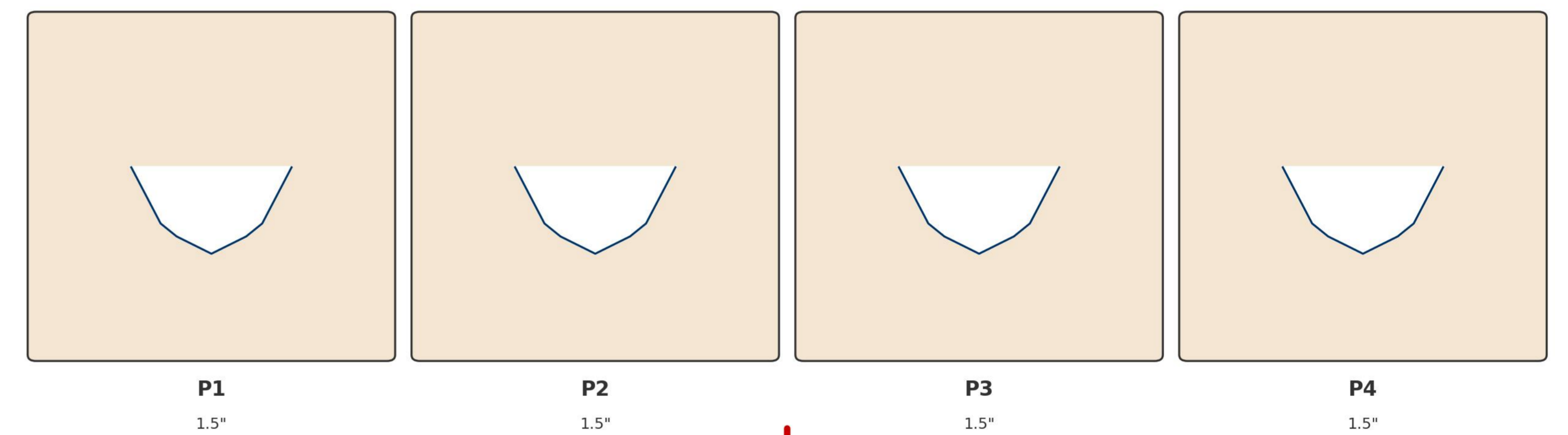
CUTTING METHOD

U-TO-V TRANSITION
 Bottom still has curve (bread knife needed).
 Sides are angled but mostly straight (utility knife). Transitional shape.

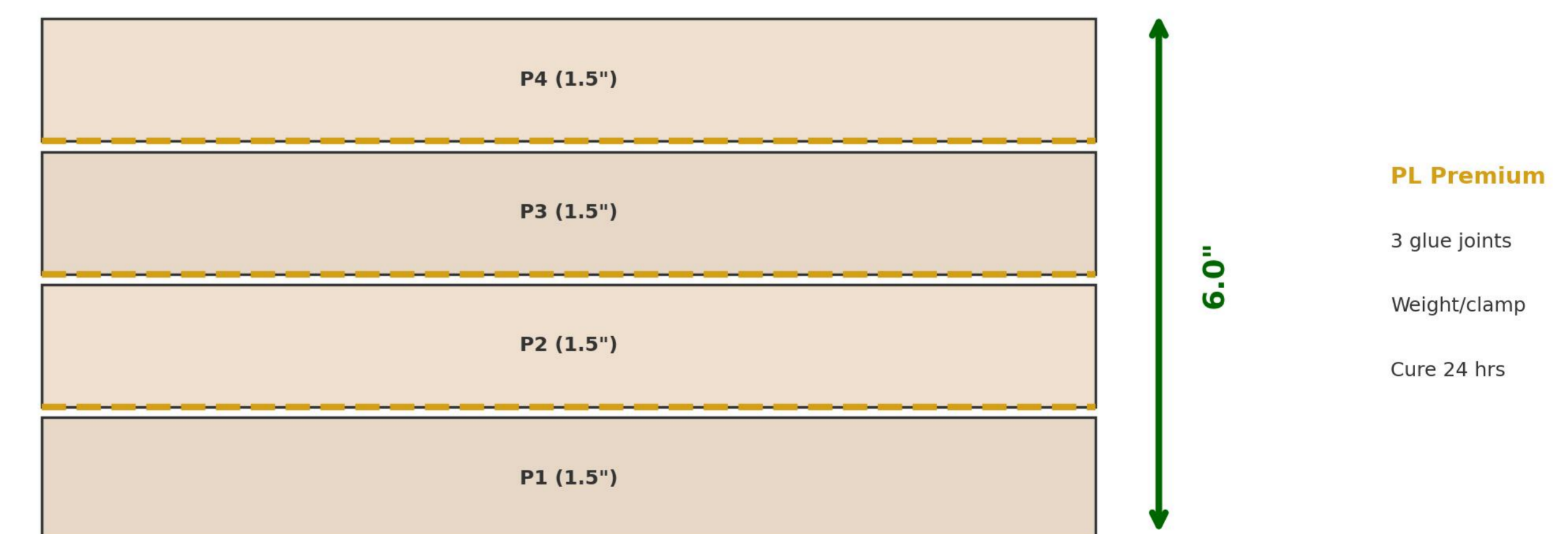


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 6" block



= 1 BLOCK (Station I)

STATION J

More pronounced V

Position: 54" from midship (108" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 24.00"
 Depth at CL: 18.00"
 Half-Breadth: 12.00"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.43" from bottom
 Spare (bottom): 5.4" below keel
 Spare (width): 11.9" each side
 Block: 6" (4 panels)

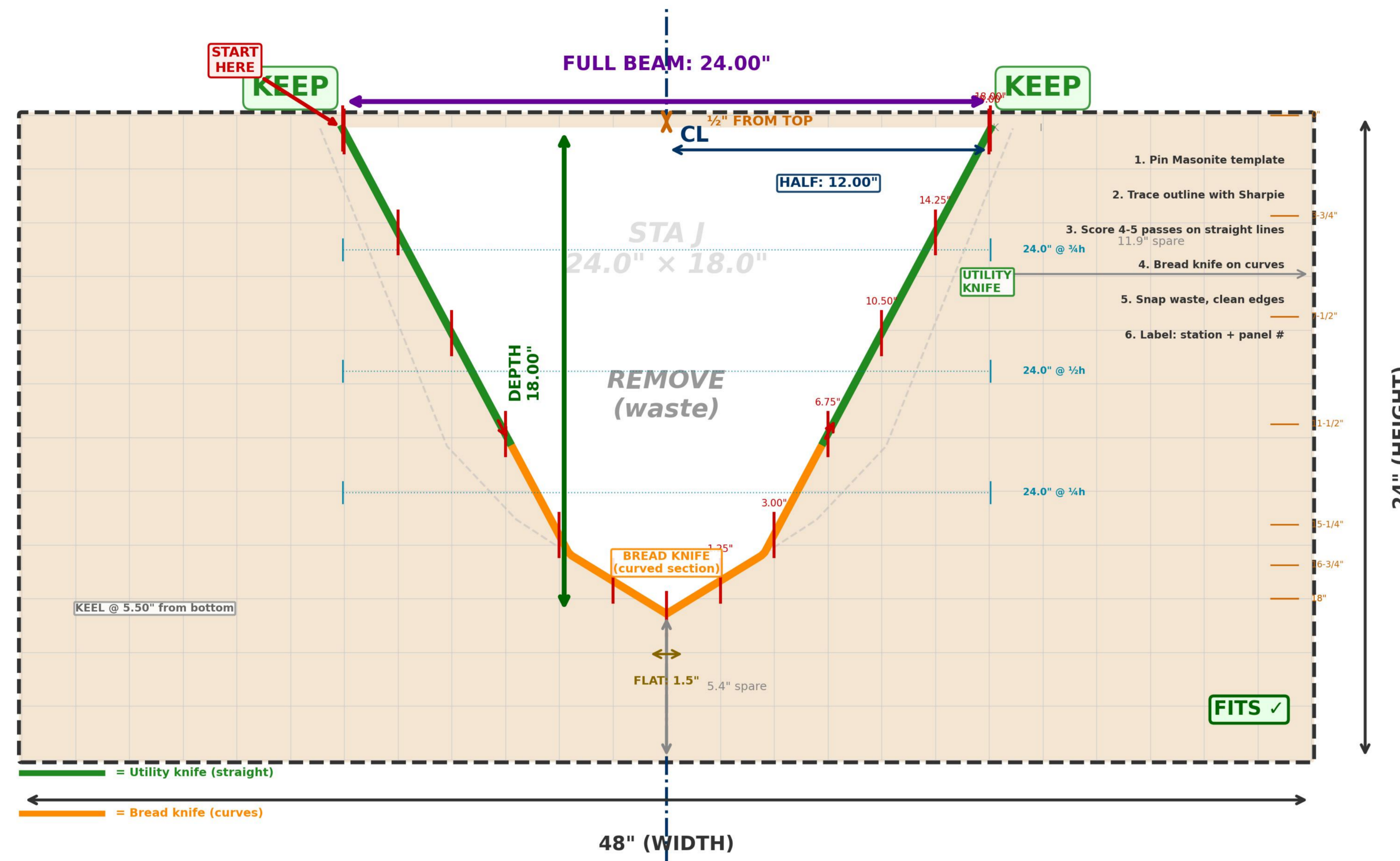
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
4.00"	3.00"
8.00"	10.50"
12.00"	18.00" (gunwale)
12.00"	18.00" (gunwale)

Full coords on template

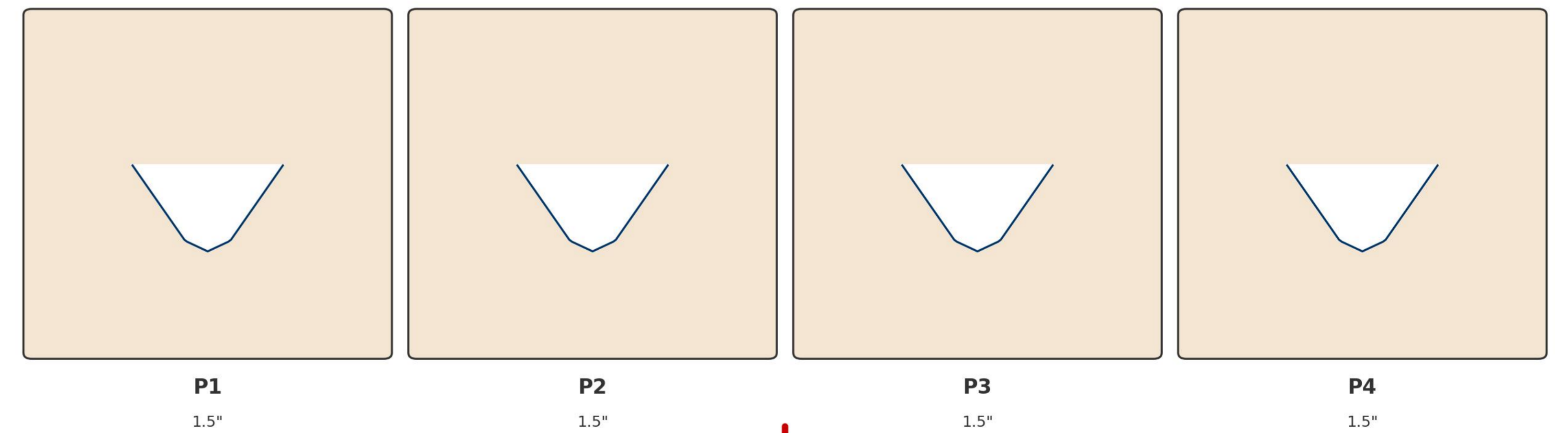
CUTTING METHOD

U-TO-V TRANSITION
 Bottom still has curve (bread knife needed).
 Sides are angled but mostly straight (utility knife). Transitional shape.

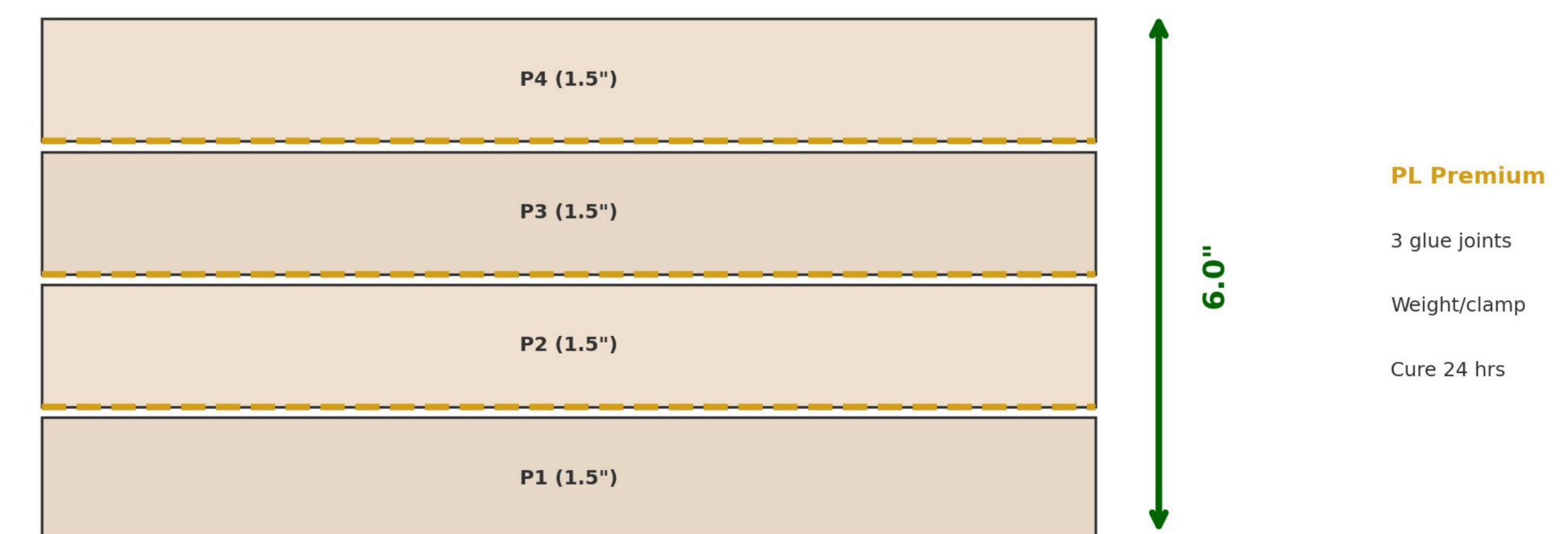


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 6" block



= 1 BLOCK (Station J)

STATION K

V-shape dominant

Position: 60" from midship (96" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 22.25"
 Depth at CL: 18.00"
 Half-Breadth: 11.25"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.59" from bottom
 Spare (bottom): 5.6" below keel
 Spare (width): 12.9" each side
 Block: 6" (4 panels)

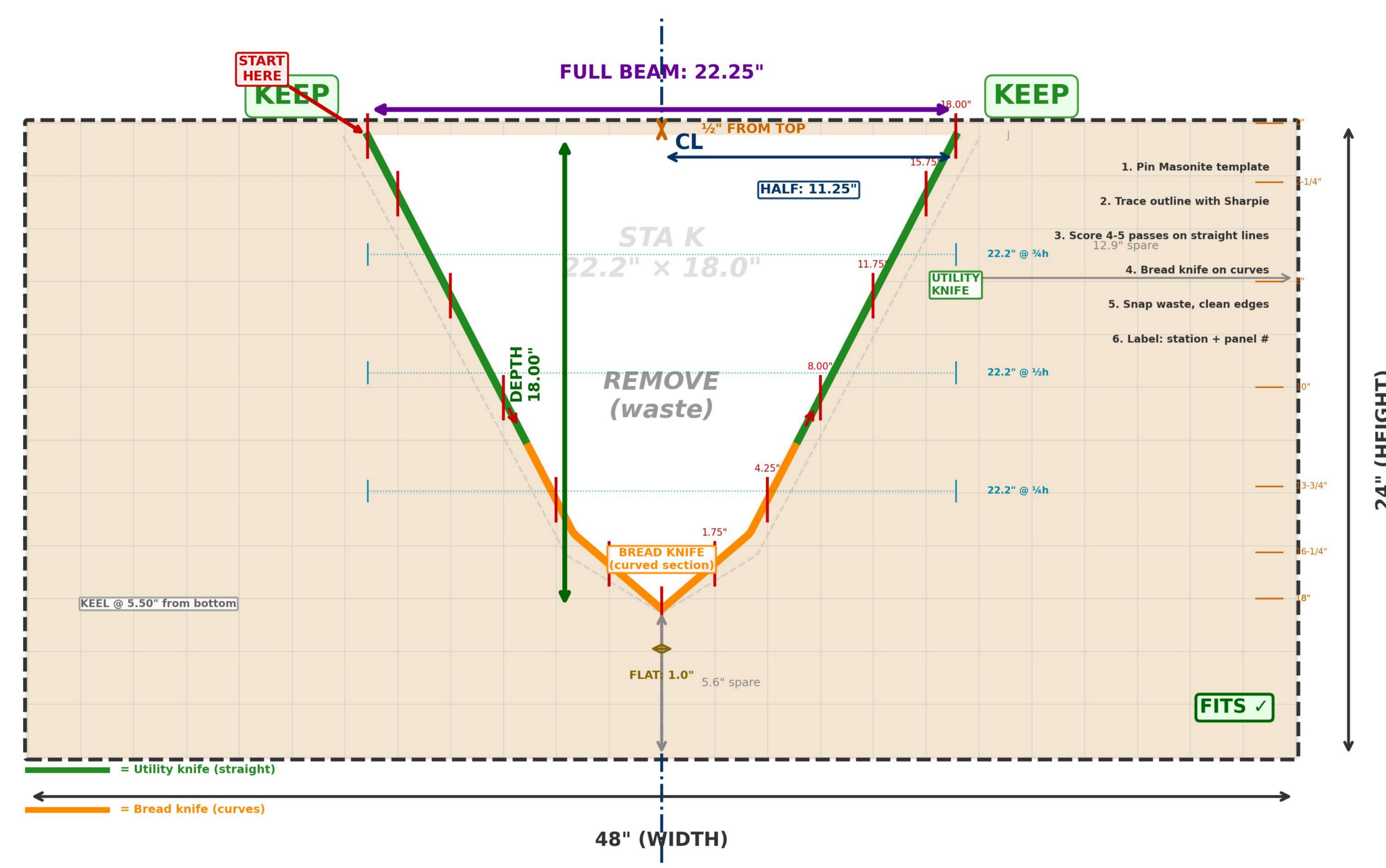
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
2.00"	1.75"
6.00"	8.00"
10.00"	15.75"
11.25"	18.00" (gunwale)

Full coords on template

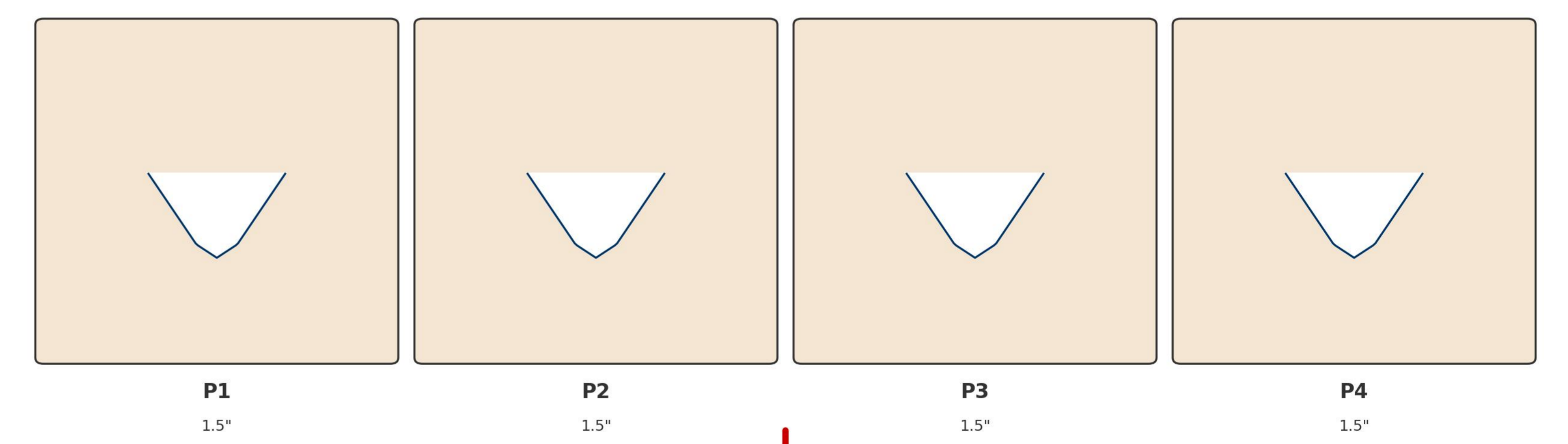
CUTTING METHOD

U-TO-V TRANSITION
 Bottom still has curve (bread knife needed).
 Sides are angled but mostly straight (utility knife). Transitional shape.

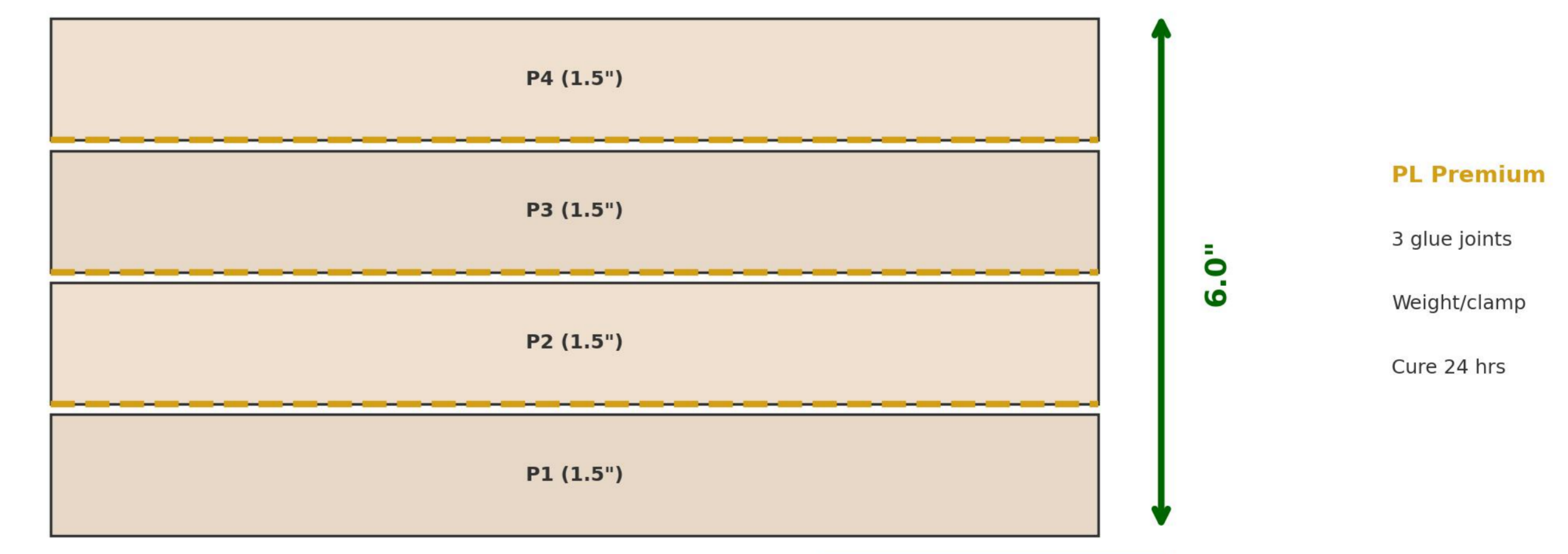


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face -> 6" block



= 1 BLOCK (Station K)

STATION L

Narrow V

Position: 66" from midship (84" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 20.25"
 Depth at CL: 17.75"
 Half-Breadth: 10.00"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.77" from bottom
 Spare (bottom): 5.8" below keel
 Spare (width): 13.9" each side
 Block: 6" (4 panels)

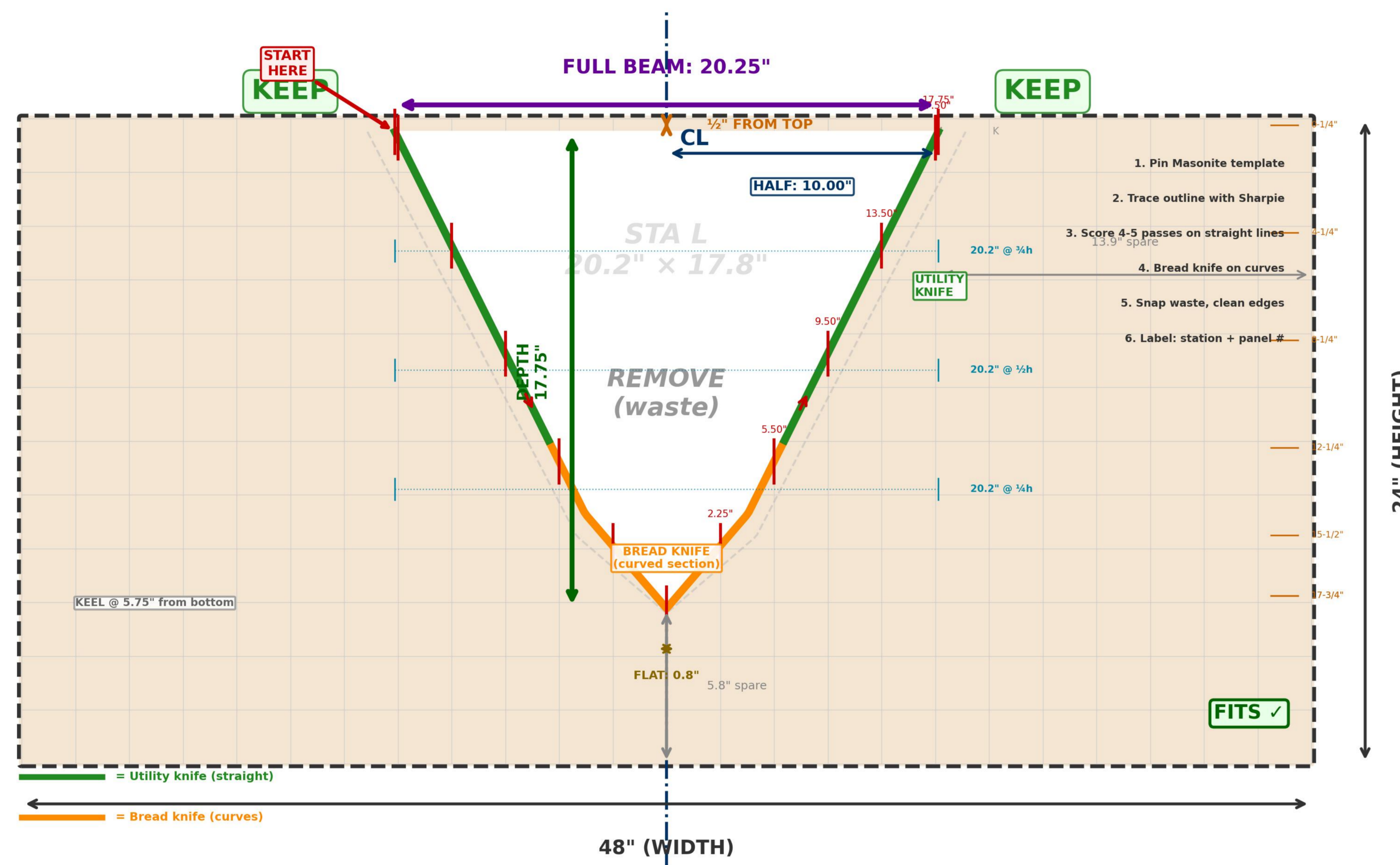
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
2.00"	2.25"
6.00"	9.50"
10.00"	17.50" (gunwale)
10.00"	17.75" (gunwale)

Full coords on template

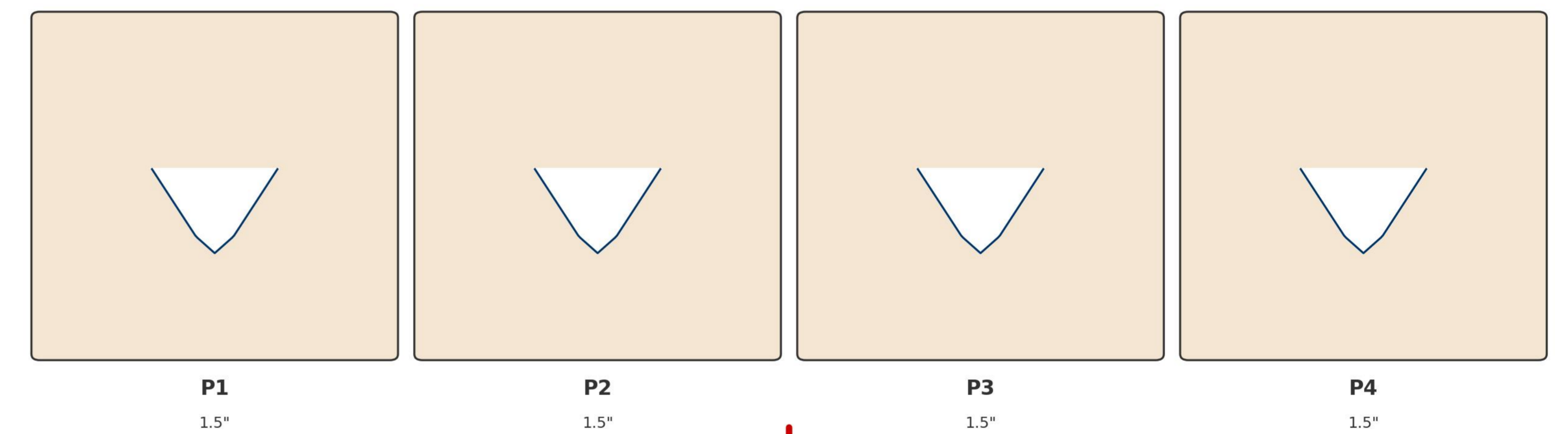
CUTTING METHOD

SHALLOW V
 Almost a V but slight curve at bottom.
 Utility knife for sides. Bread knife or utility knife for bottom — your call.

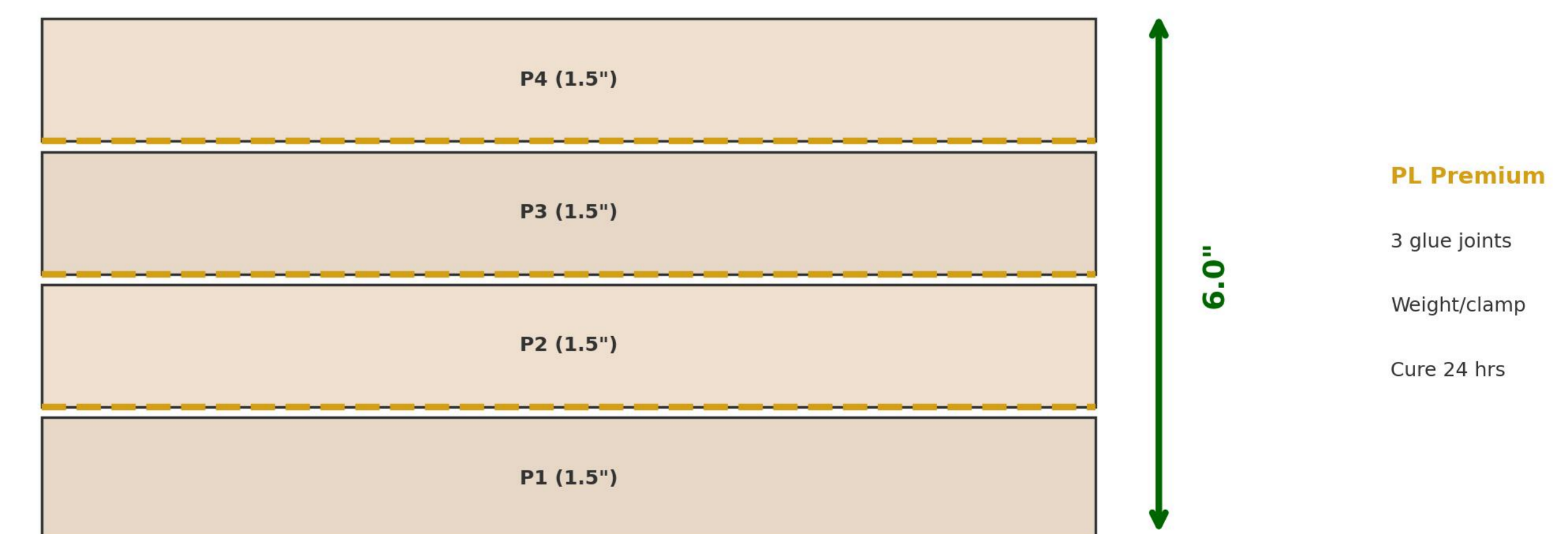


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 6" block



= 1 BLOCK (Station L)

STATION M

Sharp V, narrow

Position: 72" from midship (72" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 18.00"
 Depth at CL: 17.50"
 Half-Breadth: 9.00"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 5.98" from bottom
 Spare (bottom): 6.0" below keel
 Spare (width): 15.0" each side
 Block: 6" (4 panels)

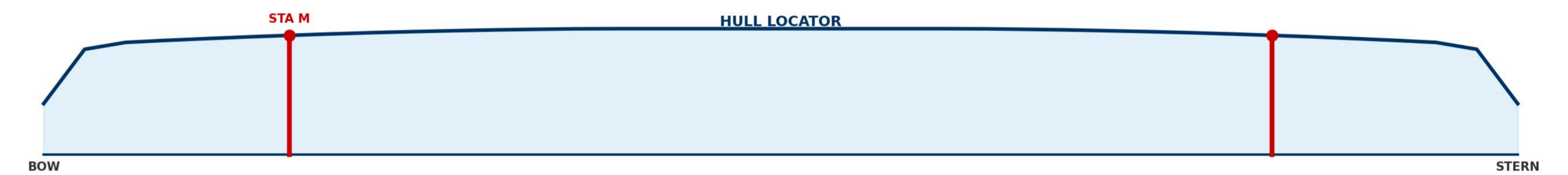
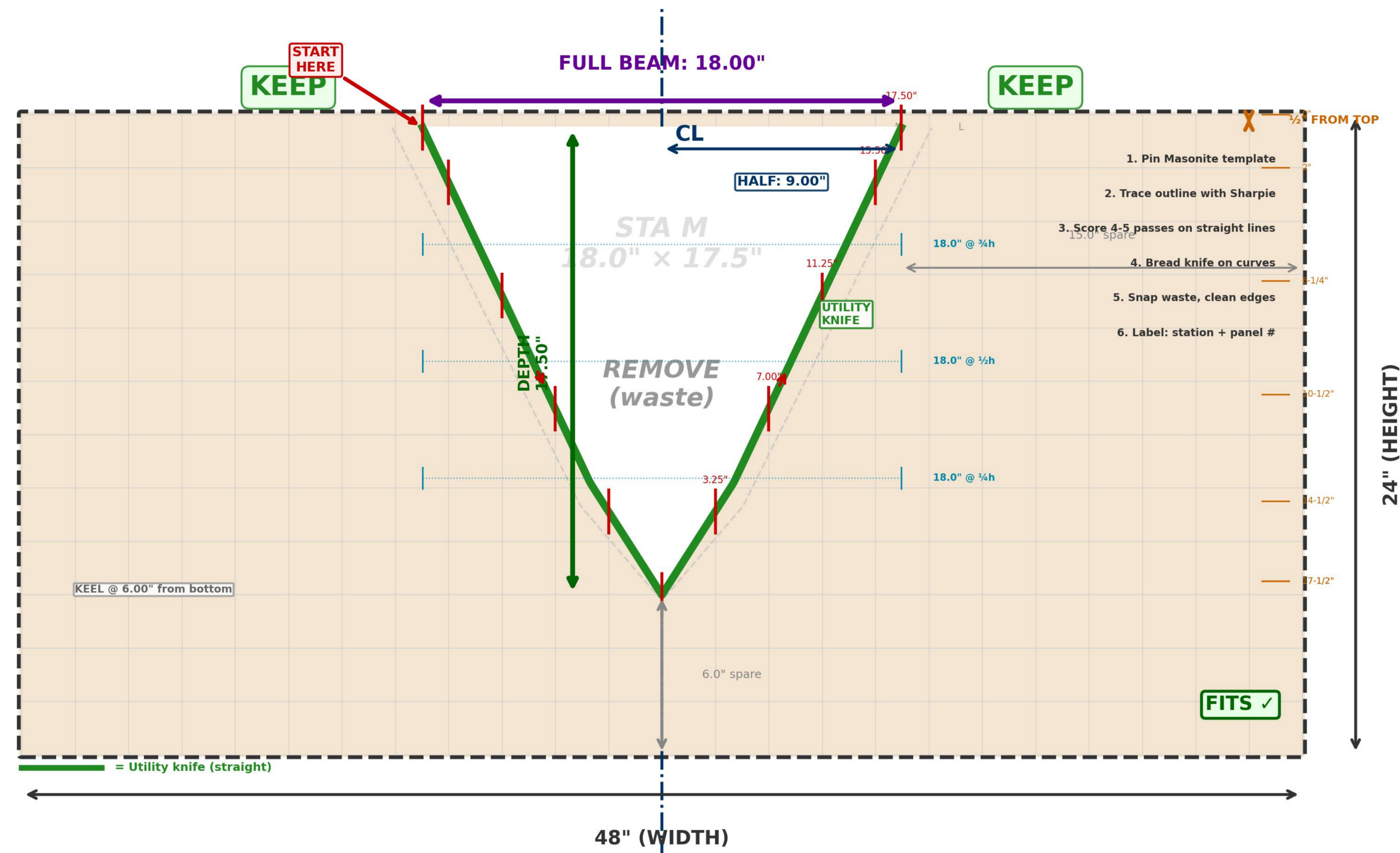
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
2.00"	3.25"
6.00"	11.25"
8.00"	15.50"
9.00"	17.50" (gunwale)

Full coords on template

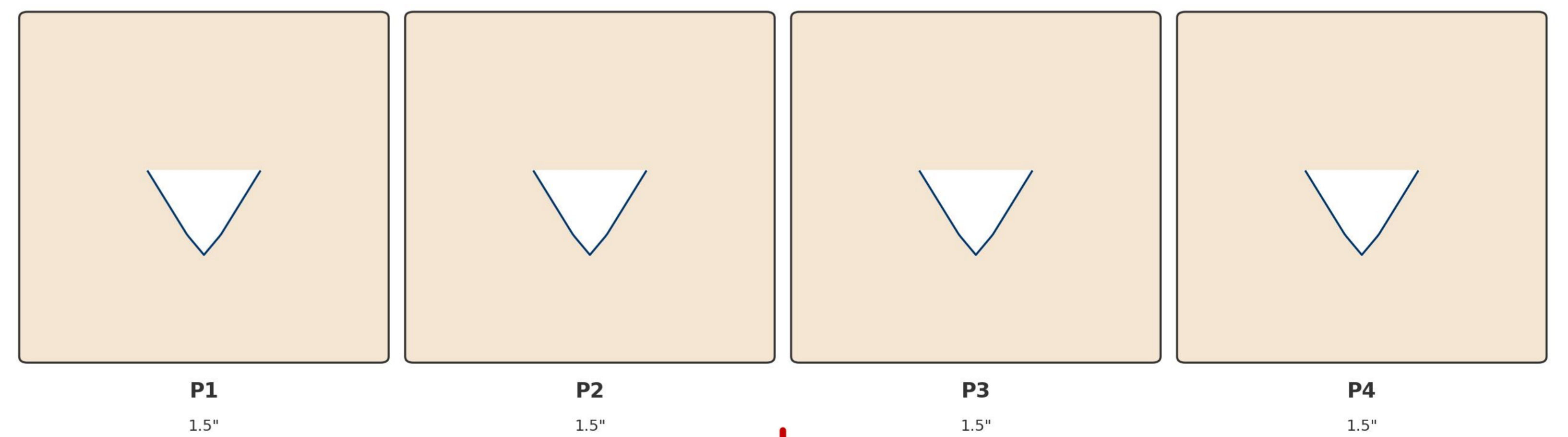
CUTTING METHOD

NARROW V
 Score both angled lines deeply (4-5 passes).
 Snap waste piece out. Clean up with bread knife.

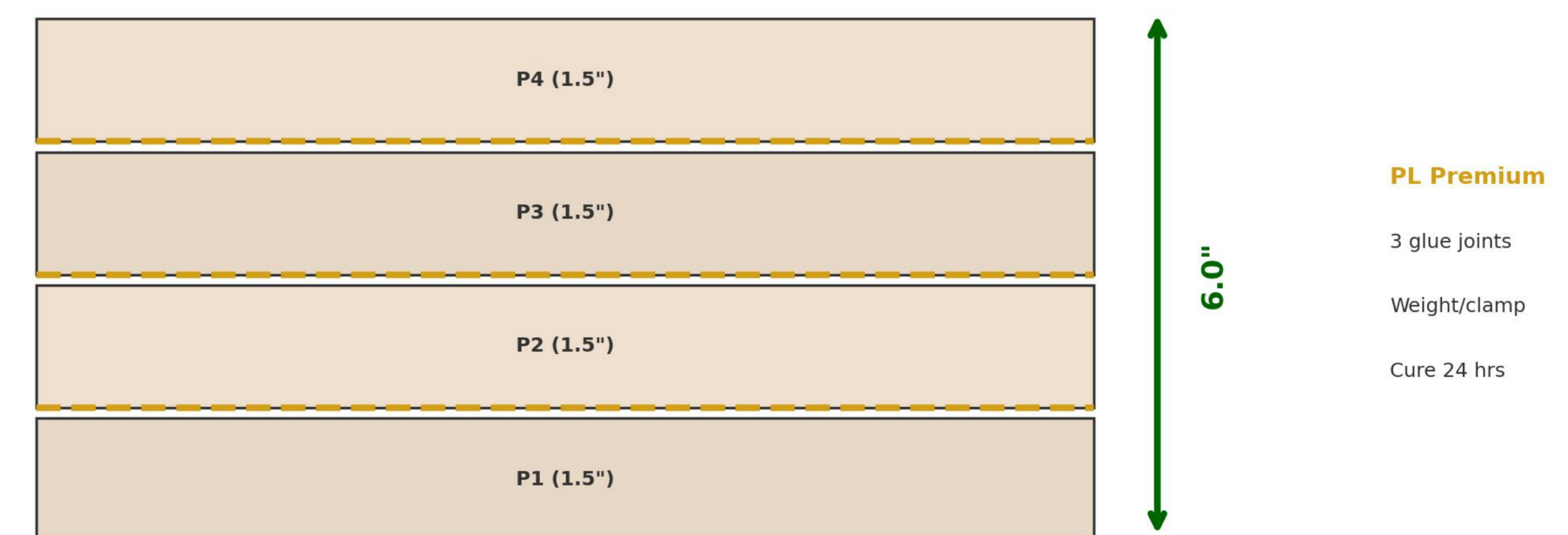


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 6" block



= 1 BLOCK (Station M)

PL Premium
 3 glue joints
 Weight/clamp
 Cure 24 hrs

STATION N

Very narrow

Position: 78" from midship (60" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 15.50"
 Depth at CL: 17.25"
 Half-Breadth: 7.75"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 6.20" from bottom
 Spare (bottom): 6.2" below keel
 Spare (width): 16.3" each side
 Block: 6" (4 panels)

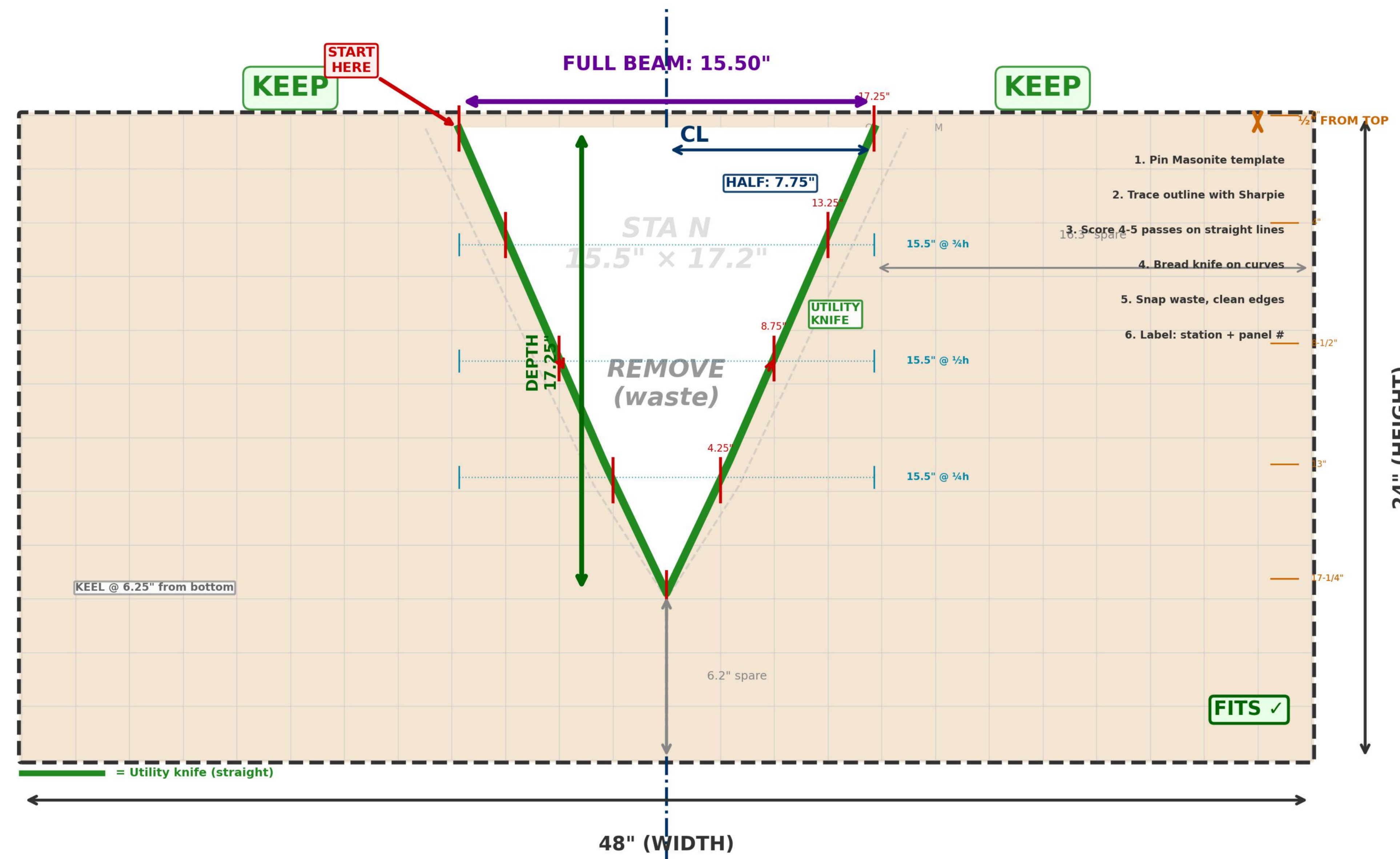
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
2.00"	4.25"
4.00"	8.75"
6.00"	13.25"
7.75"	17.25" (gunwale)

Full coords on template

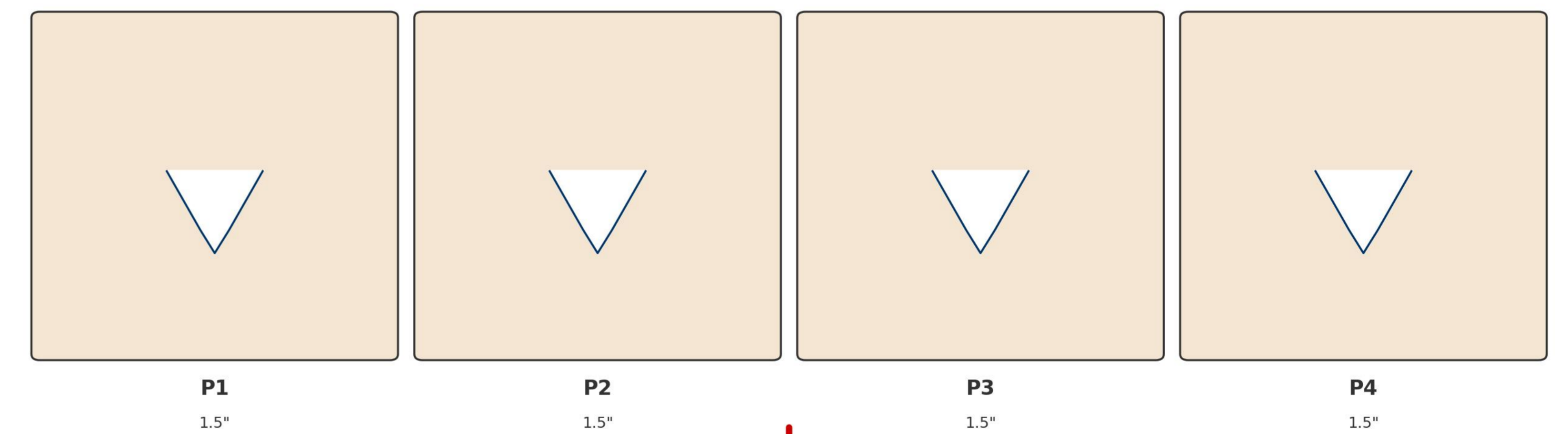
CUTTING METHOD

NARROW V
 Score both angled lines deeply (4-5 passes).
 Snap waste piece out. Clean up with bread knife.

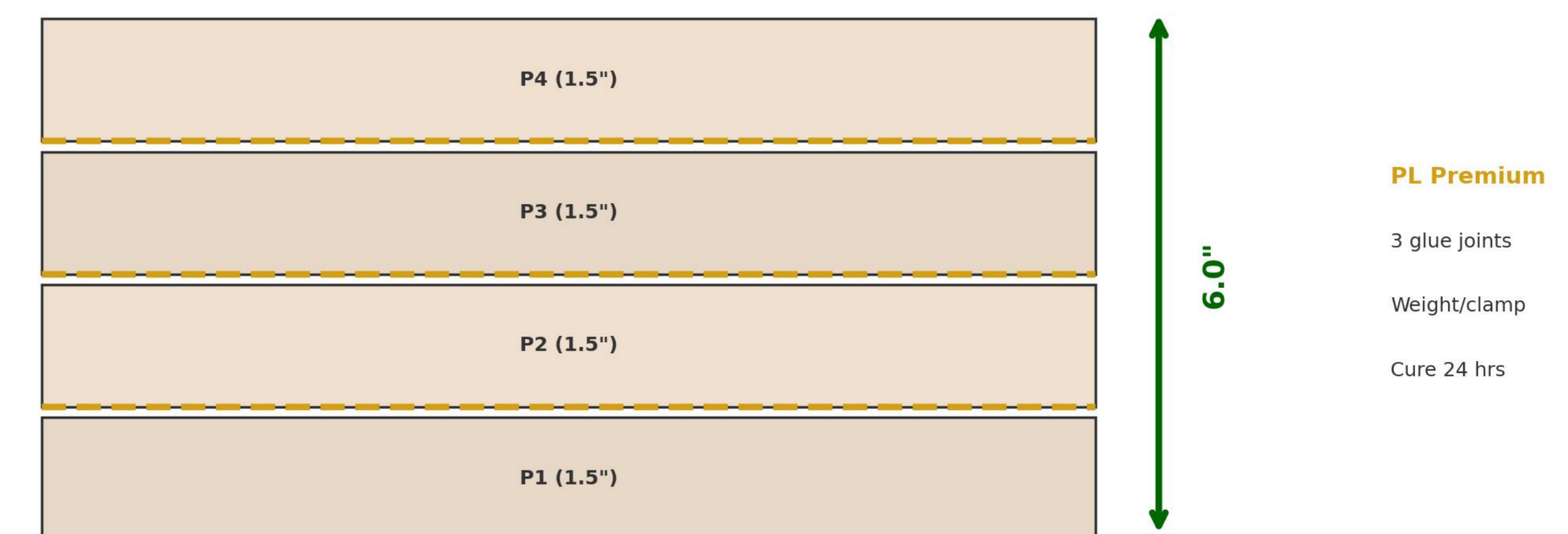


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 6" block



= 1 BLOCK (Station N)

STATION 0

Near-bow section

Position: 84" from midship (48" remaining each side)
 Prepare: 8 panels total (4/block x 2 blocks)

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 12.75"
 Depth at CL: 17.00"
 Half-Breadth: 6.50"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 6.45" from bottom
 Spare (bottom): 6.4" below keel
 Spare (width): 17.6" each side
 Block: 6" (4 panels)

KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
2.00"	5.25"
4.00"	10.75"
6.00"	16.00" (gunwale)
6.50"	17.00" (gunwale)

Full coords on template

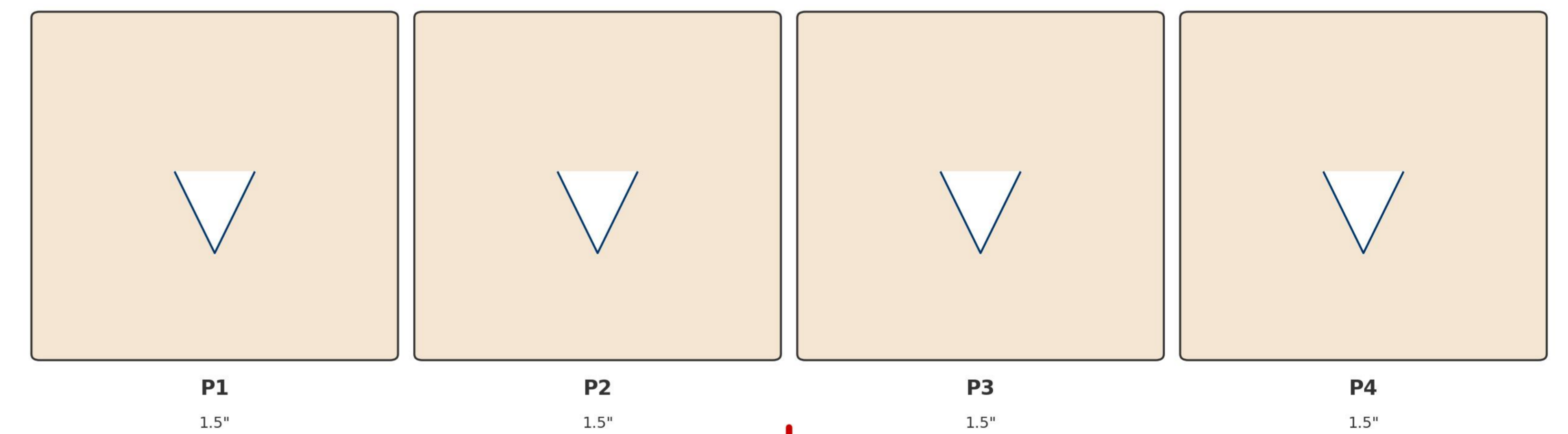
CUTTING METHOD

NARROW V
 Score both angled lines deeply (4-5 passes).
 Snap waste piece out. Clean up with bread knife.

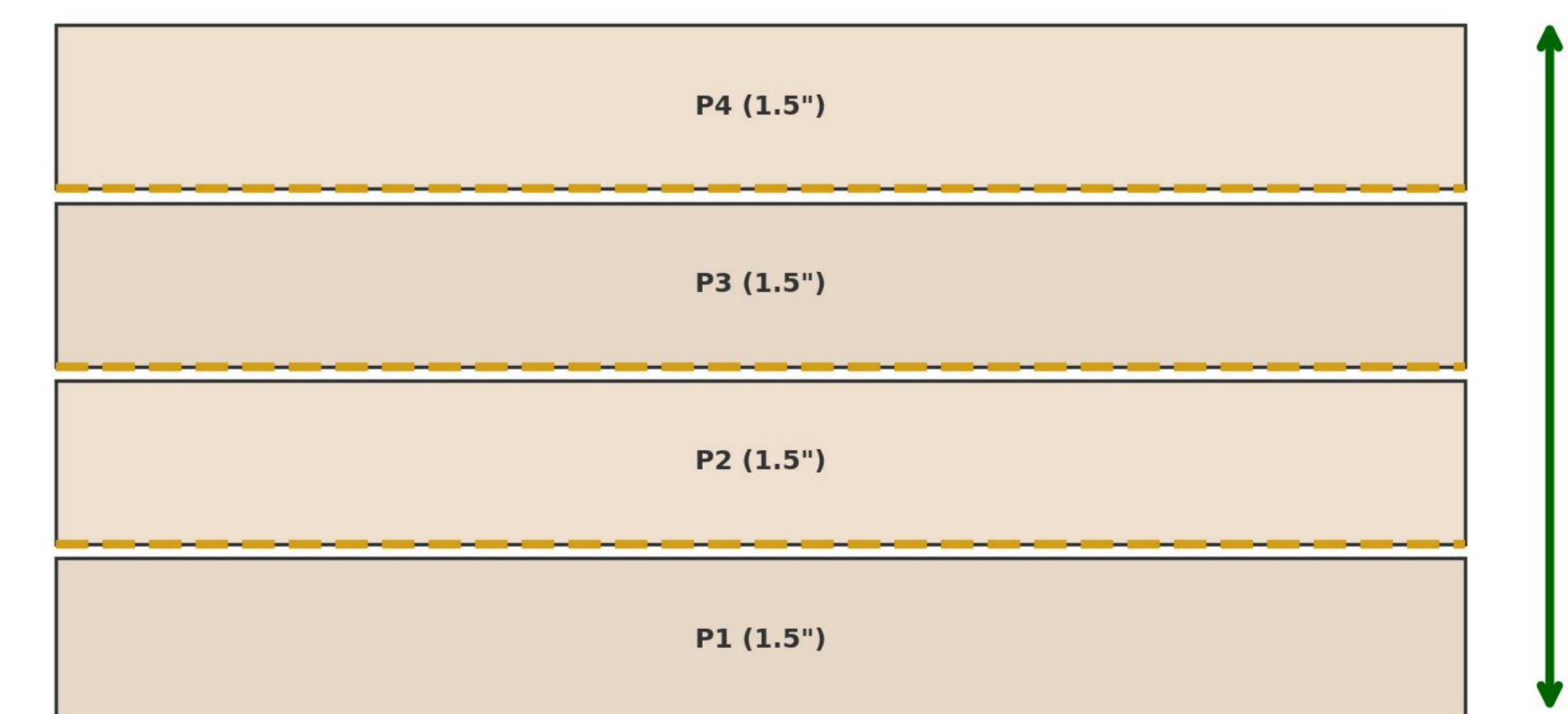


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife

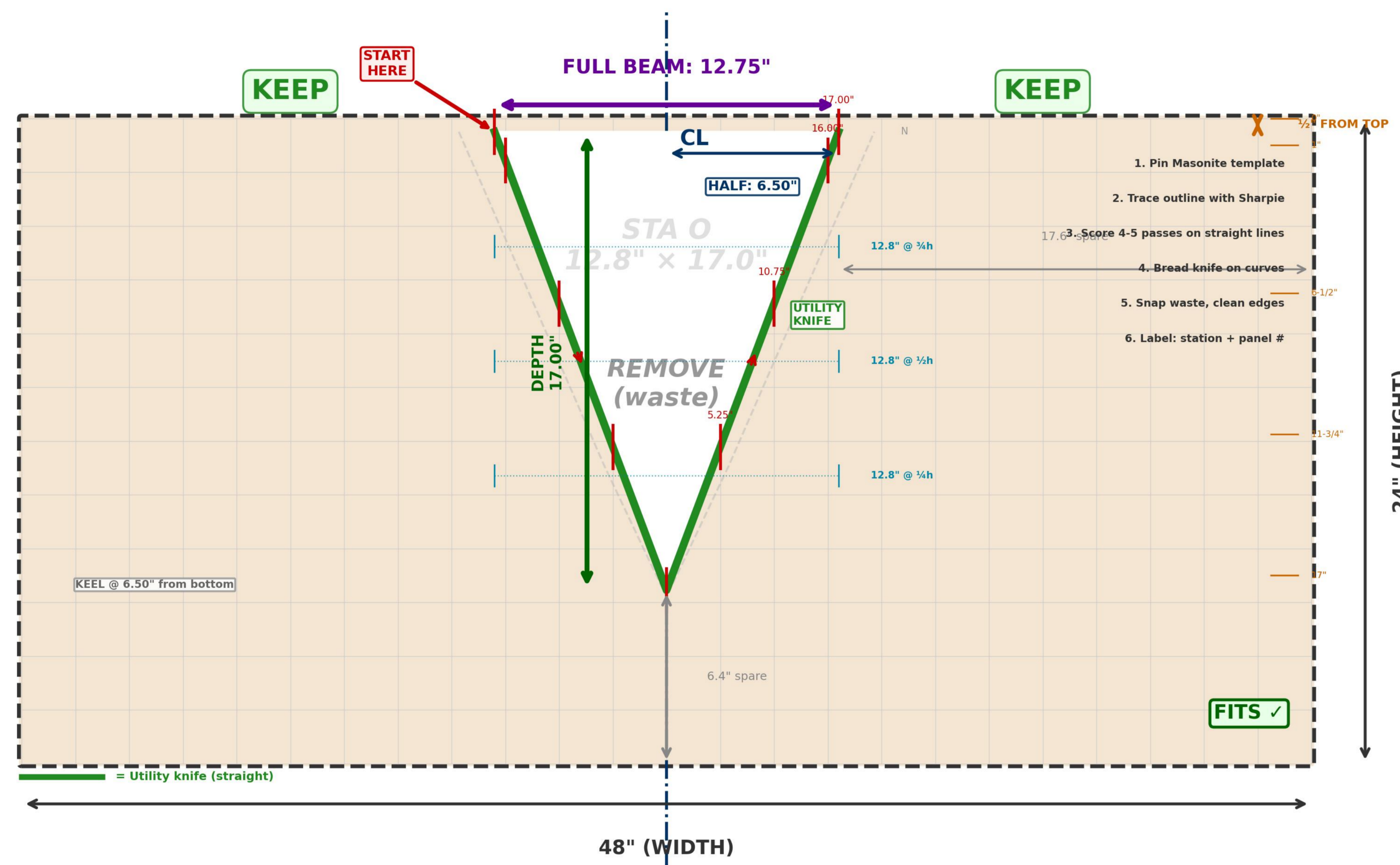


Step 2: Glue face-to-face → 6" block



PL Premium
 3 glue joints
 Weight/clamp
 Cure 24 hrs

= 1 BLOCK (Station 0)



STATION P

Fine entry — BULKHEAD HERE

Position: 90" from midship (36" remaining each side)
 Prepare: 8 panels total (4/block × 2 blocks)

CUT 8 PANELS (2 blocks, bow + stern)

DIMENSIONS

Full Beam: 10.00"
 Depth at CL: 16.75"
 Half-Breadth: 5.00"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 6.71" from bottom
 Spare (bottom): 6.7" below keel
 Spare (width): 19.0" each side
 Block: 6" (4 panels)

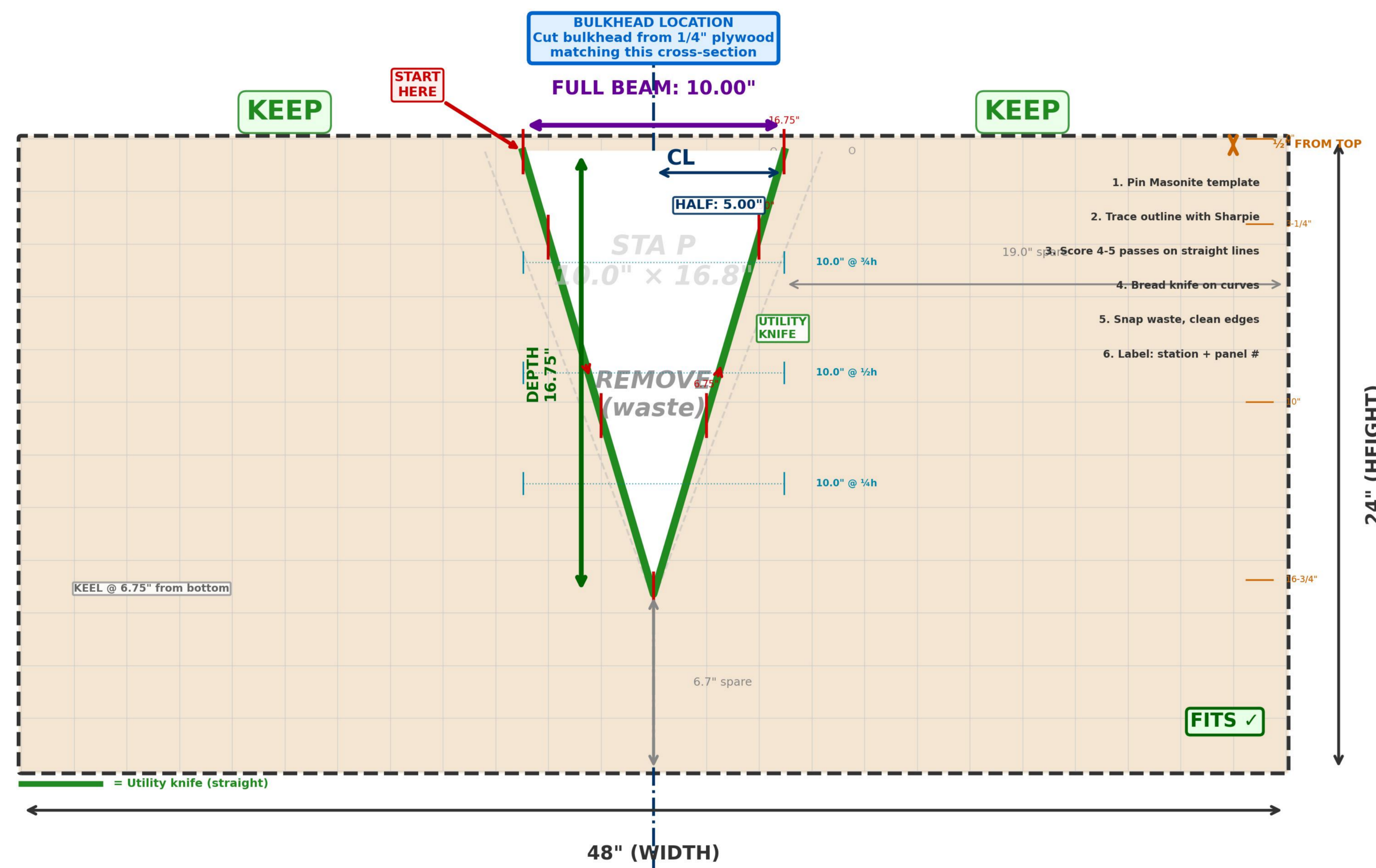
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
2.00"	6.75"
4.00"	13.50"
5.00"	16.75" (gunwale)

Full coords on template

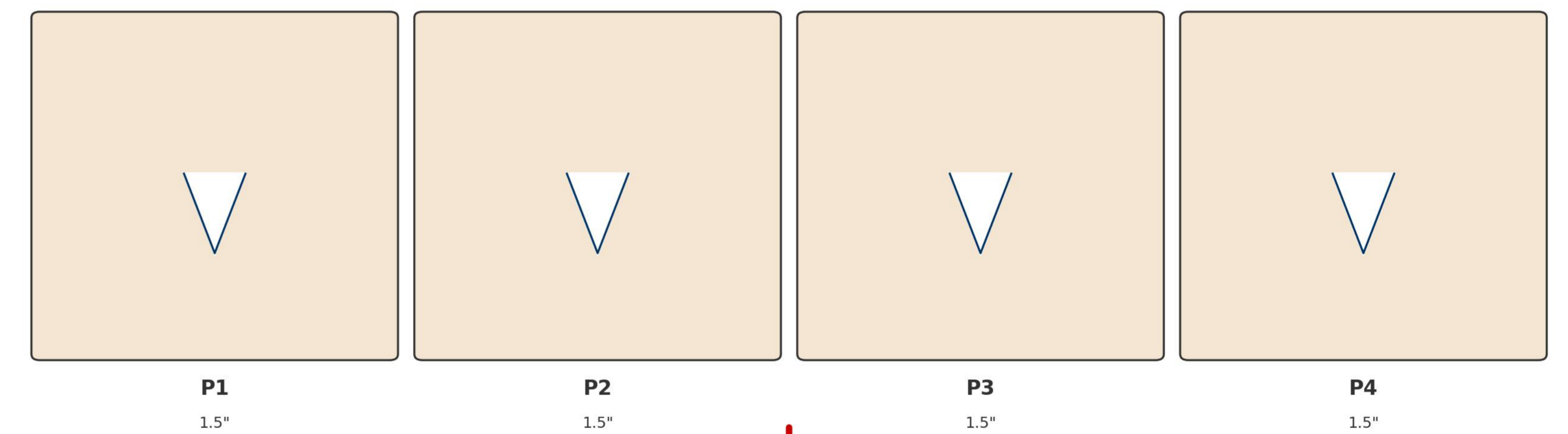
CUTTING METHOD

NARROW V
 Score both angled lines deeply (4-5 passes).
 Snap waste piece out. Clean up with bread knife.

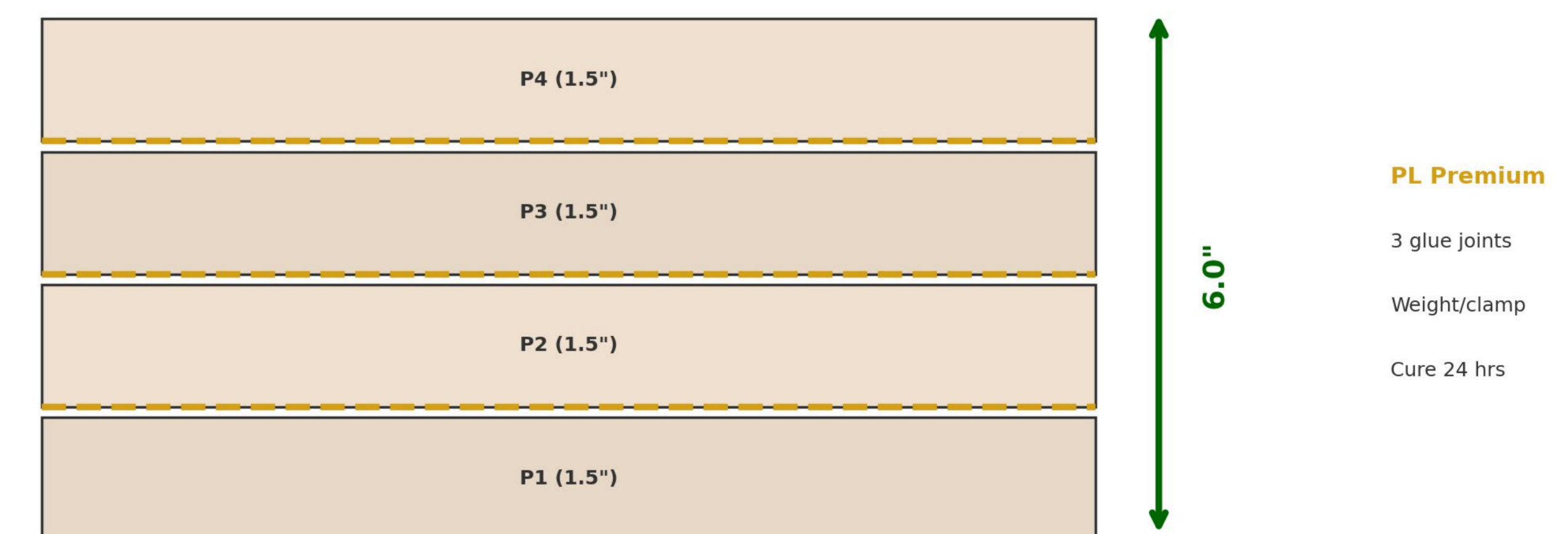


4-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 6" block



= 1 BLOCK (Station P)

STATION Q

Almost keel-only (3" block)

Position: 96" from midship (24" remaining each side)
 Prepare: 4 panels total (2/block x 2 blocks)

CUT 4 PANELS (2 blocks x 2 panels, 3" blocks)

DIMENSIONS

Full Beam: 6.75"
 Depth at CL: 16.50"
 Half-Breadth: 3.50"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 7.01" from bottom
 Spare (bottom): 7.0" below keel
 Spare (width): 20.6" each side
 Block: 3" (2 panels)

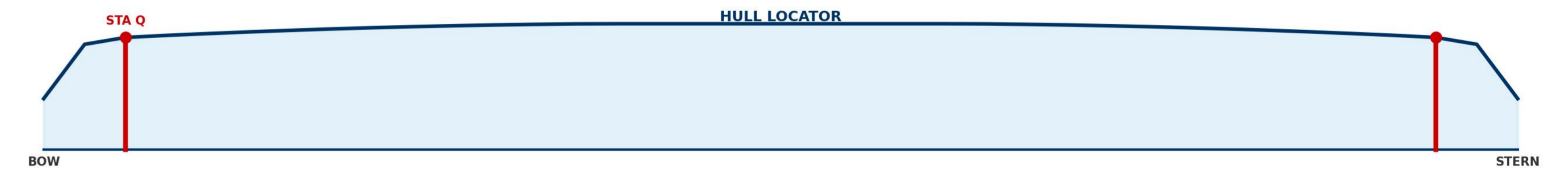
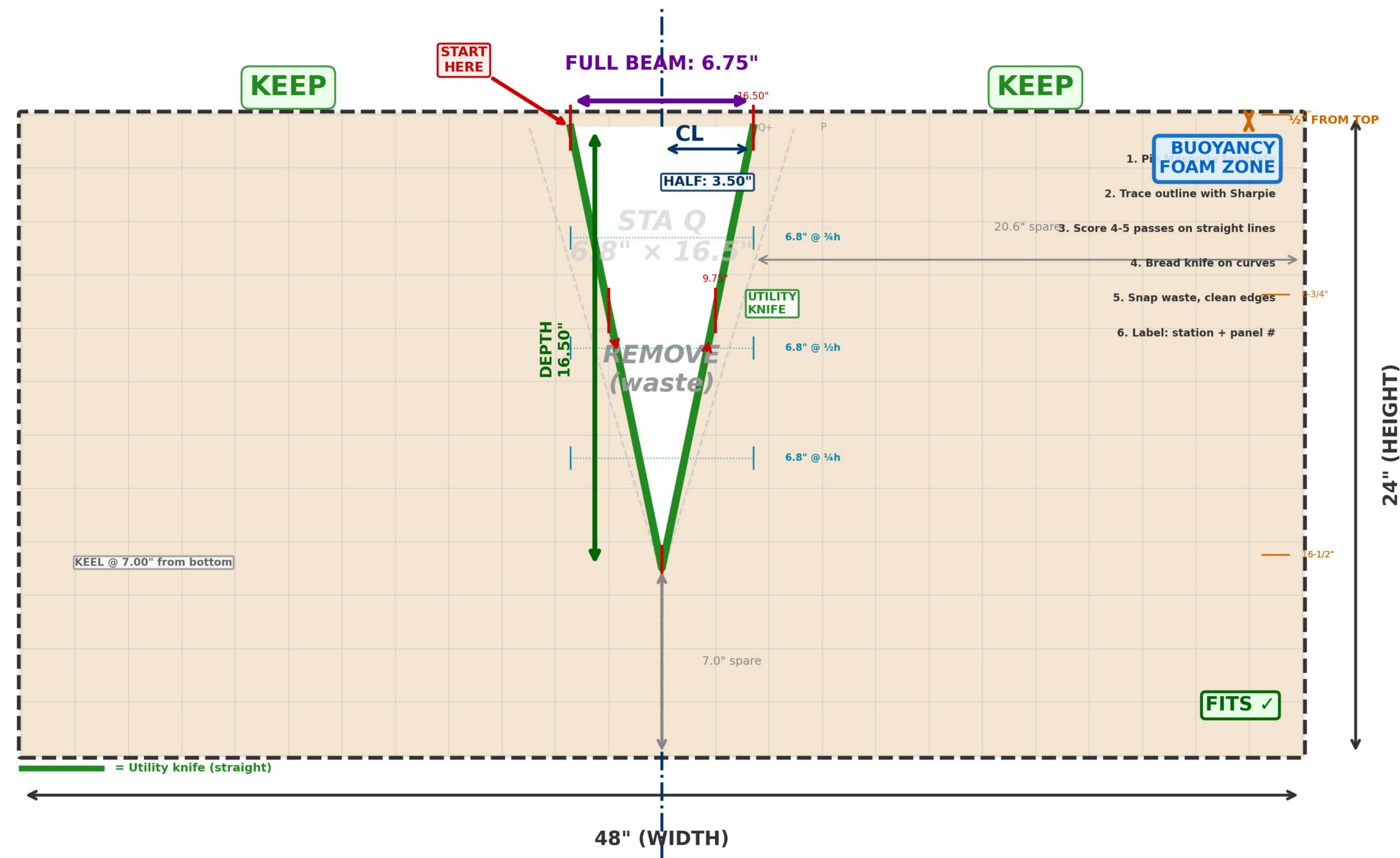
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
2.00"	9.75"
3.50"	16.50" (gunwale)

Full coords on template

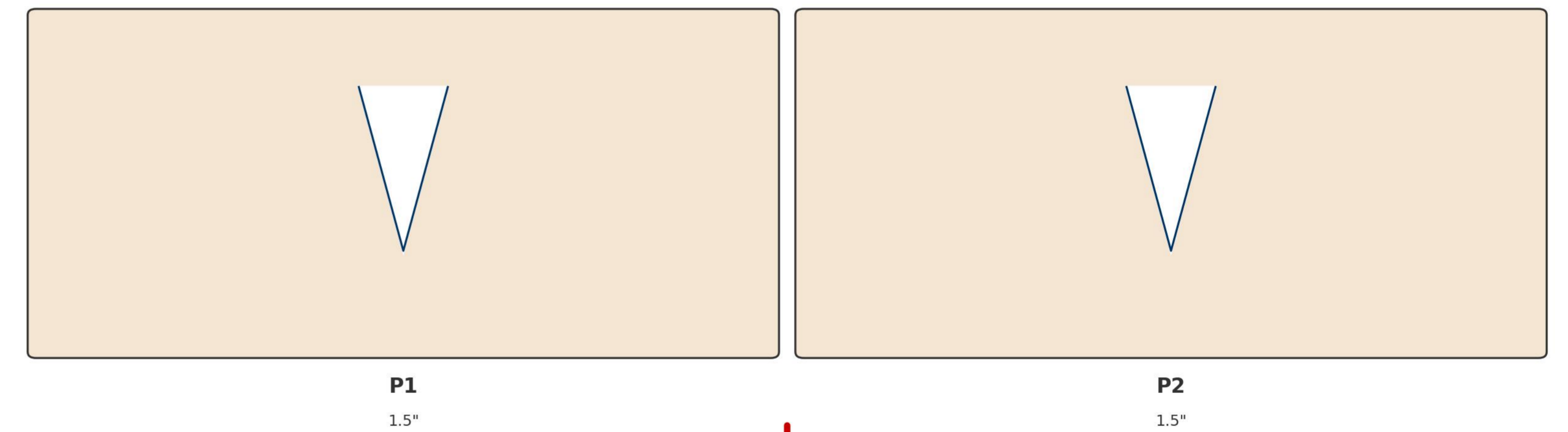
CUTTING METHOD

FINE V
 Nearly two lines meeting at a point.
 Score deeply, snap.

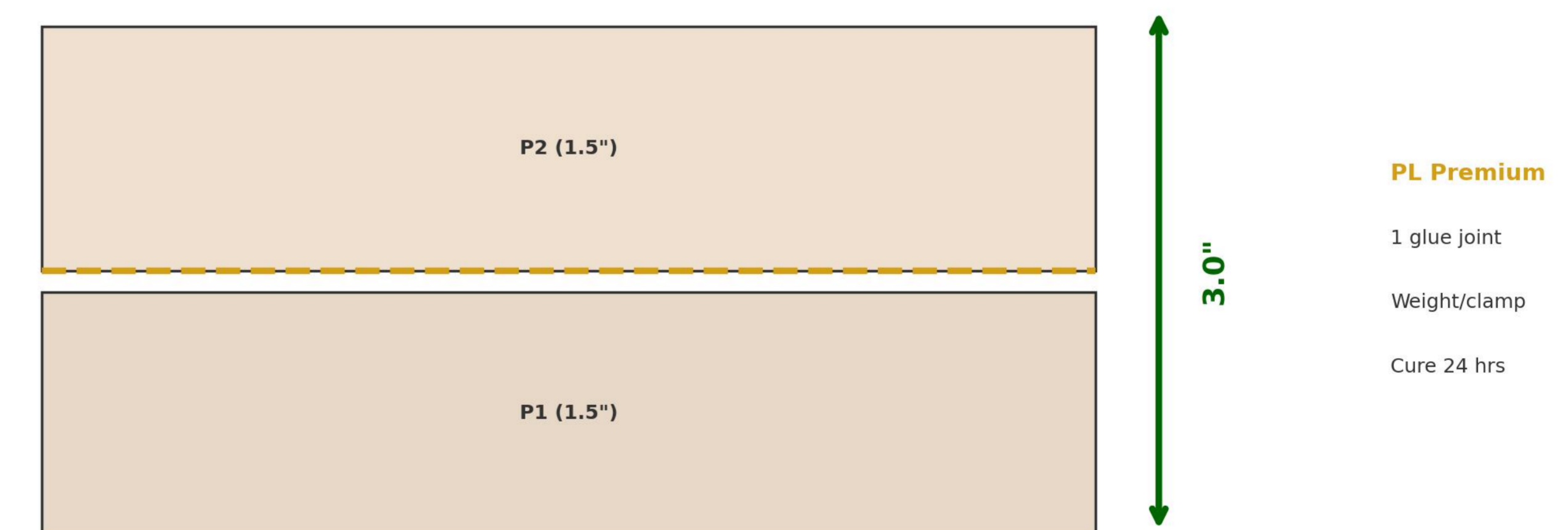


2-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 3" block



PL Premium
 1 glue joint
 Weight/clamp
 Cure 24 hrs

= 3" BLOCK (Station Q)

STATION Q+

Interpolated tip station (3" block)

Position: 99" from midship (18" remaining each side)
 Prepare: 4 panels total (2/block x 2 blocks)

CUT 4 PANELS (2 blocks x 2 panels, 3" blocks)

DIMENSIONS

Full Beam: 5.25"
 Depth at CL: 16.25"
 Half-Breadth: 2.50"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 7.35" from bottom
 Spare (bottom): 7.4" below keel
 Spare (width): 21.4" each side
 Block: 3" (2 panels)

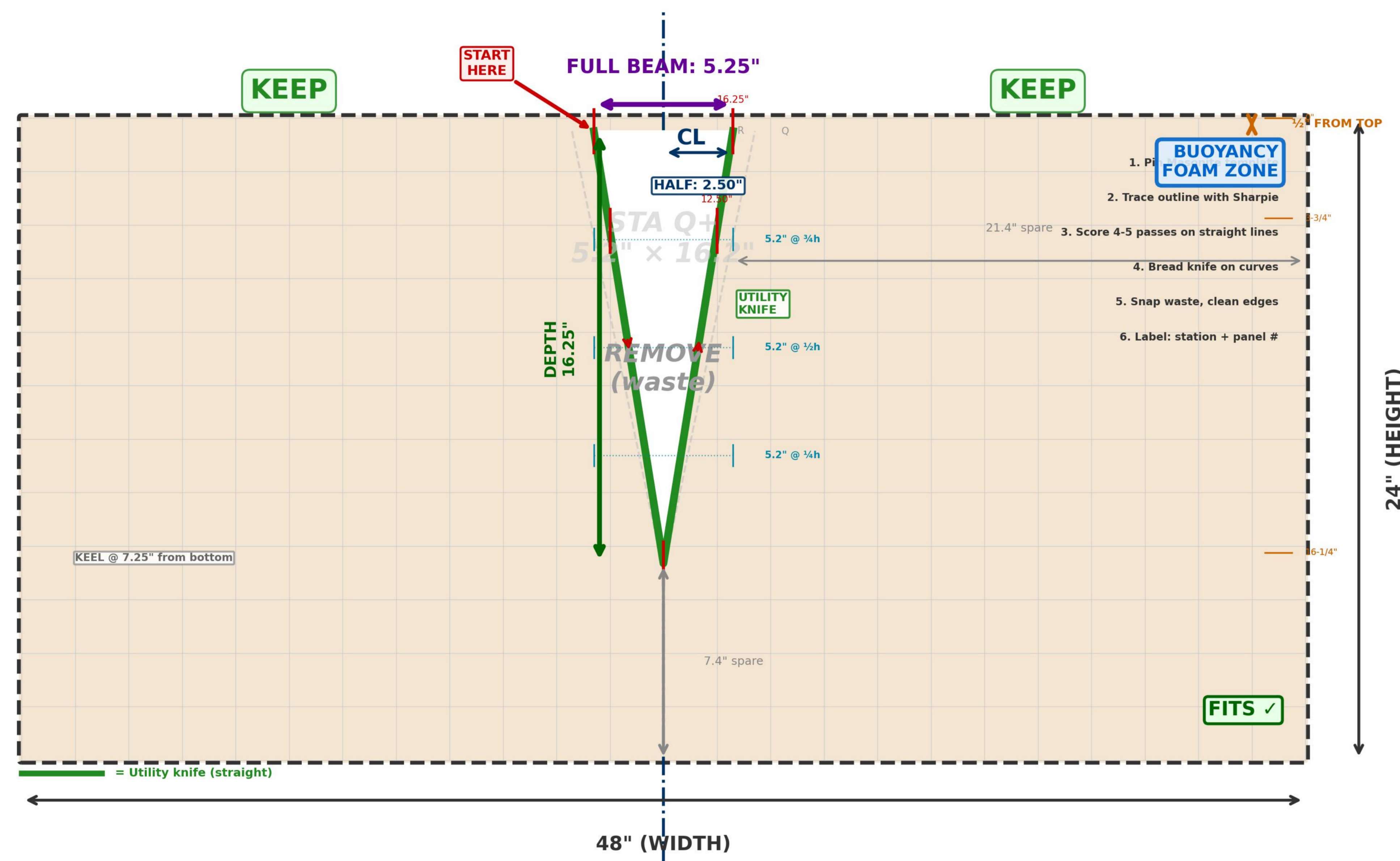
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
2.00"	12.50"
2.50"	16.25" (gunwale)

Full coords on template

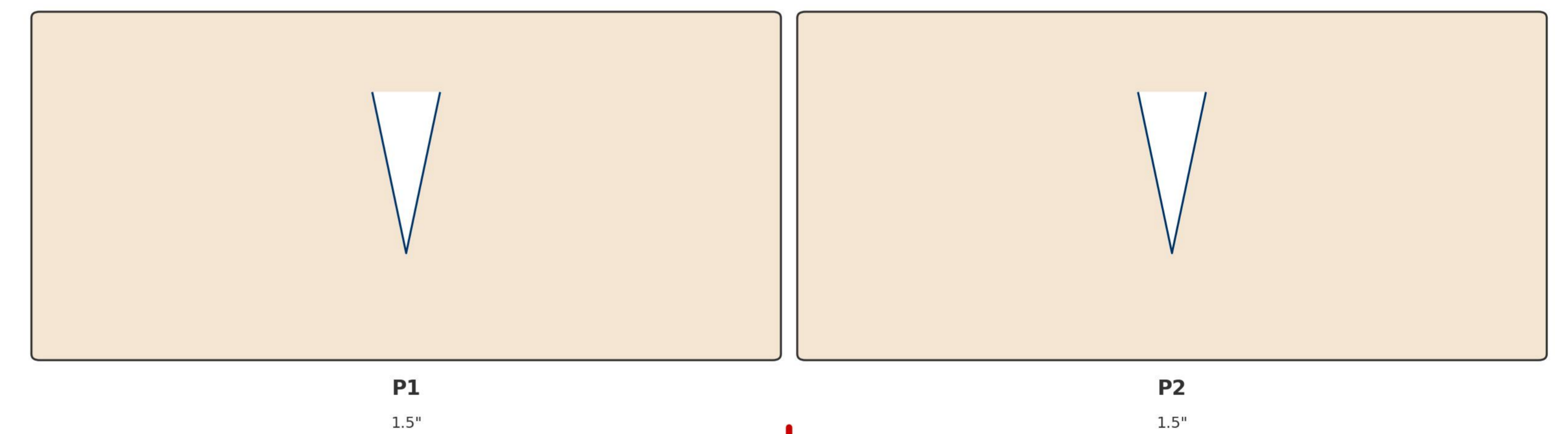
CUTTING METHOD

FINE V
 Nearly two lines meeting at a point.
 Score deeply, snap.

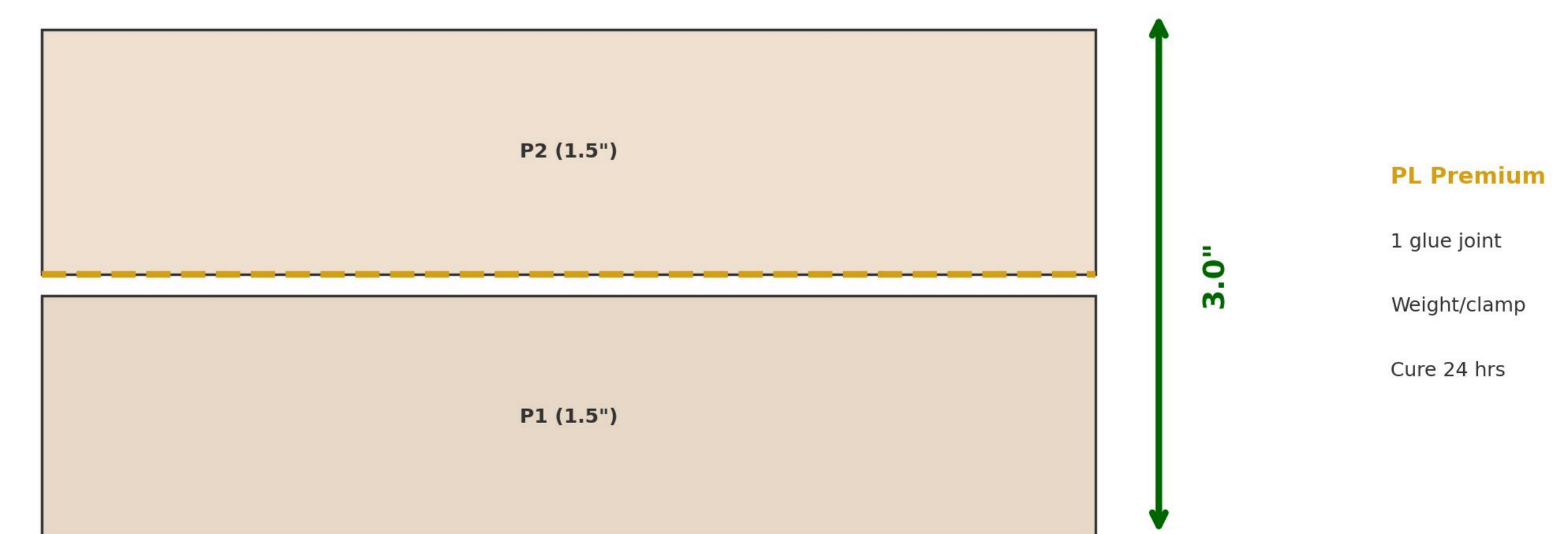


2-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 3" block



3" BLOCK (Station Q+)

PL Premium
 1 glue joint
 Weight/clamp
 Cure 24 hrs

STATION R

Vestigial width (3" block)

Position: 102" from midship (12" remaining each side)
 Prepare: 4 panels total (2/block x 2 blocks)

CUT 4 PANELS (2 blocks x 2 panels, 3" blocks)

DIMENSIONS

Full Beam: 3.50"
 Depth at CL: 15.50"
 Half-Breadth: 1.75"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 8.02" from bottom
 Spare (bottom): 8.0" below keel
 Spare (width): 22.2" each side
 Block: 3" (2 panels)

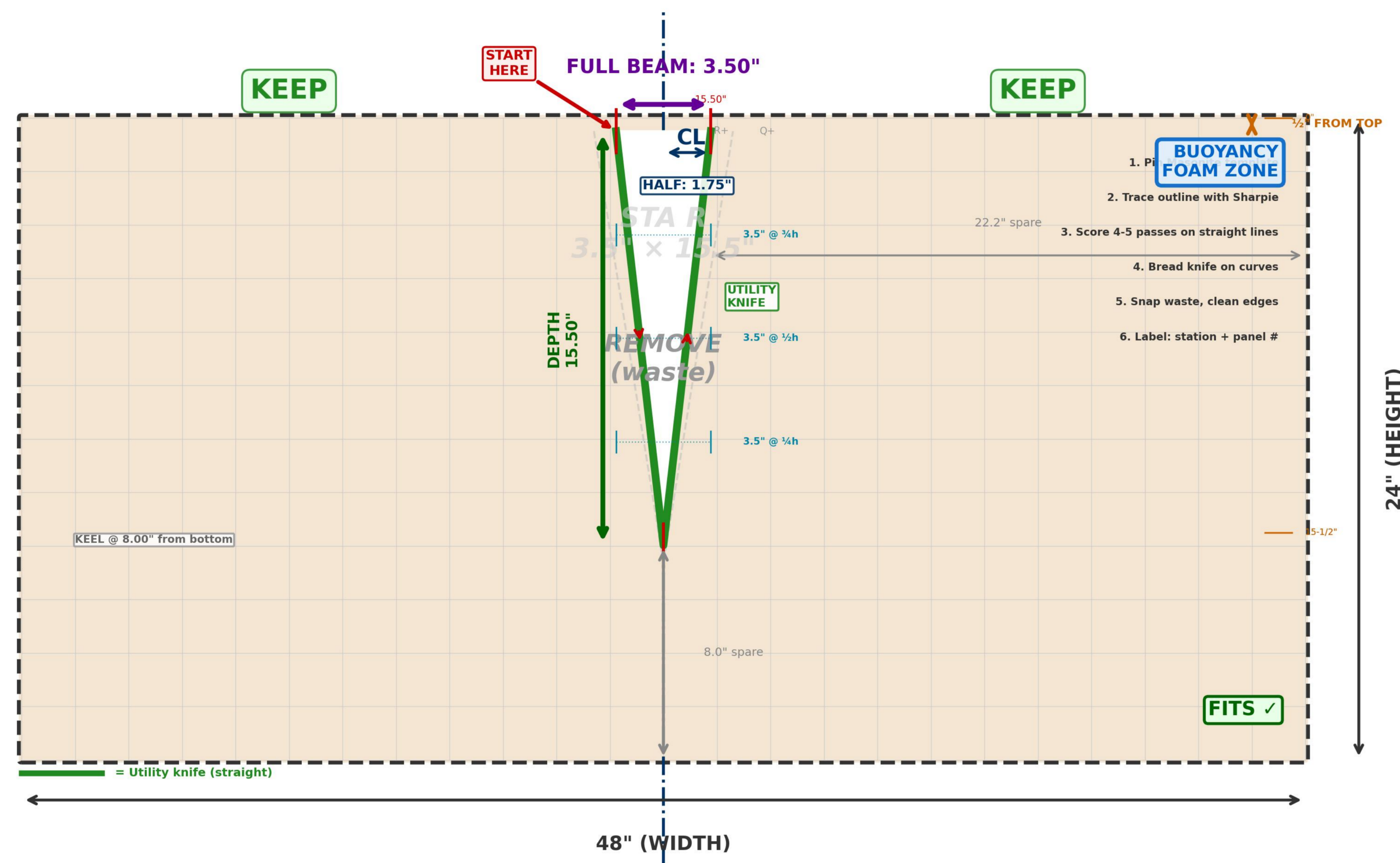
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
1.75"	15.50" (gunwale)

Full coords on template

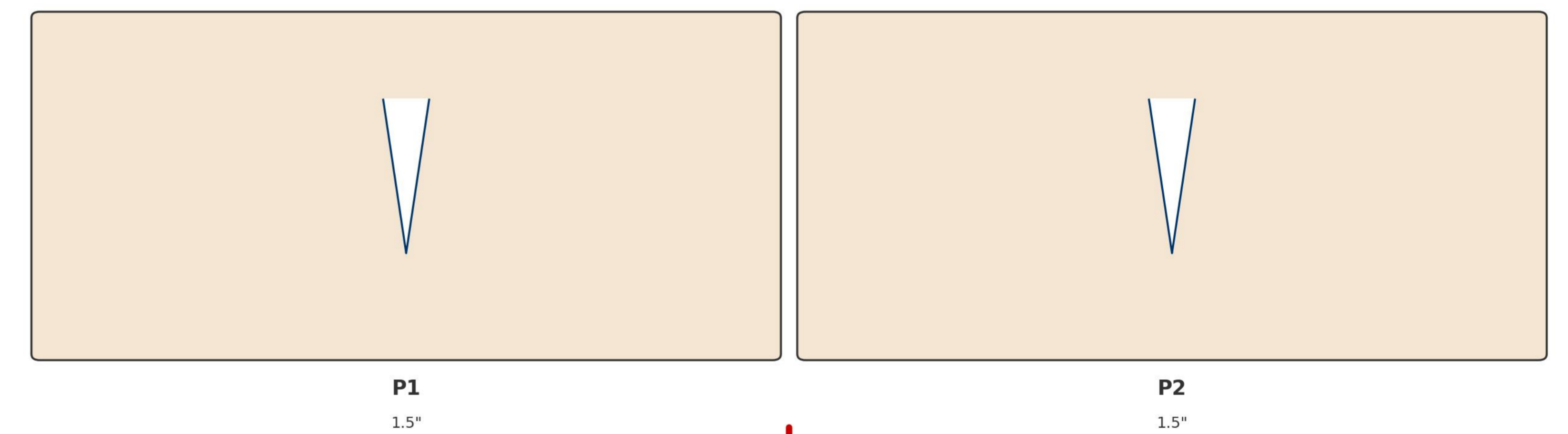
CUTTING METHOD

FINE V
 Nearly two lines meeting at a point.
 Score deeply, snap.

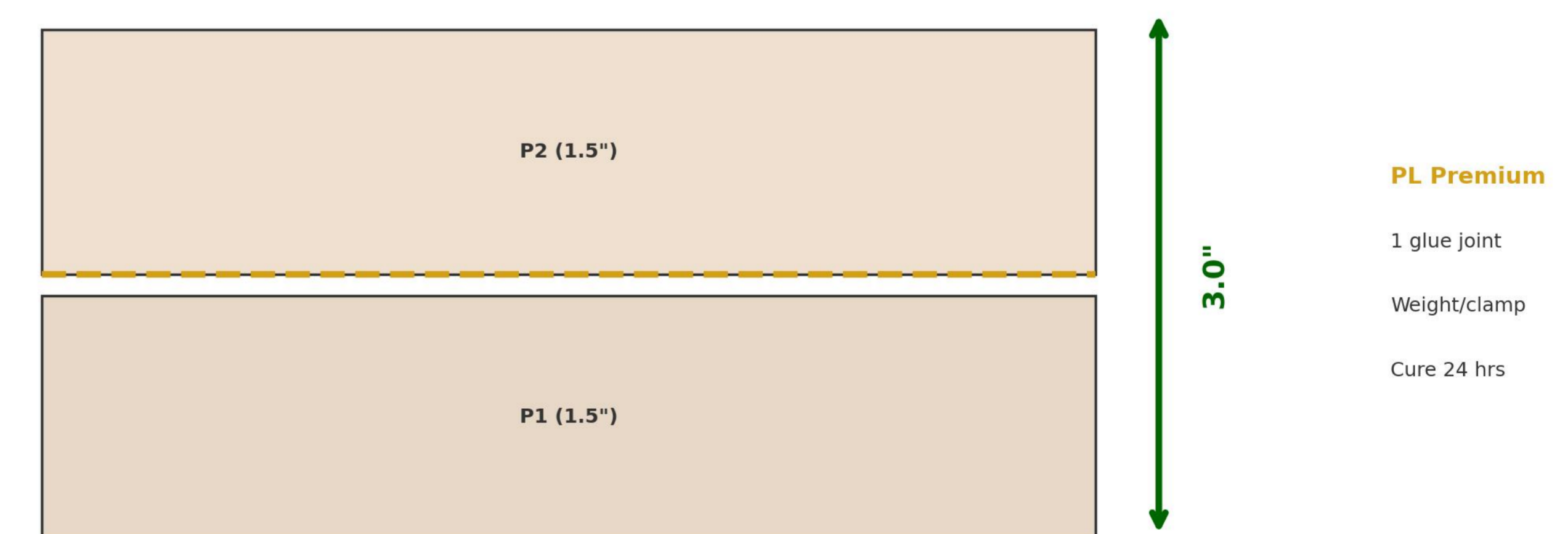


2-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 3" block



= 3" BLOCK (Station R)

PL Premium
 1 glue joint
 Weight/clamp
 Cure 24 hrs

STATION R+

Interpolated tip station (3" block)

Position: 105" from midship (6" remaining each side)
 Prepare: 4 panels total (2/block x 2 blocks)

CUT 4 PANELS (2 blocks x 2 panels, 3" blocks)

DIMENSIONS

Full Beam: 1.75"
 Depth at CL: 11.50"
 Half-Breadth: 1.00"
 Panel Size: 48"W x 24"H x 1.5"T
 Top Margin: 1/2" (gunwale below top edge)
 Gunwale at: 23.5" from bottom
 Keel at: 12.01" from bottom
 Spare (bottom): 12.0" below keel
 Spare (width): 23.1" each side
 Block: 3" (2 panels)

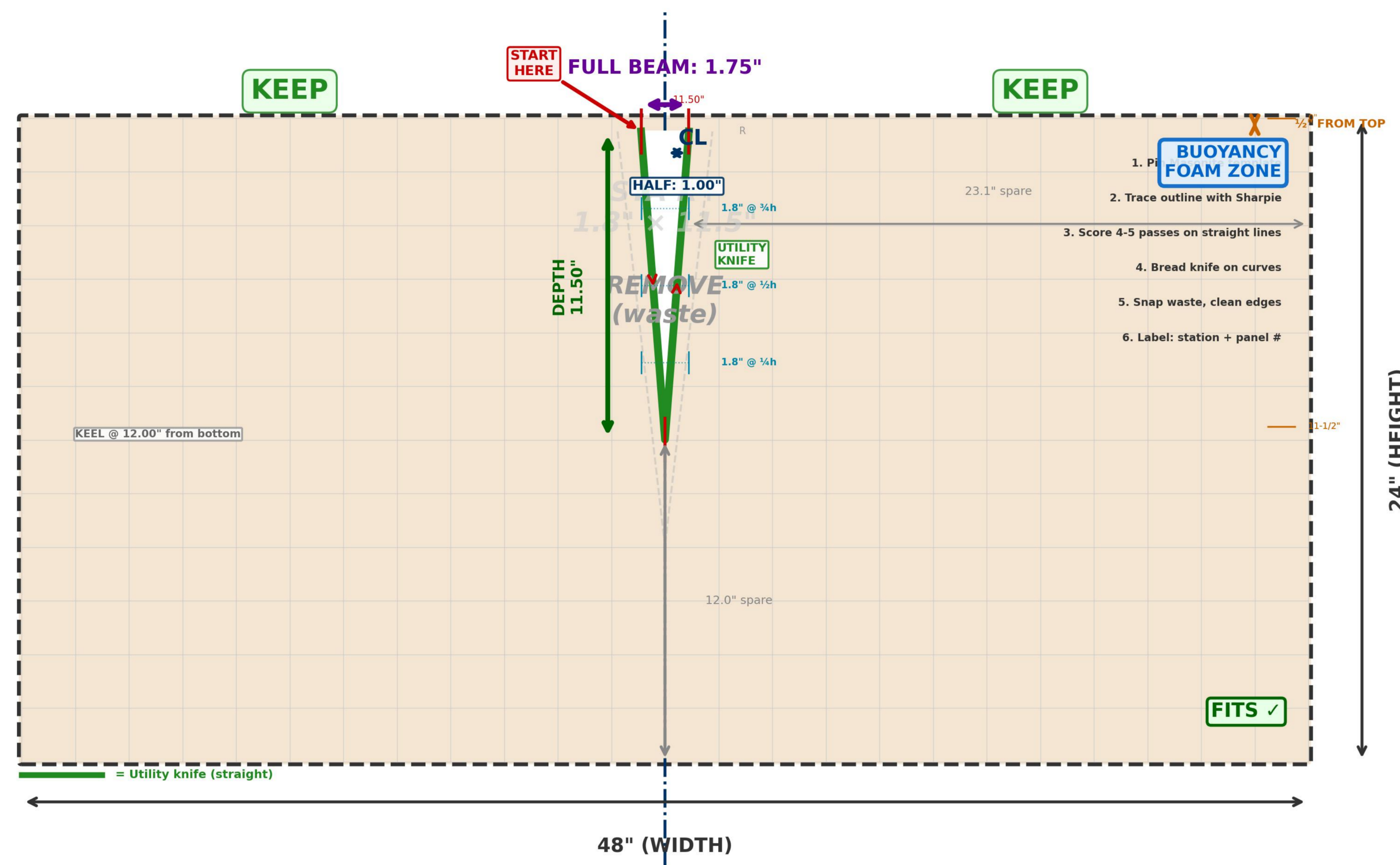
KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)
1.00"	11.50" (gunwale)

Full coords on template

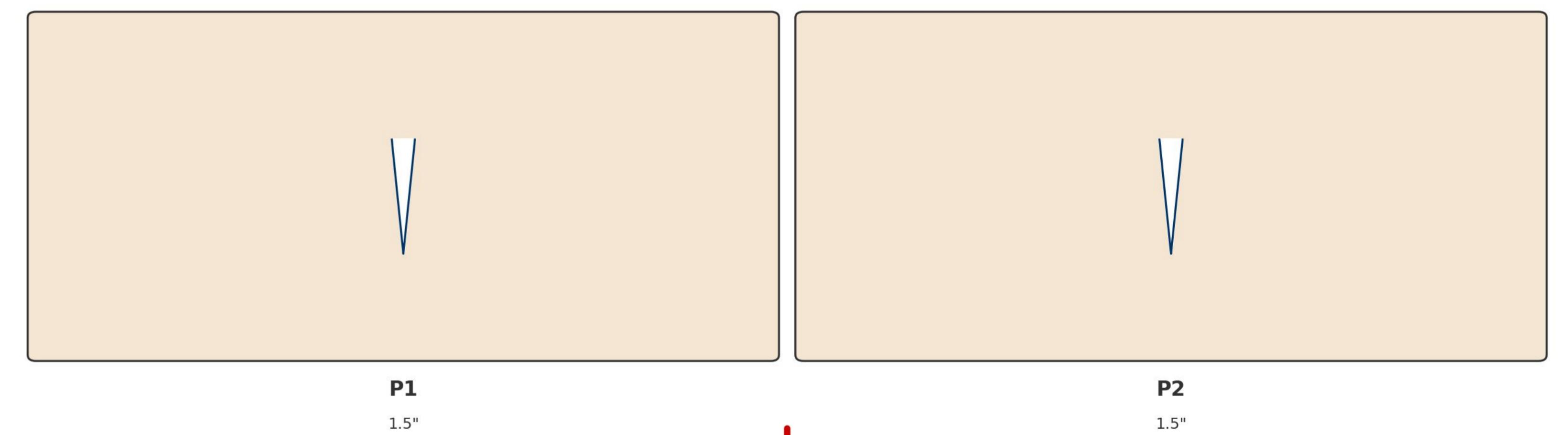
CUTTING METHOD

FINE V
 Nearly two lines meeting at a point.
 Score deeply, snap.

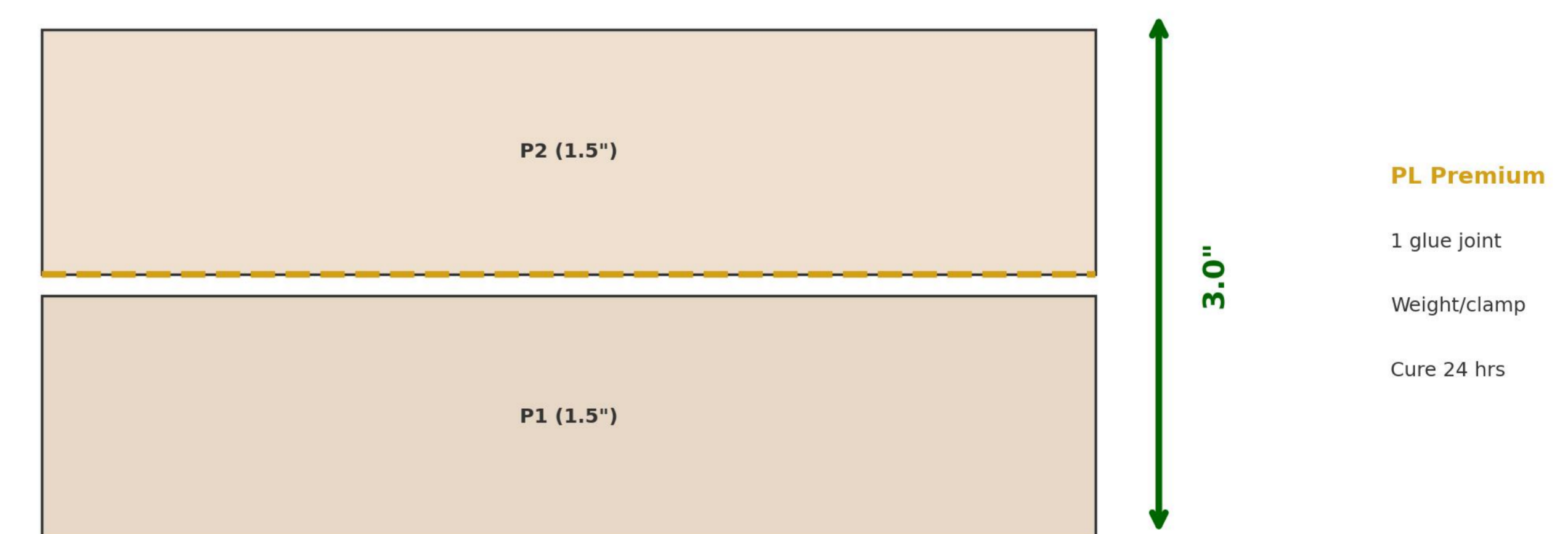


2-PANEL ASSEMBLY

Step 1: Cut each panel with knife



Step 2: Glue face-to-face → 3" block



= 3" BLOCK (Station R+)

STATION S

Keel point only

Position: 108" from midship (0" remaining each side)

ENDPOINT — no panels to cut

DIMENSIONS

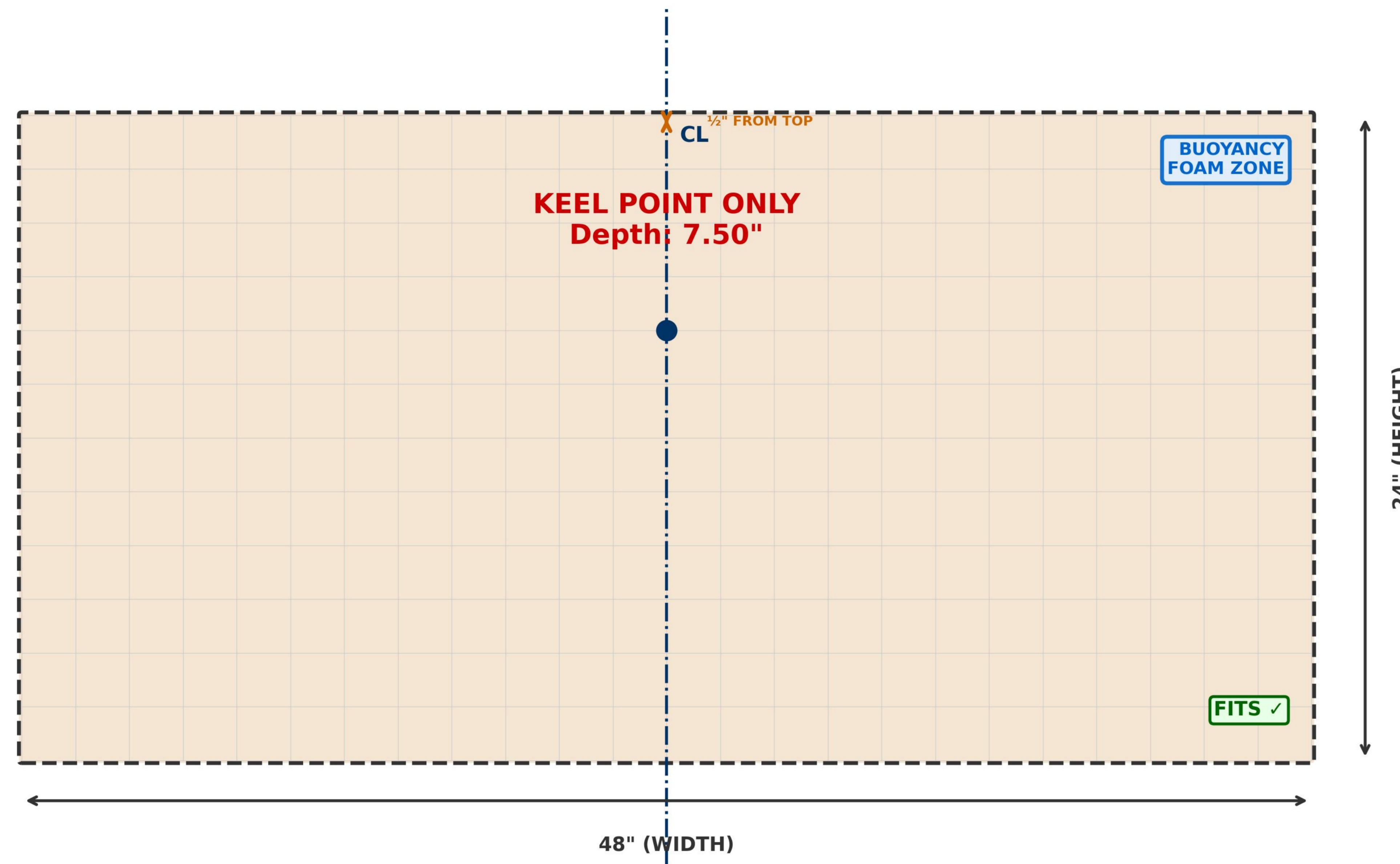
Full Beam: 0.00"
Depth at CL: 7.50"
Half-Breadth: 0.00"
Panel Size: 48"W x 24"H x 1.5"T
Top Margin: 1/2" (gunwale below top edge)
Gunwale at: 23.5" from bottom
Keel at: 16.00" from bottom
Spare (bottom): 16.0" below keel
Spare (width): 24.0" each side
Block: (endpoint)

KEY COORDINATES

FROM CL	HEIGHT
0.00"	0.00" (keel)

CUTTING METHOD

KEEL SLOT
Zero width, 7.5" deep. Score a line, snap.
Or hand-carve.



BUILD CHECKLIST

- All 39 blocks cut and labeled
- 4 panels/block glued (A-P: 6" blocks)
- 2 panels/block glued (Q-R+: 3" blocks)
- Blocks mounted on strongback at 6" spacing
- Bow & stern solid foam tips shaped
- Fair between stations (80-grit sanding board)

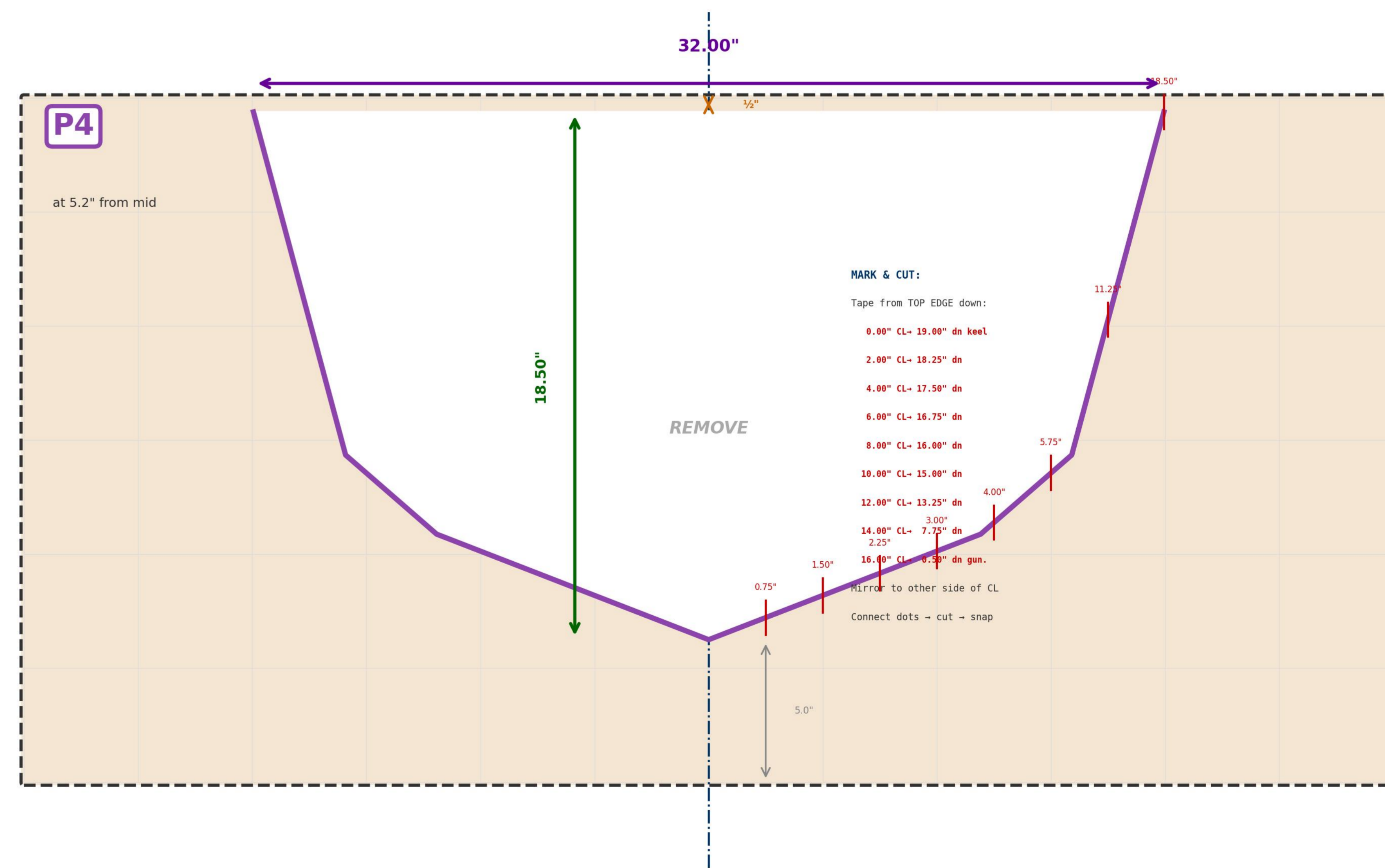
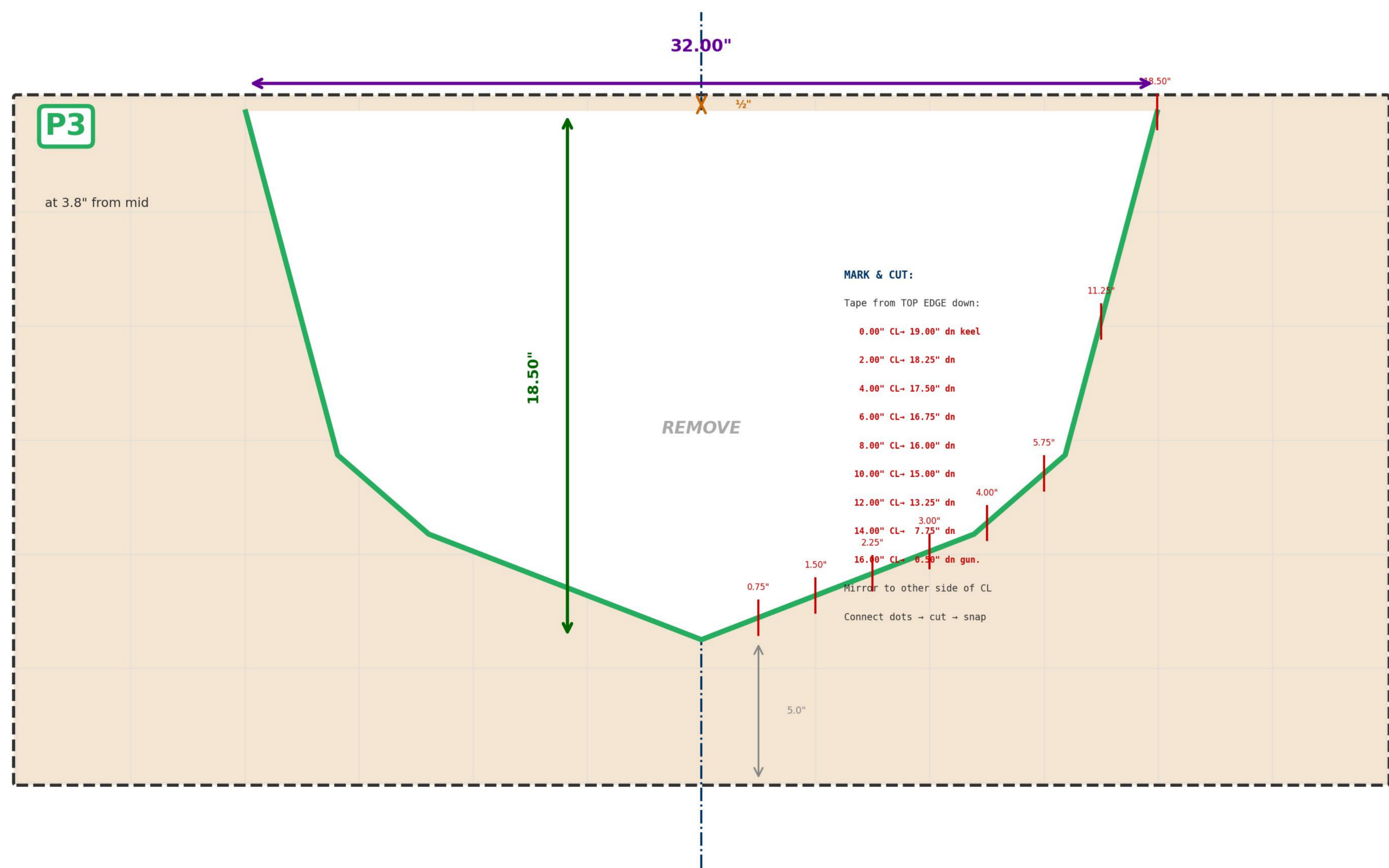
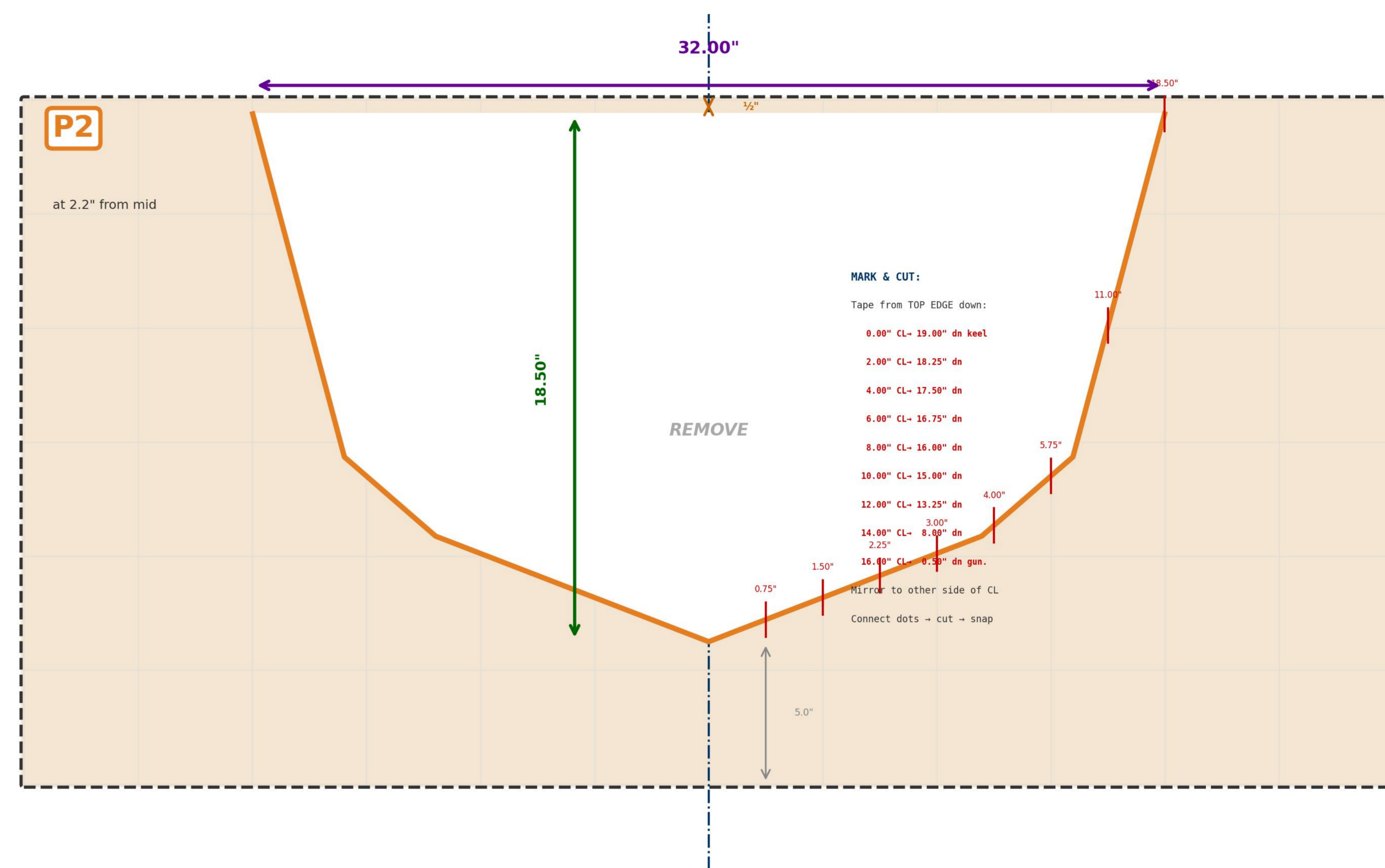
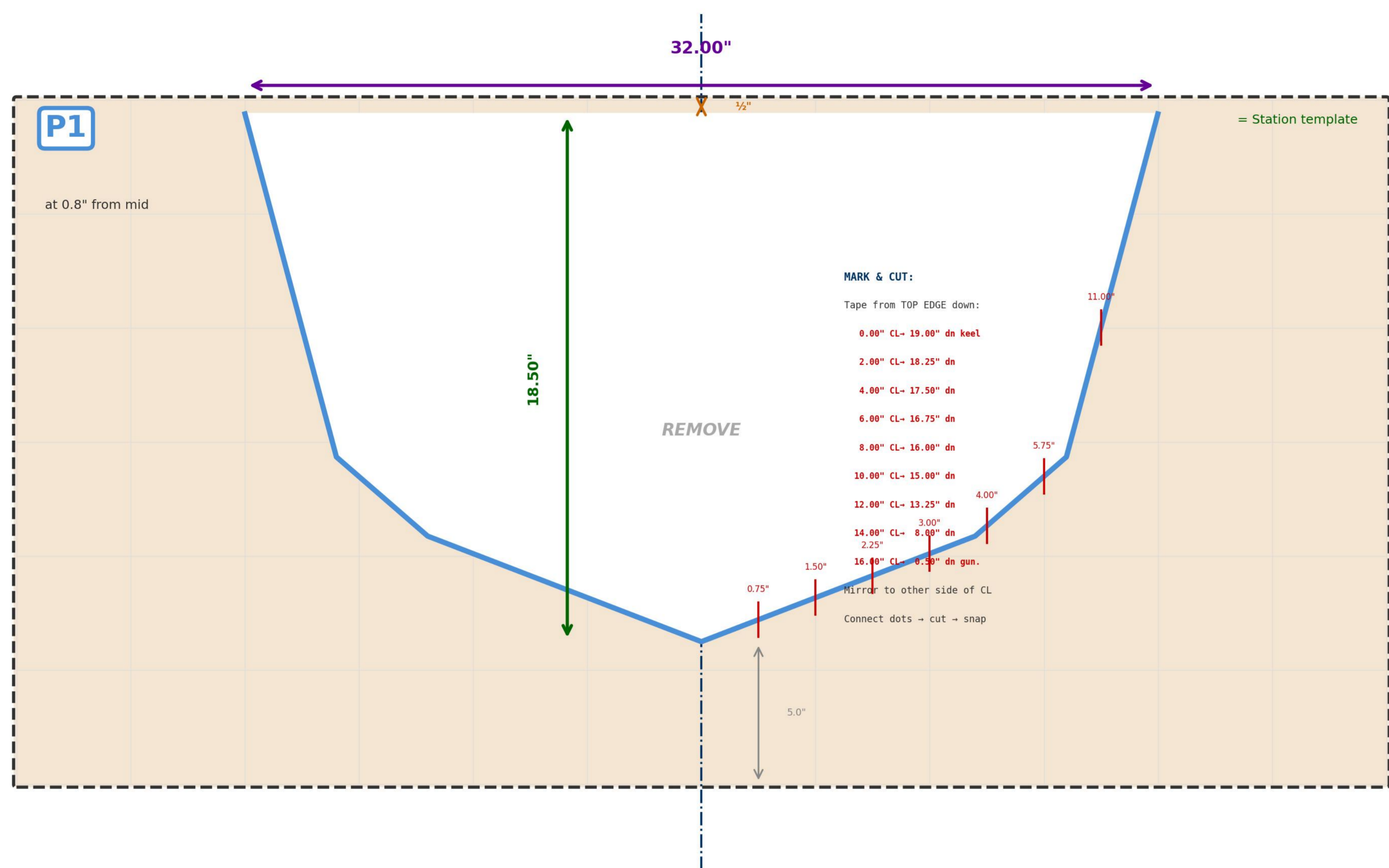
SECTION 4

Tapered Panel Sheets — Per-Panel Dimensions

21 pages follow

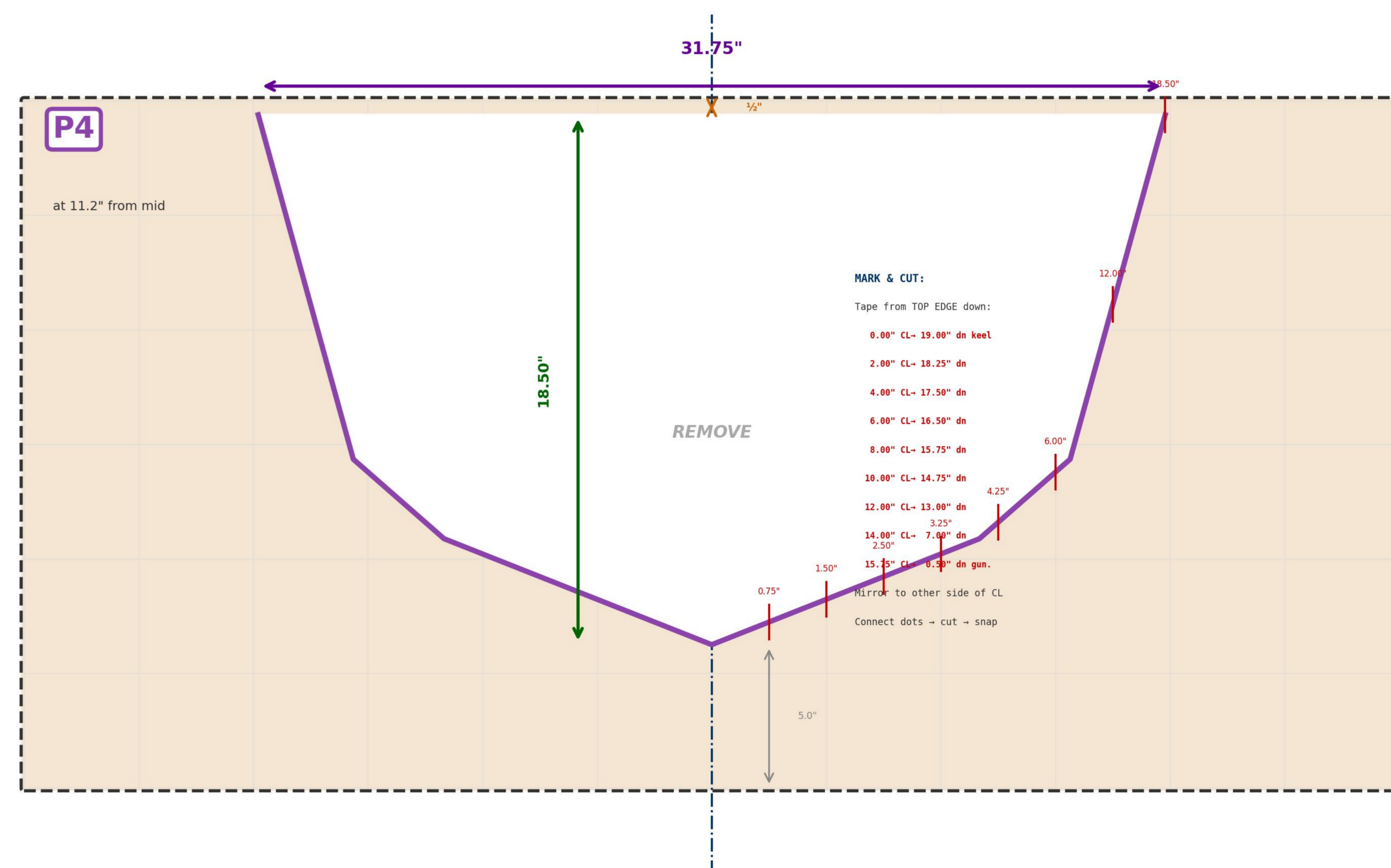
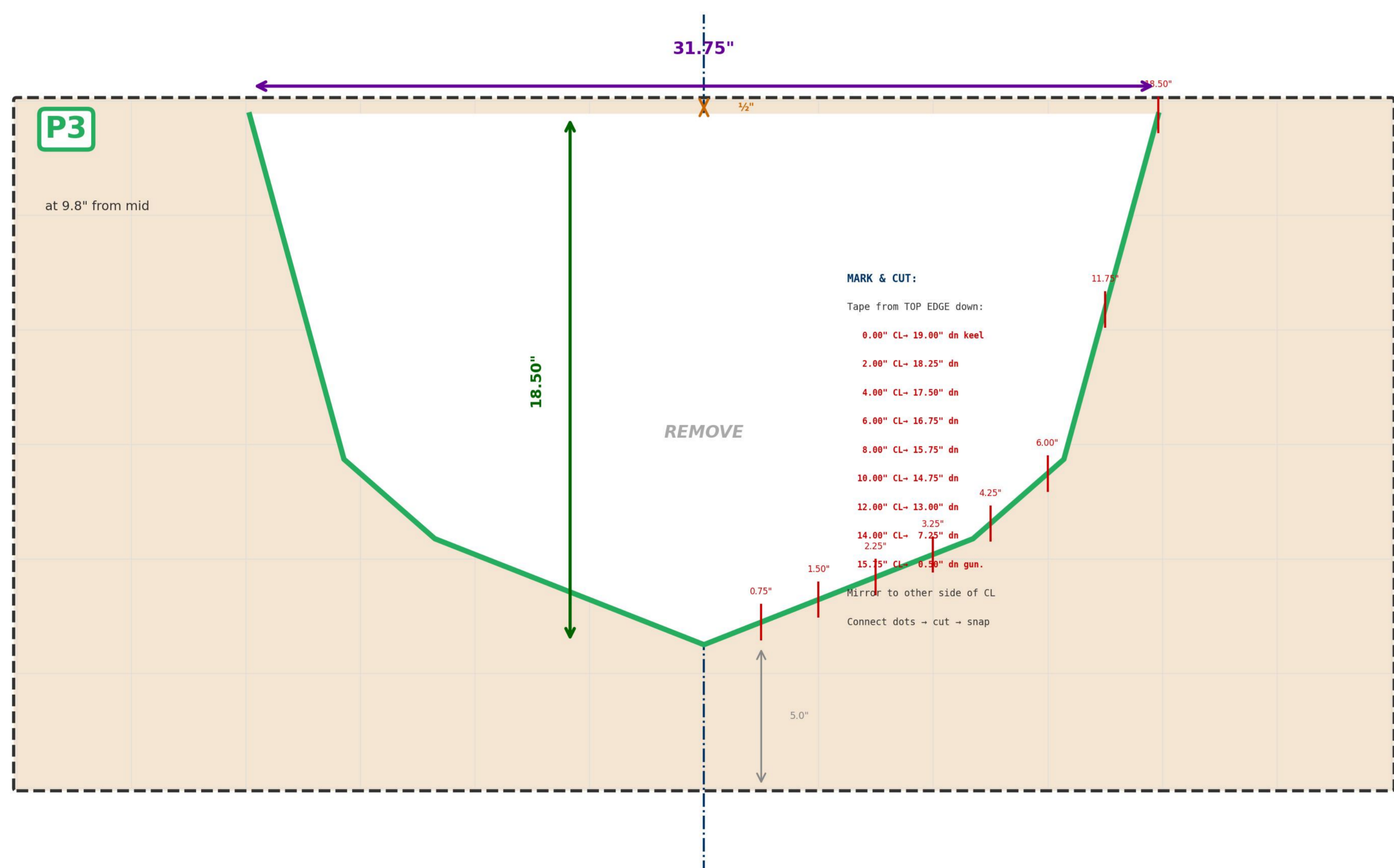
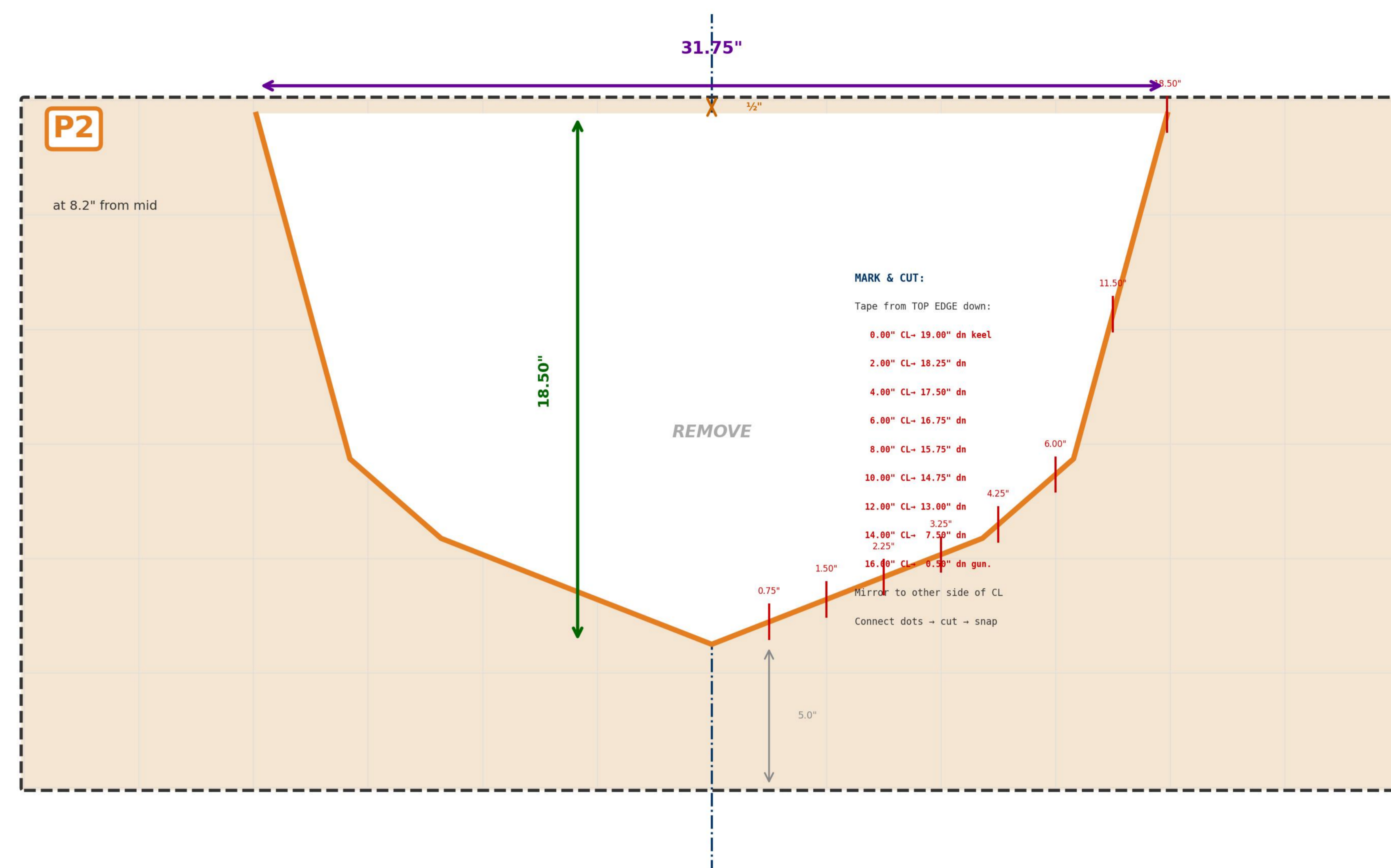
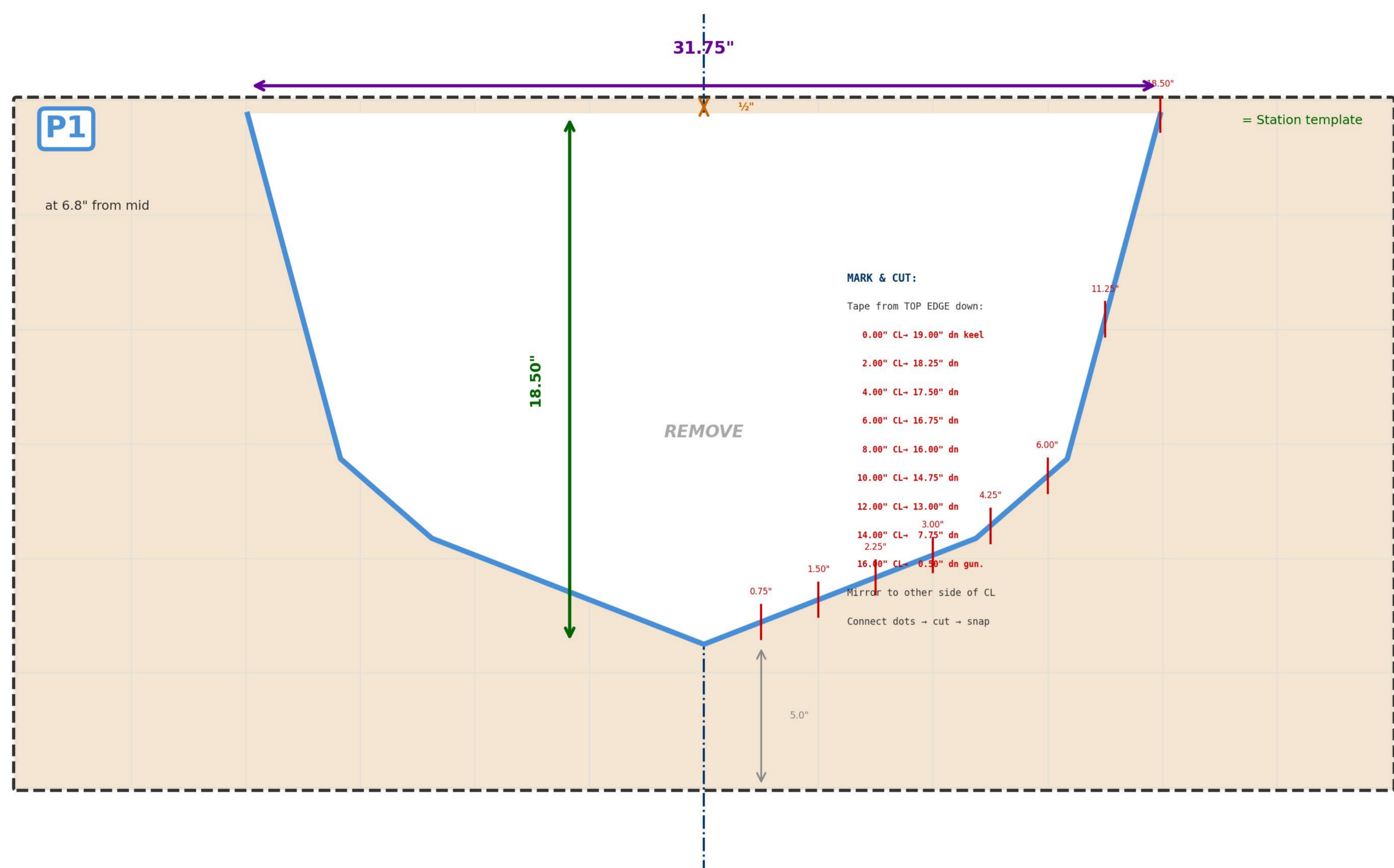
STATION A — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) (all 4 identical)

Station beam: 32.00" | Depth: 18.50" | Dist from midship: 0" | Max panel difference: 0.09" beam, 0.00" depth



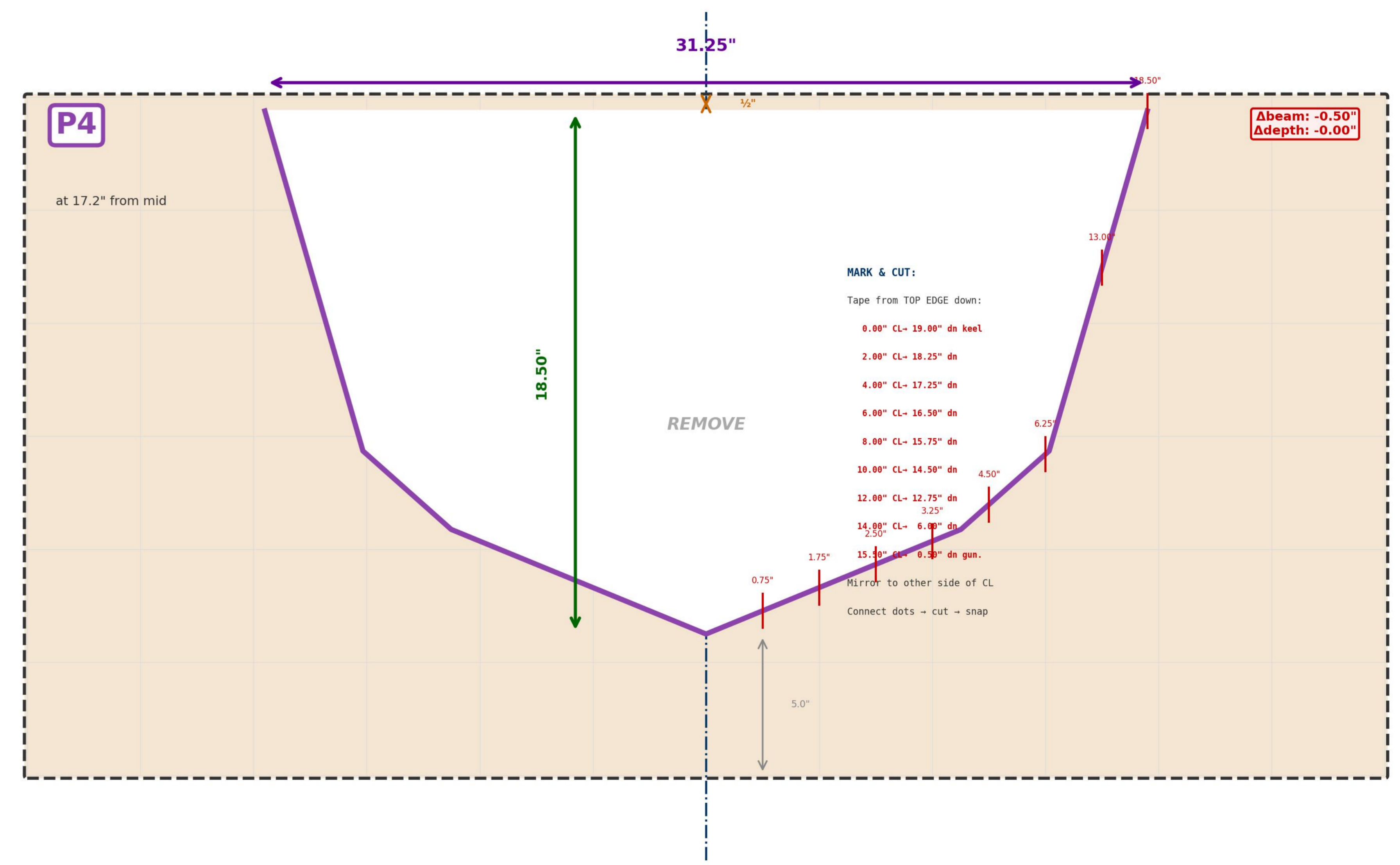
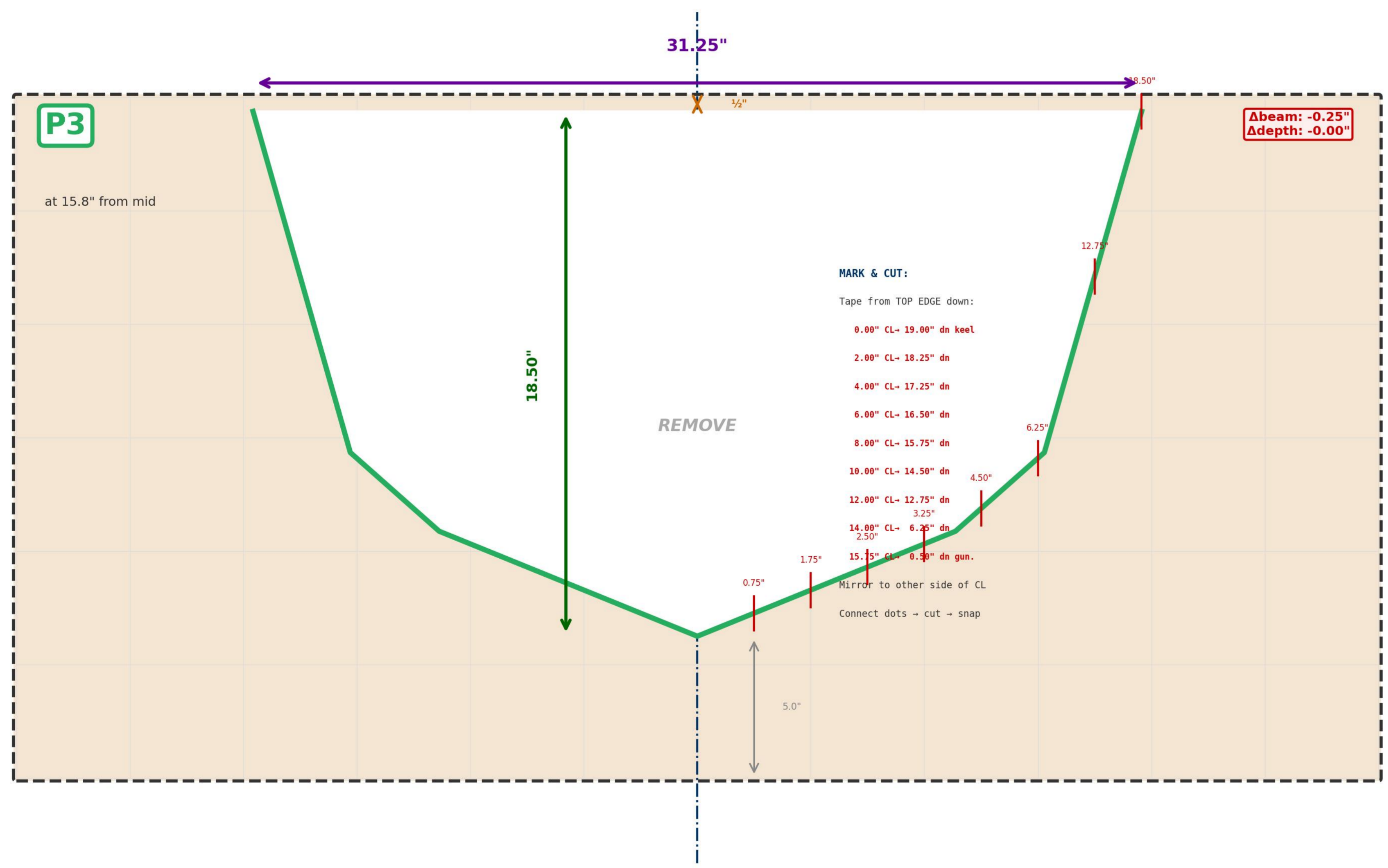
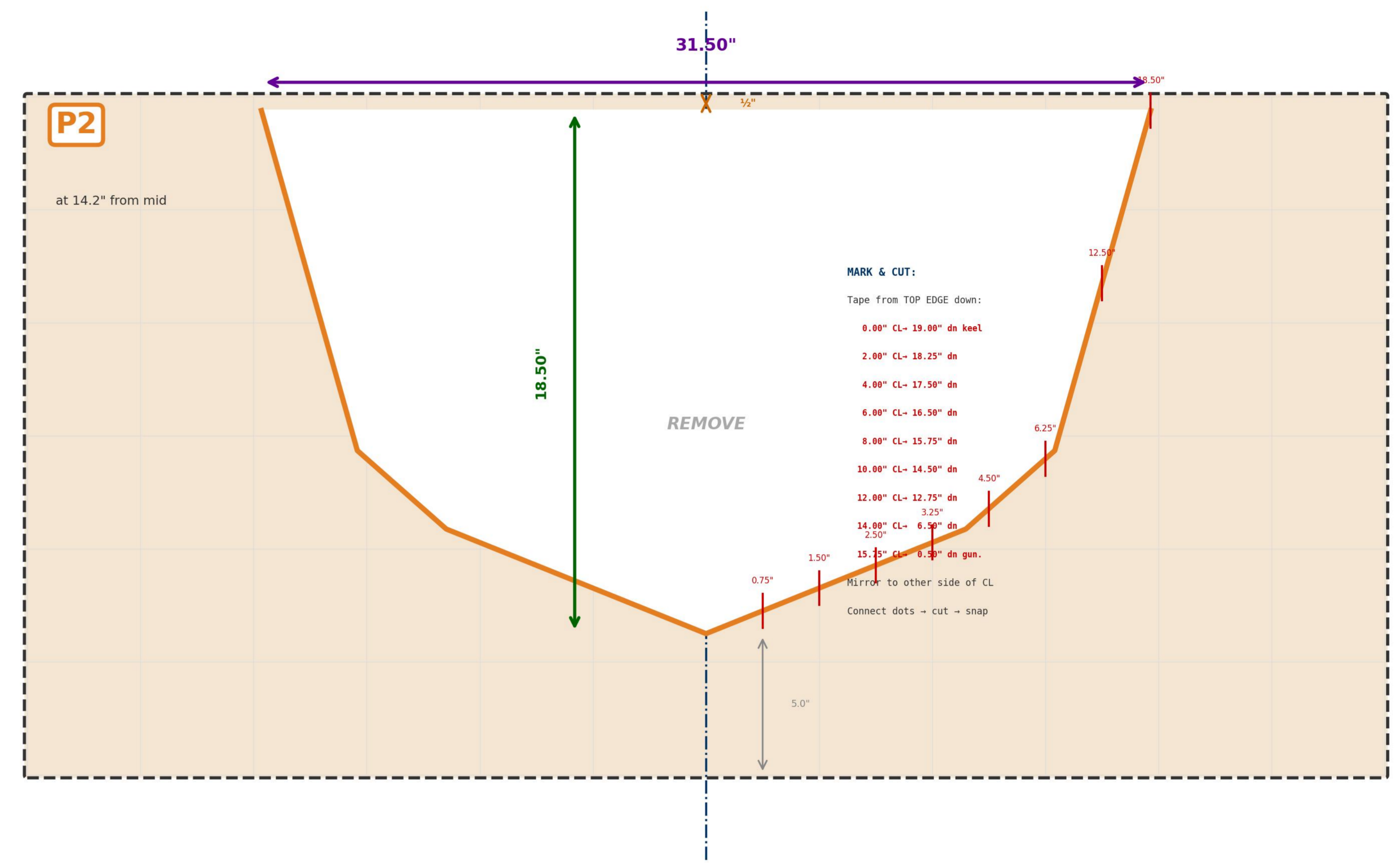
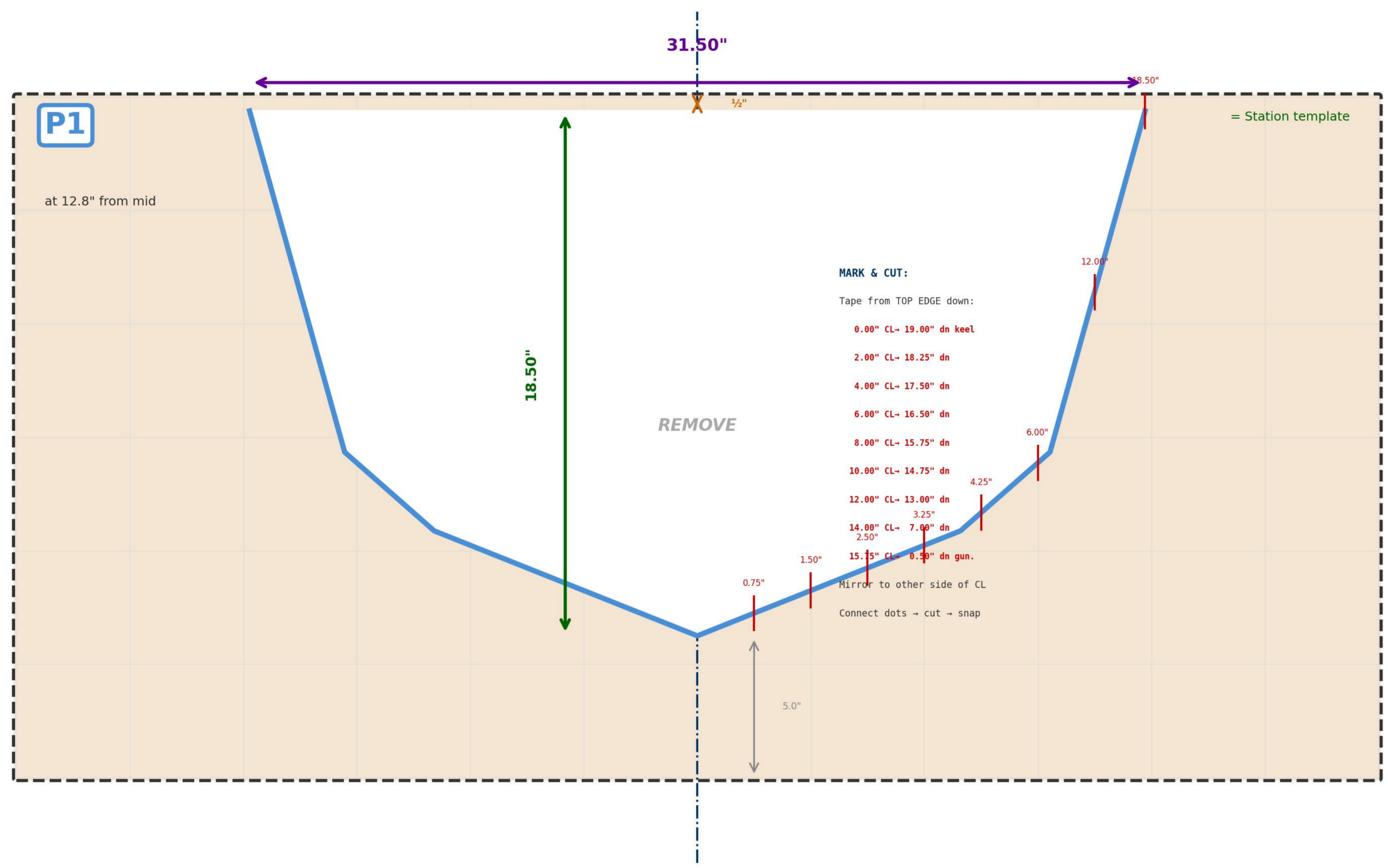
STATION B — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) (all 4 identical)

Station beam: 32.00" | Depth: 18.50" | Dist from midship: 6" | Max panel difference: 0.24" beam, 0.00" depth



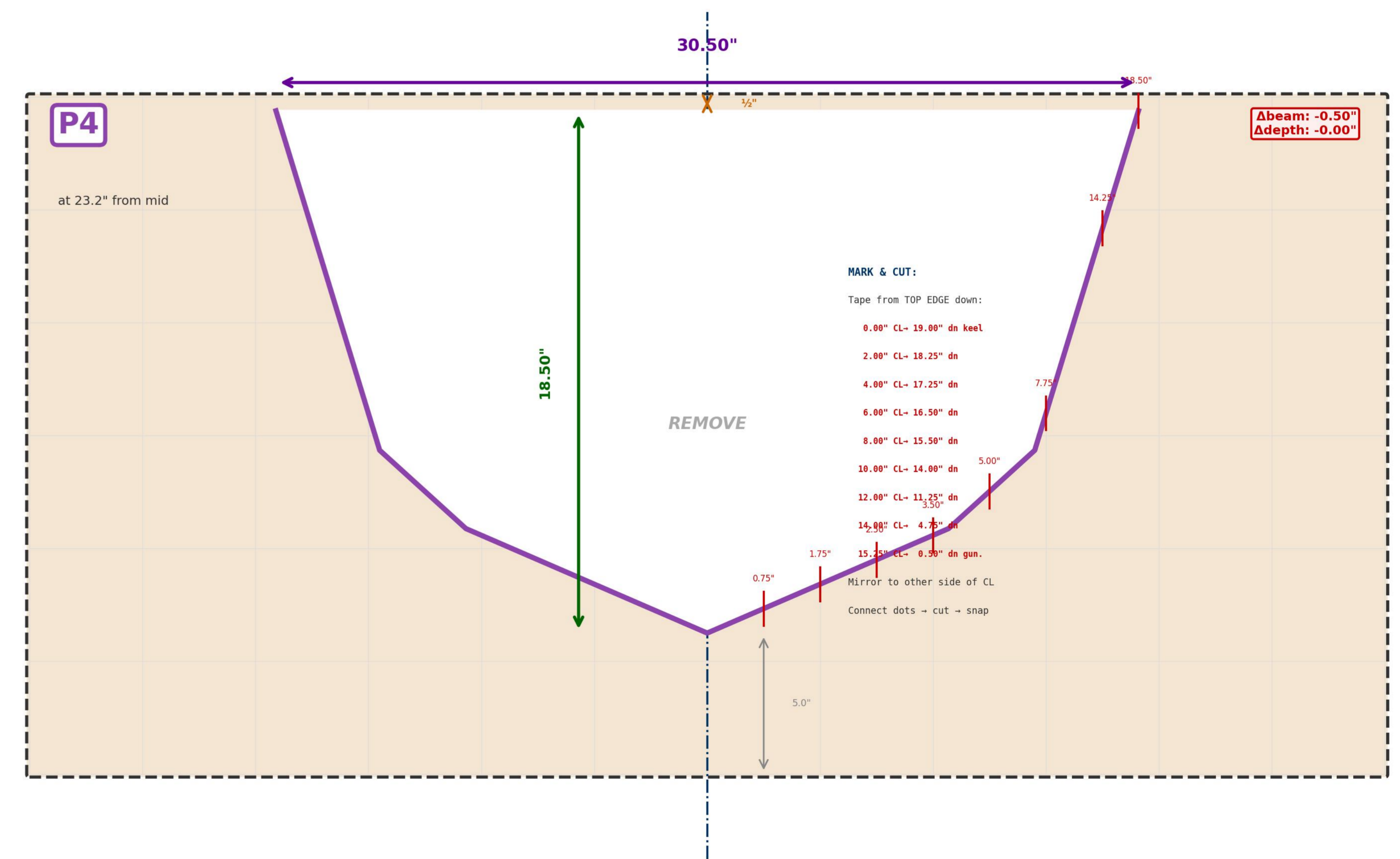
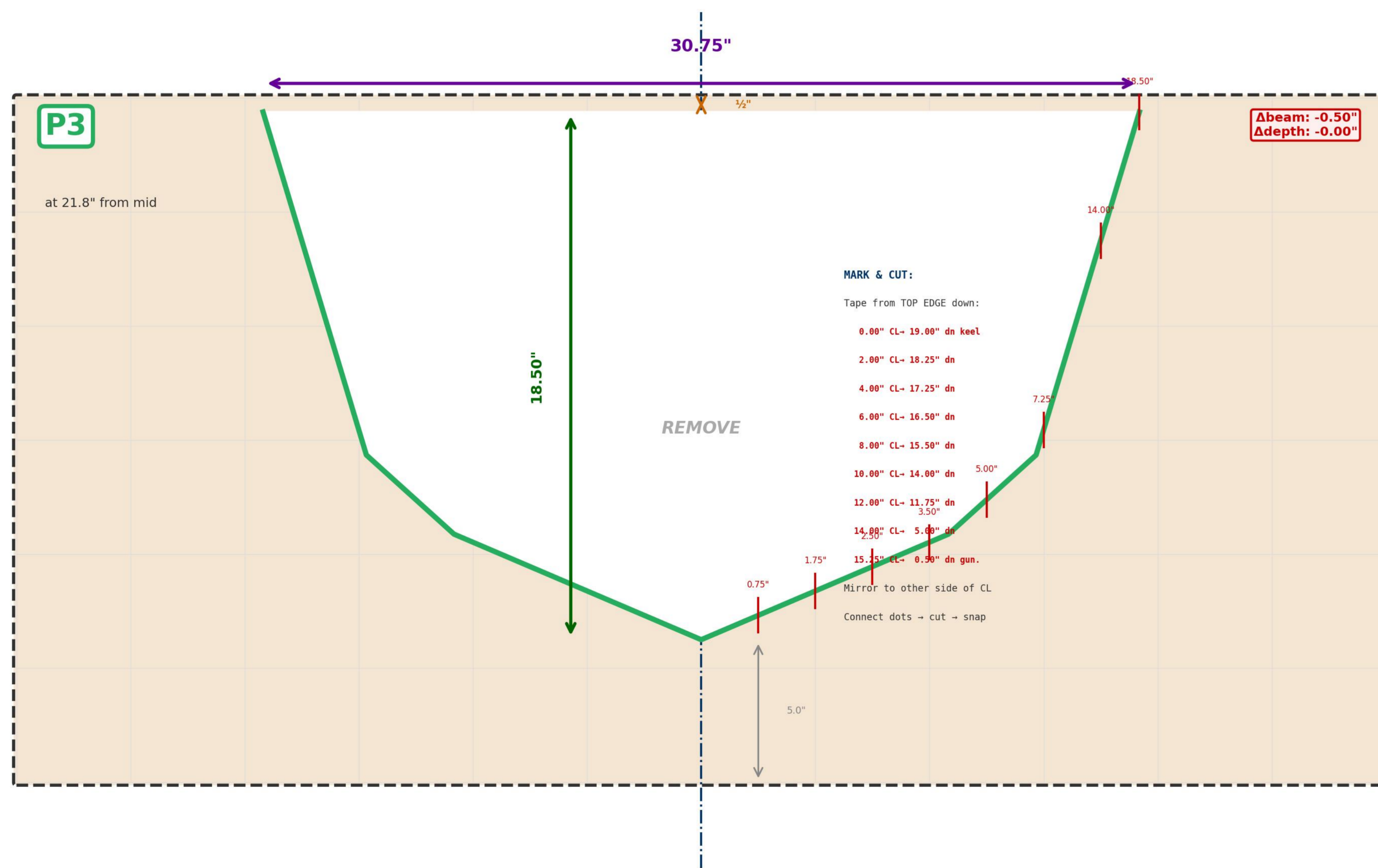
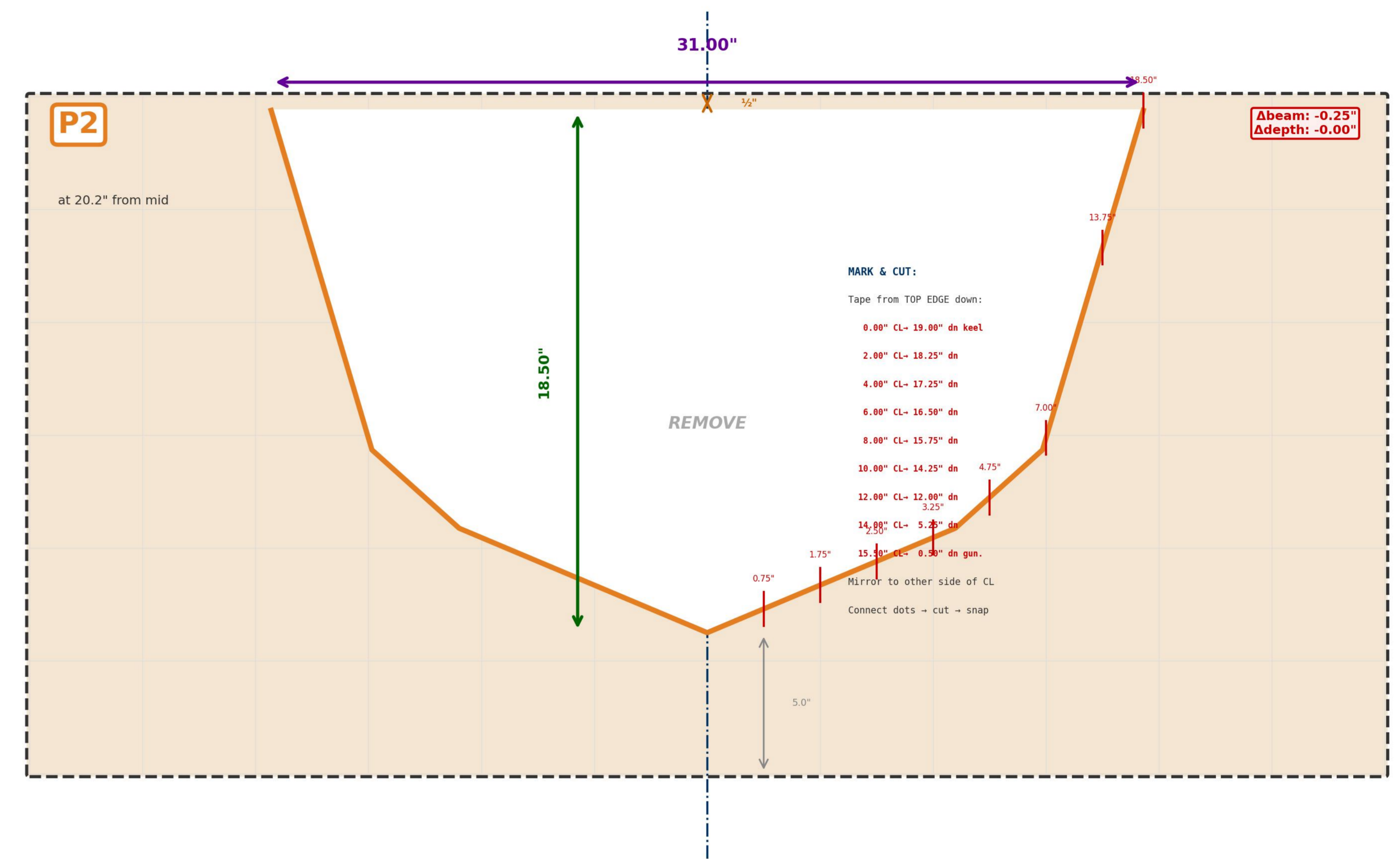
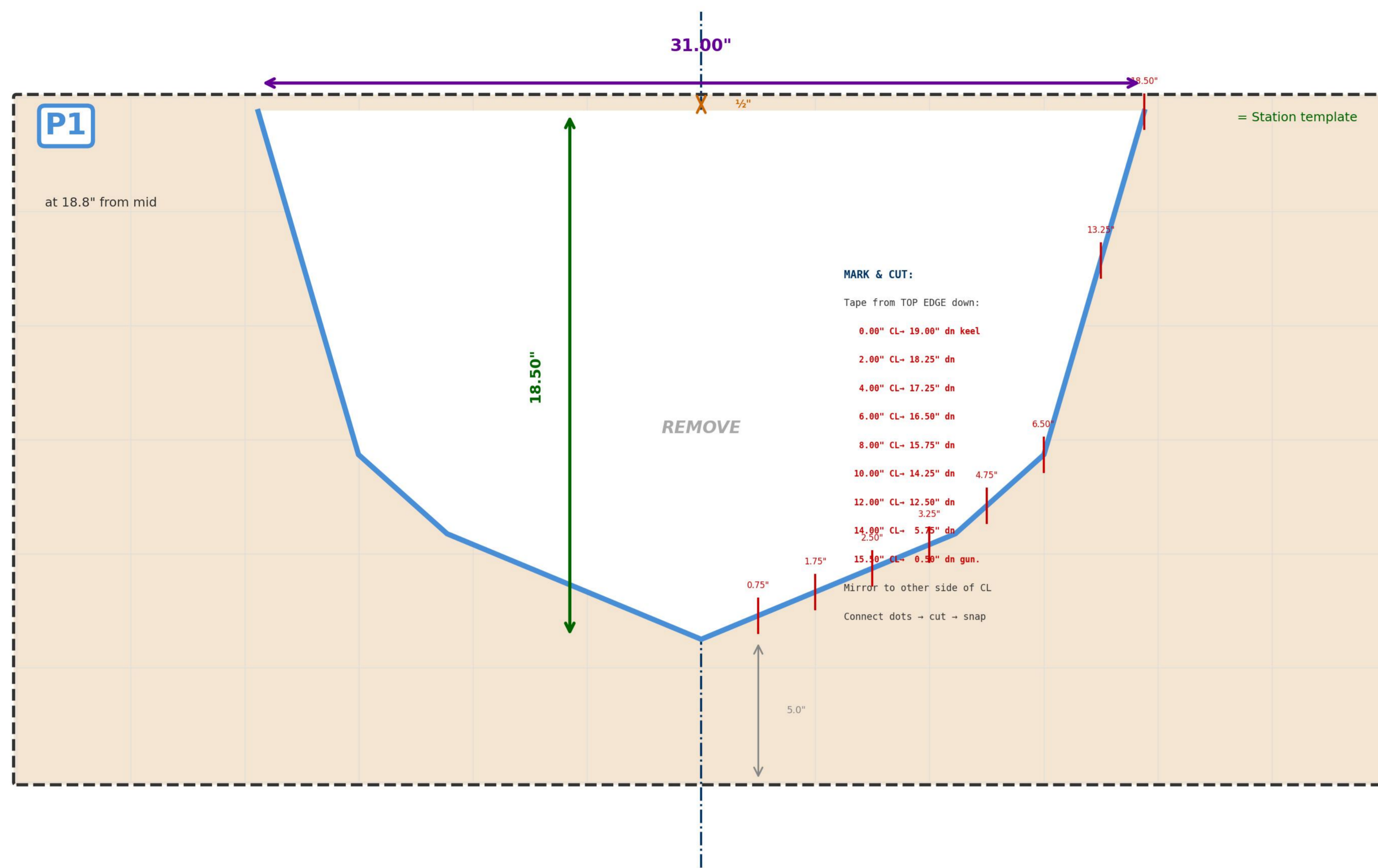
STATION C — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) \triangle PANELS DIFFER

Station beam: 31.50" | Depth: 18.50" | Dist from midship: 12" | Max panel difference: 0.42" beam, 0.00" depth



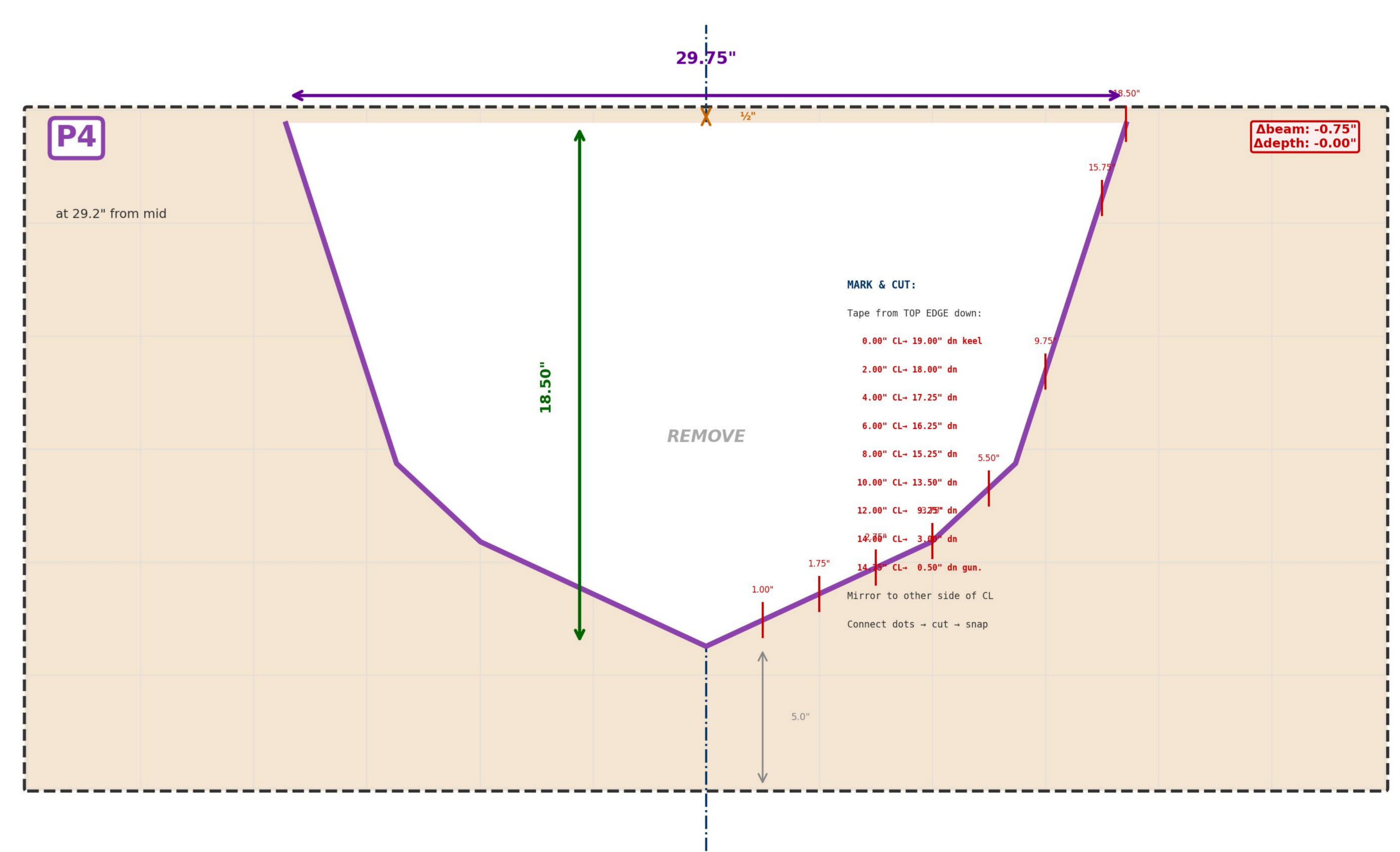
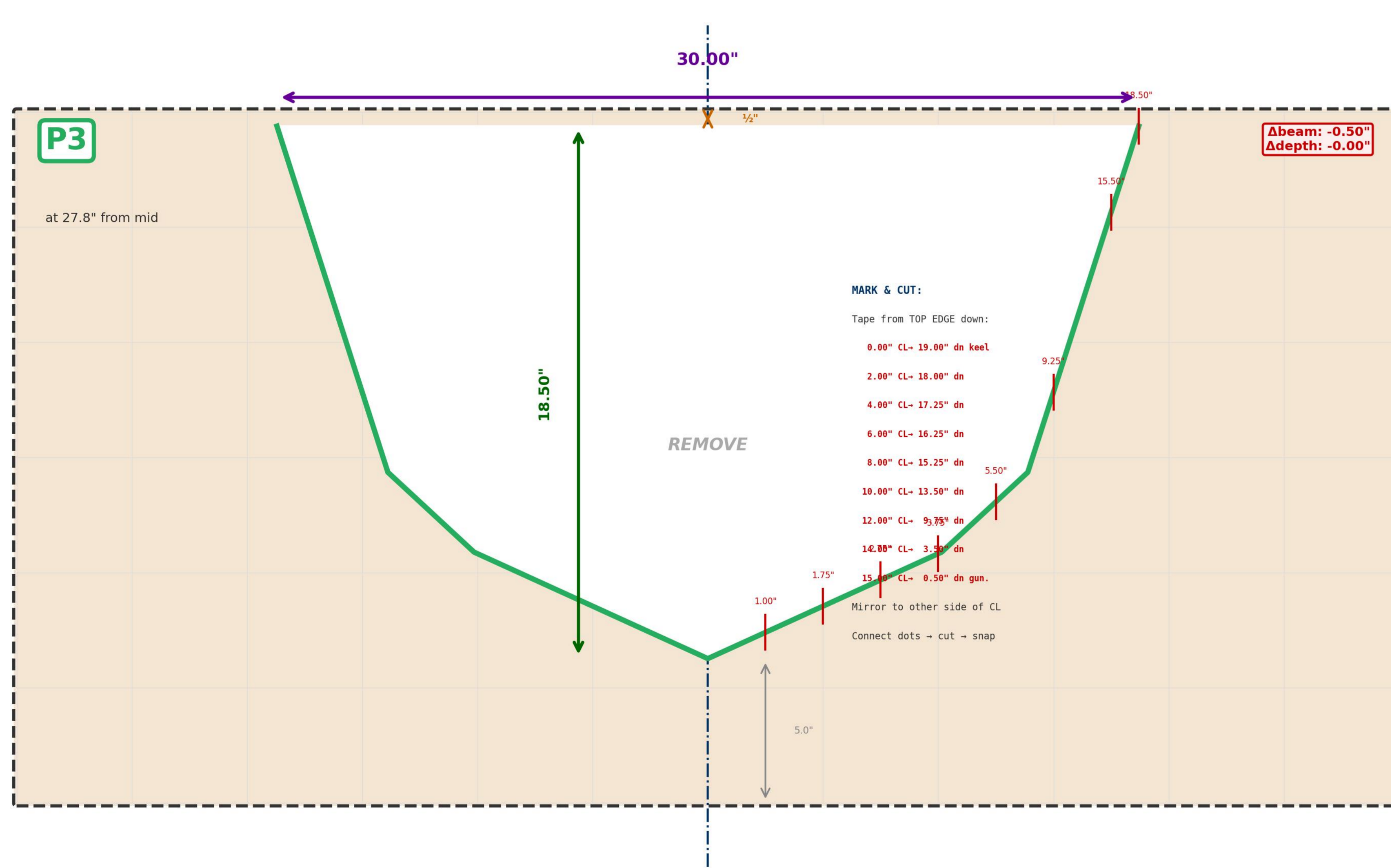
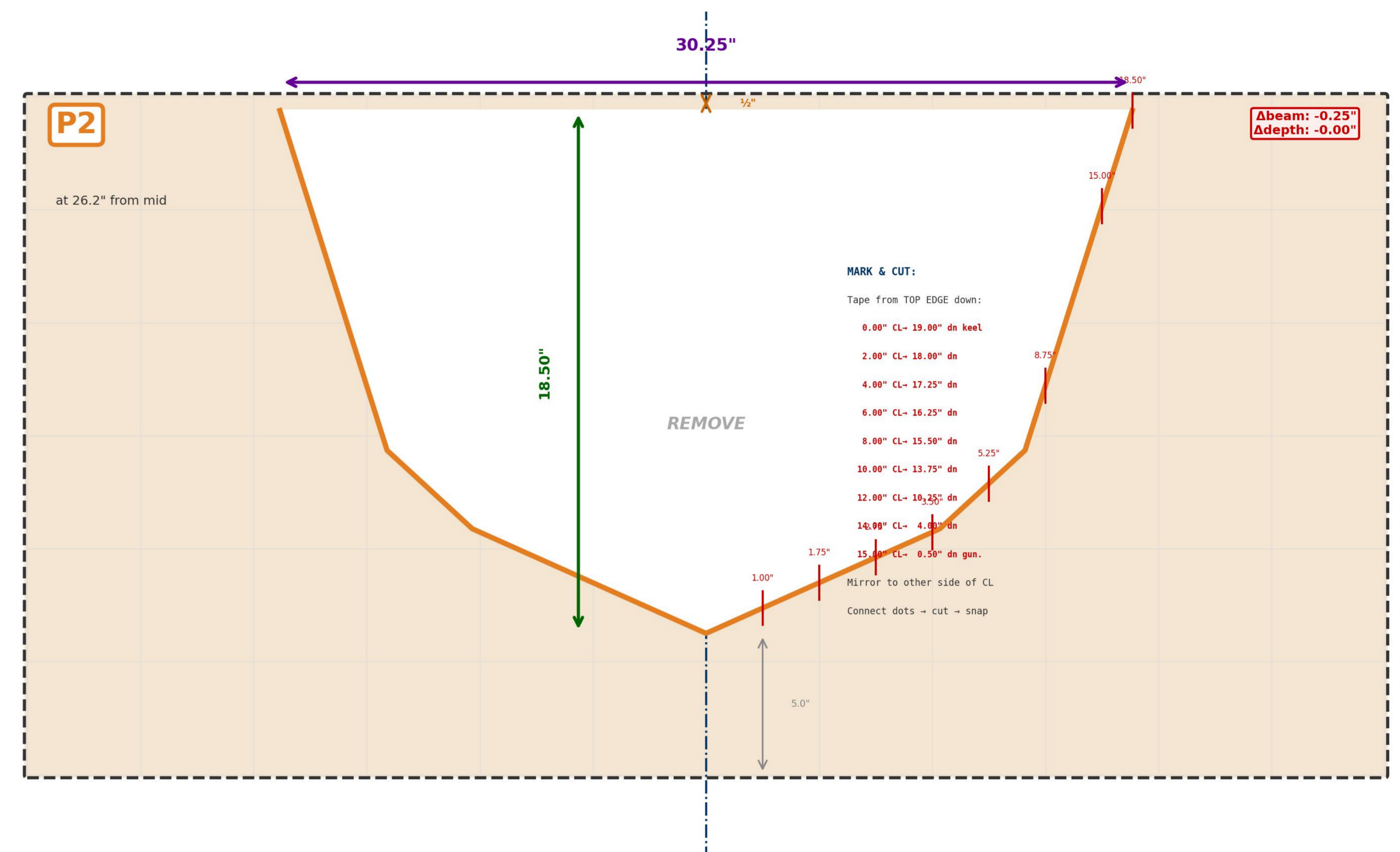
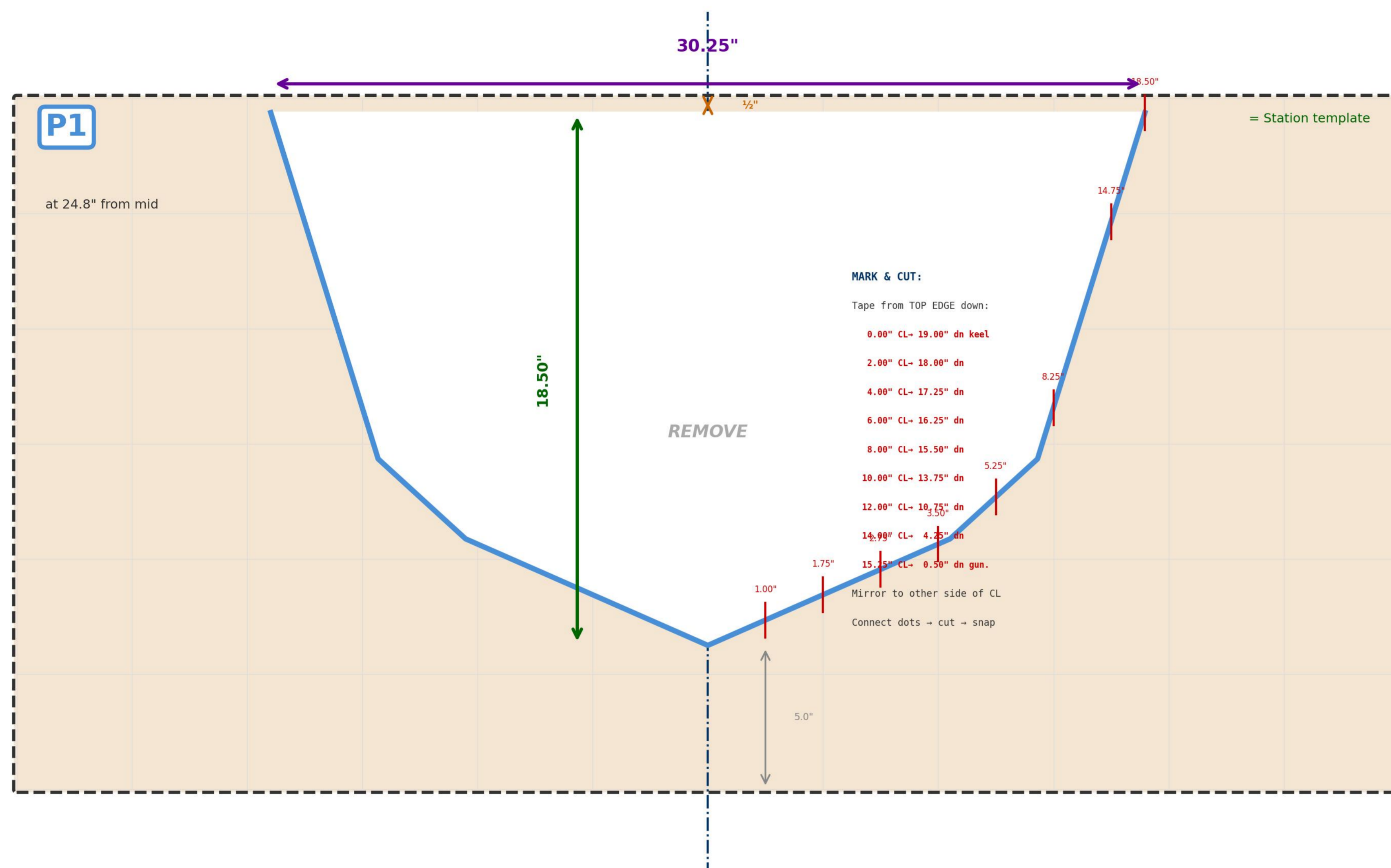
STATION D — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) ⚠️ PANELS DIFFER

Station beam: 31.25" | Depth: 18.50" | Dist from midship: 18" | Max panel difference: 0.59" beam, 0.00" depth



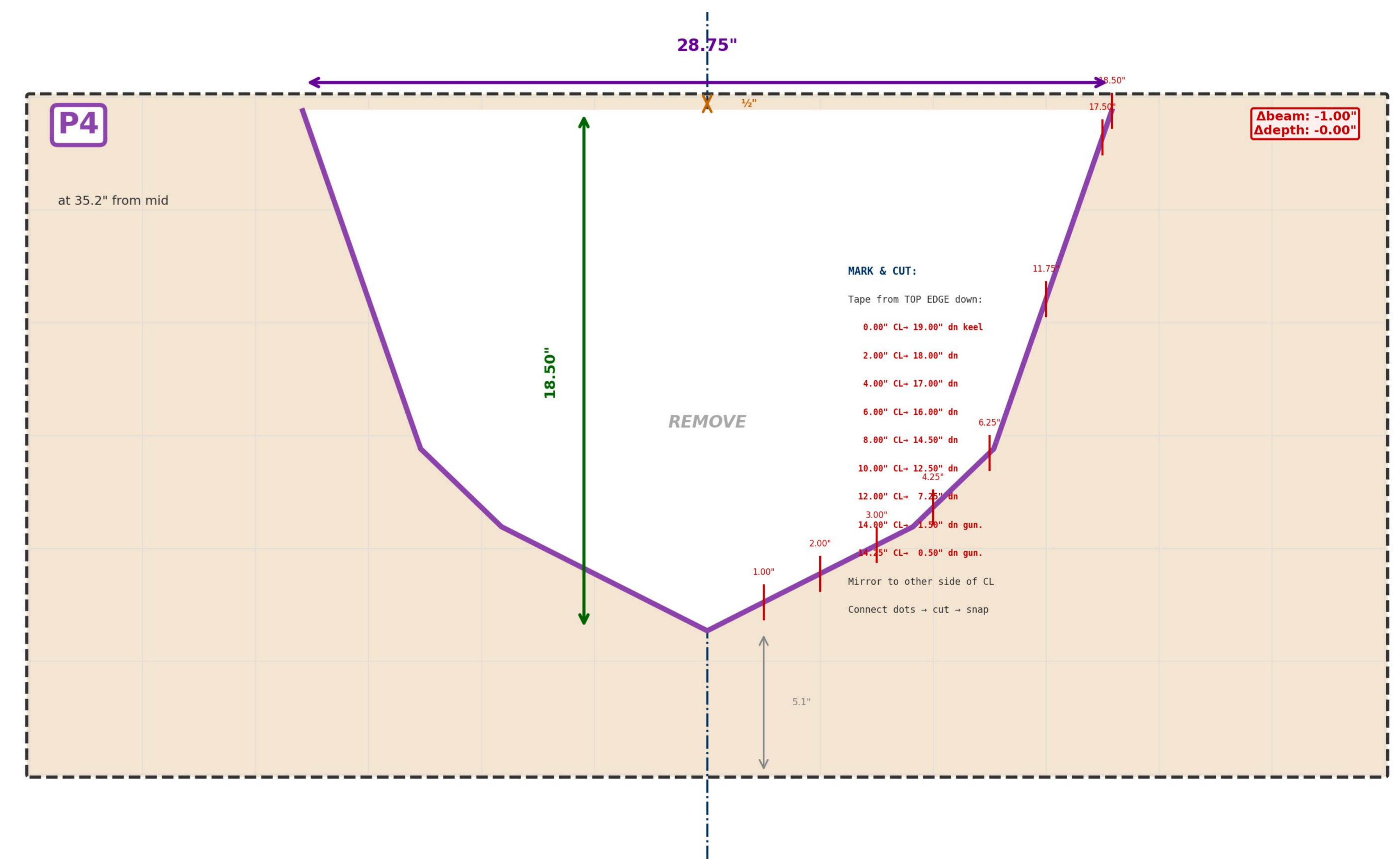
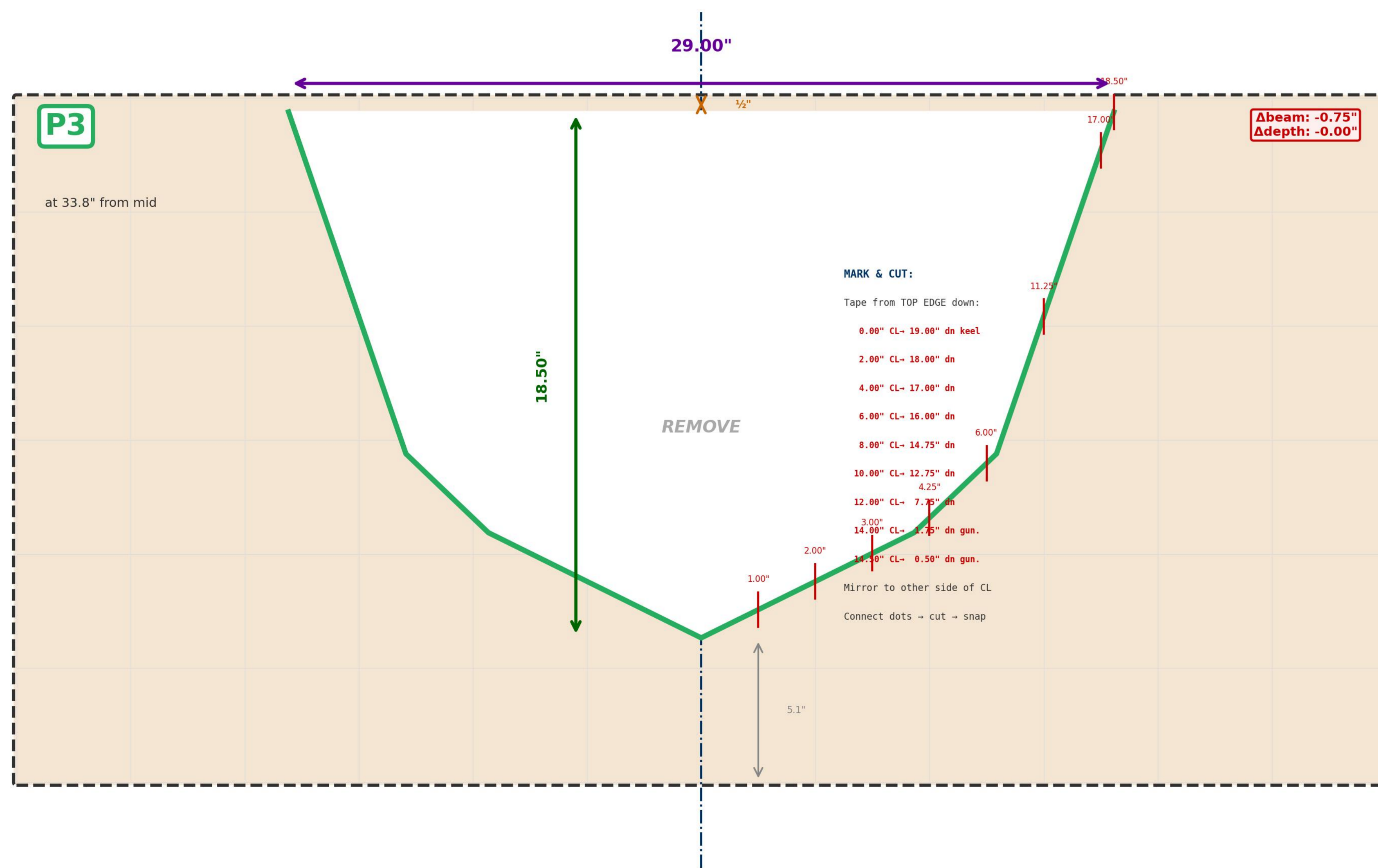
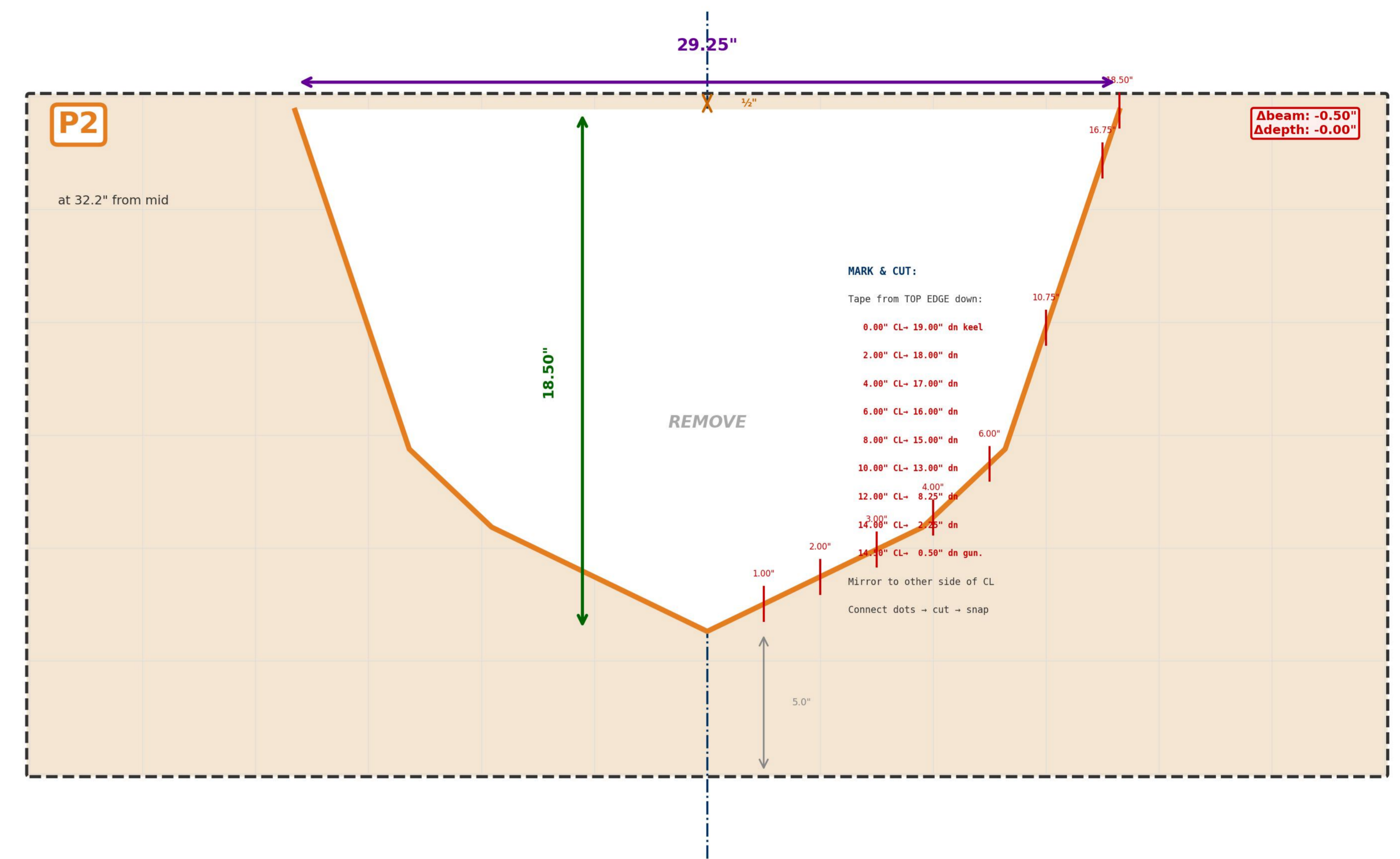
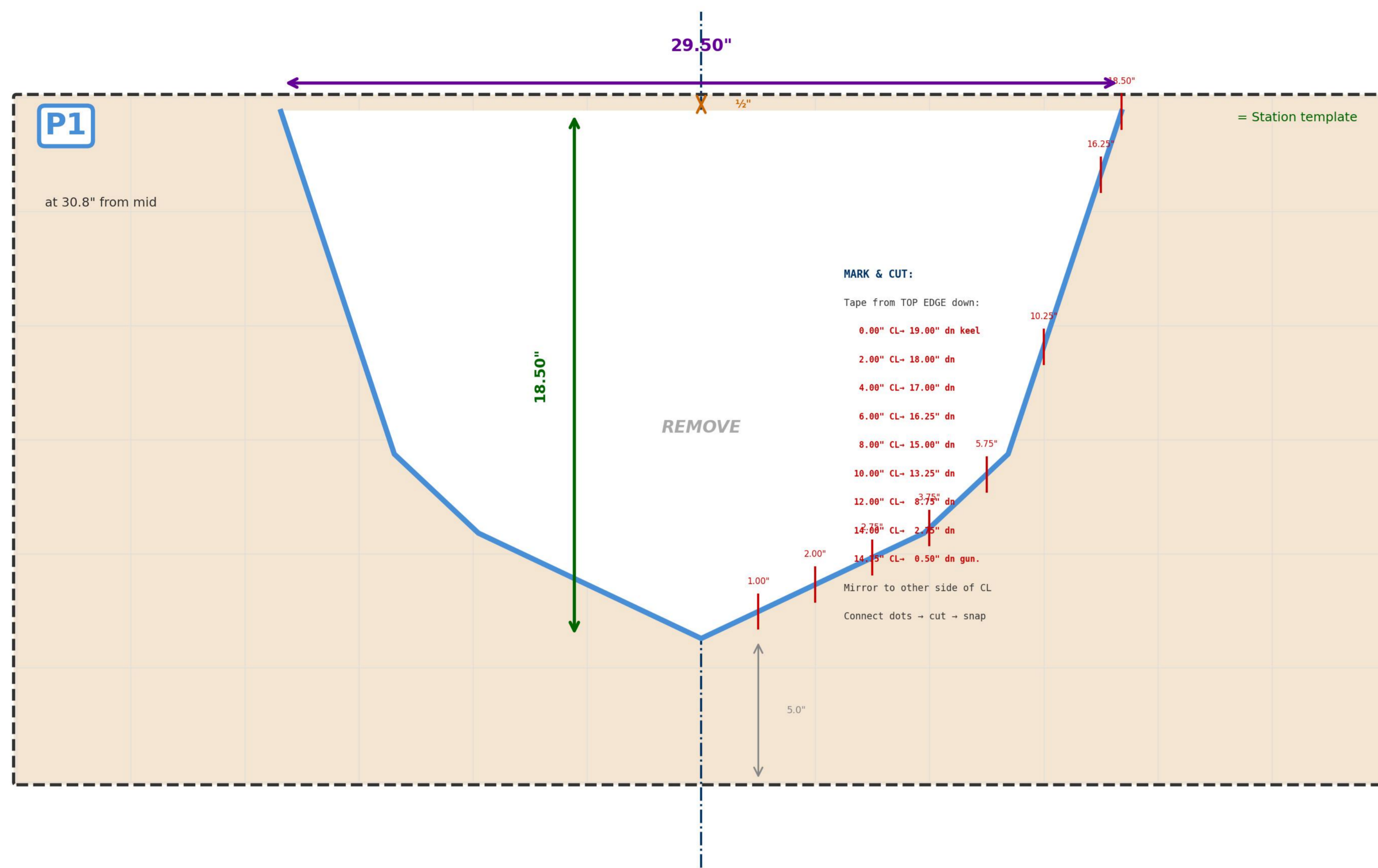
STATION E — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) \triangle PANELS DIFFER

Station beam: 30.50" | Depth: 18.50" | Dist from midship: 24" | Max panel difference: 0.75" beam, 0.02" depth



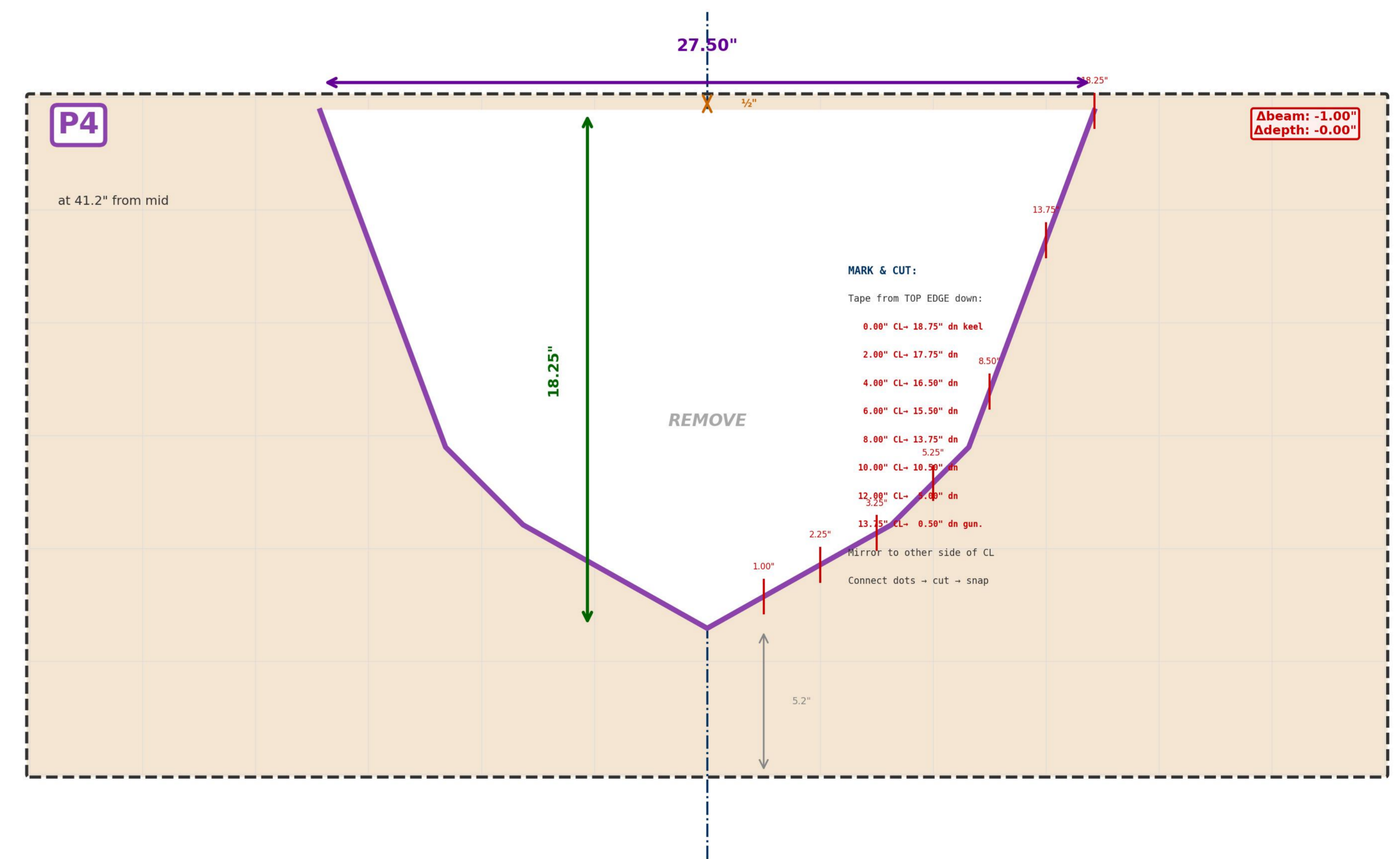
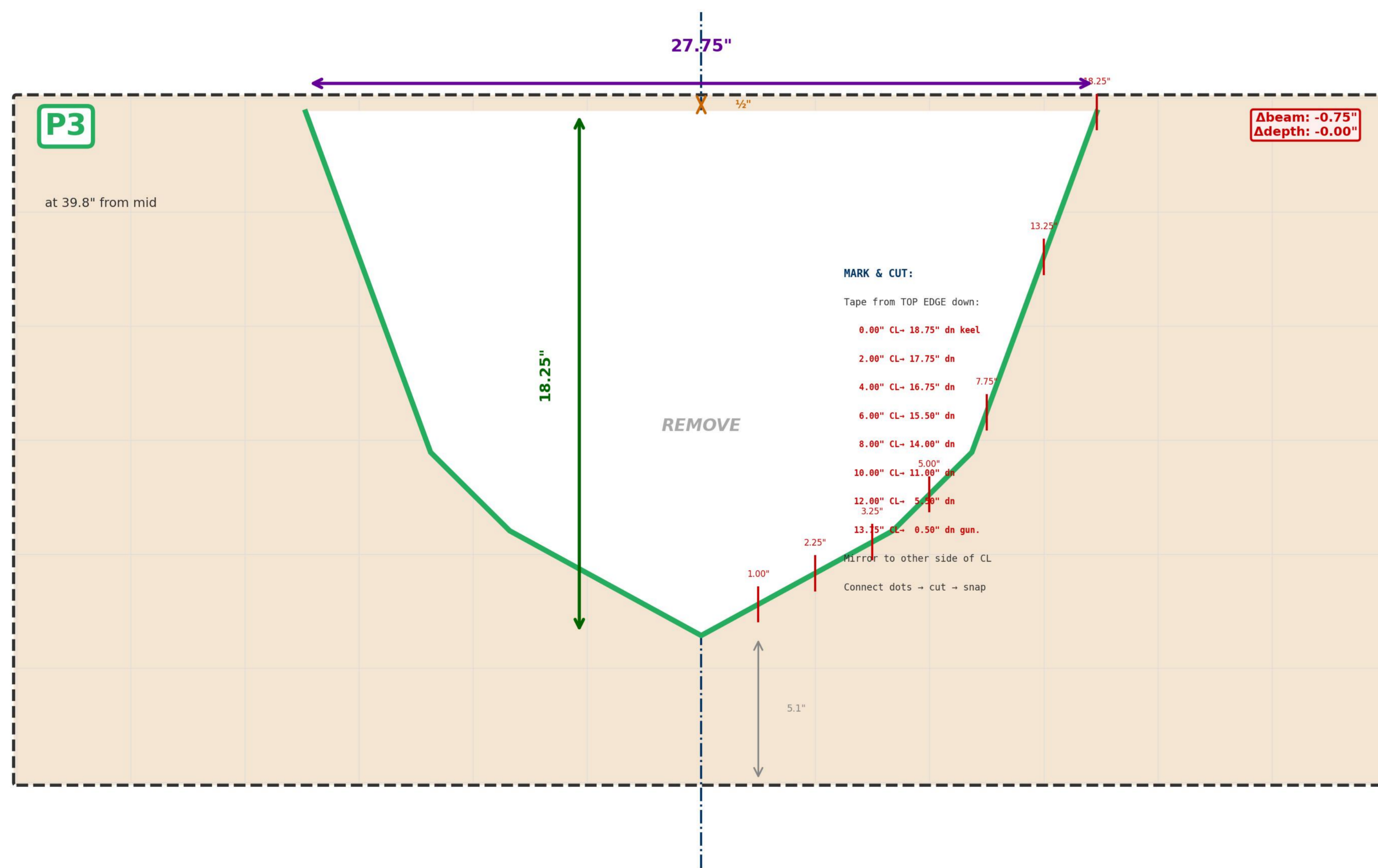
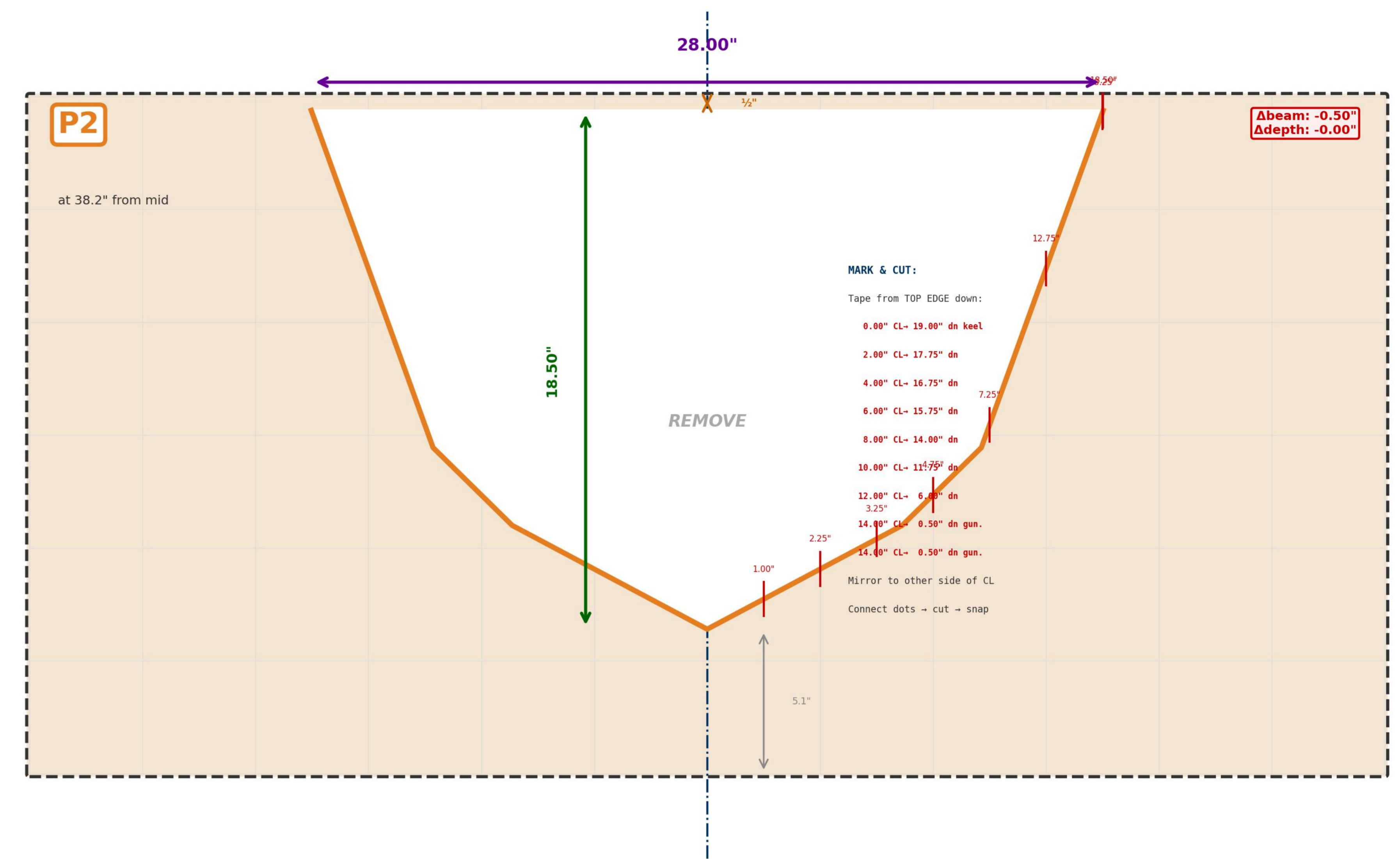
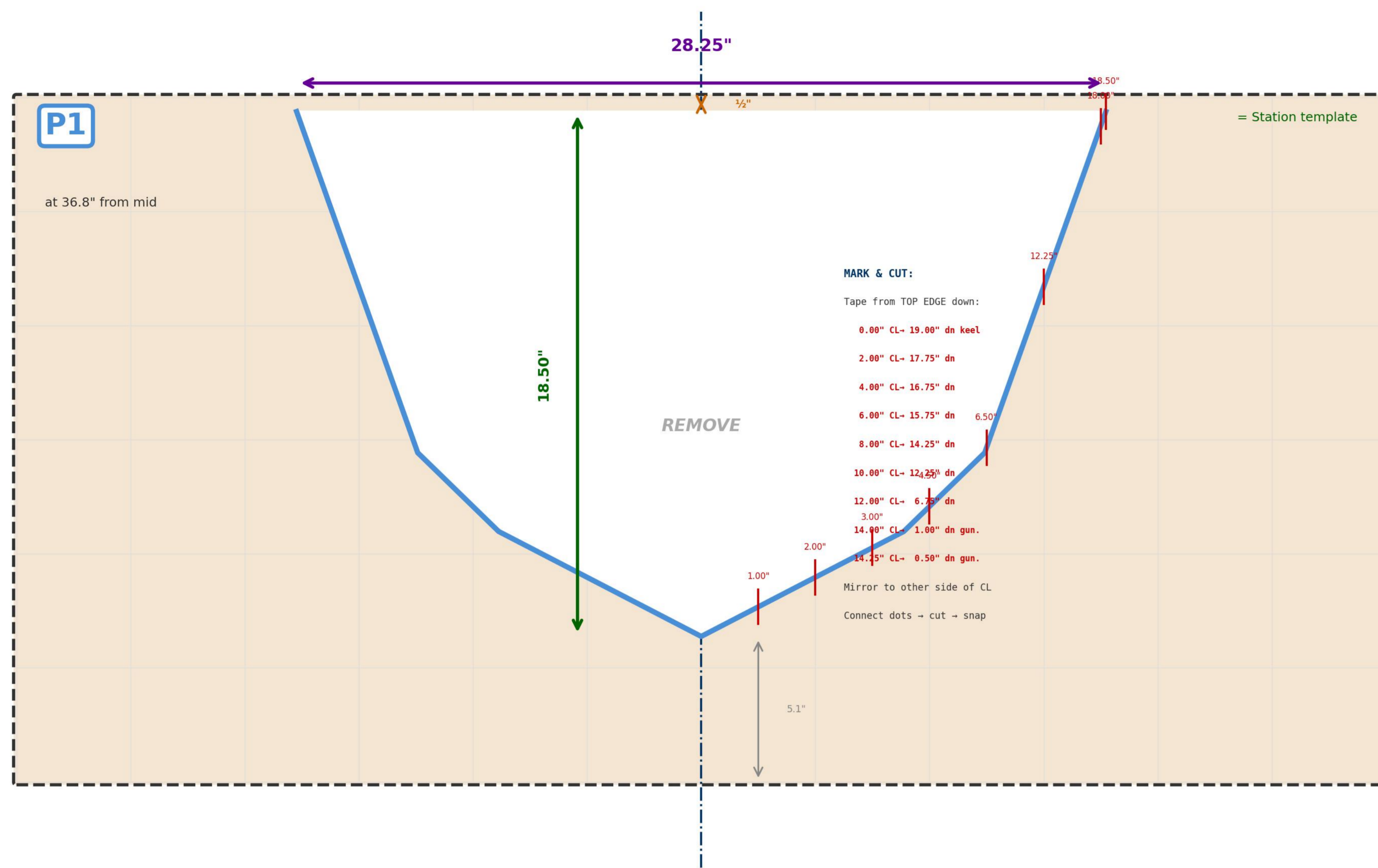
STATION F — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) ⚠️ PANELS DIFFER

Station beam: 29.50" | Depth: 18.50" | Dist from midship: 30" | Max panel difference: 0.95" beam, 0.06" depth



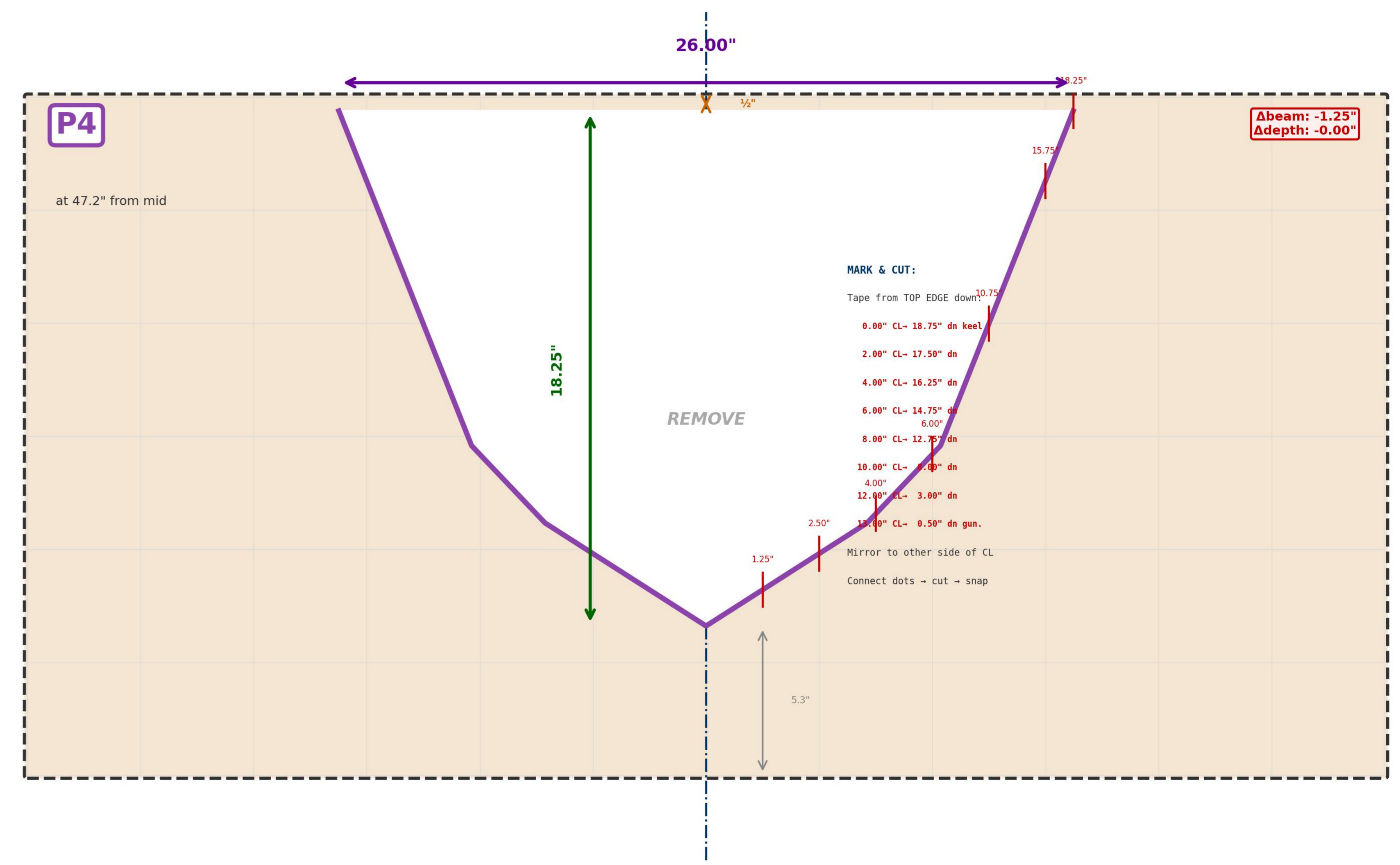
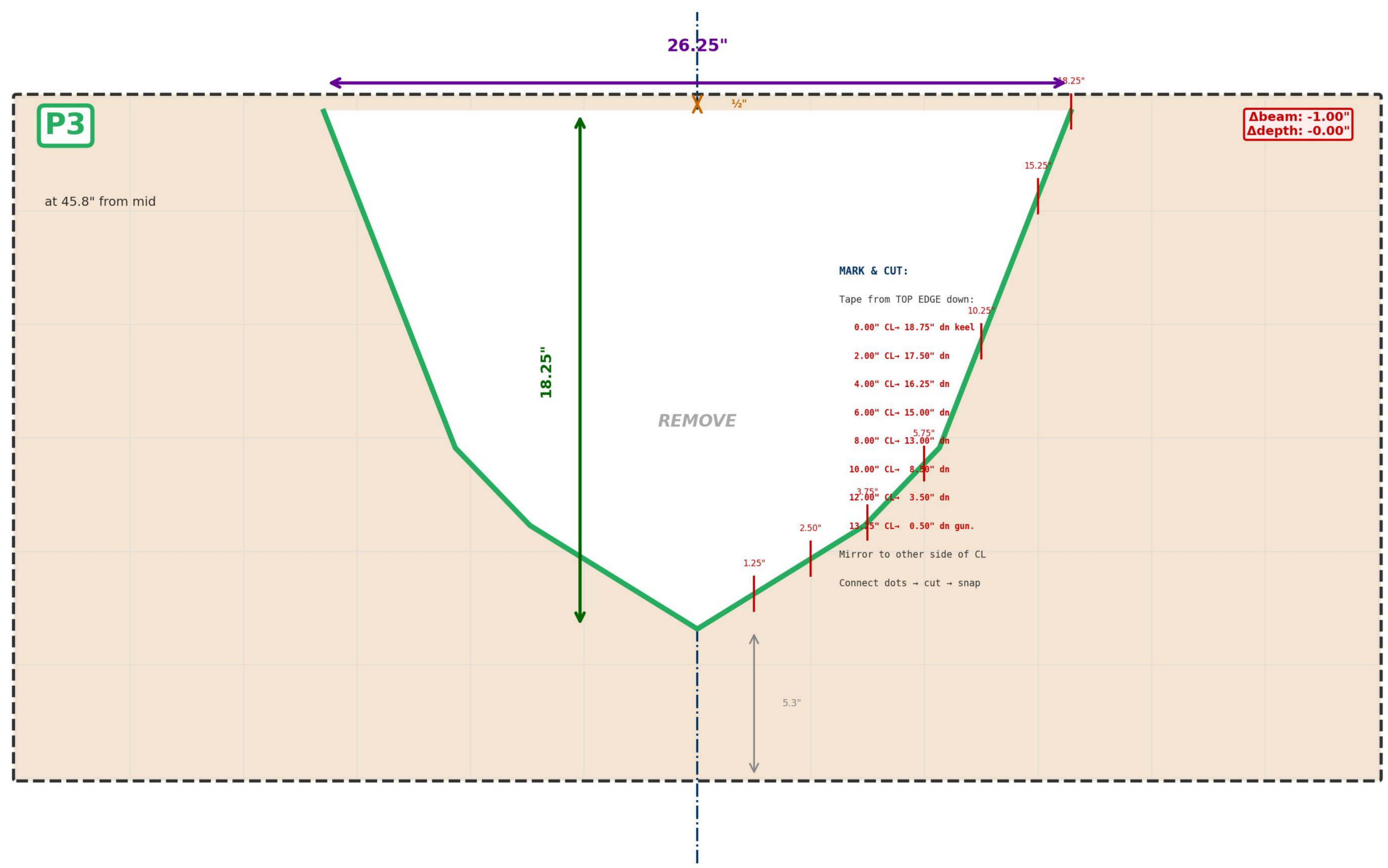
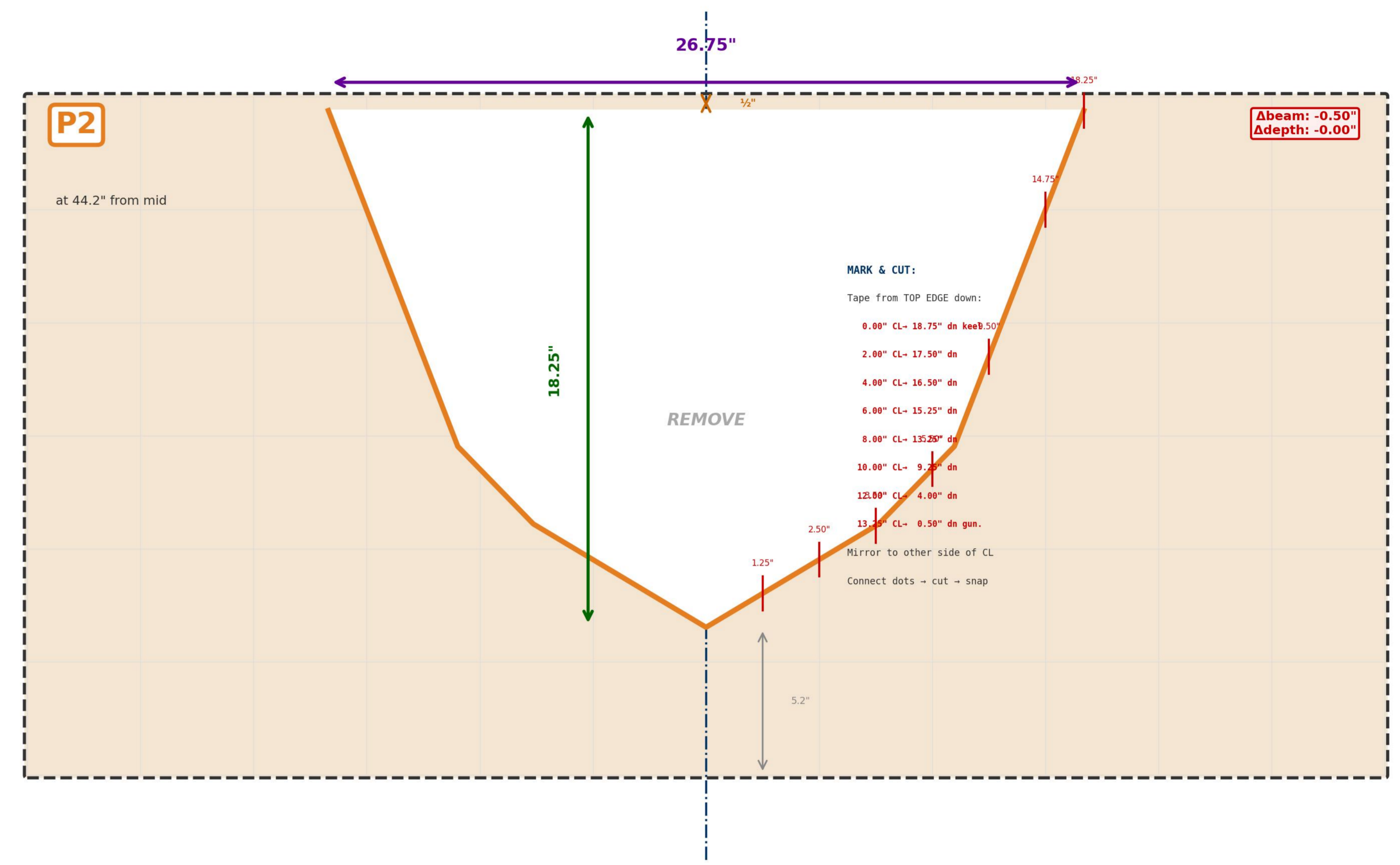
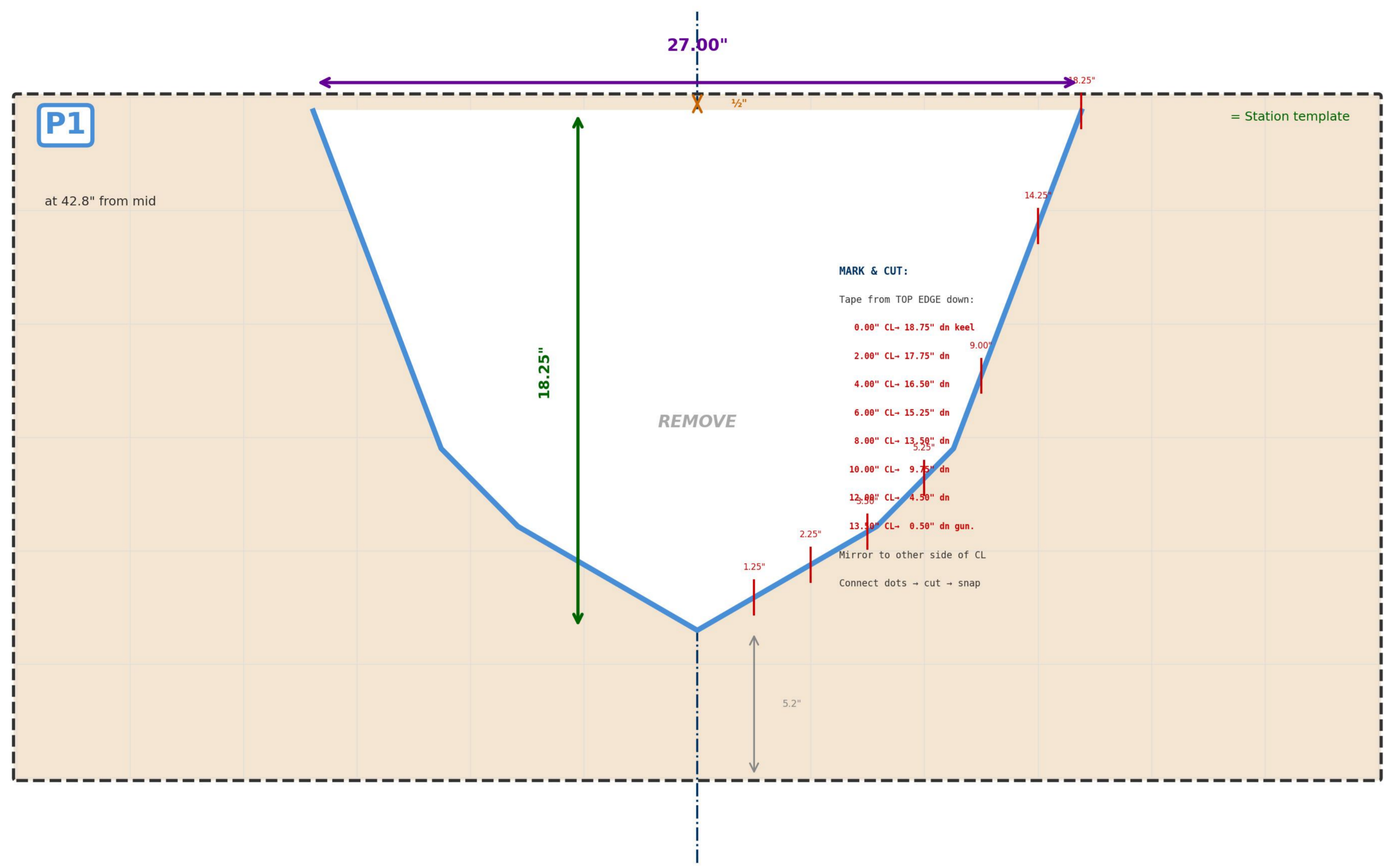
STATION G — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) ⚠️ PANELS DIFFER

Station beam: 28.50" | Depth: 18.50" | Dist from midship: 36" | Max panel difference: 1.10" beam, 0.08" depth



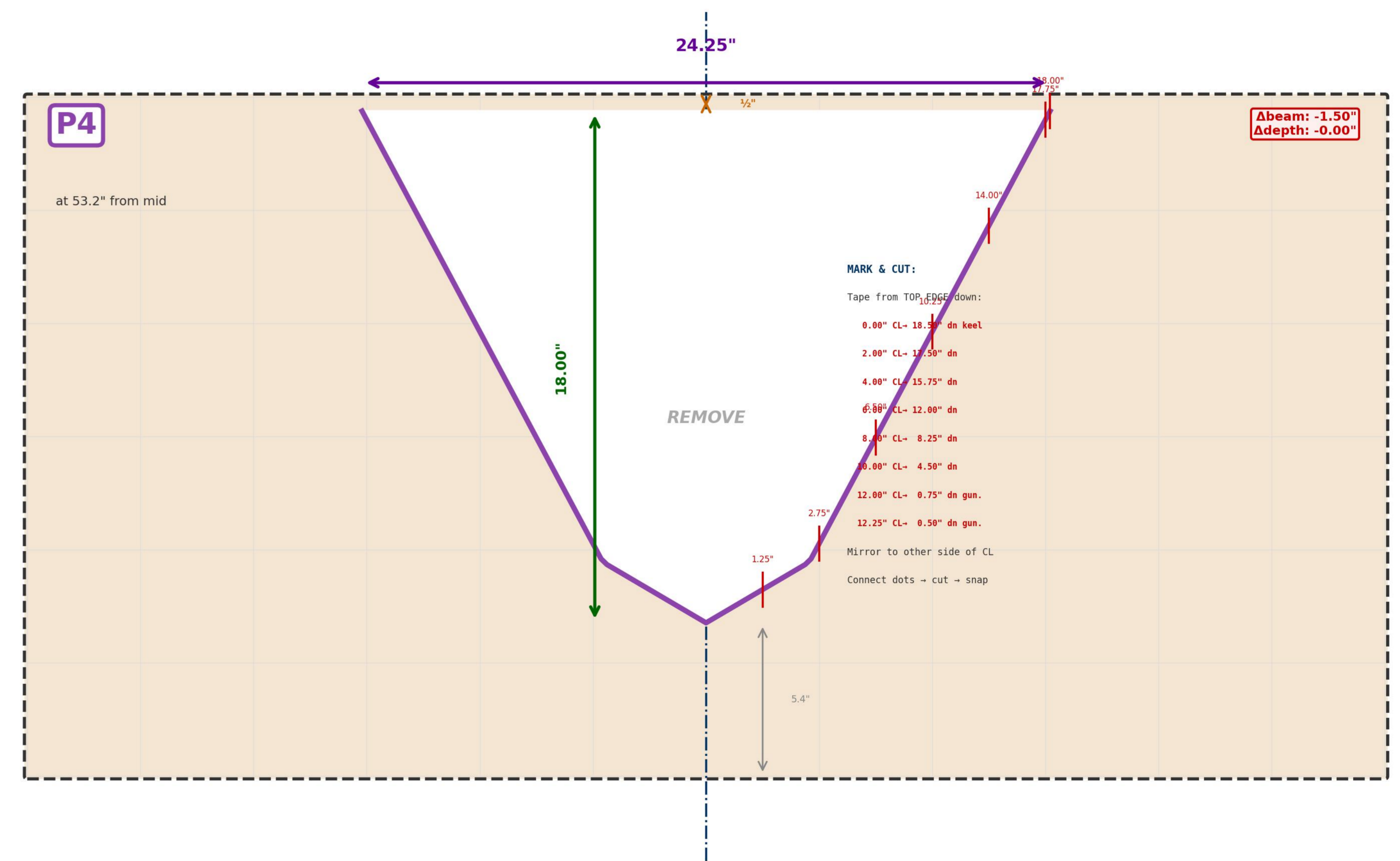
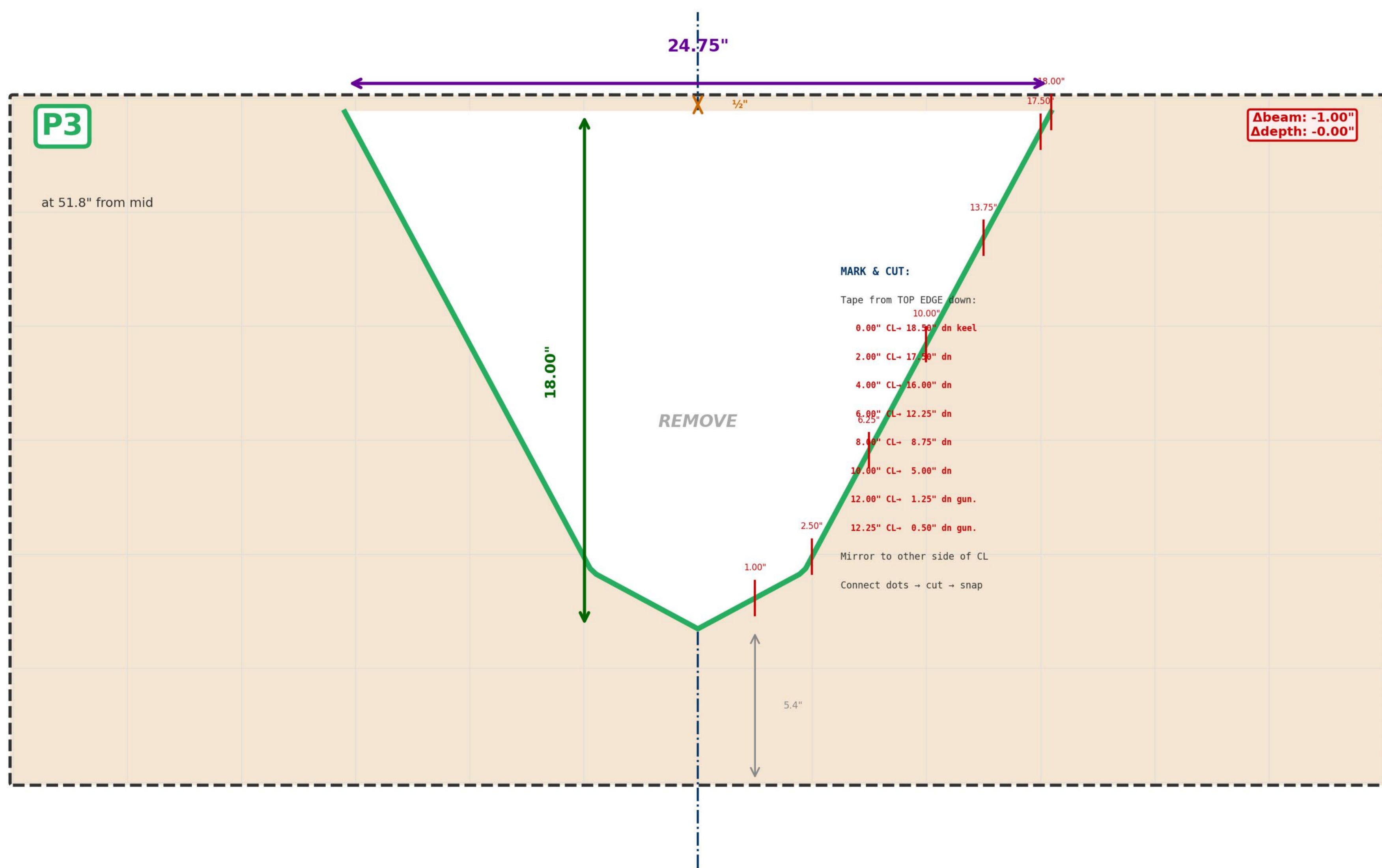
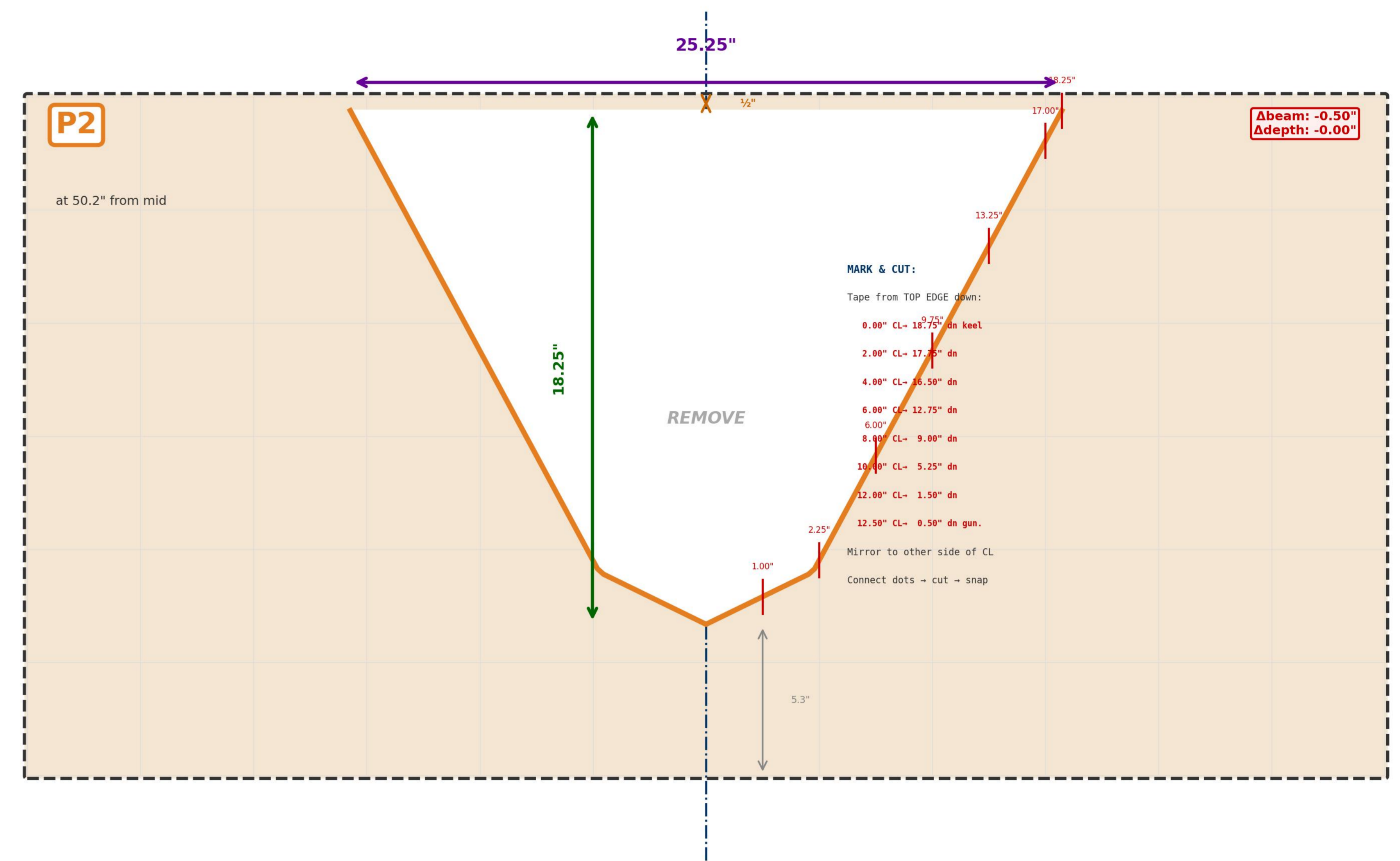
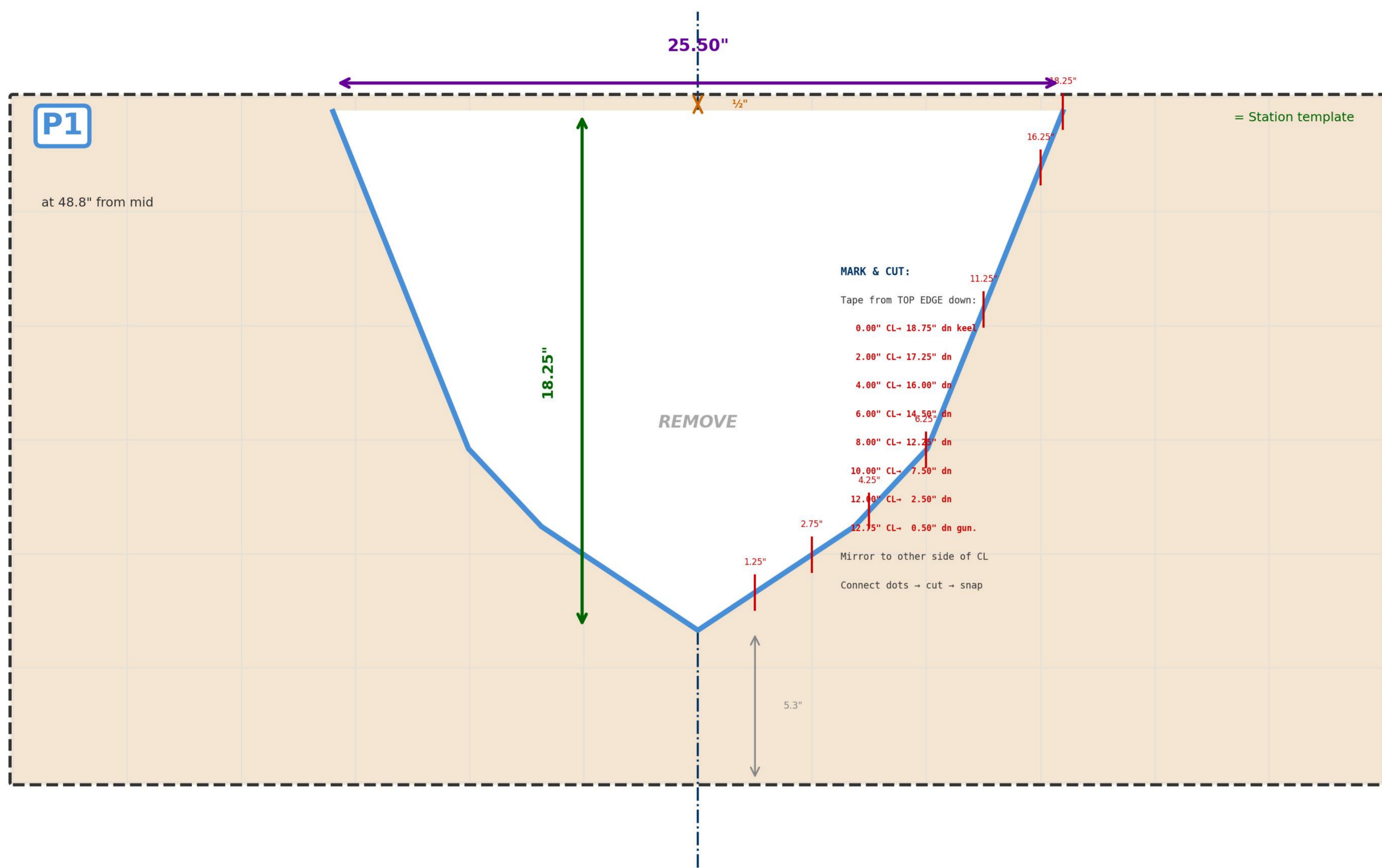
STATION H — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) ⚠️ PANELS DIFFER

Station beam: 27.25" | Depth: 18.25" | Dist from midship: 42" | Max panel difference: 1.30" beam, 0.11" depth



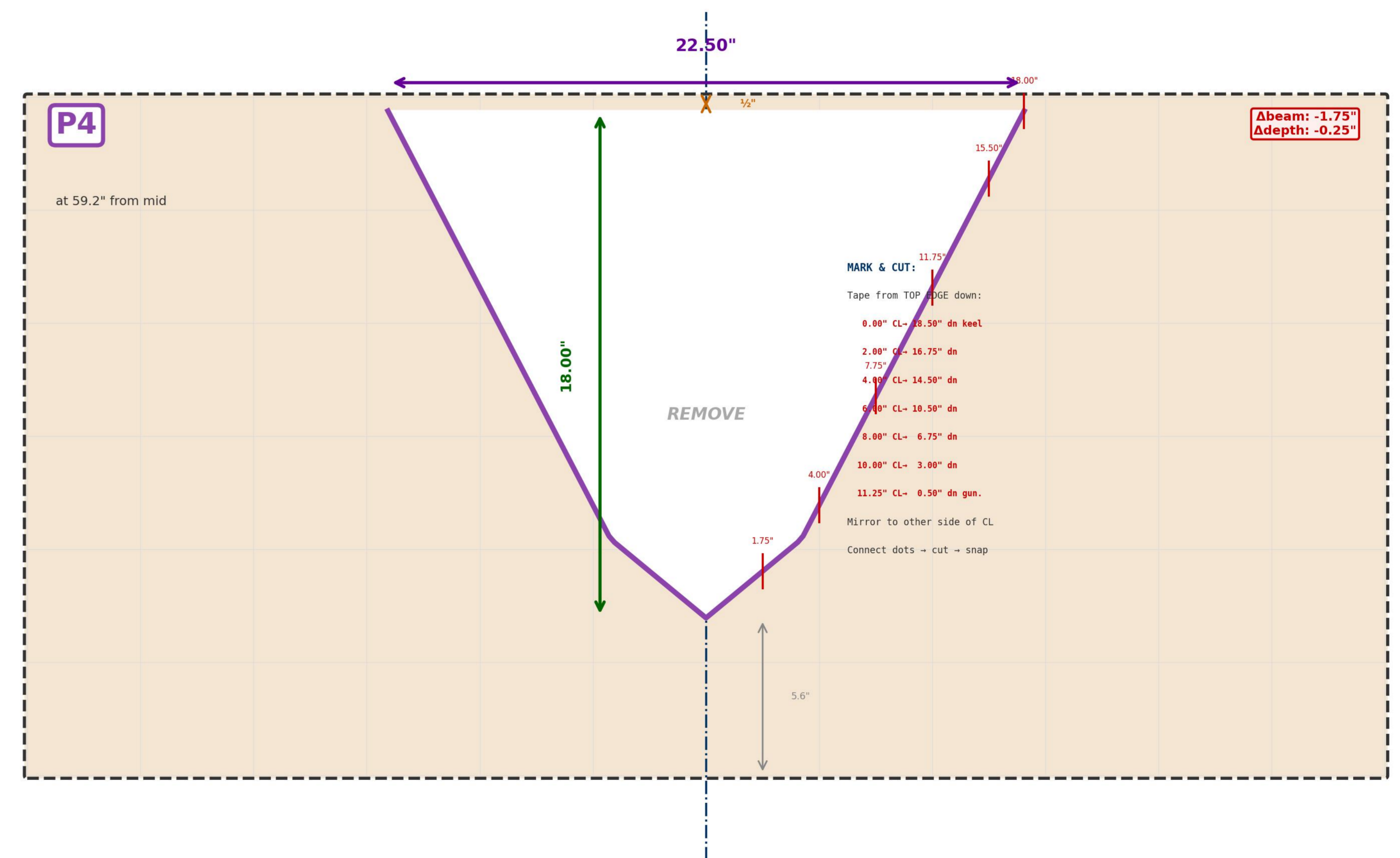
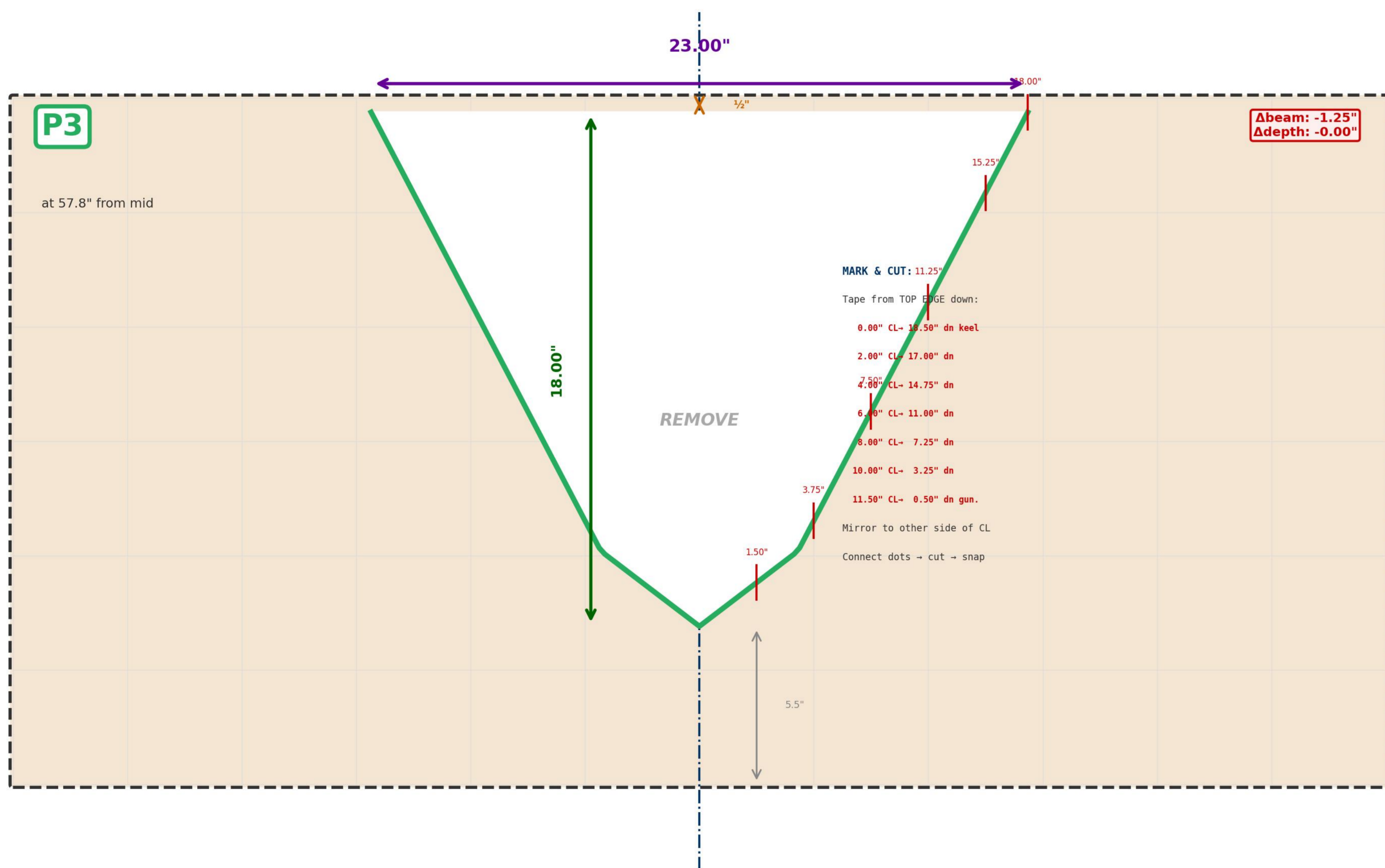
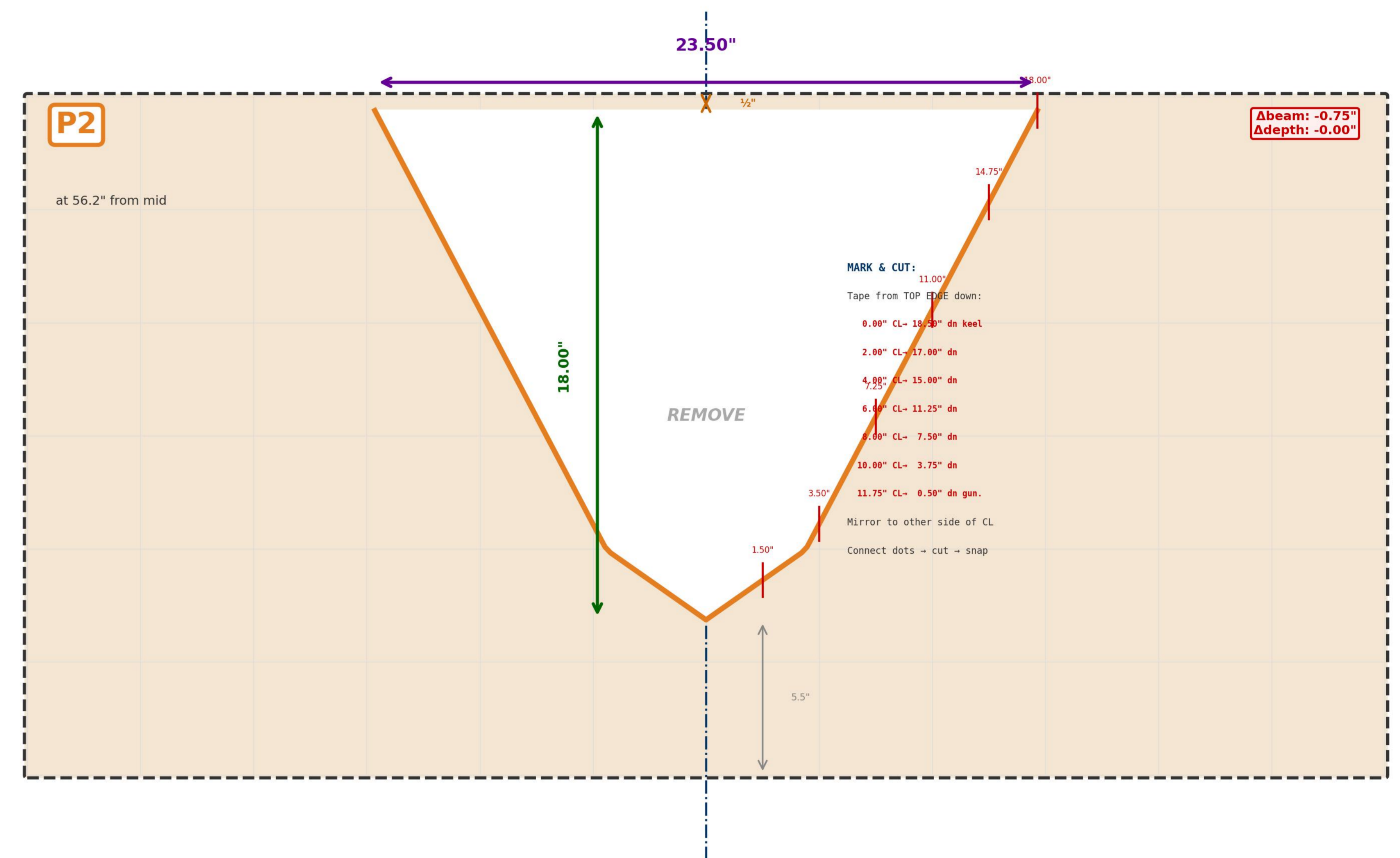
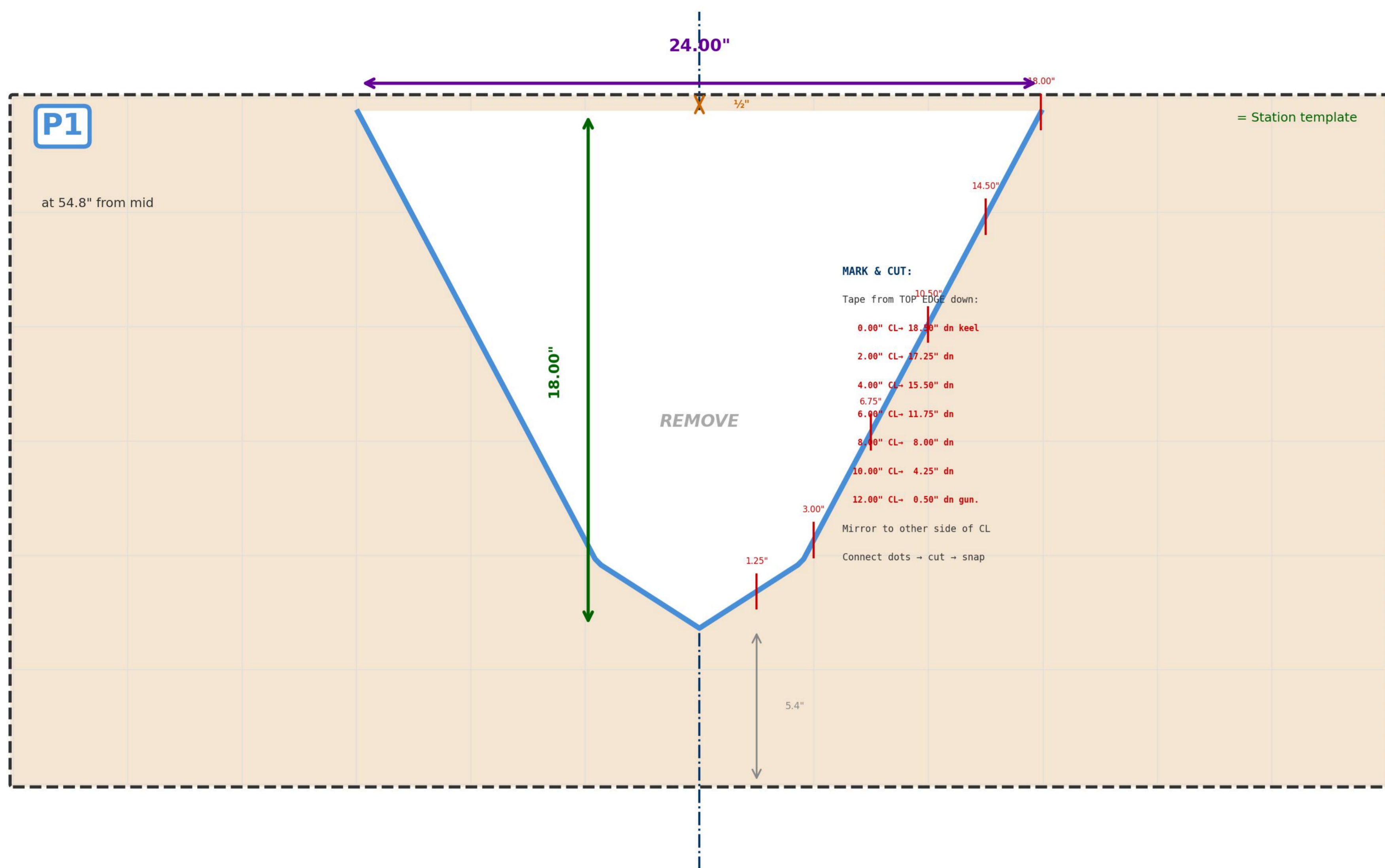
STATION I — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) \triangle PANELS DIFFER

Station beam: 25.75" | Depth: 18.25" | Dist from midship: 48" | Max panel difference: 1.45" beam, 0.11" depth



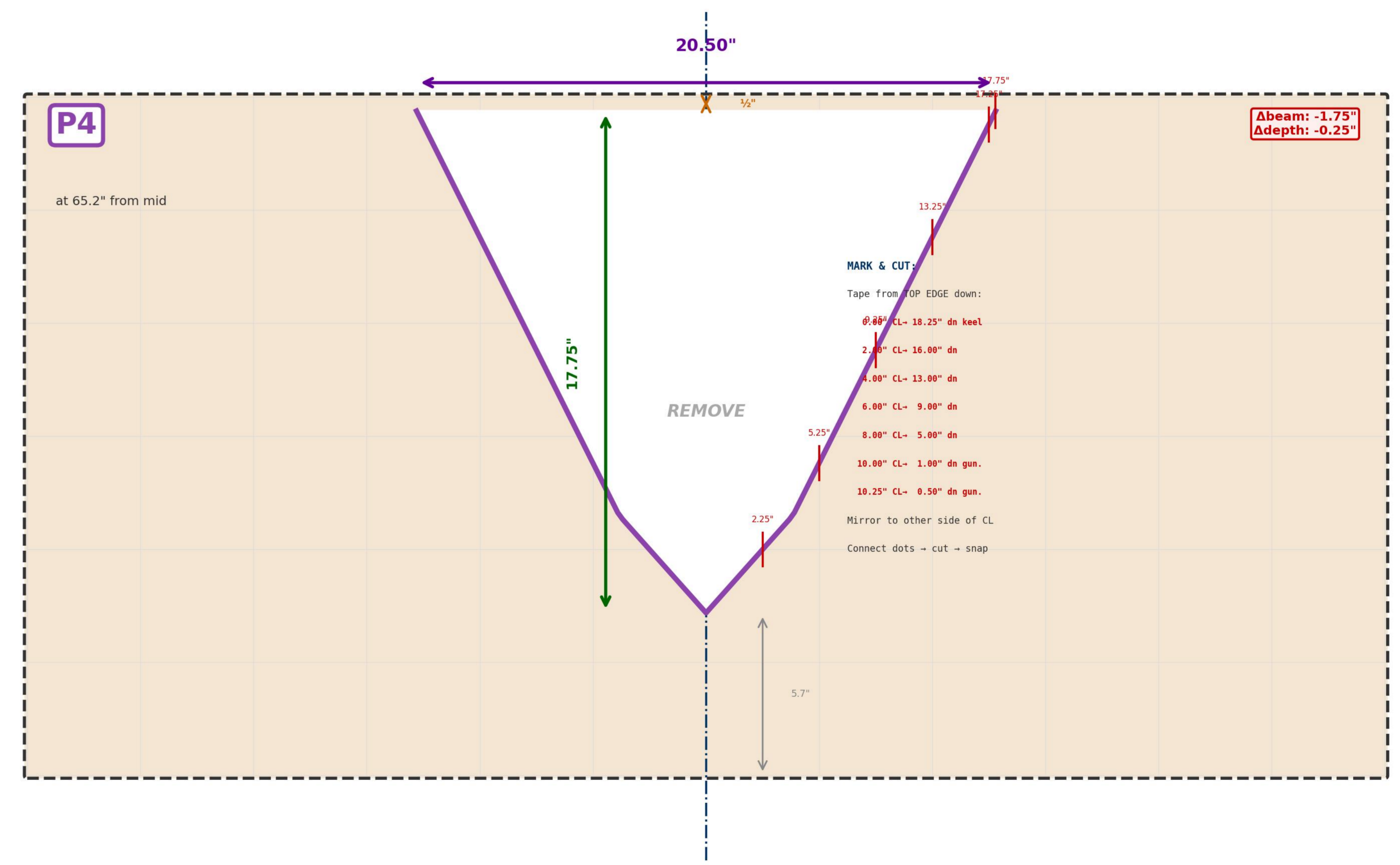
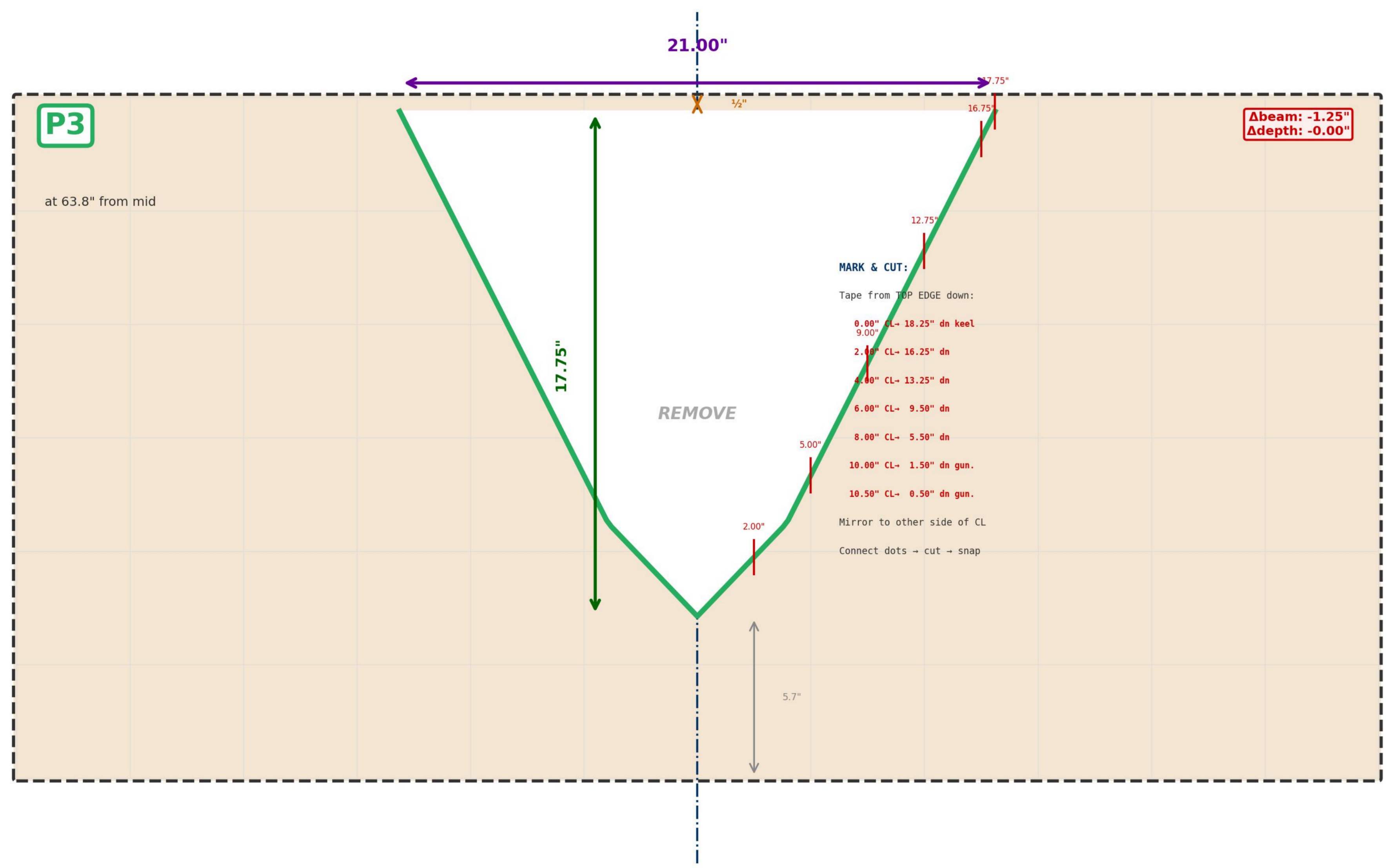
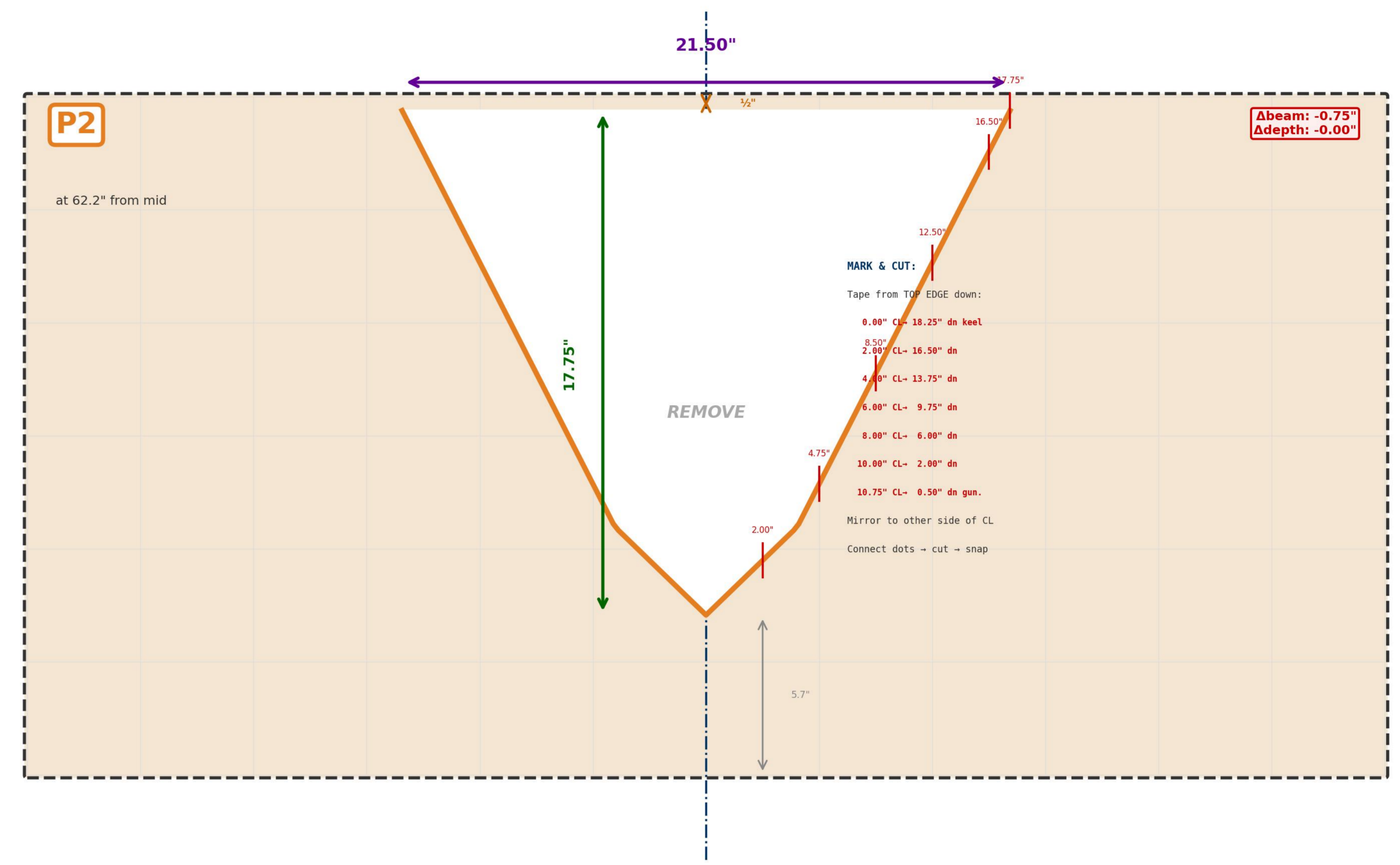
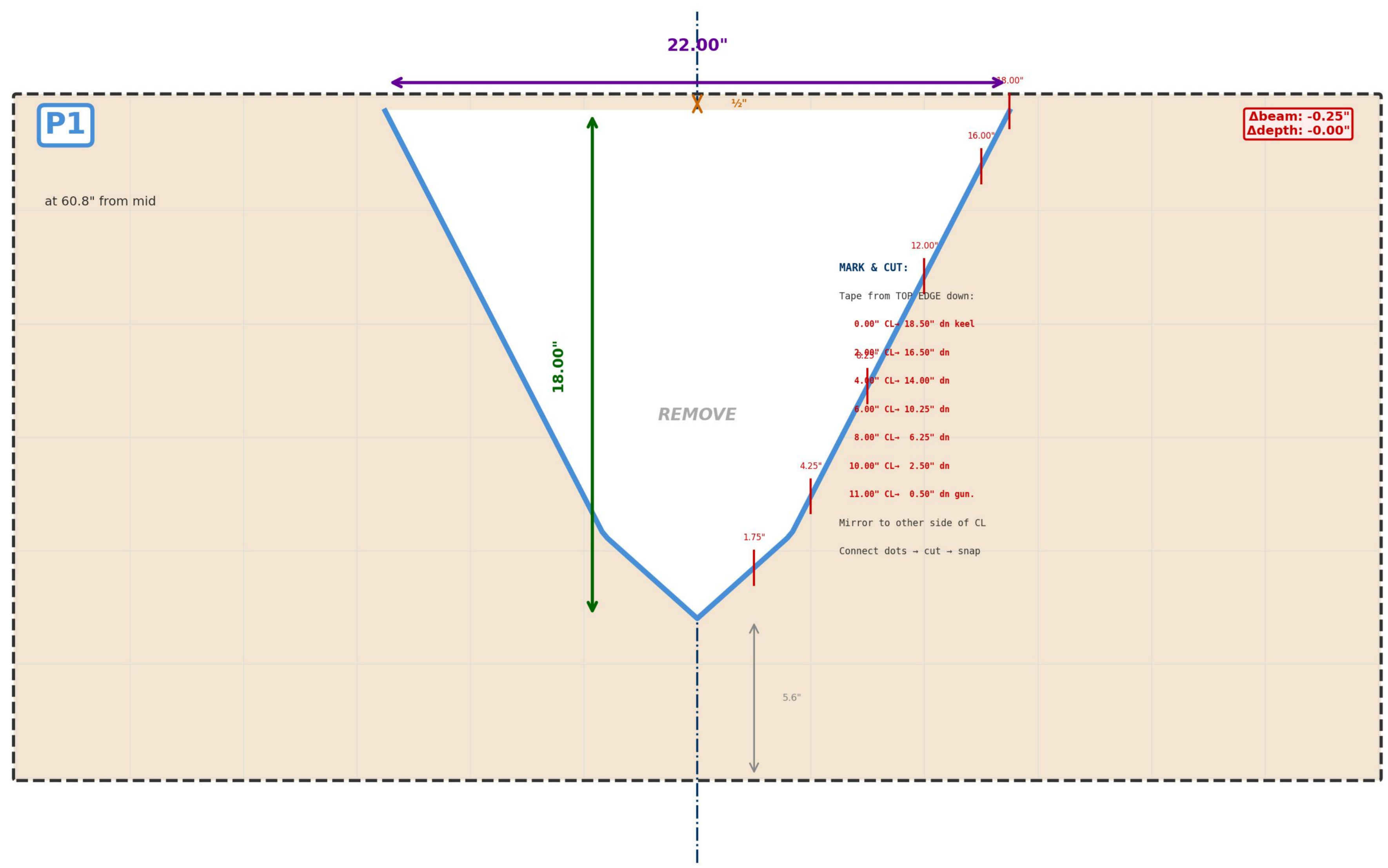
STATION J — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) \triangle PANELS DIFFER

Station beam: 24.00" | Depth: 18.00" | Dist from midship: 54" | Max panel difference: 1.63" beam, 0.14" depth



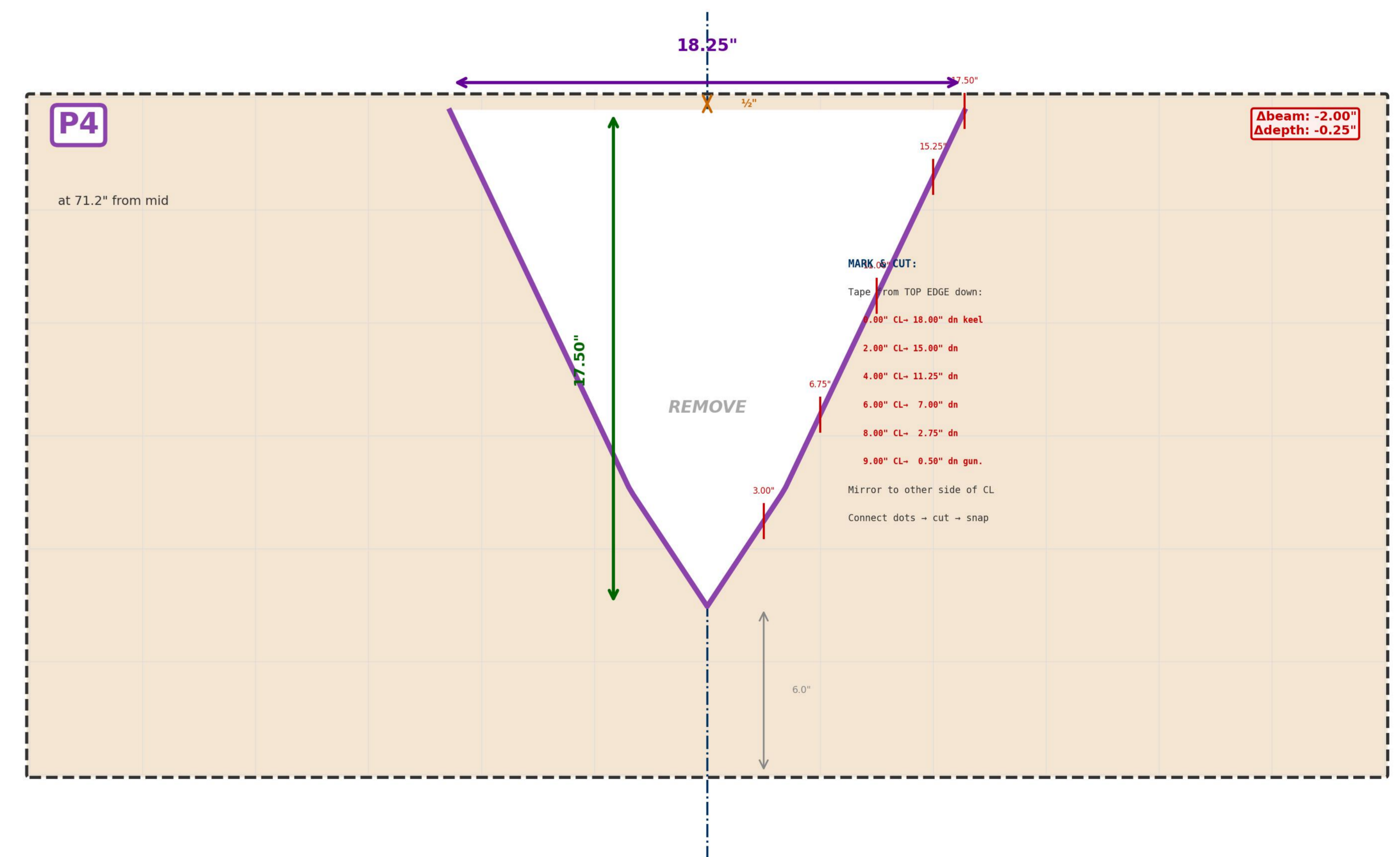
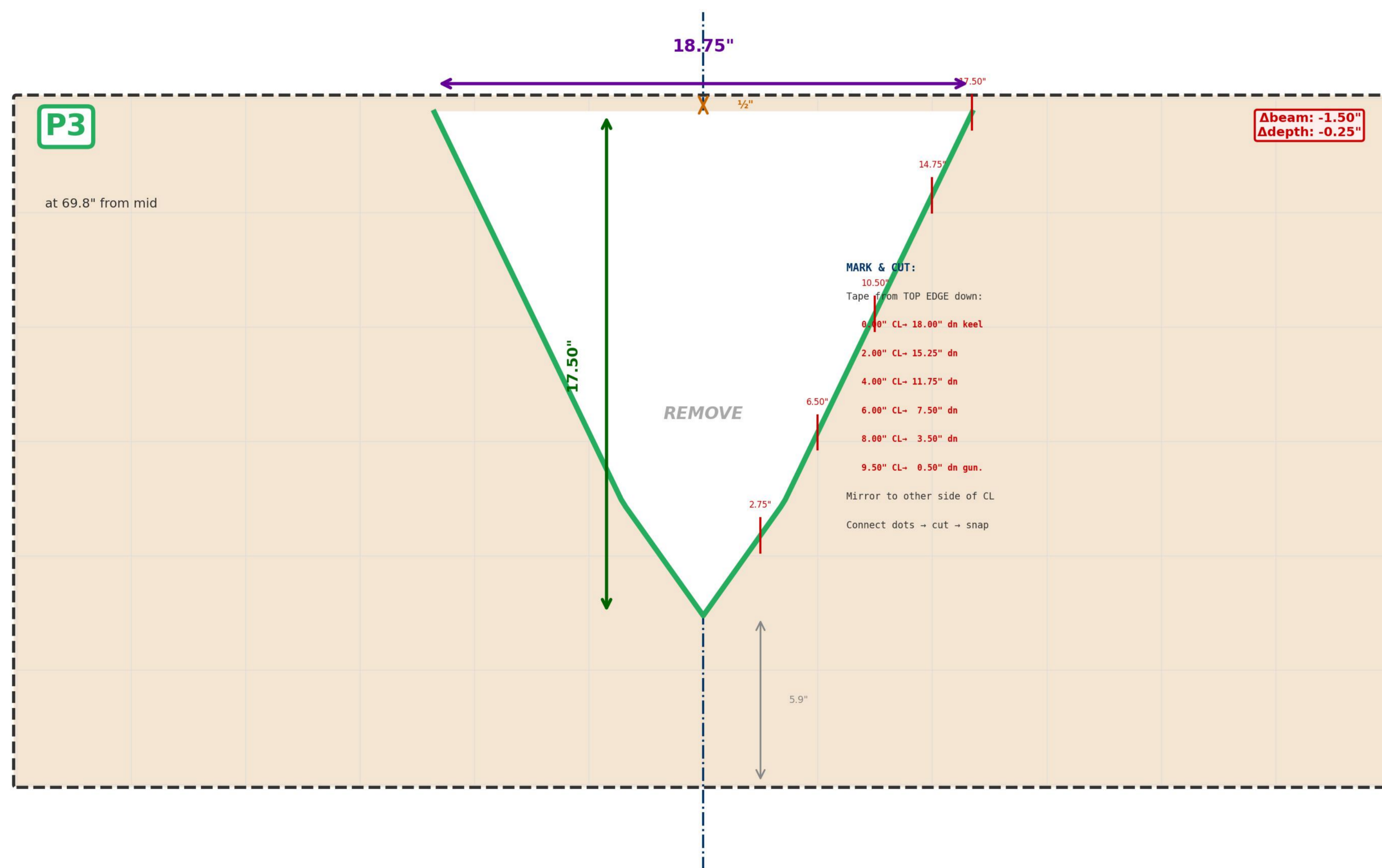
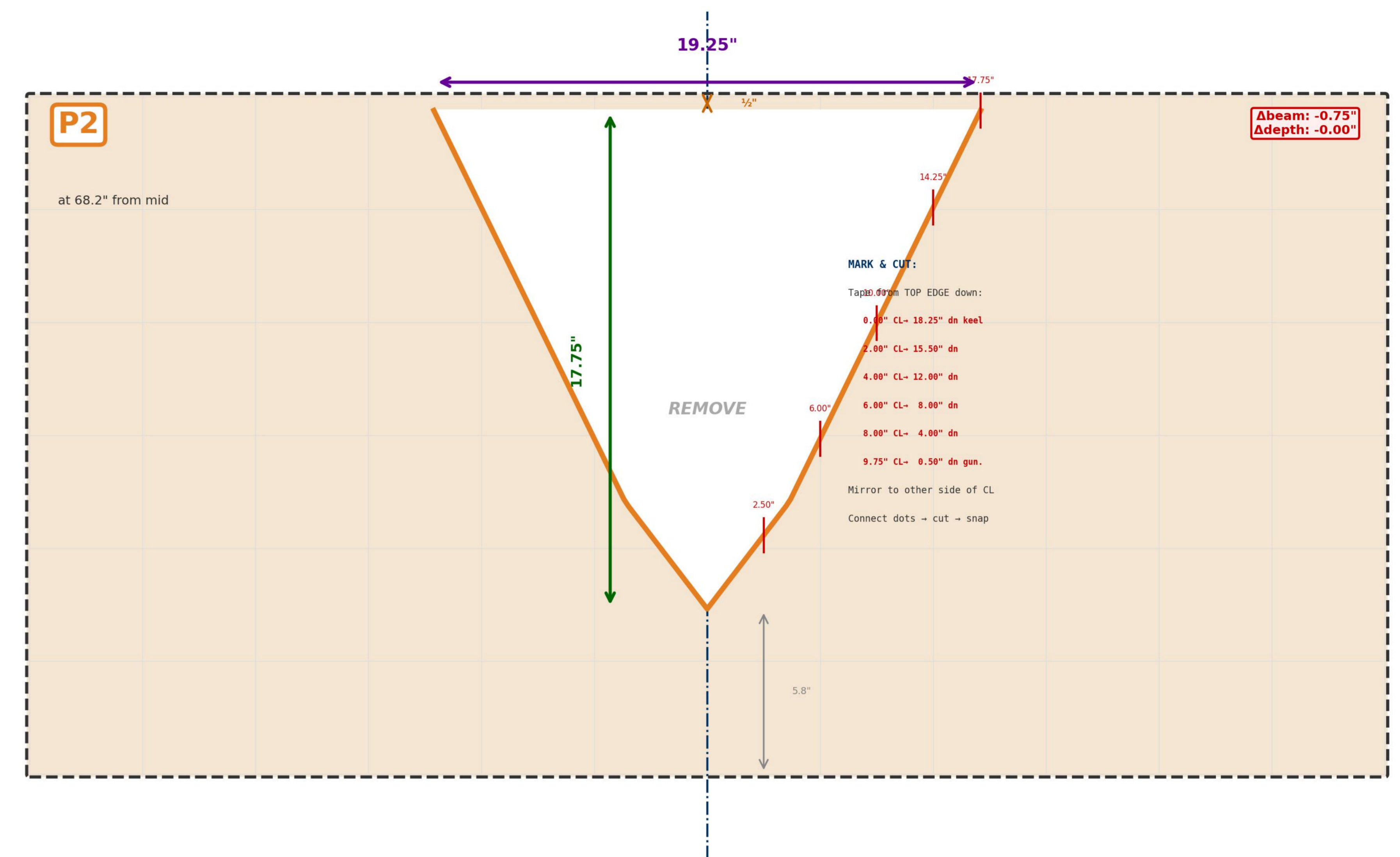
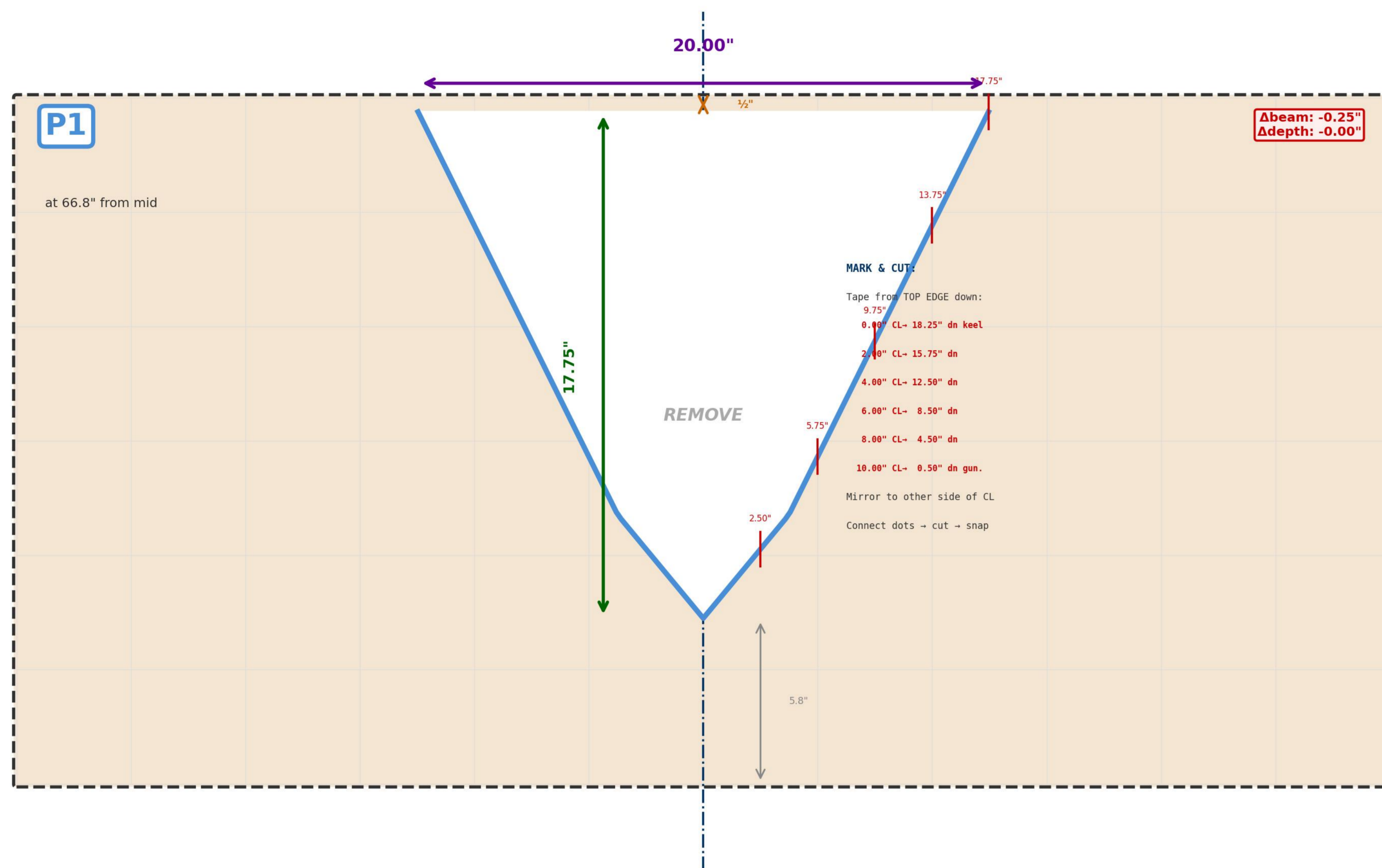
STATION K — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) ⚠️ PANELS DIFFER

Station beam: 22.25" | Depth: 18.00" | Dist from midship: 60" | Max panel difference: 1.79" beam, 0.16" depth



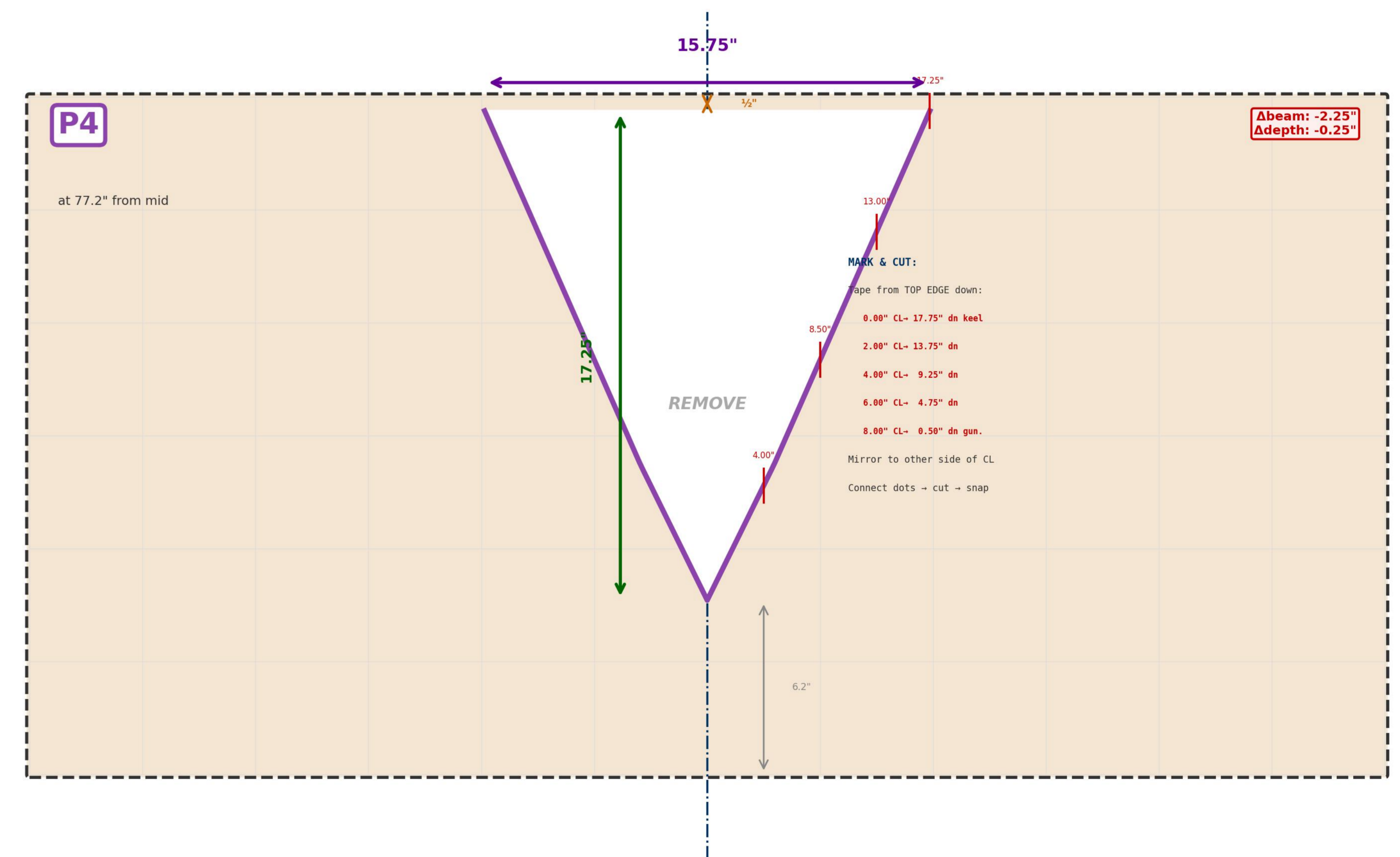
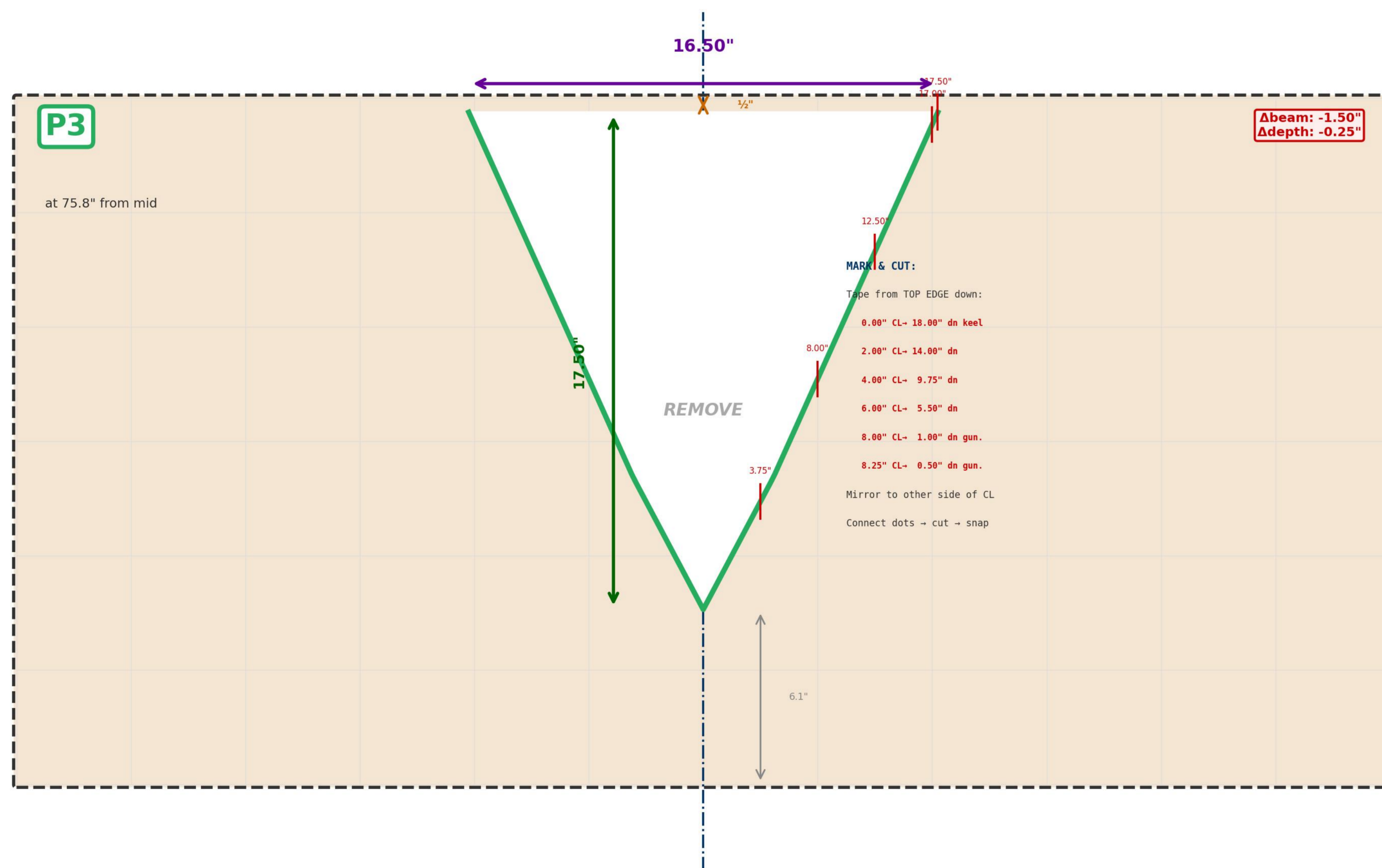
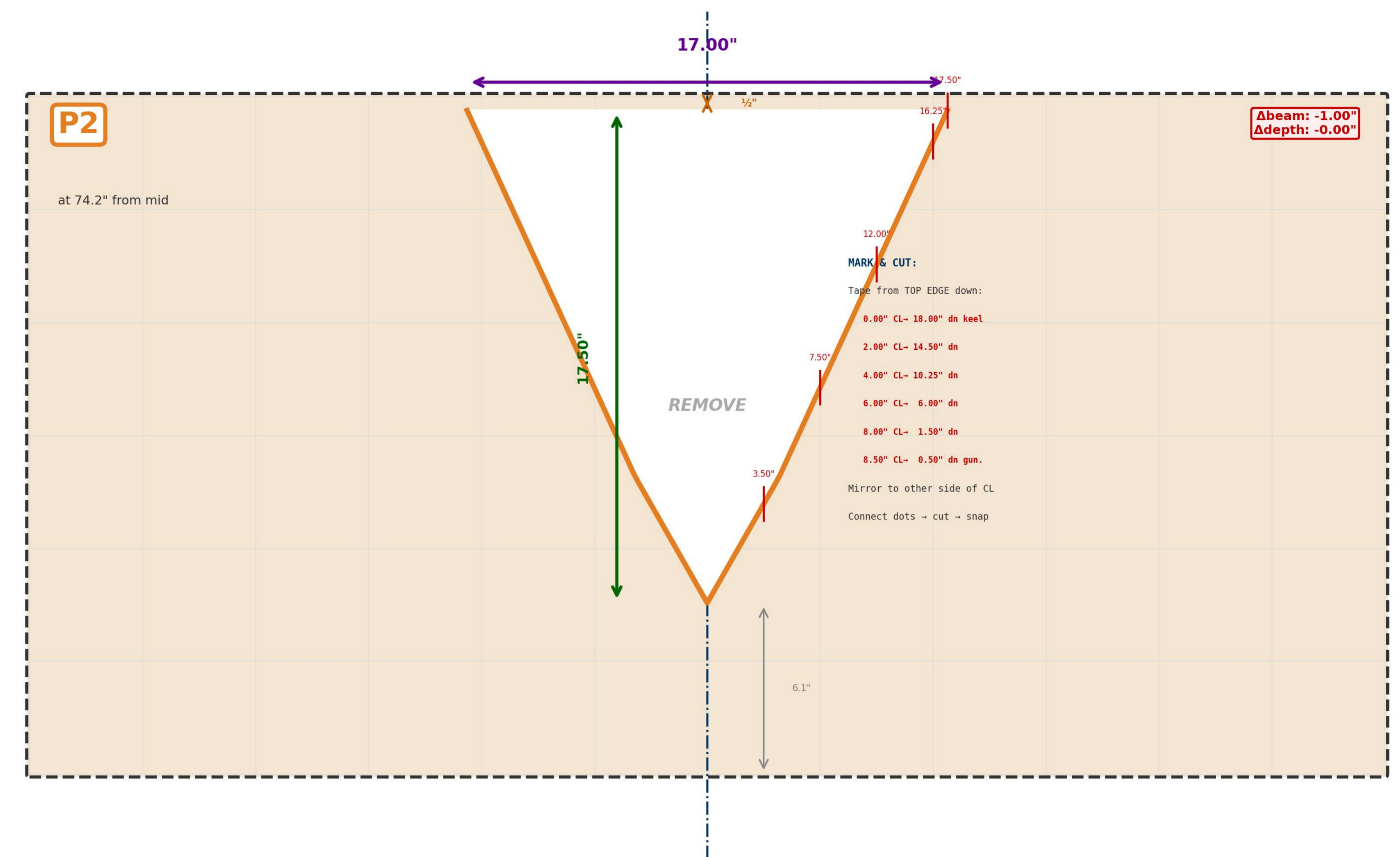
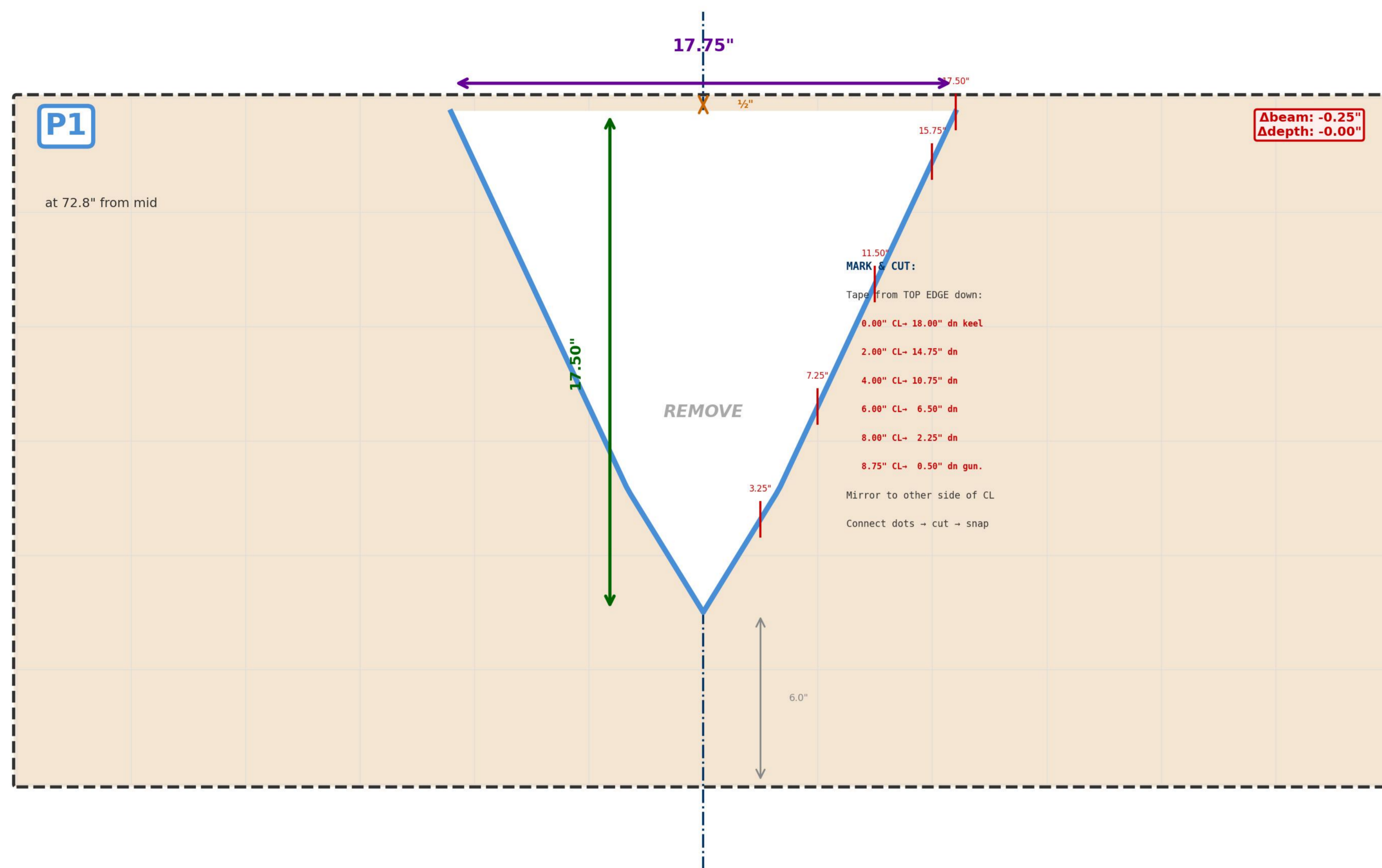
STATION L — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) △ PANELS DIFFER

Station beam: 20.25" | Depth: 17.75" | Dist from midship: 66" | Max panel difference: 1.99" beam, 0.18" depth



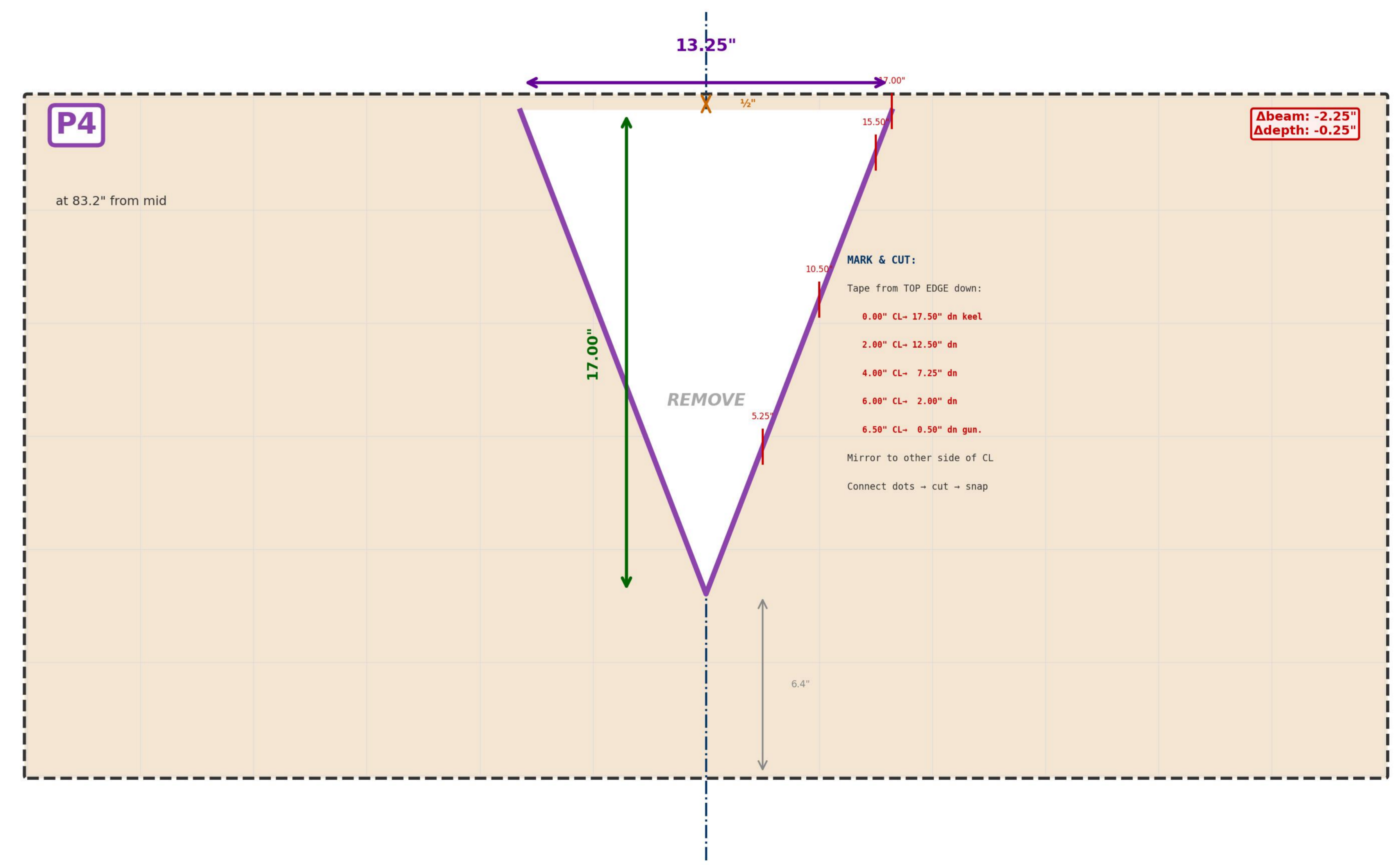
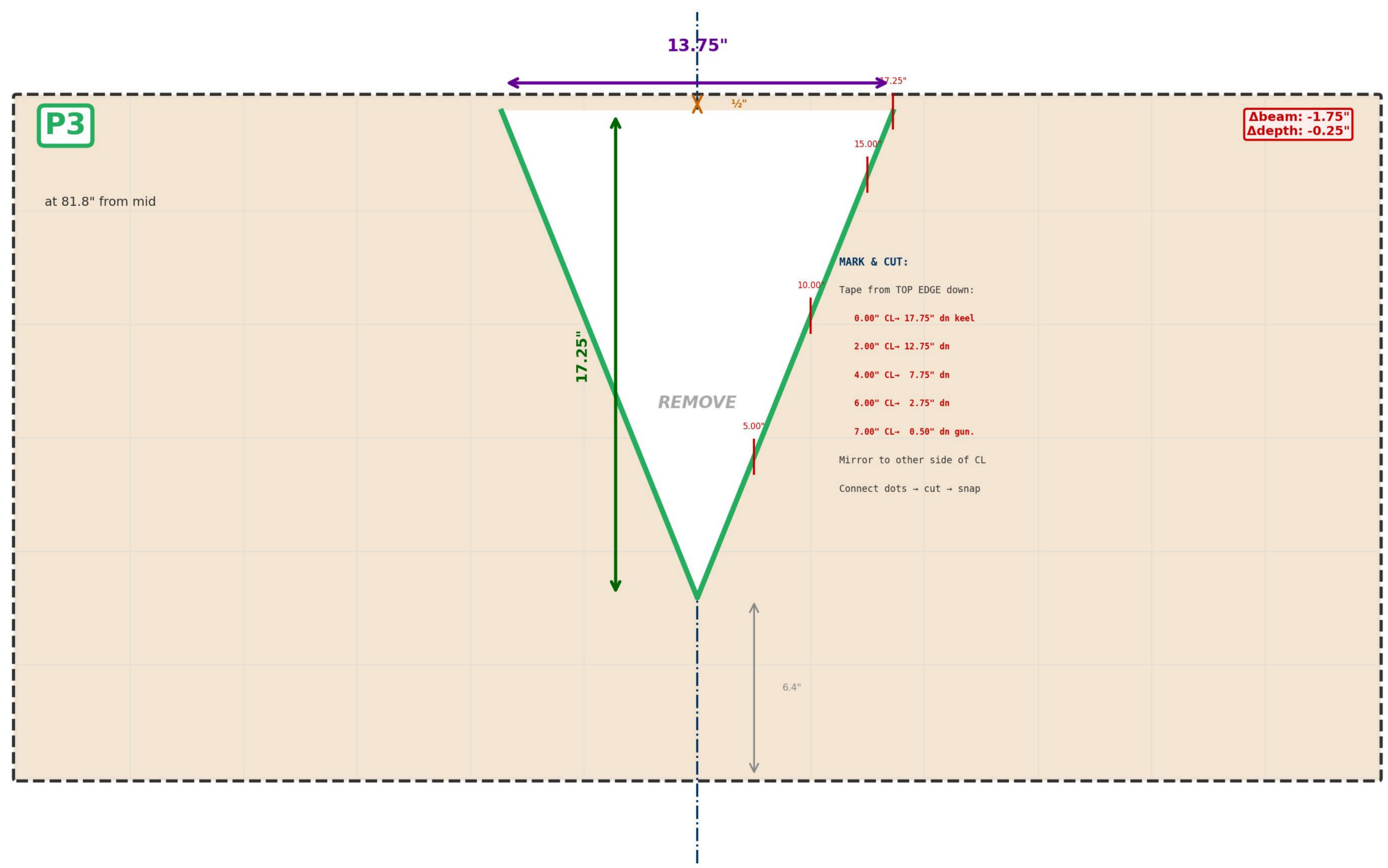
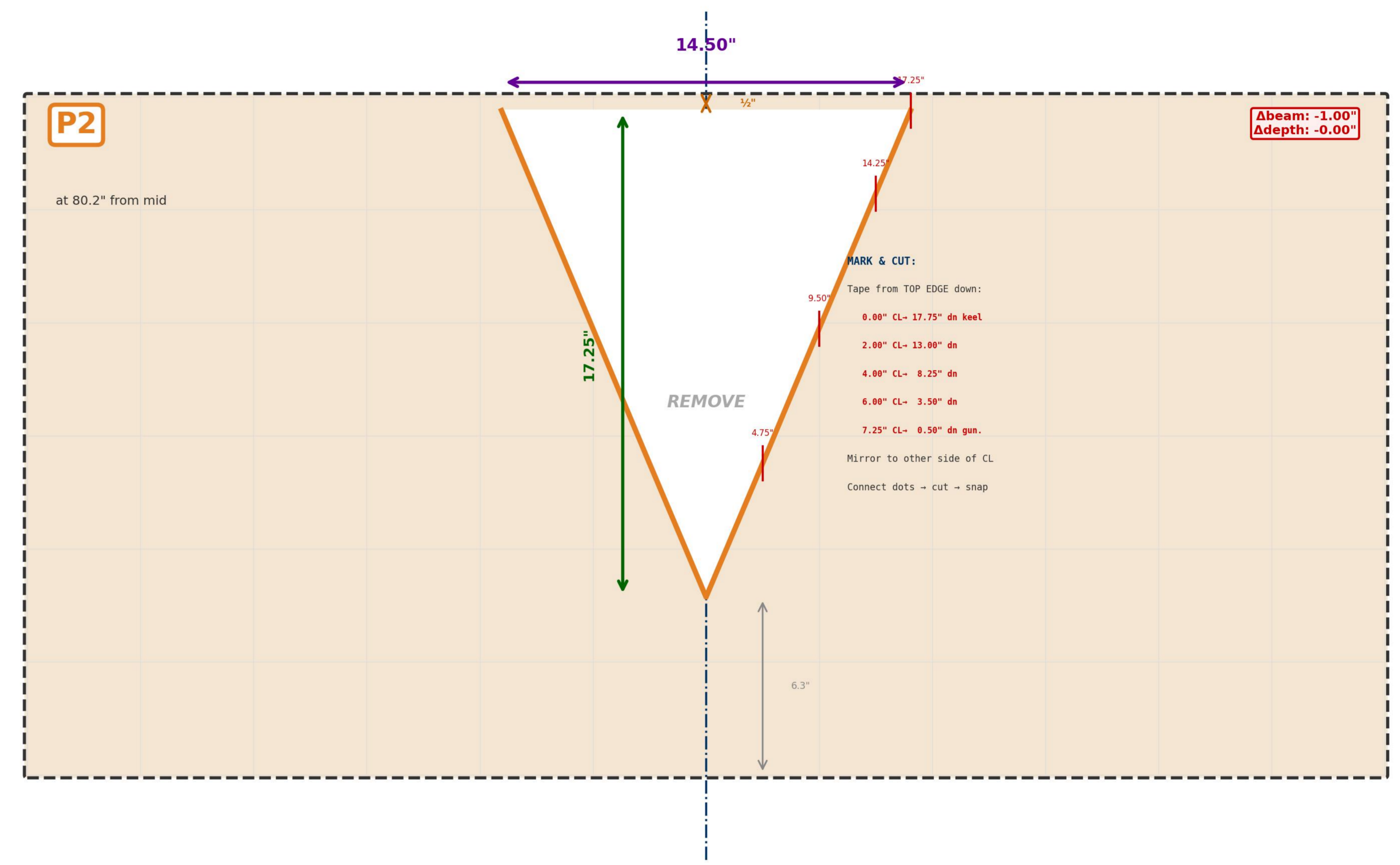
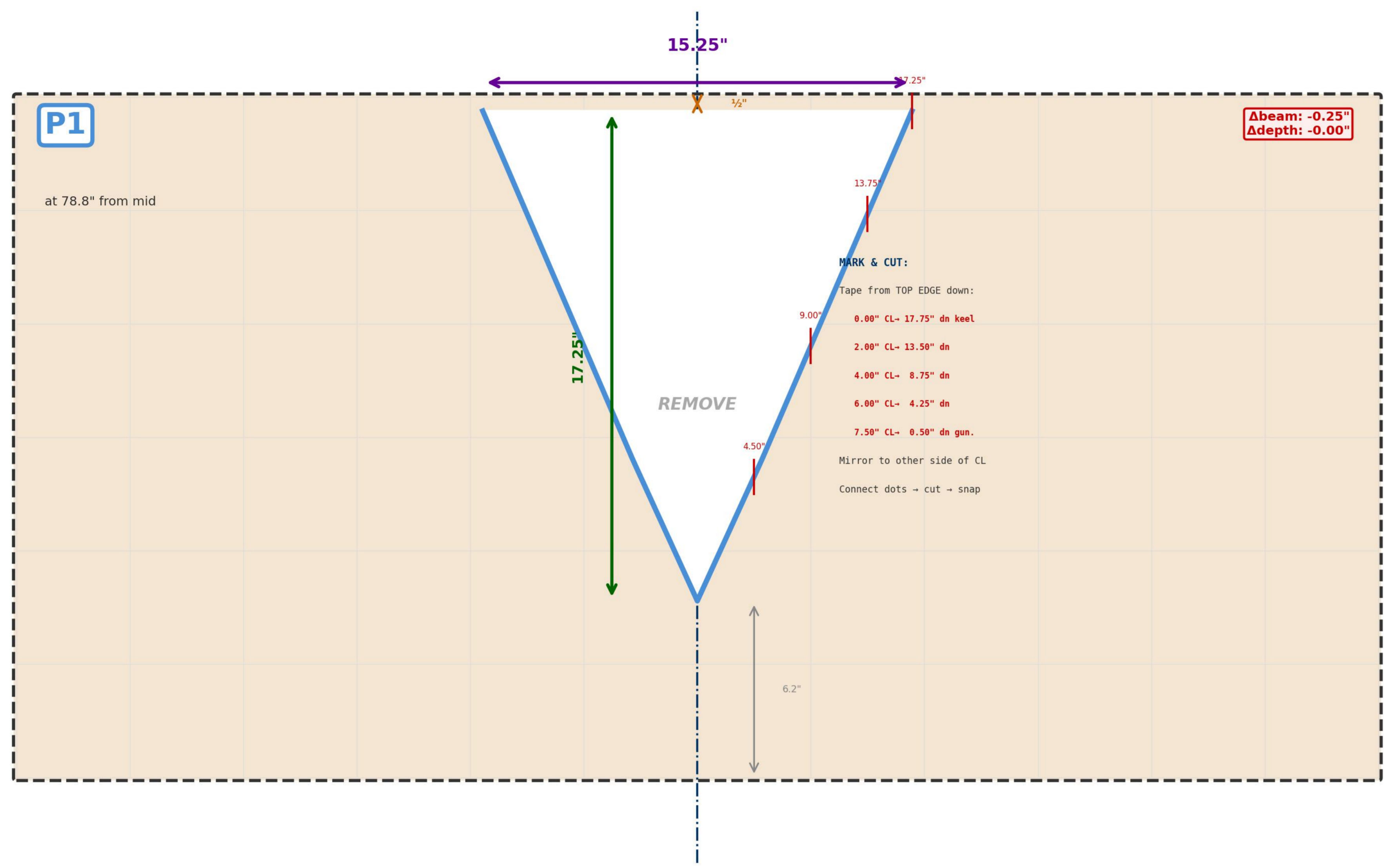
STATION M — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) \triangle PANELS DIFFER

Station beam: 18.00" | Depth: 17.50" | Dist from midship: 72" | Max panel difference: 2.17" beam, 0.19" depth



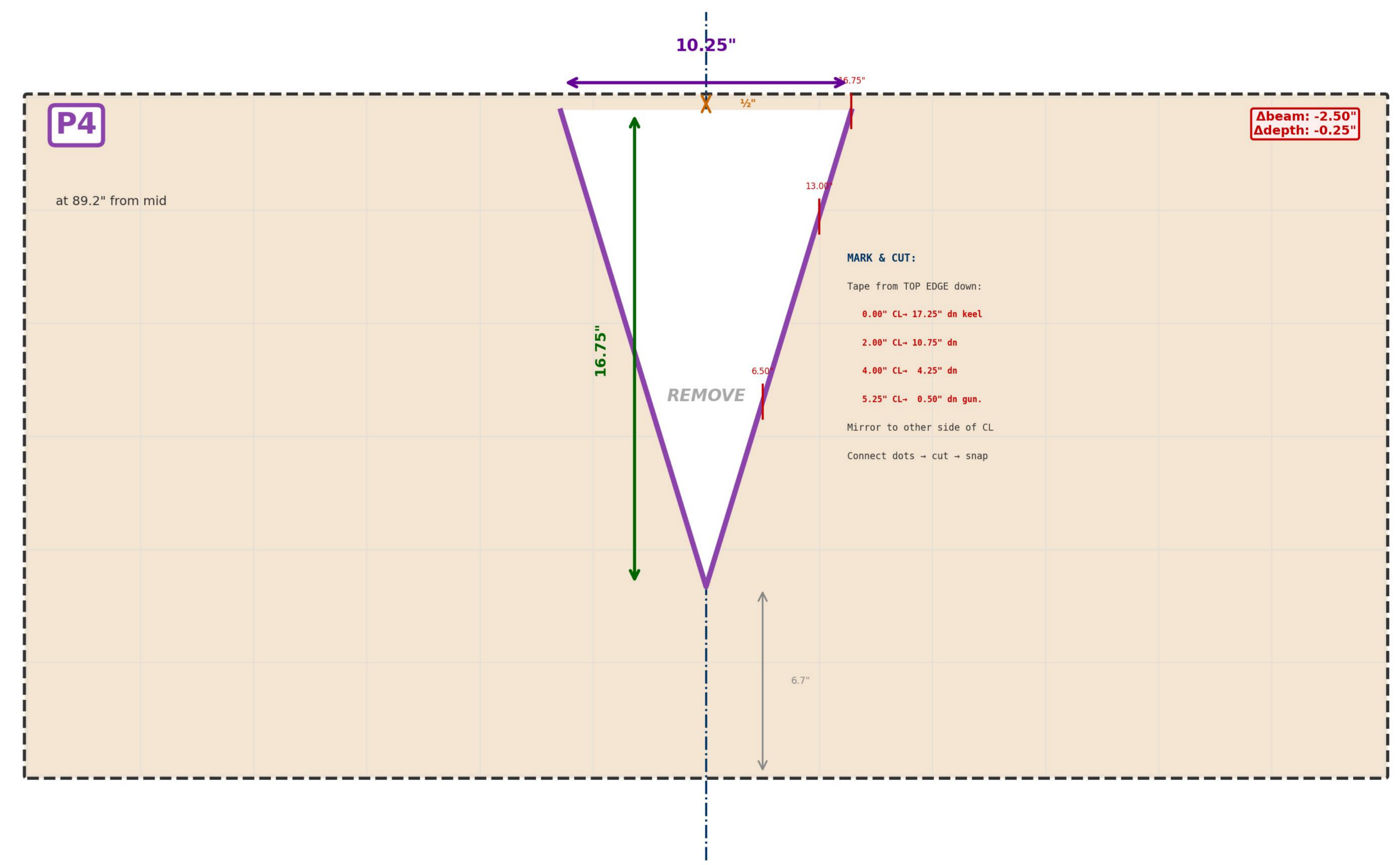
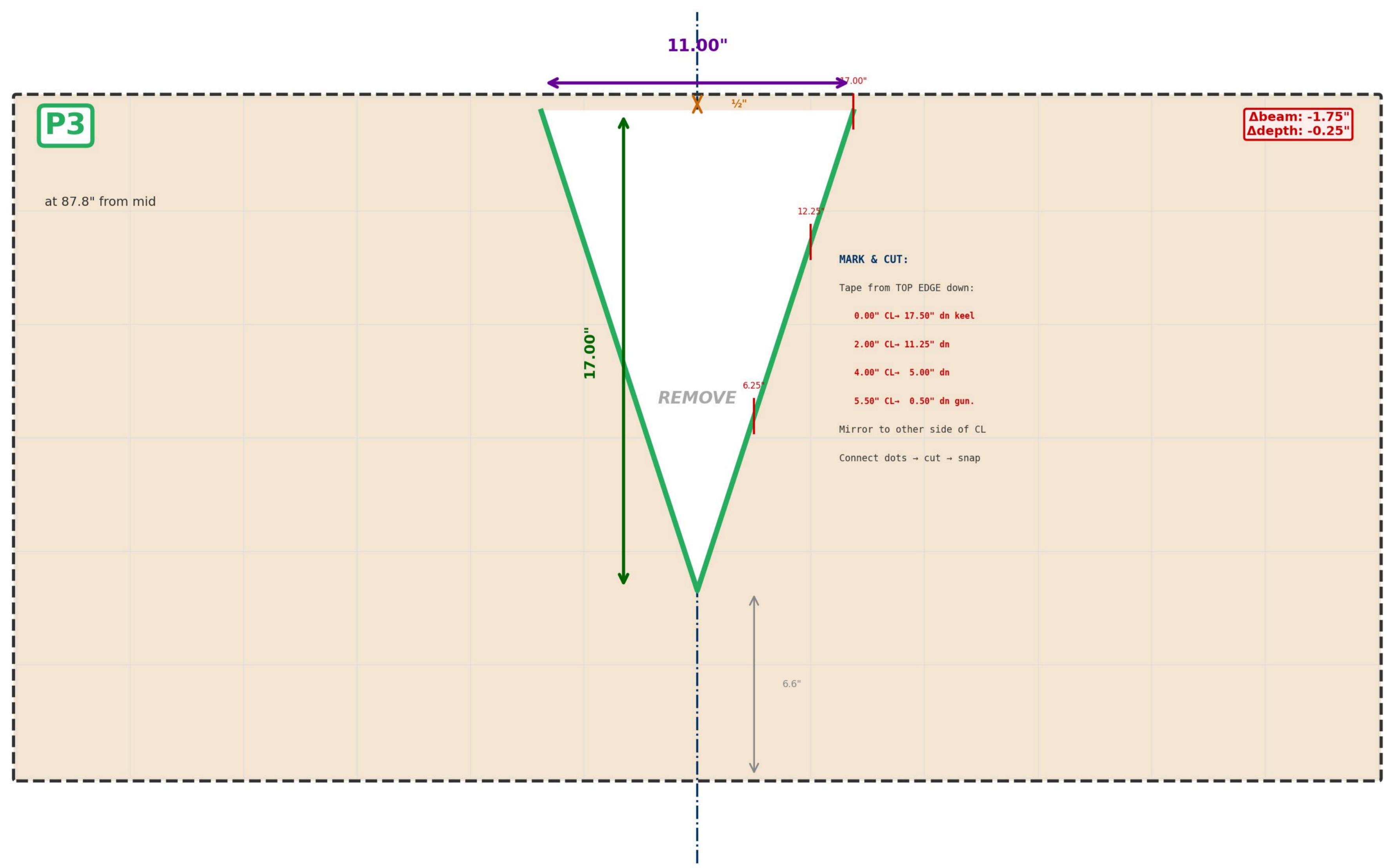
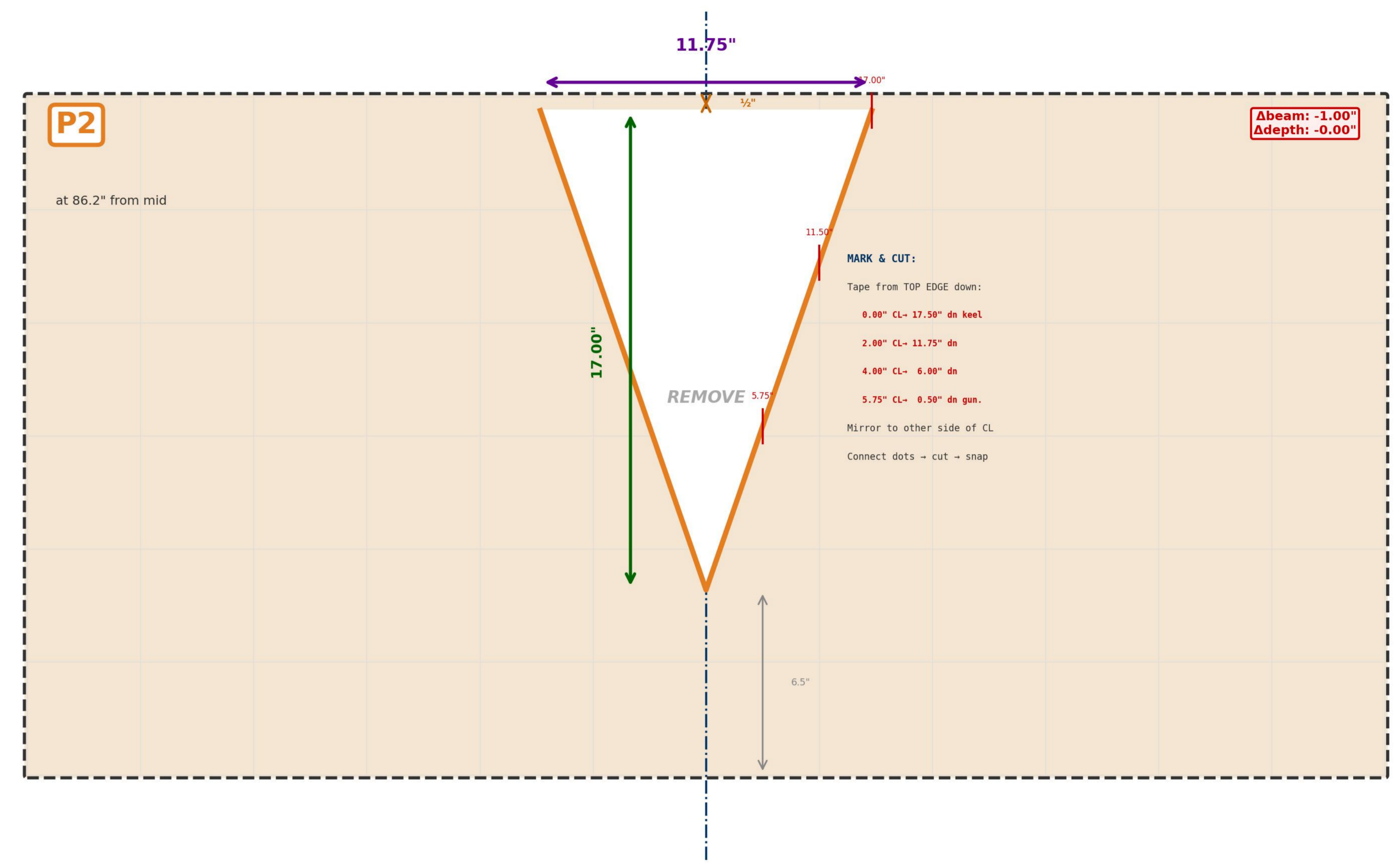
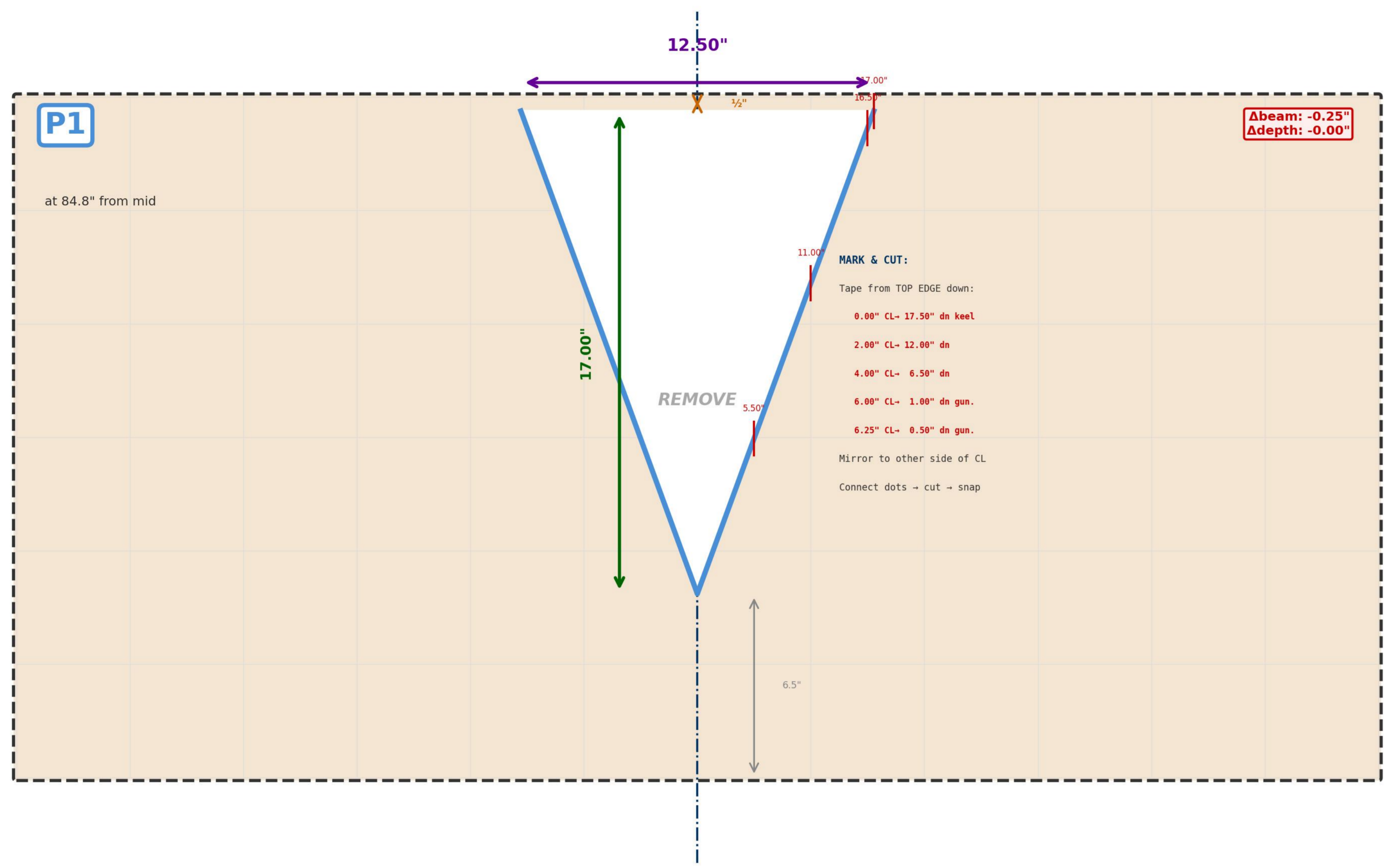
STATION N — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) ⚠️ PANELS DIFFER

Station beam: 15.50" | Depth: 17.25" | Dist from midship: 78" | Max panel difference: 2.33" beam, 0.22" depth



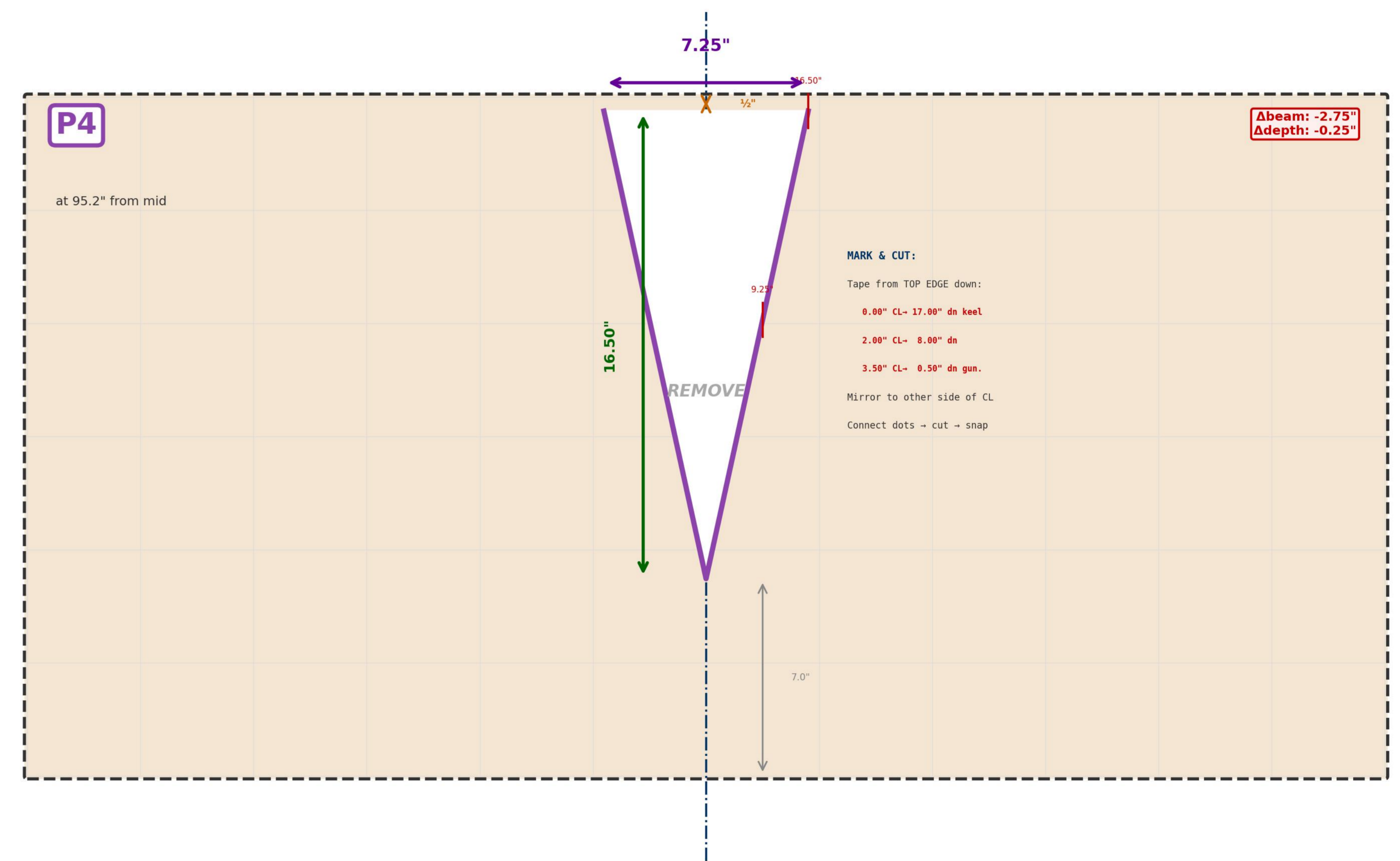
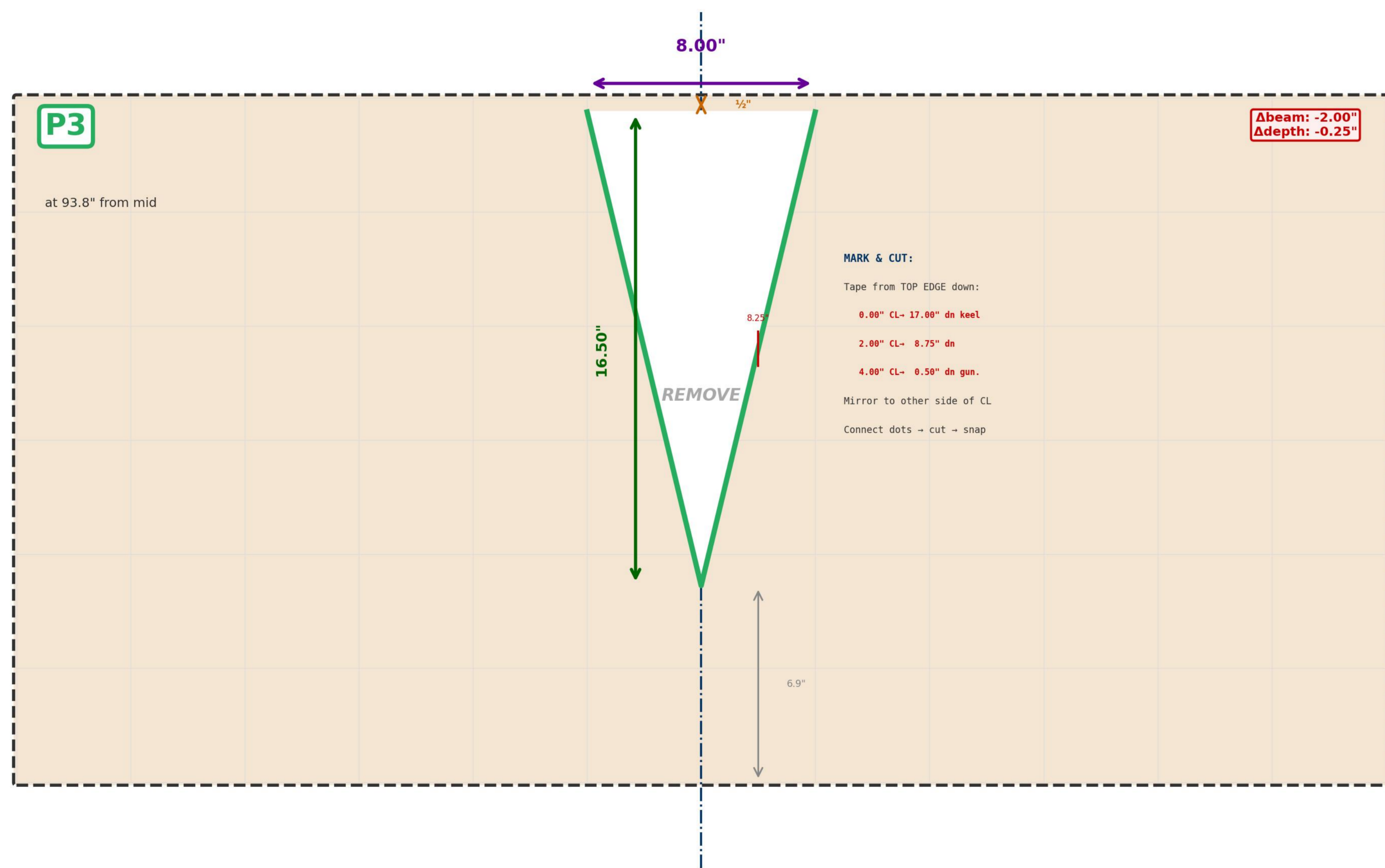
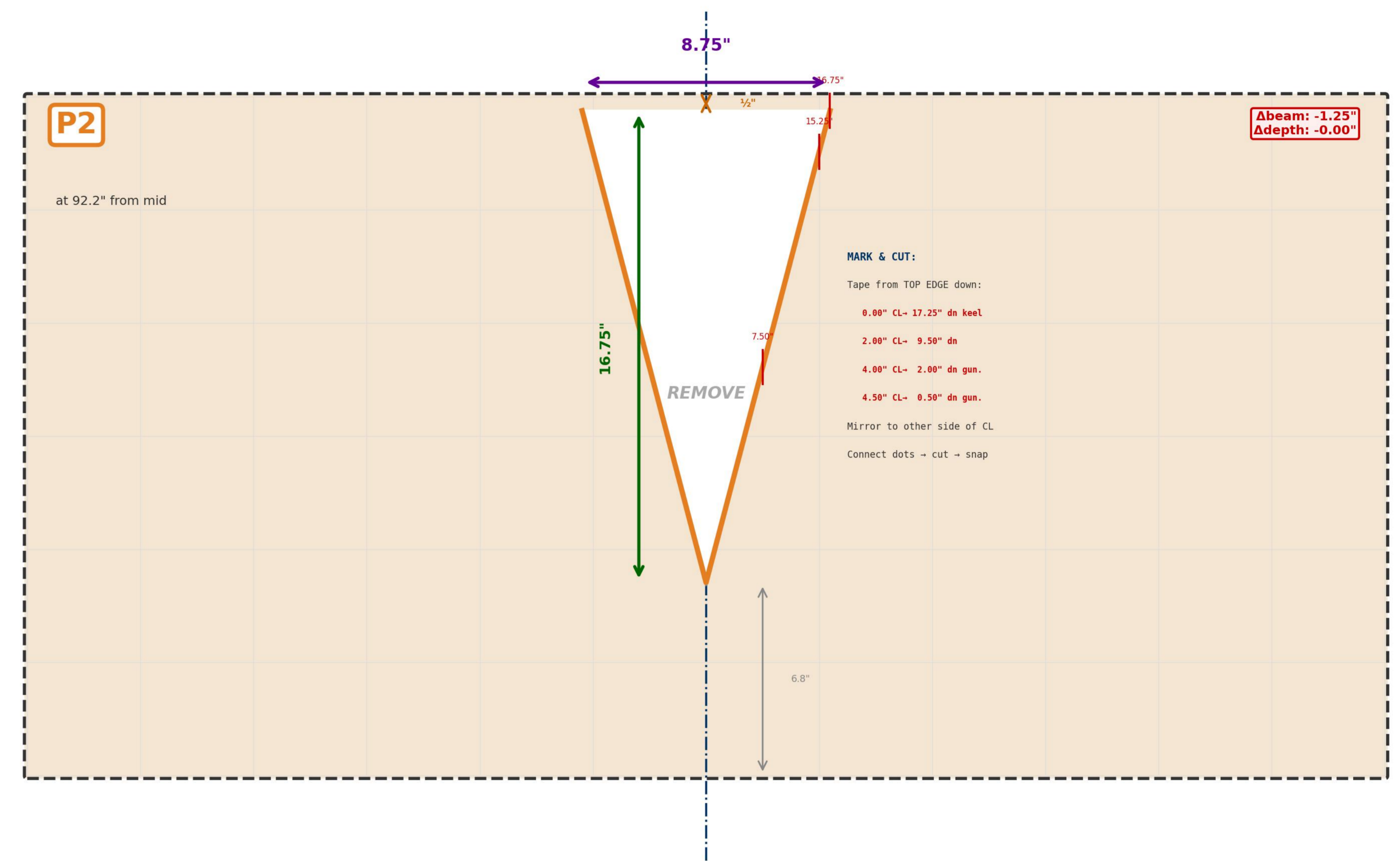
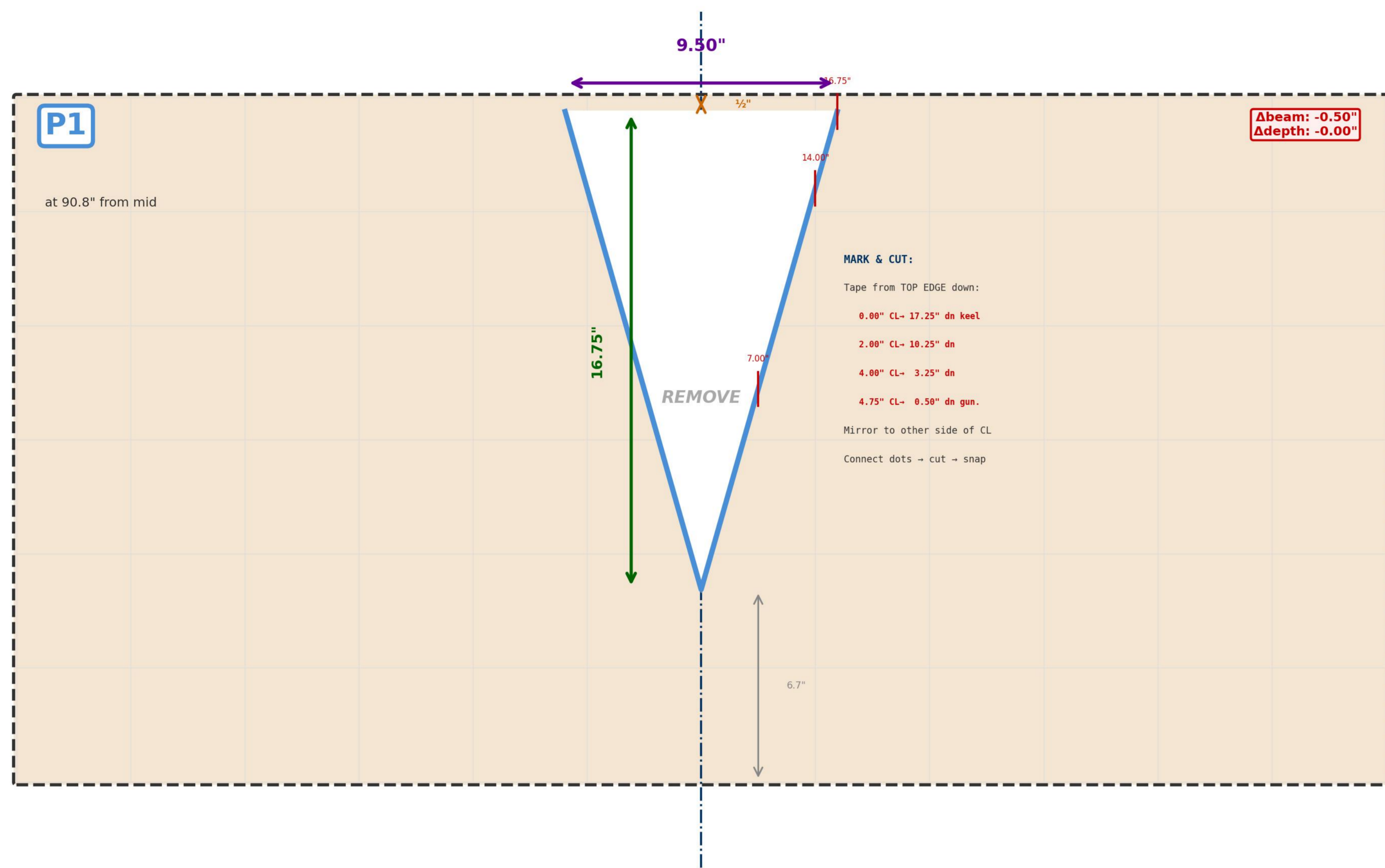
STATION 0 — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) ⚠️ PANELS DIFFER

Station beam: 12.75" | Depth: 17.00" | Dist from midship: 84" | Max panel difference: 2.52" beam, 0.23" depth



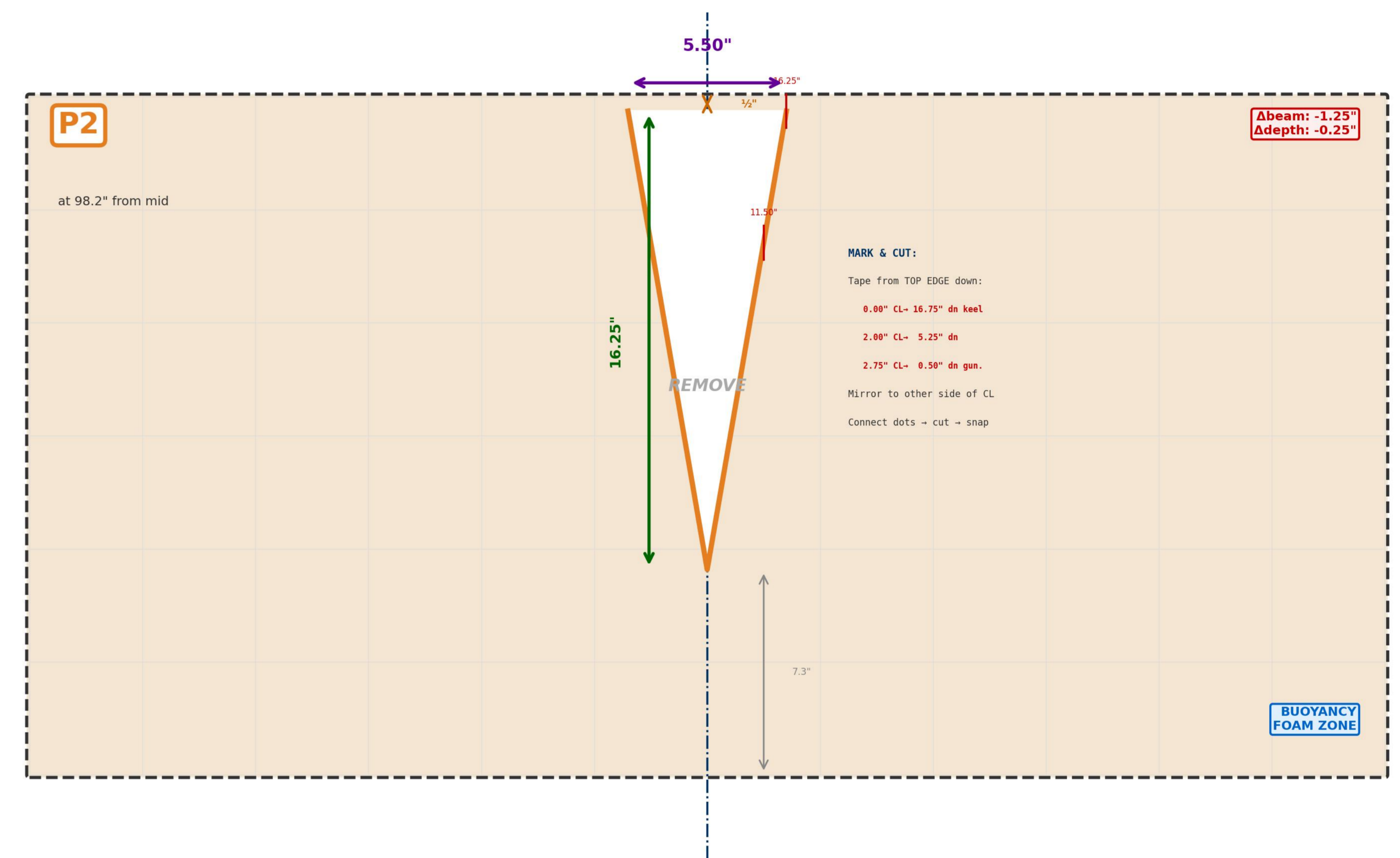
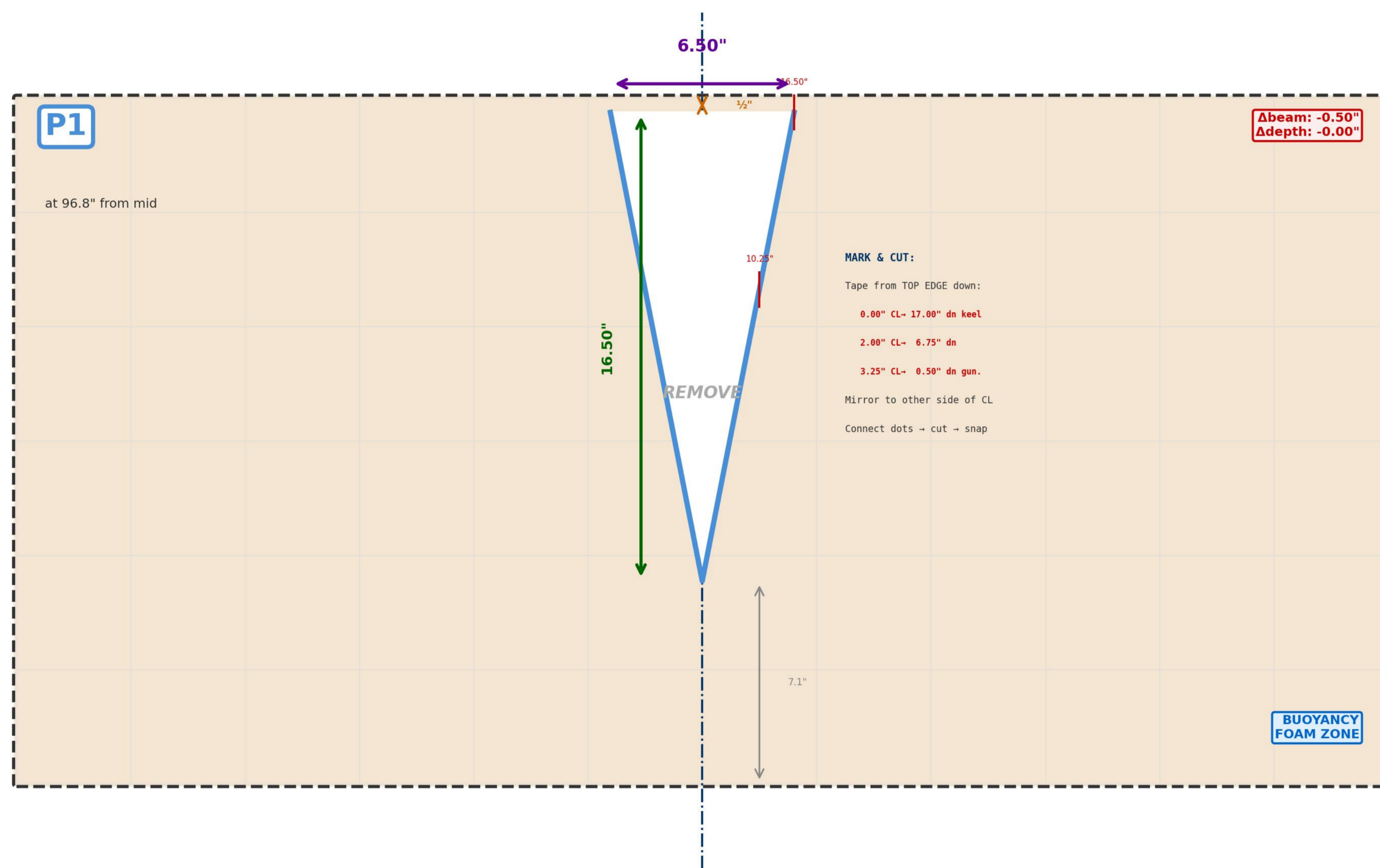
STATION P — TAPERED PANEL CUTS (6" BLOCK — 4 PANELS) \triangle PANELS DIFFER

Station beam: 10.00" | Depth: 16.75" | Dist from midship: 90" | Max panel difference: 2.70" beam, 0.26" depth



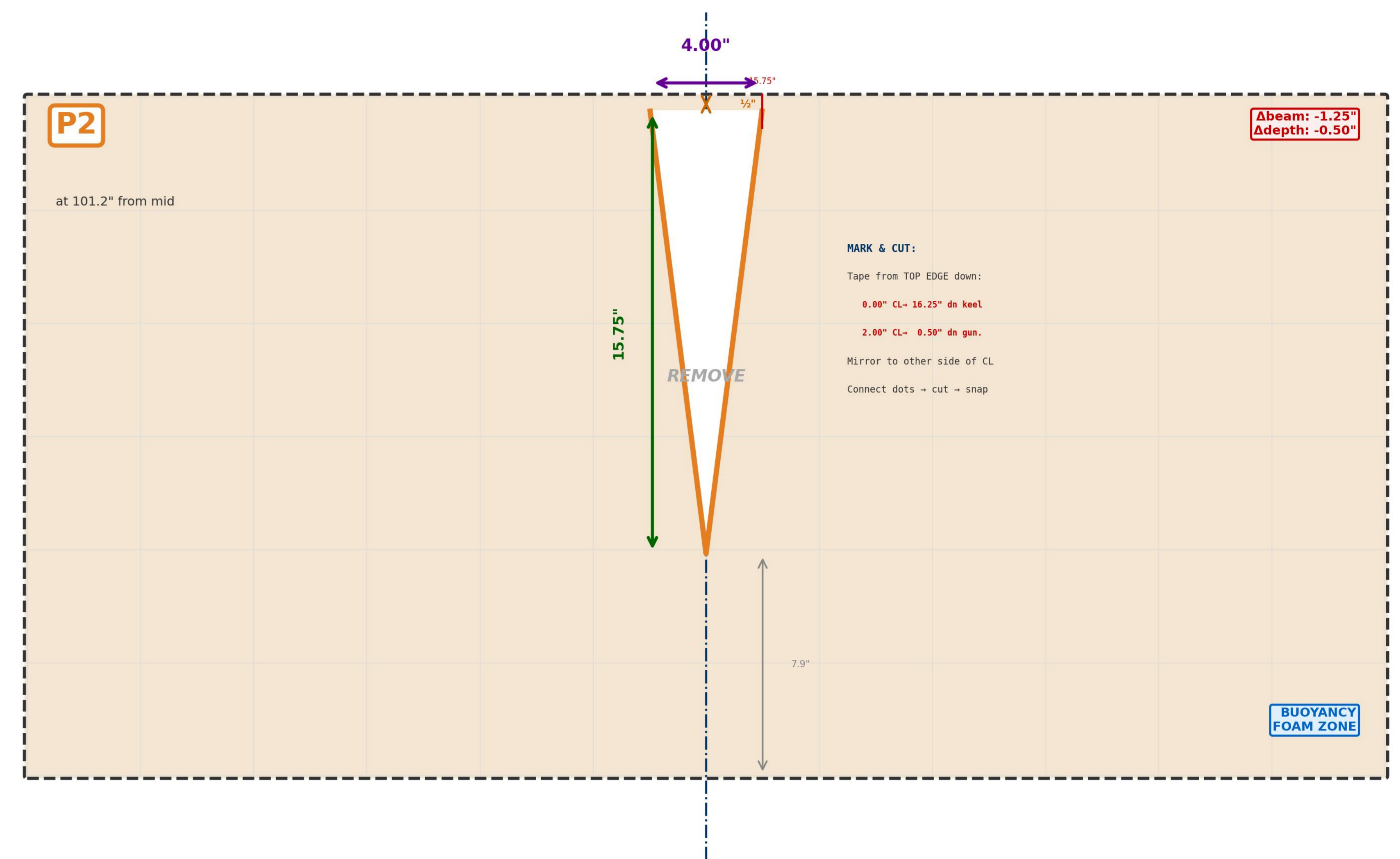
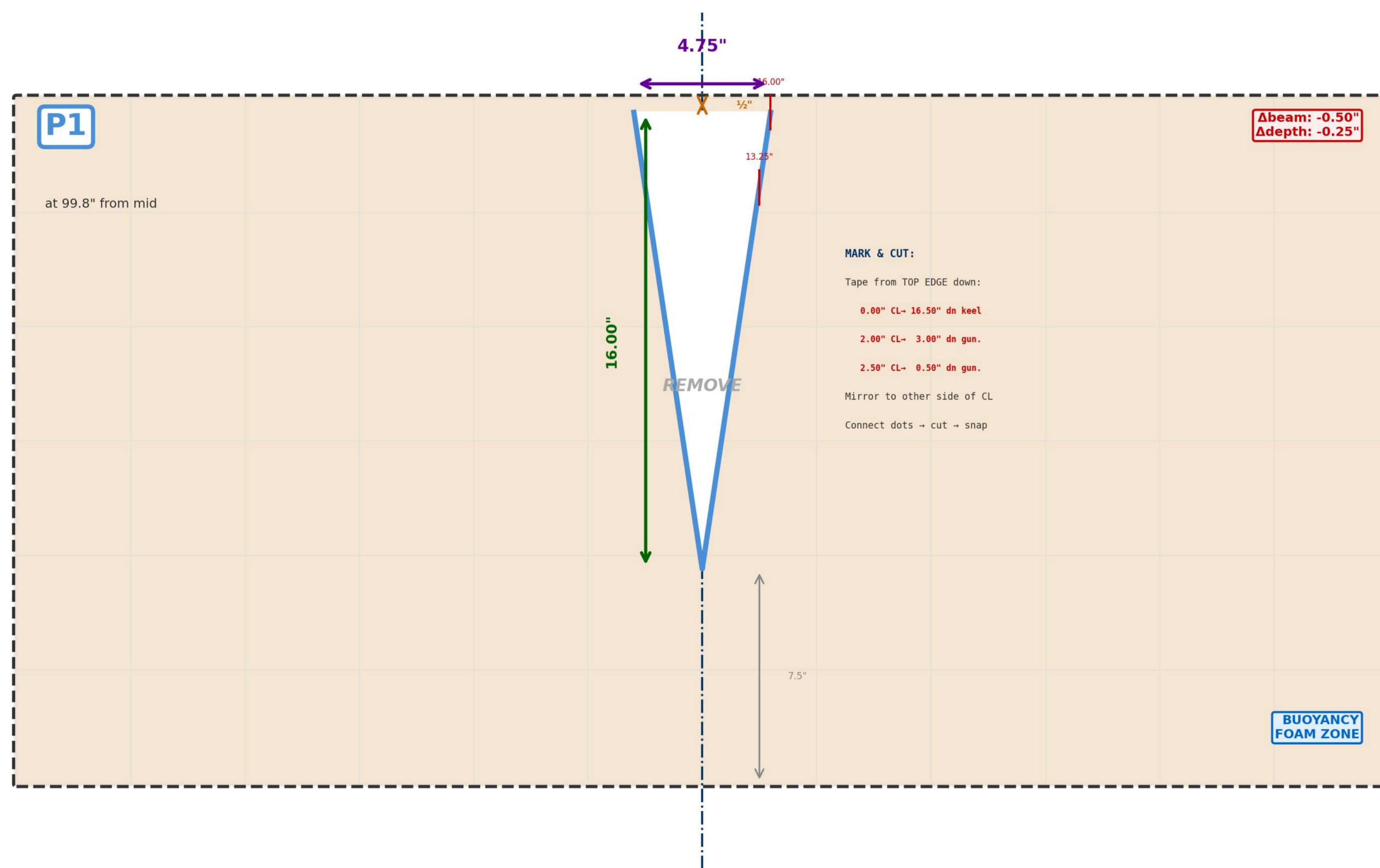
STATION Q — TAPERED PANEL CUTS (3" BLOCK — 2 PANELS) ⚠️ PANELS DIFFER

Station beam: 6.75" | Depth: 16.50" | Dist from midship: 96" | Max panel difference: 1.23" beam, 0.25" depth



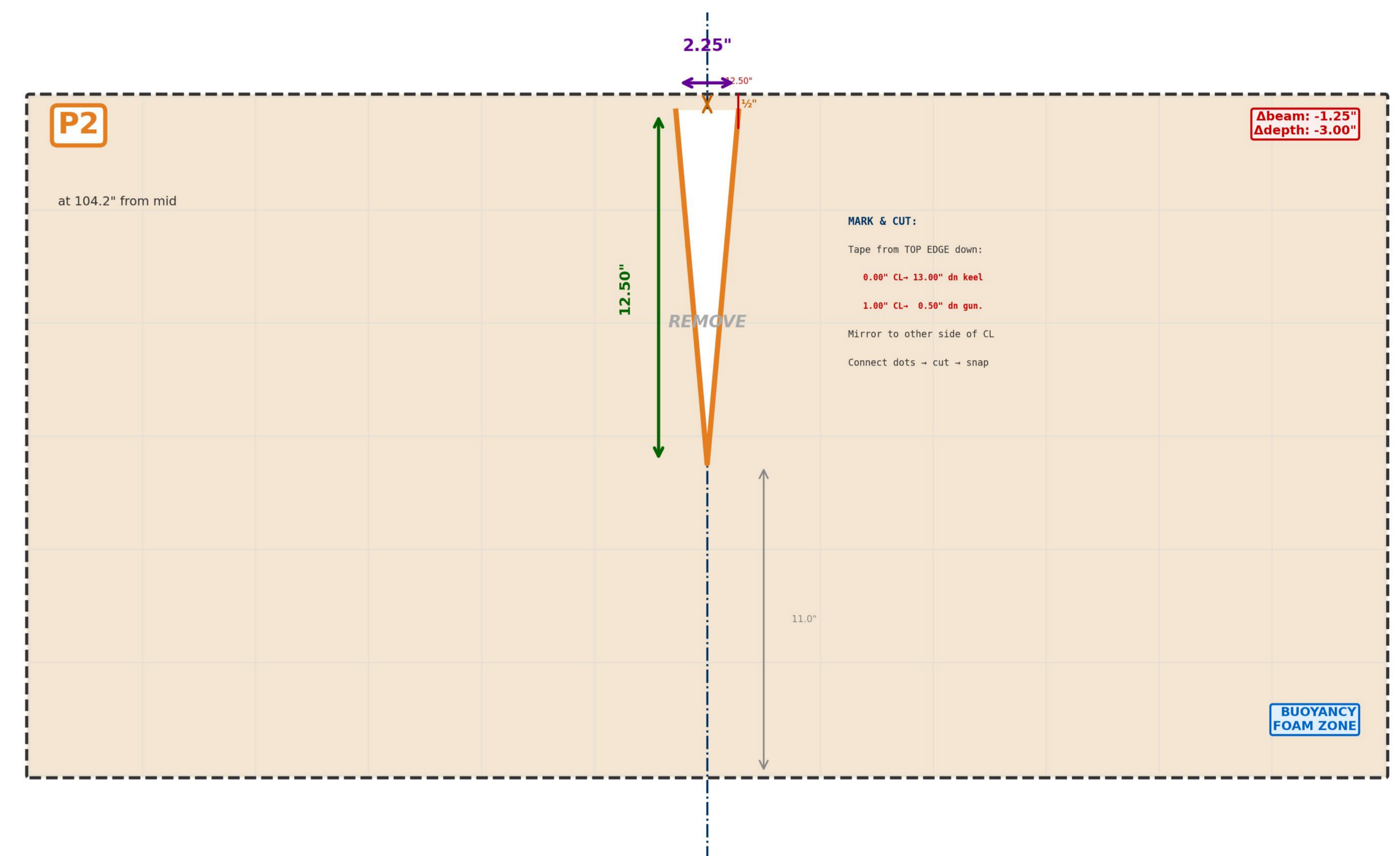
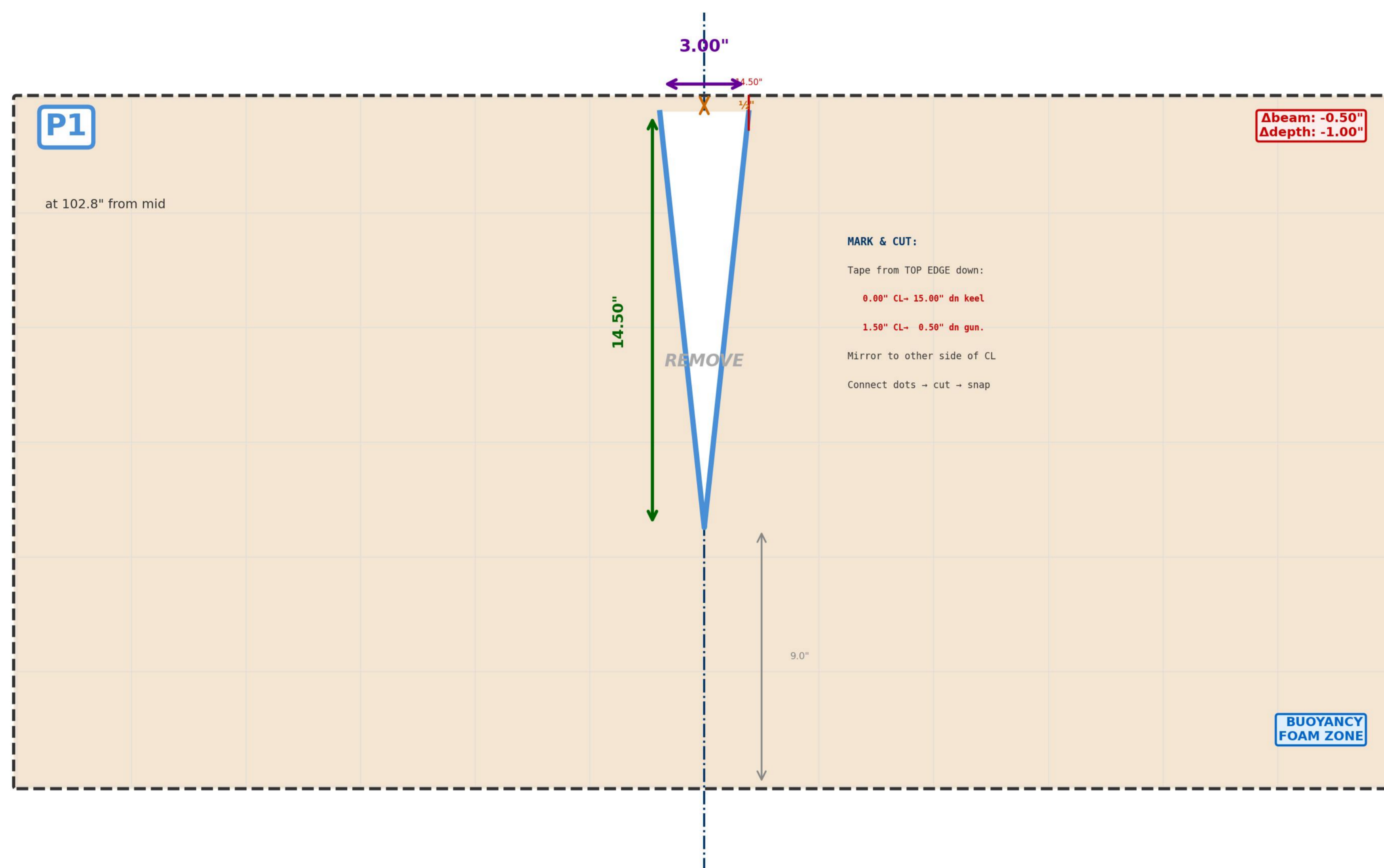
STATION Q+ — TAPERED PANEL CUTS (3" BLOCK — 2 PANELS) ⚠ PANELS DIFFER

Station beam: 5.25" | Depth: 16.25" | Dist from midship: 99" | Max panel difference: 1.25" beam, 0.50" depth



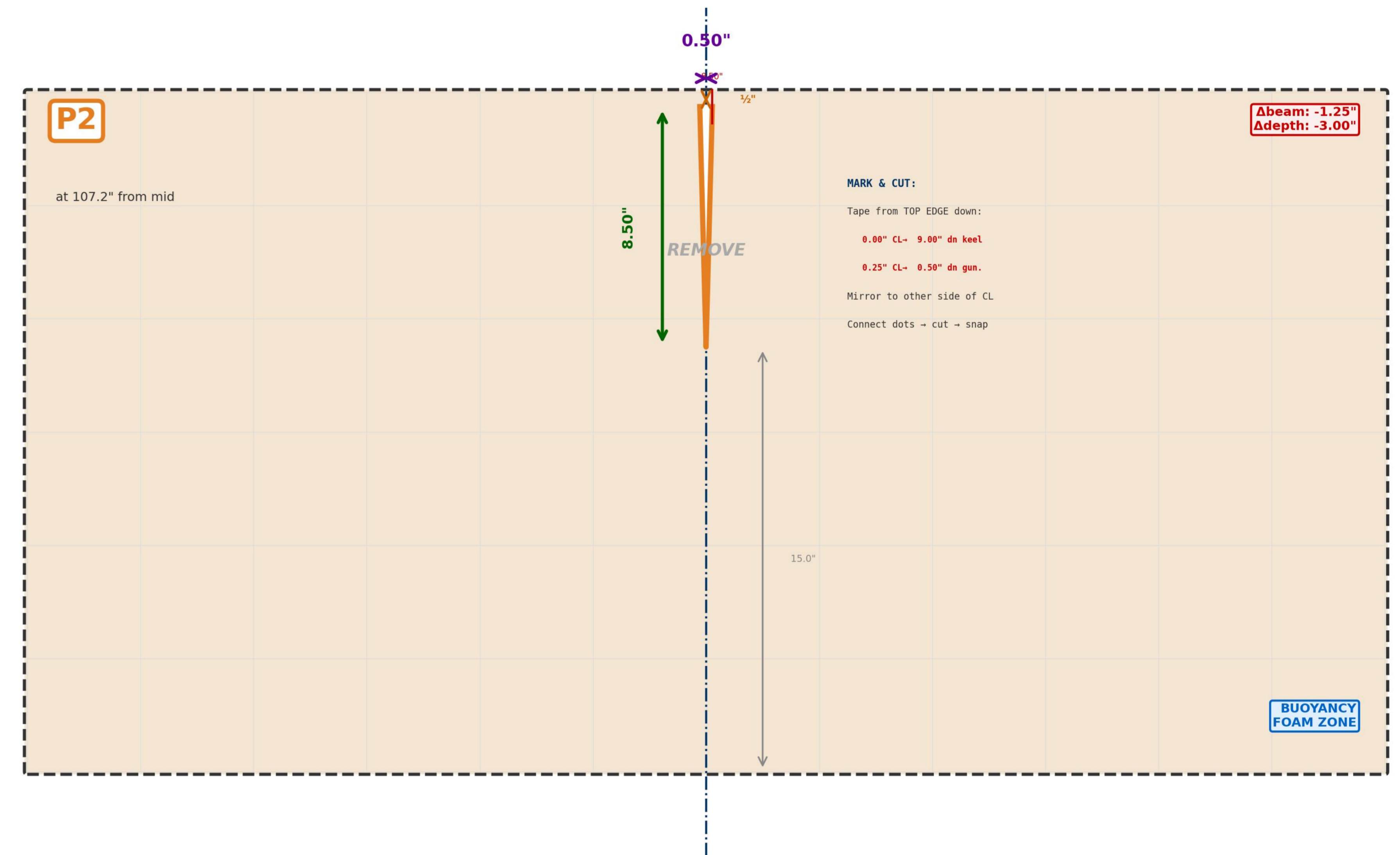
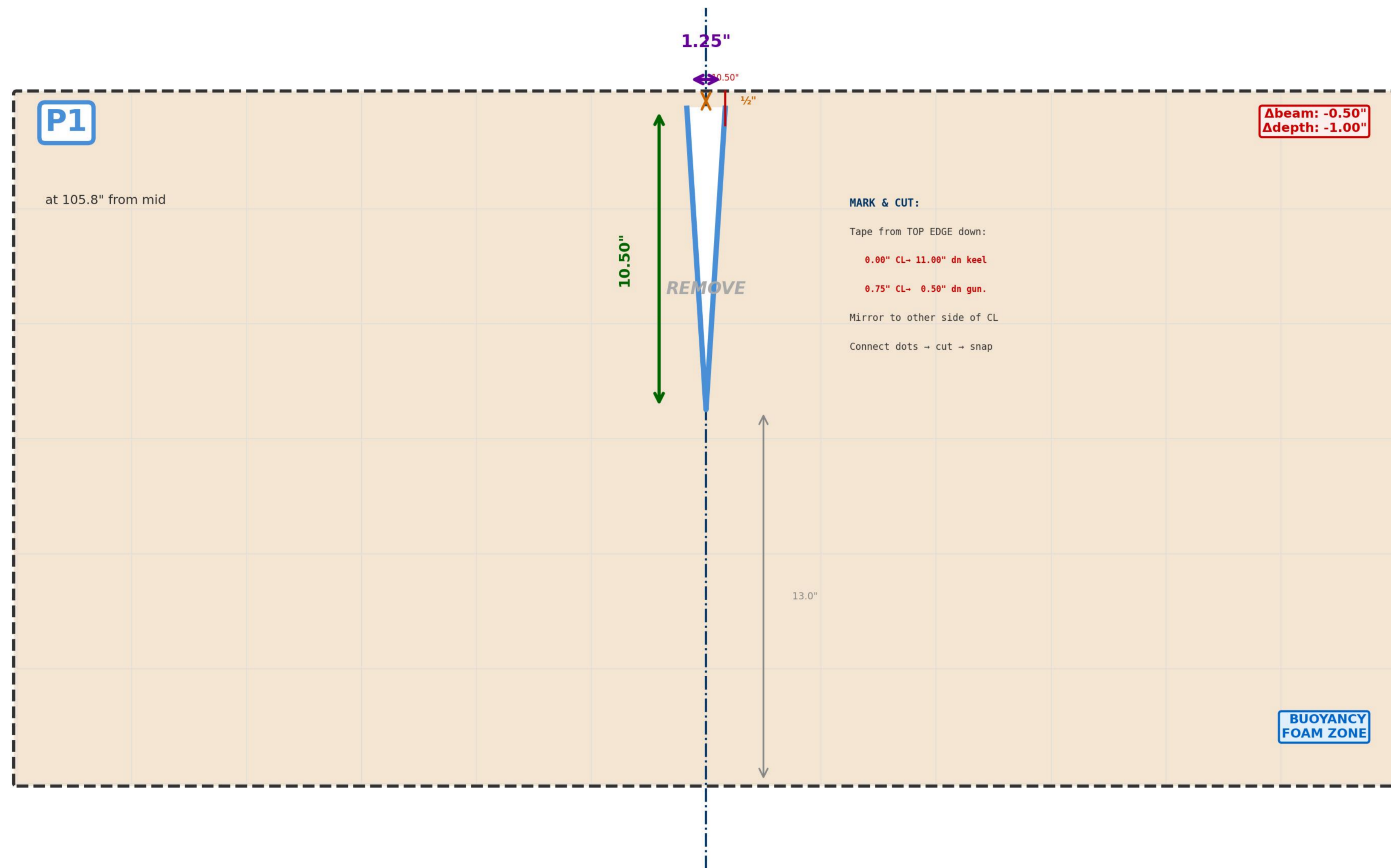
STATION R — TAPERED PANEL CUTS (3" BLOCK — 2 PANELS) ⚠️ PANELS DIFFER

Station beam: 3.50" | Depth: 15.50" | Dist from midship: 102" | Max panel difference: 1.32" beam, 2.99" depth



STATION R+ — TAPERED PANEL CUTS (3" BLOCK — 2 PANELS) ⚠ PANELS DIFFER

Station beam: 1.75" | Depth: 11.50" | Dist from midship: 105" | Max panel difference: 1.34" beam, 2.99" depth



STATION S — KEEL ENDPOINT

Distance from midship: 108"

Depth: 7.50" | Beam: 0.00"

No panels to cut — this is the tip endpoint.

BUOYANCY FOAM ZONE — Fill solid with closed-cell foam

SECTION 5

Visual Cutting Guide — Step-by-Step Instructions

24 pages follow

VISUAL CUTTING GUIDE

NAU Pluto Jacks 2026 Concrete Canoe

Print this. Bring it to the shop.

40

Foam Sheets

160

Panels Cut

148

Panels Needed

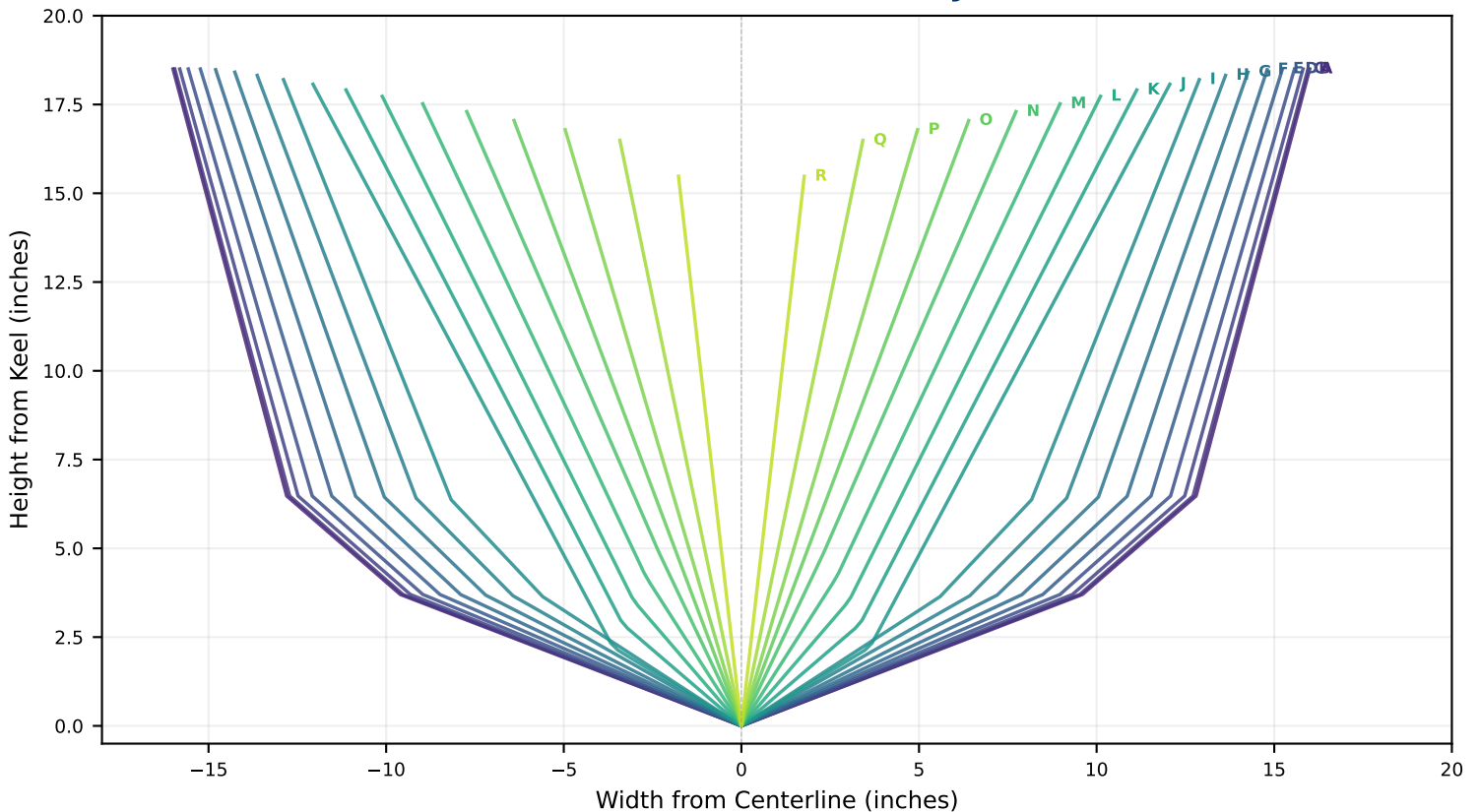
37

Glued Blocks

222"

Mold Length

All 19 Cross-Sections (Body Plan)

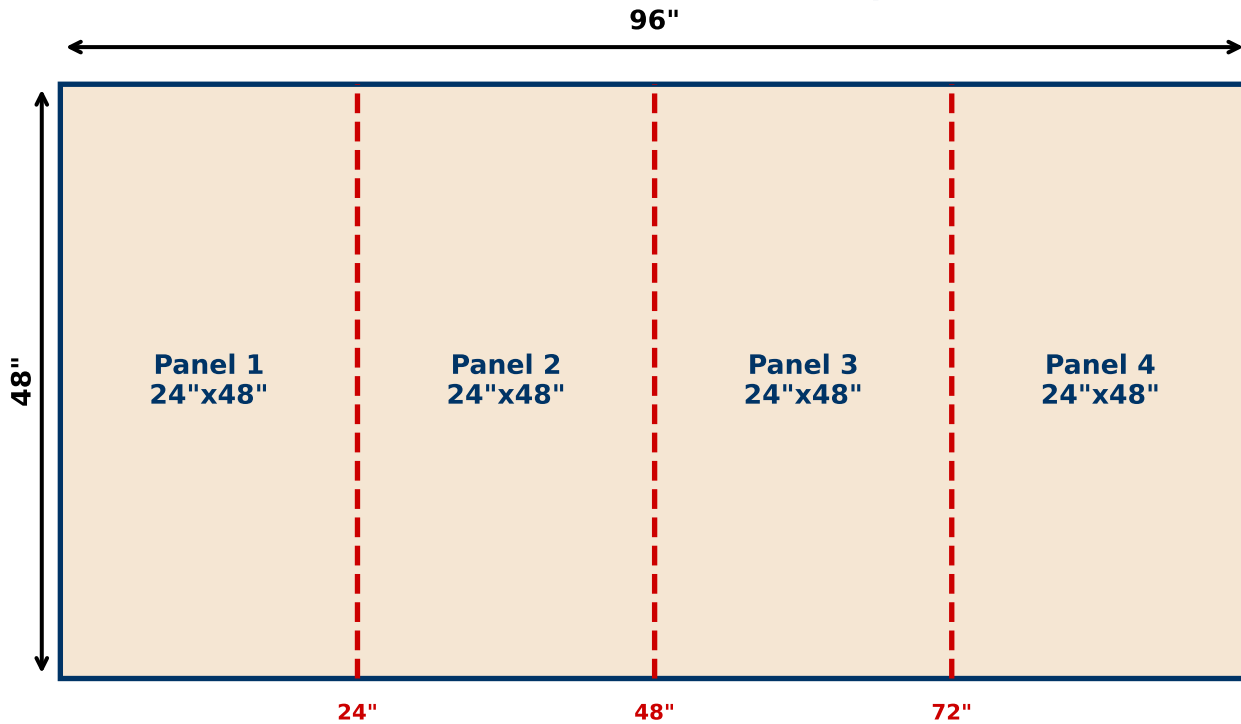


METHOD SUMMARY



SHEET PREP & SETUP

Divide Each 48"x96" Sheet into 4 Equal Panels



TOOL CHECKLIST

- Utility knife + extra blades (50 pack)
- Bread knife (serrated, 10"+)
- Metal straightedge / T-square (48")
- Sharpie markers (black, thick tip)
- Measuring tape (25 ft)
- Carpenter's square
- PL Premium adhesive (6 tubes)
- Caulk gun
- Clamps or heavy weights (40+ lbs)
- Cutting mat or plywood backer

SAFETY GEAR

- ▲ Safety glasses (foam dust)
- ▲ Dust mask / N95 respirator
- ▲ Cut-resistant gloves (utility knife)
- ▲ Knee pads (floor cutting)
- ▲ First aid kit nearby

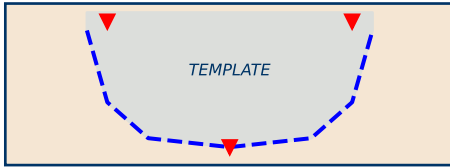
WORKSPACE SETUP

- Large flat surface (4'x8' table or floor)
- Good lighting (overhead + task)
- Sweep area clear of debris
- Stack foam sheets nearby for access
- Trash bags for foam scraps

HOW TO MARK & CUT

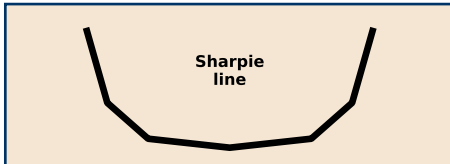
General Procedure for Every Station

1. PIN TEMPLATE



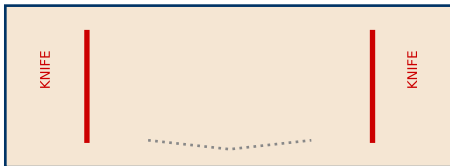
Pin Masonite template to foam panel.
Align bottom edge with panel bottom.

2. TRACE OUTLINE



Trace around template edge with Sharpie.
Use thick tip for visibility.

3. SCORE STRAIGHT SECTIONS



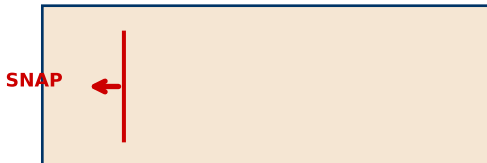
Utility knife along straight/nearly-straight lines. Score 3-4 passes before cutting through.

4. SAW CURVES



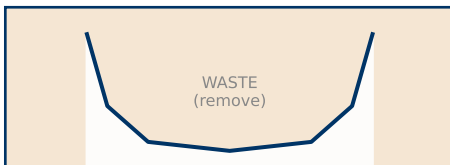
Bread knife for curved sections. Slow, steady strokes. Let the blade do the work.

5. SNAP SCORED FOAM



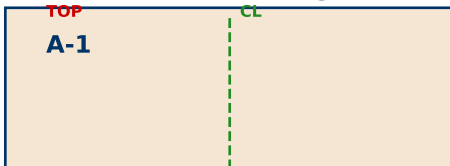
Bend along scored line. Foam snaps cleanly. Smooth any rough edges with knife.

6. REMOVE CUT-OUT



Lift out the hull-shaped piece. This is waste. Keep the outer panel with the cut-out hole.

7. LABEL EVERYTHING



Write station letter + panel # (e.g. "A-1"). Mark TOP arrow and CL (centerline) on each.

PRO TIPS

Score 3-4 passes before cutting through -- do NOT try to cut in one pass.

Fresh blade every 10-15 panels. Dull blades tear foam instead of cutting.

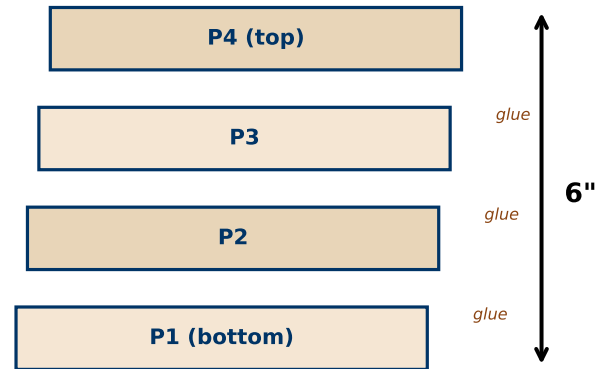
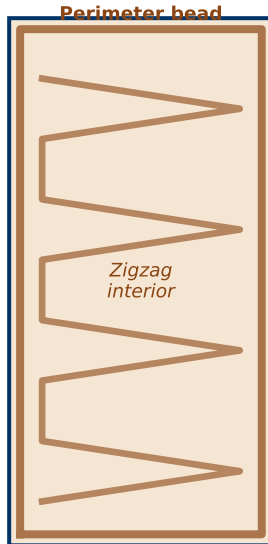
Cut OUTSIDE the line (waste side) -- you can always trim more, never add back.

HOW TO GLUE & STACK

Assembling 4 Panels into a 6" Block

PL Premium Bead Pattern

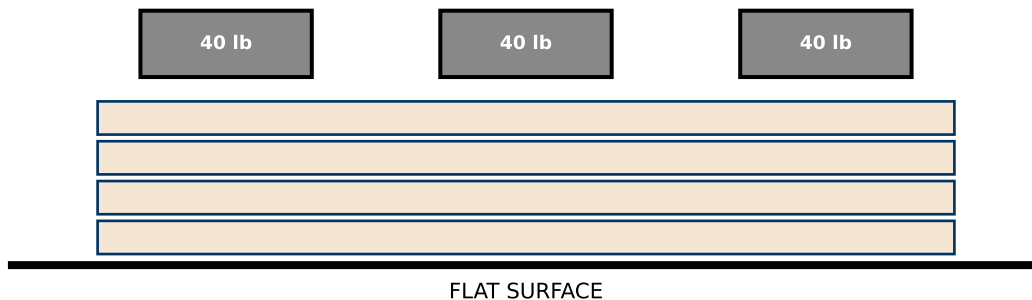
Stacking Order



Clamping & Curing

24 HOUR CURE -- DO NOT MOVE

PL Premium needs 24h to fully bond. Moving early = weak joints.



RESULT: 6" FOAM BLOCK

After 24 hours, you have a solid 6" thick foam block with the hull cross-section cut through all 4 layers. This block mounts on the strongback at its station position.

Each block represents 6" of hull length. 37 blocks x 6" = 222" total mold.

The mold is 6" longer than the hull (216") to allow for trimming at bow & stern.

Quality check: Look through the block from the side -- all 4 profiles must align.

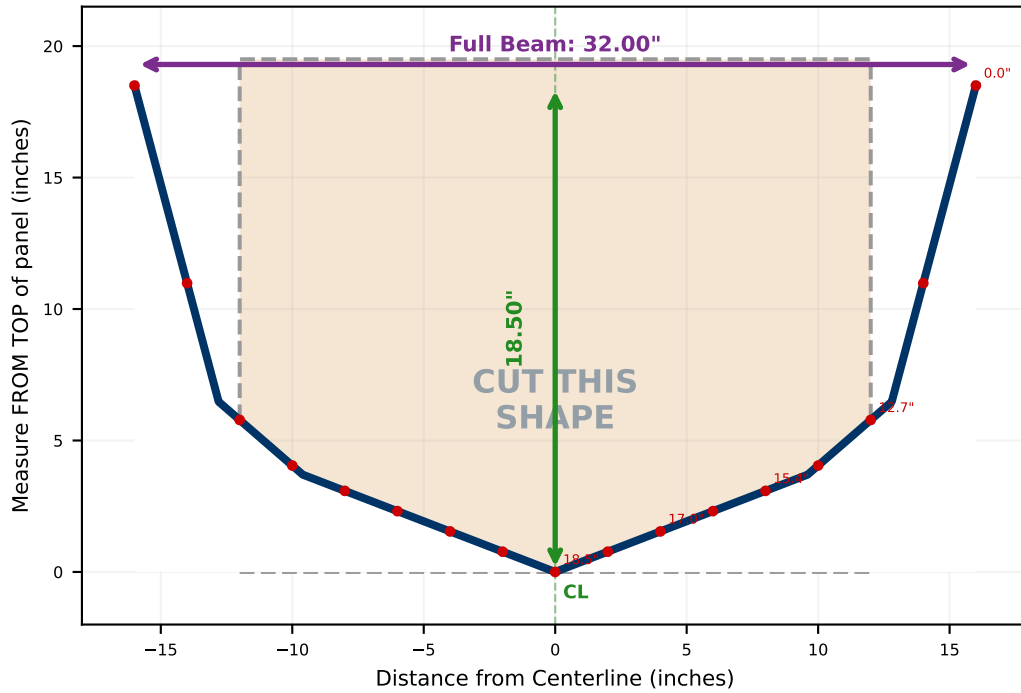
If any panel is off by more than 1/8", re-cut it before the glue cures.

STATION A

Wide U, flattest bottom | 0" from midship | 1 block(s) = 4 panels

COORDINATE TABLE

FROM CL	FROM TOP
0.0"	18.50"
2.0"	17.73"
4.0"	16.96"
6.0"	16.19"
8.0"	15.42"
10.0"	14.45"
12.0"	12.72"
14.0"	7.52"
16.0"	0.00"



Station A

Wide U, flattest bottom

Full Beam: 32.00"

Half-Breadth: 16.00"

Depth: 18.50"

Distance from Mid: 0"

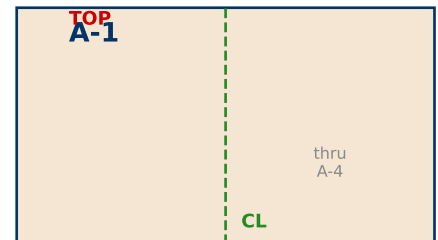
Blocks: 1

Panels: 4

CUTTING APPROACH

Wide U shape. Flat bottom. Score straight lines down both sides with utility knife. Use bread knife to saw across the curved bottom. The bottom is nearly flat -- follow the template closely.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

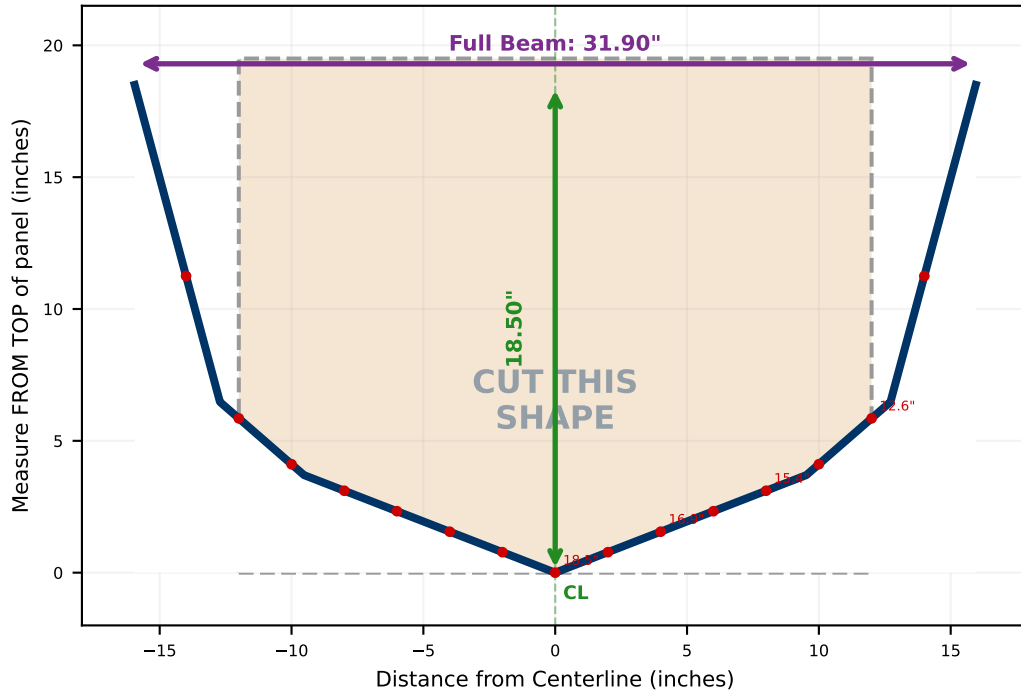
Half-breadth = 16.00" from CL at gunwale. Depth = 18.50" at centerline.

STATION B

Nearly identical to midship | 6" from midship | 2 block(s) = 8 panels

COORDINATE TABLE

FROM CL	FROM TOP
0.0"	18.50"
2.0"	17.72"
4.0"	16.95"
6.0"	16.17"
8.0"	15.39"
10.0"	14.39"
12.0"	12.65"
14.0"	7.25"



Station B

Nearly identical to midship

Full Beam: 31.90"

Half-Breadth: 15.95"

Depth: 18.50"

Distance from Mid: 6"

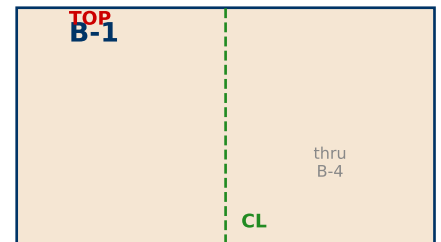
Blocks: 2

Panels: 8

CUTTING APPROACH

Wide U shape. Flat bottom. Score straight lines down both sides with utility knife. Use bread knife to saw across the curved bottom. The bottom is nearly flat -- follow the template closely.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

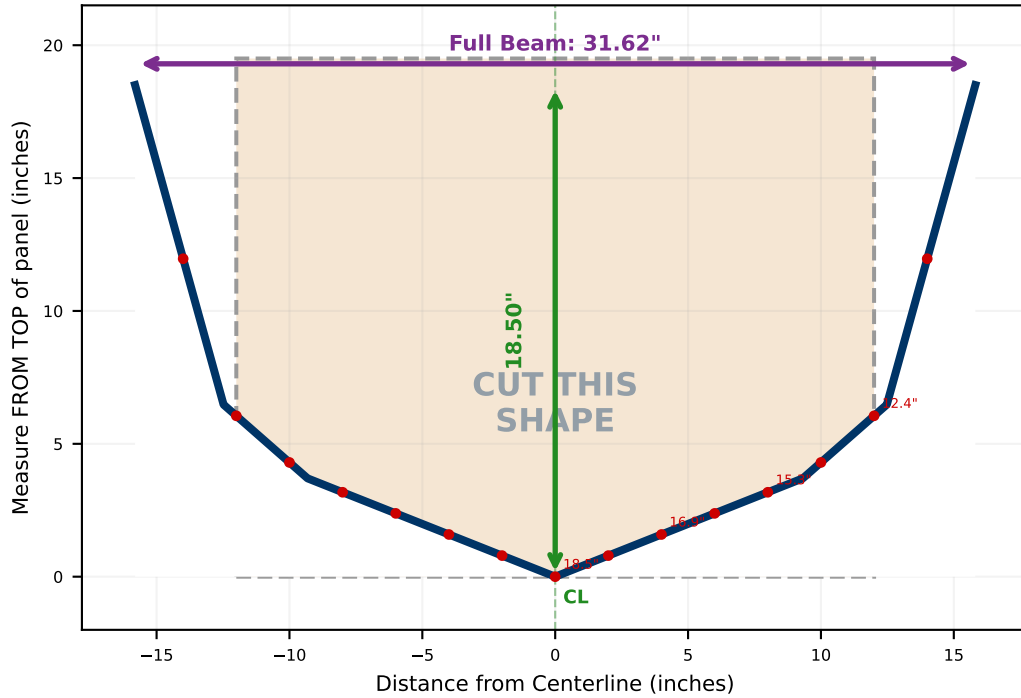
Half-breadth = 15.95" from CL at gunwale. Depth = 18.50" at centerline.

STATION C

Slight narrowing | 12" from midship | 2 block(s) = 8 panels

COORDINATE TABLE

FROM CL	FROM TOP
0.0"	18.50"
2.0"	17.71"
4.0"	16.91"
6.0"	16.12"
8.0"	15.32"
10.0"	14.20"
12.0"	12.45"
14.0"	6.54"

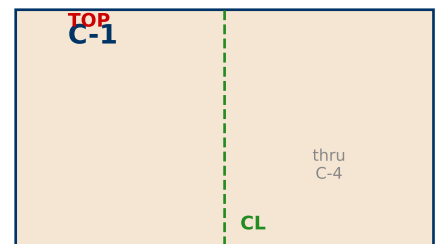


Station C	Full Beam: 31.62"	Depth: 18.50"	Blocks: 2
Slight narrowing	Half-Breadth: 15.81"	Distance from Mid: 12"	Panels: 8

CUTTING APPROACH

Wide U shape. Flat bottom. Score straight lines down both sides with utility knife. Use bread knife to saw across the curved bottom. The bottom is nearly flat -- follow the template closely.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

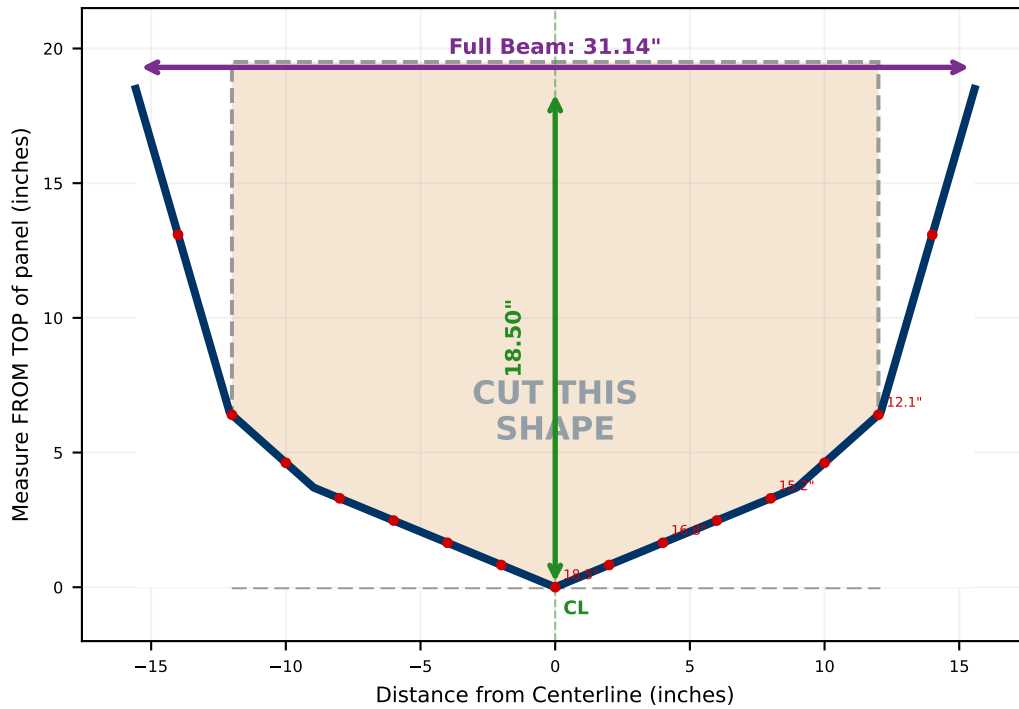
Half-breadth = 15.81" from CL at gunwale. Depth = 18.50" at centerline.

STATION D

Gentle taper begins | 18" from midship | 2 block(s) = 8 panels

COORDINATE TABLE

FROM CL	FROM TOP
0.0"	18.50"
2.0"	17.67"
4.0"	16.85"
6.0"	16.02"
8.0"	15.20"
10.0"	13.88"
12.0"	12.10"
14.0"	5.41"



Station D

Gentle taper begins

Full Beam: 31.14"

Half-Breadth: 15.57"

Depth: 18.50"

Distance from Mid: 18"

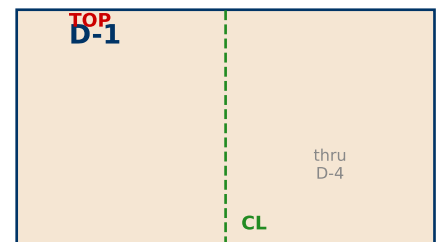
Blocks: 2

Panels: 8

CUTTING APPROACH

Wide U shape. Flat bottom. Score straight lines down both sides with utility knife. Use bread knife to saw across the curved bottom. The bottom is nearly flat -- follow the template closely.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

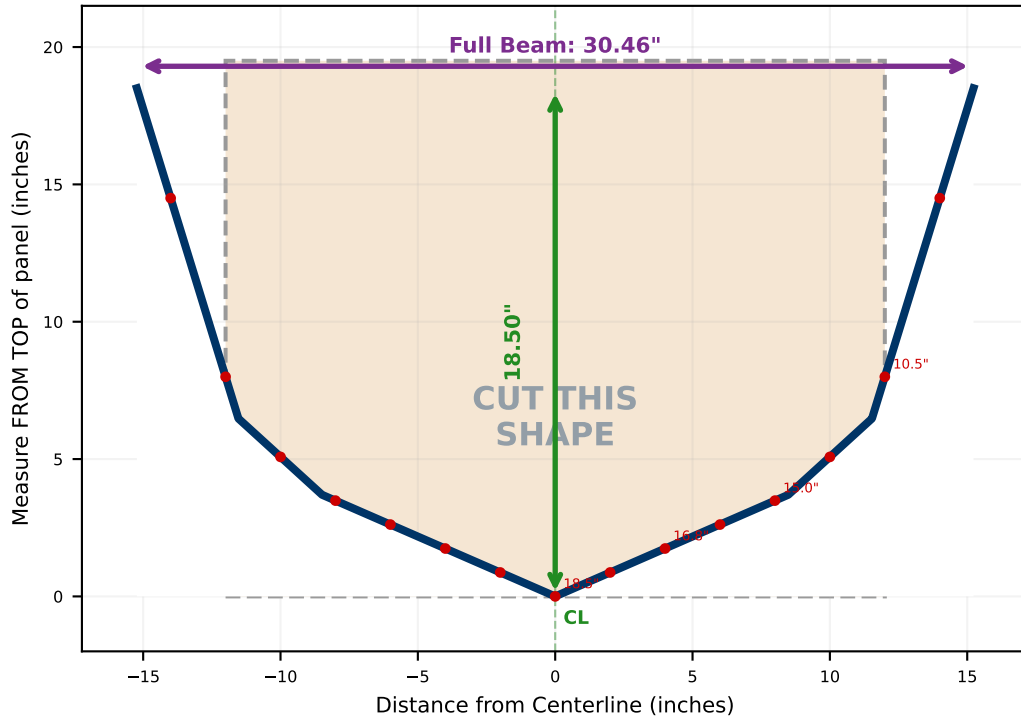
Half-breadth = 15.57" from CL at gunwale. Depth = 18.50" at centerline.

STATION E

Continued taper | 24" from midship | 2 block(s) = 8 panels

COORDINATE TABLE

FROM CL	FROM TOP
0.0"	18.50"
2.0"	17.63"
4.0"	16.76"
6.0"	15.88"
8.0"	15.01"
10.0"	13.42"
12.0"	10.50"
14.0"	4.00"

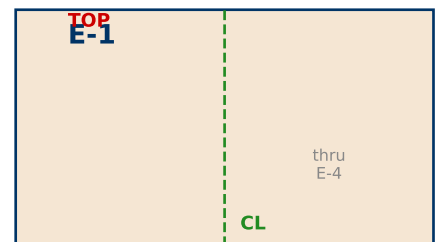


Station E	Full Beam: 30.46"	Depth: 18.50"	Blocks: 2
Continued taper	Half-Breadth: 15.23"	Distance from Mid: 24"	Panels: 8

CUTTING APPROACH

Wide U shape. Flat bottom. Score straight lines down both sides with utility knife. Use bread knife to saw across the curved bottom. The bottom is nearly flat -- follow the template closely.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

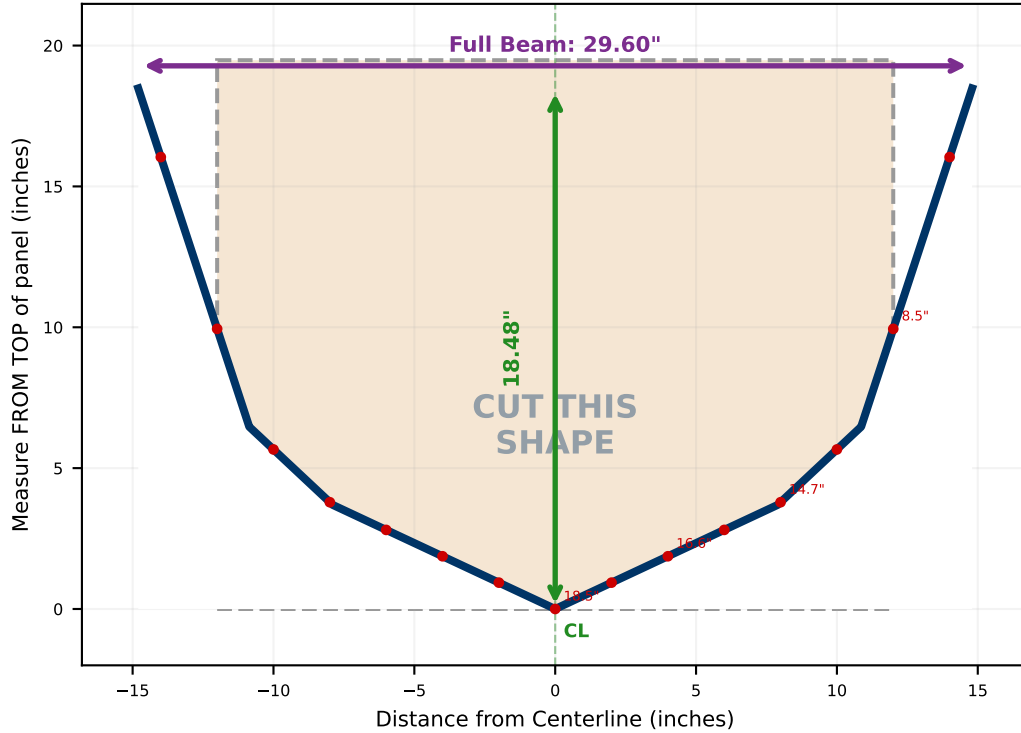
Half-breadth = 15.23" from CL at gunwale. Depth = 18.50" at centerline.

STATION F

Depth starts decreasing | 30" from midship | 2 block(s) = 8 panels

COORDINATE TABLE

FROM CL	FROM TOP
0.0"	18.48"
2.0"	17.54"
4.0"	16.61"
6.0"	15.67"
8.0"	14.69"
10.0"	12.82"
12.0"	8.54"
14.0"	2.44"



Station F

Full Beam: 29.60"

Depth: 18.48"

Blocks: 2

Depth starts decreasing

Half-Breadth: 14.80"

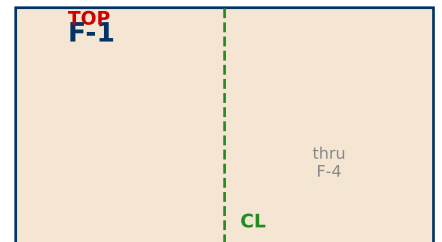
Distance from Mid: 30"

Panels: 8

CUTTING APPROACH

Transition shape. Bottom is developing a V. Sides are still straight -- utility knife. Bottom curve needs bread knife -- angle changes from flat to V here.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

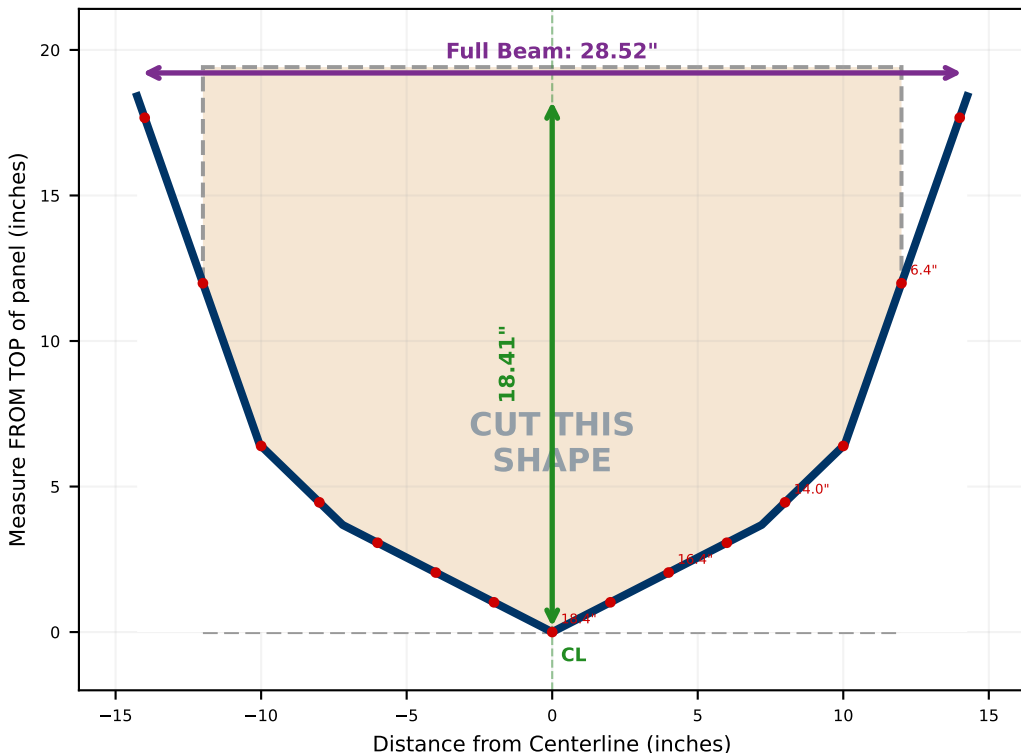
VERIFY:

Half-breadth = 14.80" from CL at gunwale. Depth = 18.48" at centerline.

STATION G

V-shape developing | 36" from midship | 2 block(s) = 8 panels

COORDINATE TABLE



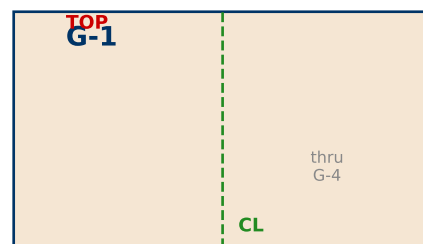
FROM CL	FROM TOP
0.0"	18.41"
2.0"	17.39"
4.0"	16.36"
6.0"	15.34"
8.0"	13.95"
10.0"	12.02"
12.0"	6.43"
14.0"	0.74"

Station G	Full Beam: 28.52"	Depth: 18.41"	Blocks: 2
V-shape developing	Half-Breadth: 14.26"	Distance from Mid: 36"	Panels: 8

CUTTING APPROACH

Transition shape. Bottom is developing a V. Sides are still straight -- utility knife. Bottom curve needs bread knife -- angle changes from flat to V here.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

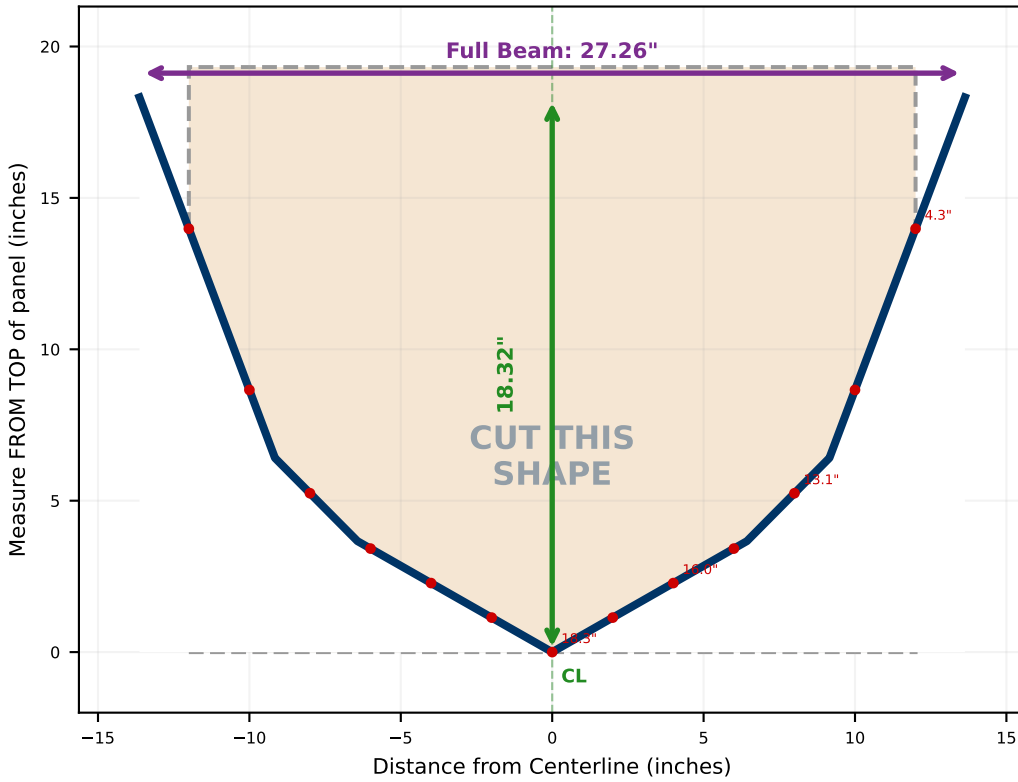
VERIFY:

Half-breadth = 14.26" from CL at gunwale. Depth = 18.41" at centerline.

STATION H

Clear V-bottom emerging | 42" from midship | 2 block(s) = 8 panels

COORDINATE TABLE



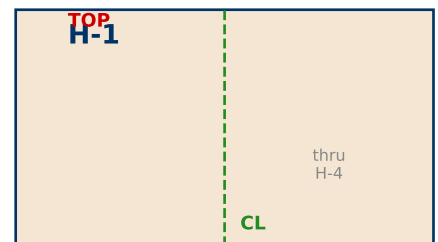
FROM CL	FROM TOP
0.0"	18.32"
2.0"	17.18"
4.0"	16.04"
6.0"	14.90"
8.0"	13.07"
10.0"	9.66"
12.0"	4.34"

Station H	Full Beam: 27.26"	Depth: 18.32"	Blocks: 2
Clear V-bottom emerging	Half-Breadth: 13.63"	Distance from Mid: 42"	Panels: 8

CUTTING APPROACH

Transition shape. Bottom is developing a V. Sides are still straight -- utility knife. Bottom curve needs bread knife -- angle changes from flat to V here.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

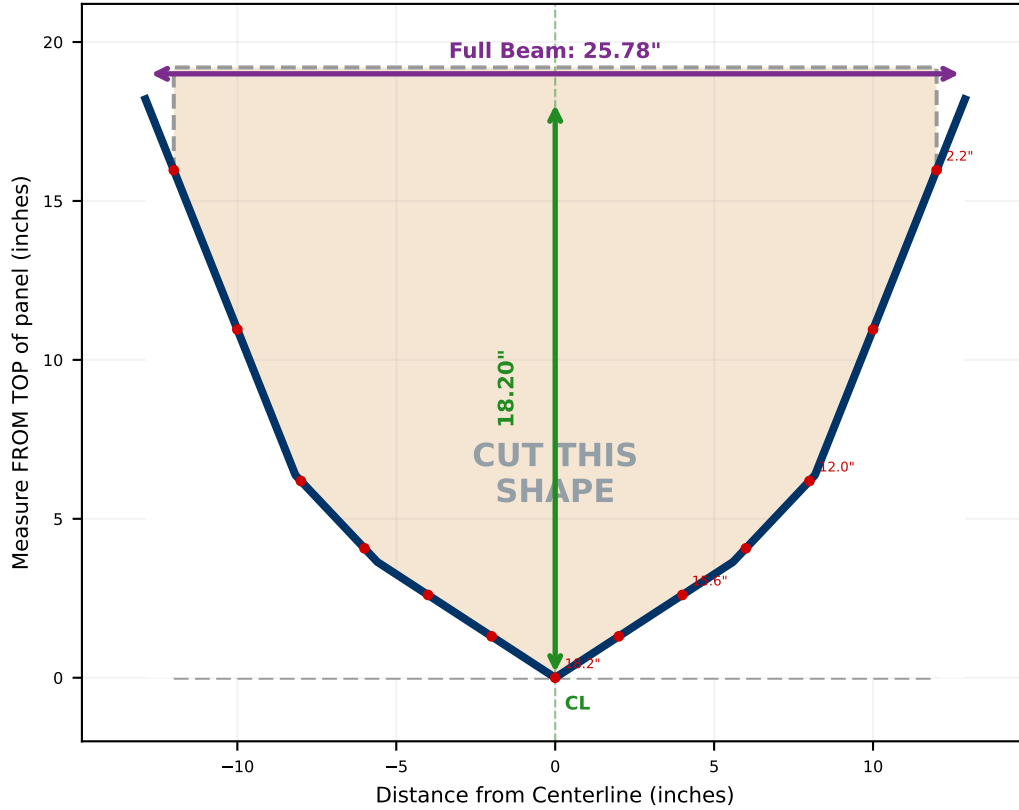
VERIFY:

Half-breadth = 13.63" from CL at gunwale. Depth = 18.32" at centerline.

STATION I

Transitional U-to-V | 48" from midship | 2 block(s) = 8 panels

COORDINATE TABLE



FROM CL	FROM TOP
0.0"	18.20"
2.0"	16.90"
4.0"	15.60"
6.0"	14.13"
8.0"	12.01"
10.0"	7.24"
12.0"	2.23"

Station I

Transitional U-to-V

Full Beam: 25.78"

Half-Breadth: 12.89"

Depth: 18.20"

Distance from Mid: 48"

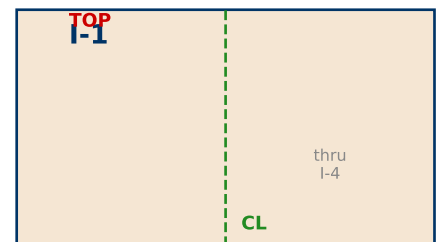
Blocks: 2

Panels: 8

CUTTING APPROACH

V-bottom. Two straight angled cuts from the gunwale line down to the keel point. Utility knife works for both cuts. Touch up the V-point with bread knife if needed.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

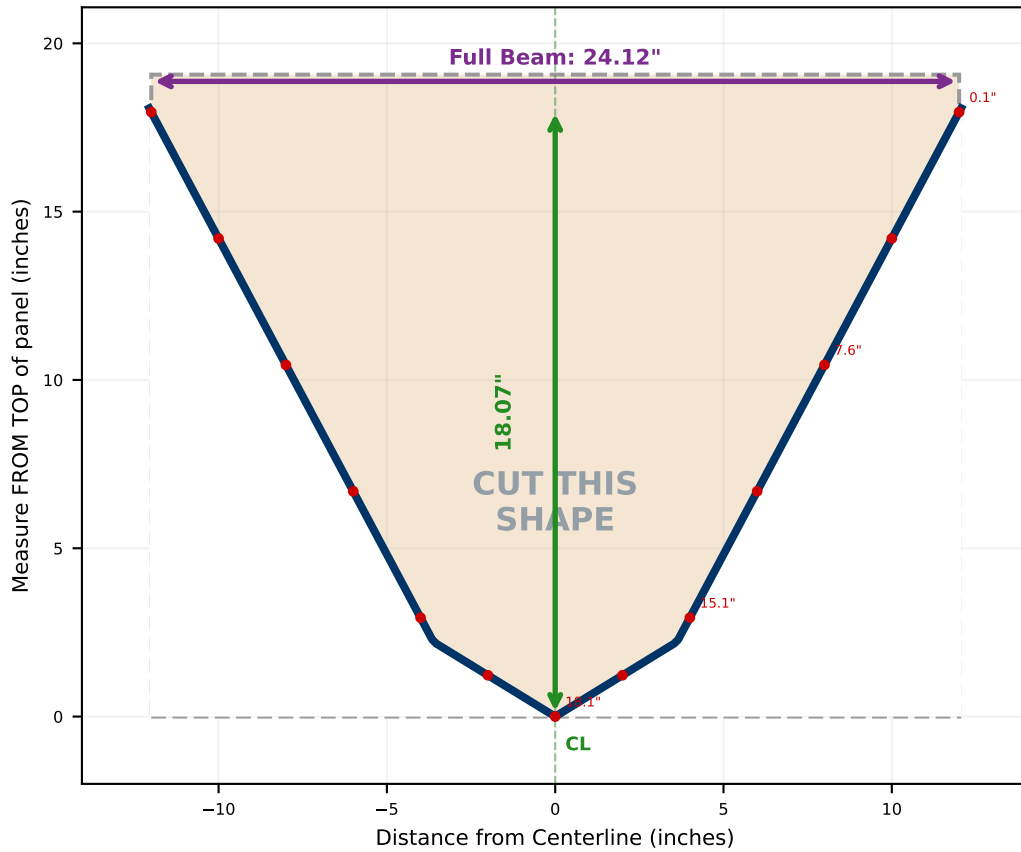
VERIFY:

Half-breadth = 12.89" from CL at gunwale. Depth = 18.20" at centerline.

STATION J

More pronounced V | 54" from midship | 2 block(s) = 8 panels

COORDINATE TABLE



FROM CL	FROM TOP
0.0"	18.07"
2.0"	16.84"
4.0"	15.13"
6.0"	11.38"
8.0"	7.62"
10.0"	3.87"
12.0"	0.11"

Station J

Full Beam: 24.12"

Depth: 18.07"

Blocks: 2

More pronounced V

Half-Breadth: 12.06"

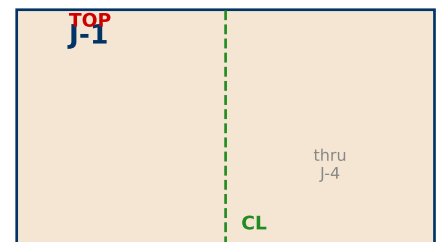
Distance from Mid: 54"

Panels: 8

CUTTING APPROACH

V-bottom. Two straight angled cuts from the gunwale line down to the keel point. Utility knife works for both cuts. Touch up the V-point with bread knife if needed.

LABELING



QC CHECK:

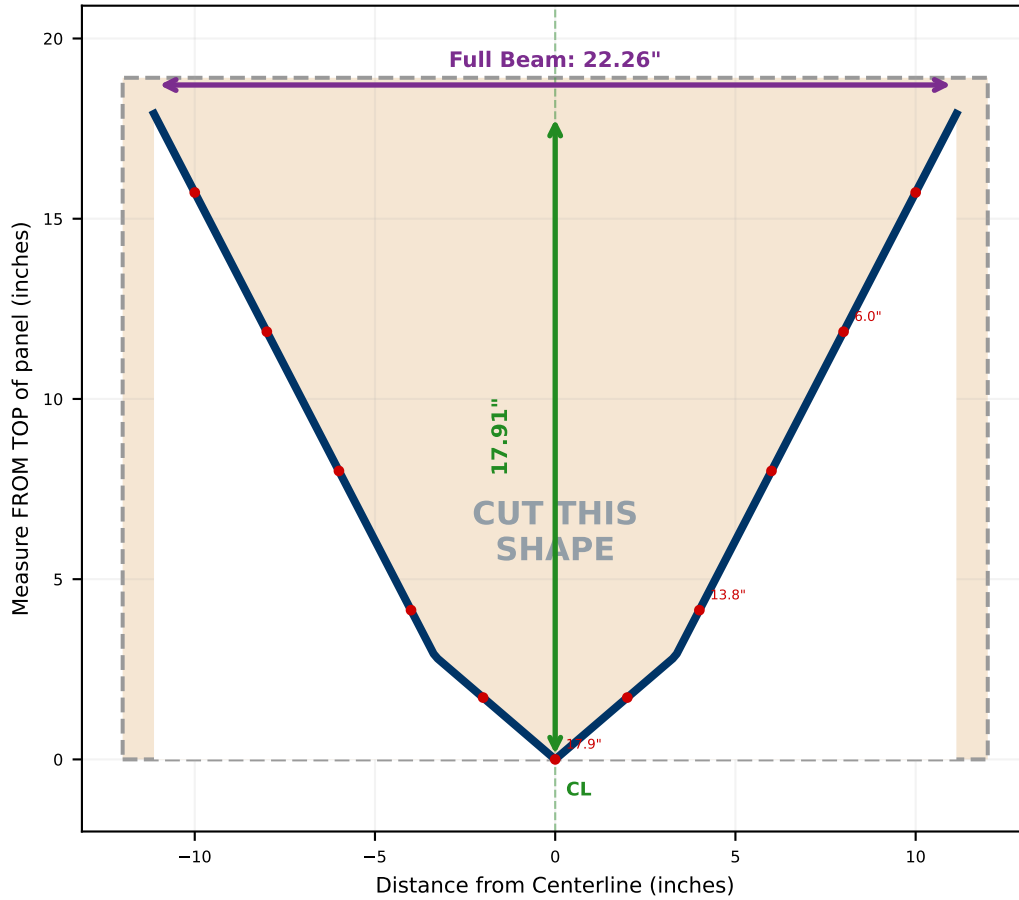
Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

Half-breadth = 12.06" from CL at gunwale. Depth = 18.07" at centerline.

STATION K

V-shape dominant | 60" from midship | 2 block(s) = 8 panels



COORDINATE TABLE

FROM CL	FROM TOP
0.0"	17.91"
2.0"	16.19"
4.0"	13.77"
6.0"	9.91"
8.0"	6.04"
10.0"	2.18"

Station K

V-shape dominant

Full Beam: 22.26"

Half-Breadth: 11.13"

Depth: 17.91"

Distance from Mid: 60"

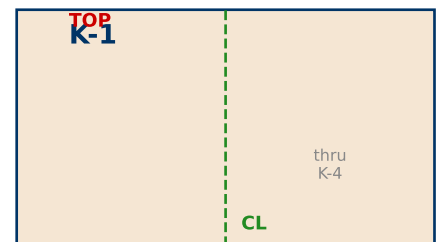
Blocks: 2

Panels: 8

CUTTING APPROACH

V-bottom. Two straight angled cuts from the gunwale line down to the keel point. Utility knife works for both cuts. Touch up the V-point with bread knife if needed.

LABELING



QC CHECK:

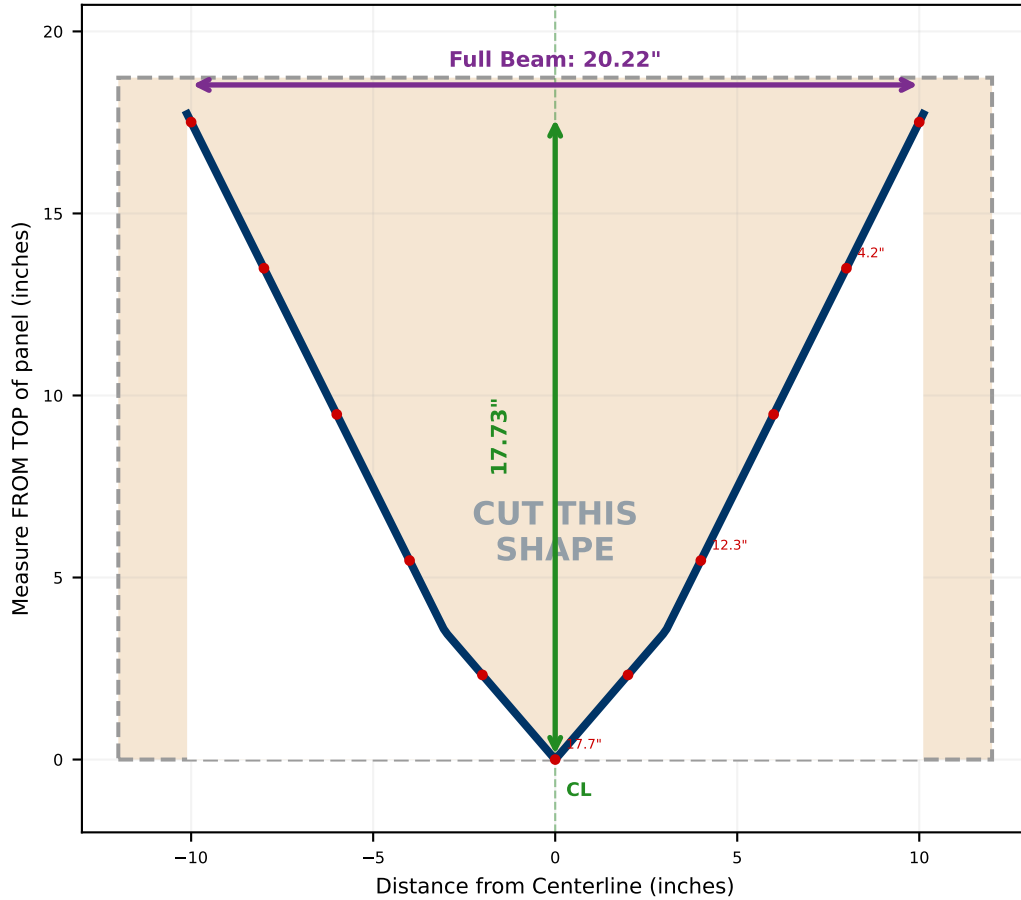
Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

Half-breadth = 11.13" from CL at gunwale. Depth = 17.91" at centerline.

STATION L

Narrow V | 66" from midship | 2 block(s) = 8 panels



COORDINATE TABLE

FROM CL	FROM TOP
0.0"	17.73"
2.0"	15.41"
4.0"	12.26"
6.0"	8.25"
8.0"	4.23"
10.0"	0.22"

Station L

Narrow V

Full Beam: 20.22"

Half-Breadth: 10.11"

Depth: 17.73"

Distance from Mid: 66"

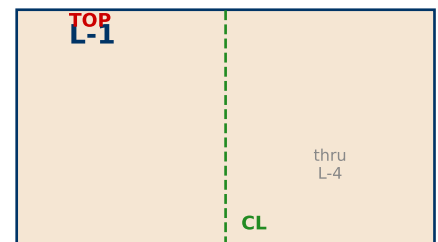
Blocks: 2

Panels: 8

CUTTING APPROACH

V-bottom. Two straight angled cuts from the gunwale line down to the keel point. Utility knife works for both cuts. Touch up the V-point with bread knife if needed.

LABELING



QC CHECK:

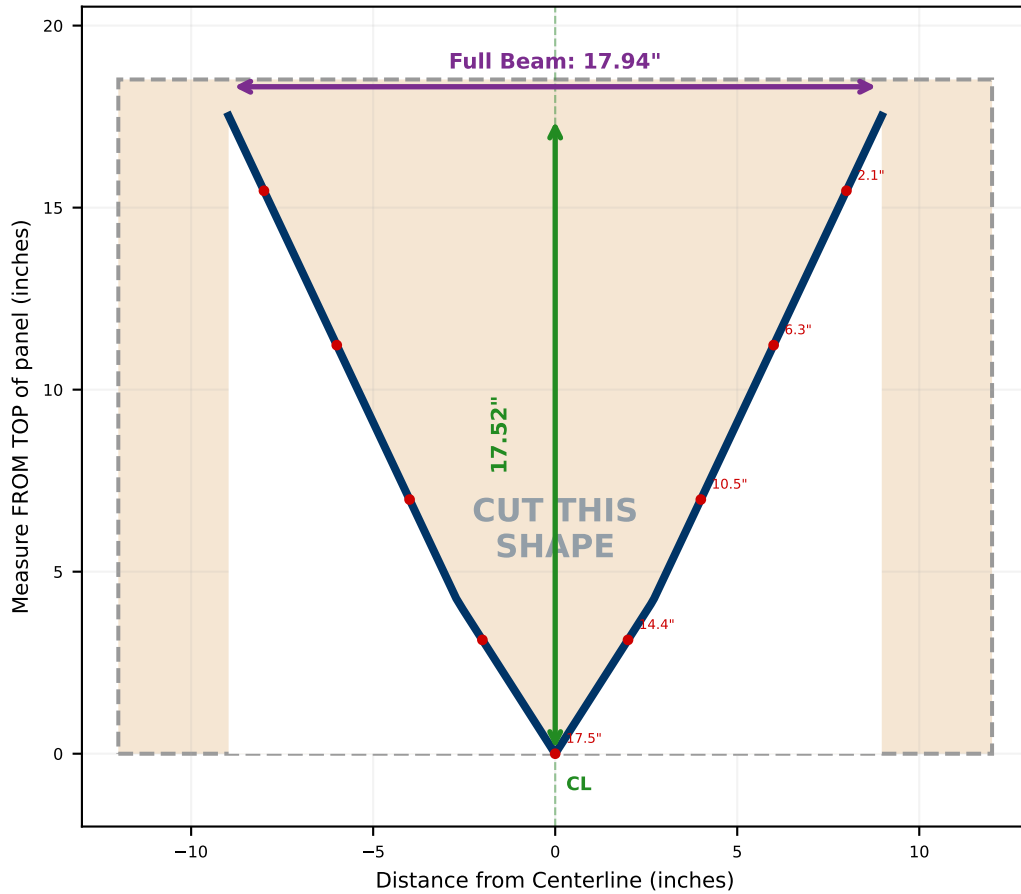
Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

Half-breadth = 10.11" from CL at gunwale. Depth = 17.73" at centerline.

STATION M

Sharp V, narrow | 72" from midship | 2 block(s) = 8 panels



COORDINATE TABLE

FROM CL	FROM TOP
0.0"	17.52"
2.0"	14.39"
4.0"	10.54"
6.0"	6.30"
8.0"	2.06"

Station M

Sharp V, narrow

Full Beam: 17.94"

Half-Breadth: 8.97"

Depth: 17.52"

Distance from Mid: 72"

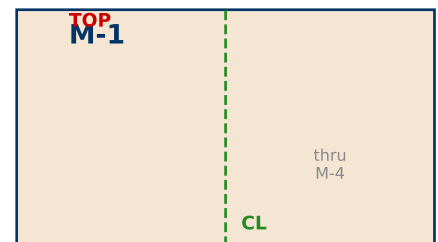
Blocks: 2

Panels: 8

CUTTING APPROACH

Very narrow V. Score both angled lines deeply with utility knife (4-5 passes). Snap the waste piece out. Clean up with bread knife if ragged.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

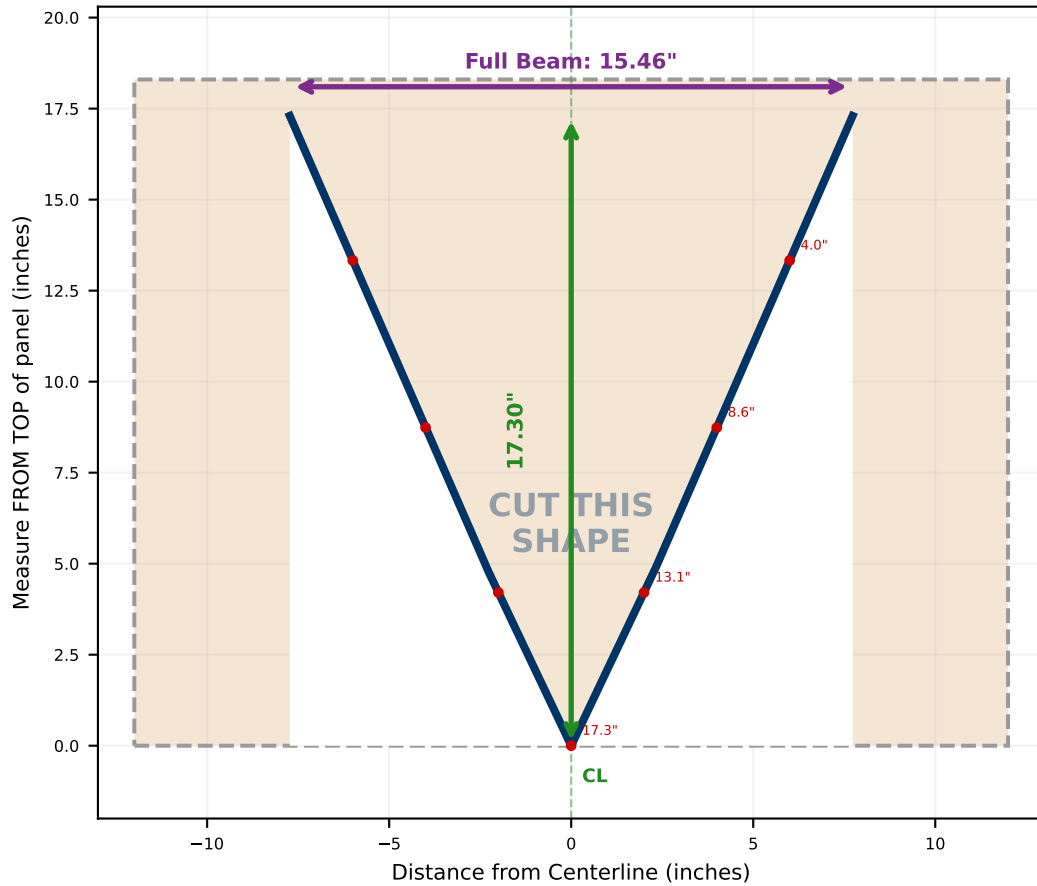
Half-breadth = 8.97" from CL at gunwale. Depth = 17.52" at centerline.

STATION N

Very narrow | 78" from midship | 2 block(s) = 8 panels

COORDINATE TABLE

FROM CL	FROM TOP
0.0"	17.30"
2.0"	13.09"
4.0"	8.56"
6.0"	3.97"

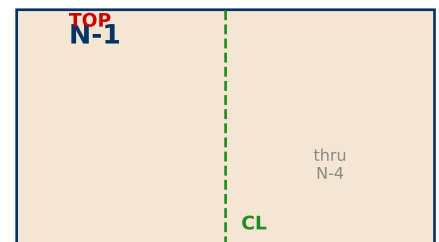


Station N	Full Beam: 15.46"	Depth: 17.30"	Blocks: 2
Very narrow	Half-Breadth: 7.73"	Distance from Mid: 78"	Panels: 8

CUTTING APPROACH

Very narrow V. Score both angled lines deeply with utility knife (4-5 passes). Snap the waste piece out. Clean up with bread knife if ragged.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

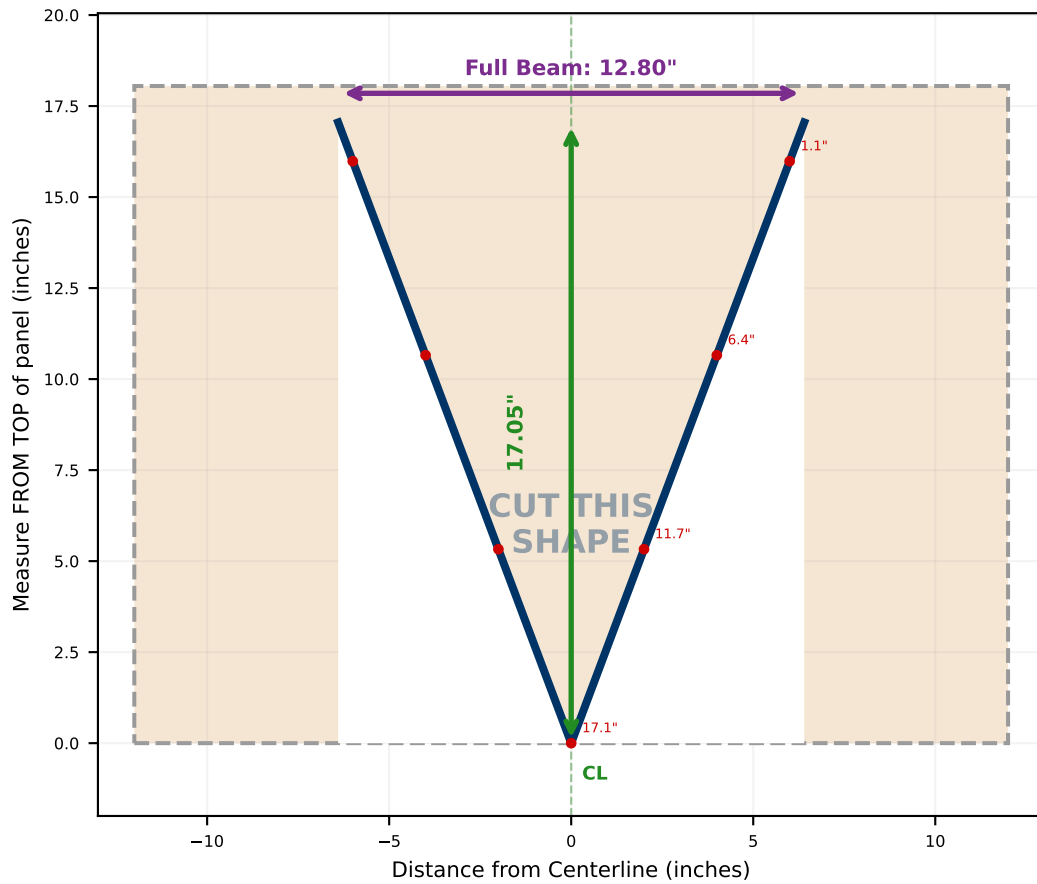
Half-breadth = 7.73" from CL at gunwale. Depth = 17.30" at centerline.

STATION 0

Near-bow section | 84" from midship | 2 block(s) = 8 panels

COORDINATE TABLE

FROM CL	FROM TOP
0.0"	17.05"
2.0"	11.72"
4.0"	6.39"
6.0"	1.07"



Station 0

Full Beam: 12.80"

Depth: 17.05"

Blocks: 2

Near-bow section

Half-Breadth: 6.40"

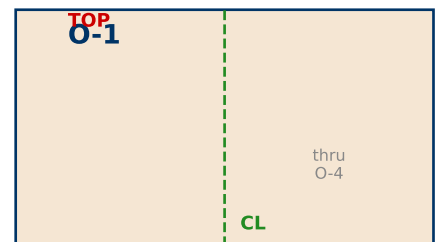
Distance from Mid: 84"

Panels: 8

CUTTING APPROACH

Very narrow V. Score both angled lines deeply with utility knife (4-5 passes). Snap the waste piece out. Clean up with bread knife if ragged.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

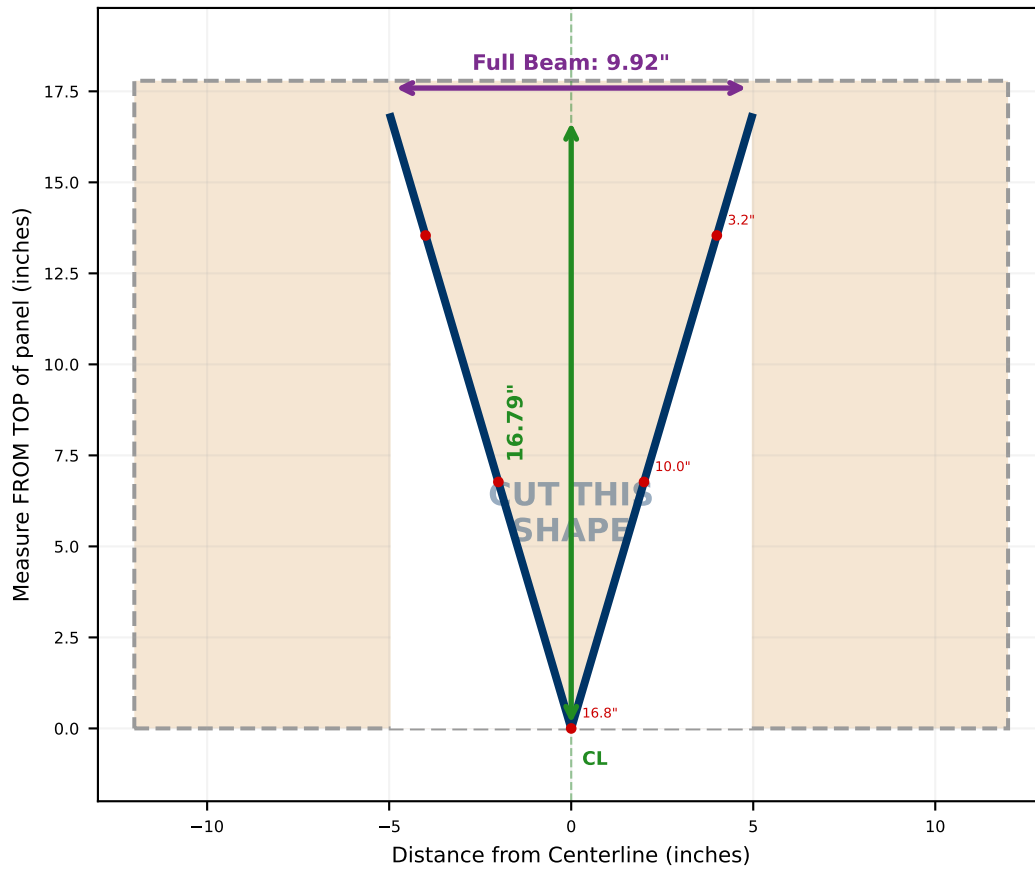
Half-breadth = 6.40" from CL at gunwale. Depth = 17.05" at centerline.

STATION P

Fine entry | 90" from midship | 2 block(s) = 8 panels

COORDINATE TABLE

FROM CL	FROM TOP
0.0"	16.79"
2.0"	10.02"
4.0"	3.25"



Station P

Full Beam: 9.92"

Depth: 16.79"

Blocks: 2

Fine entry

Half-Breadth: 4.96"

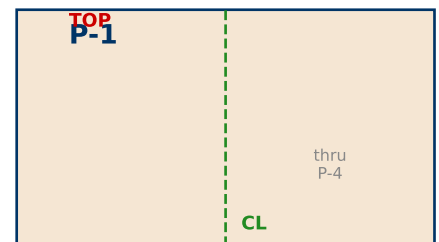
Distance from Mid: 90"

Panels: 8

CUTTING APPROACH

Very narrow V. Score both angled lines deeply with utility knife (4-5 passes). Snap the waste piece out. Clean up with bread knife if ragged.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

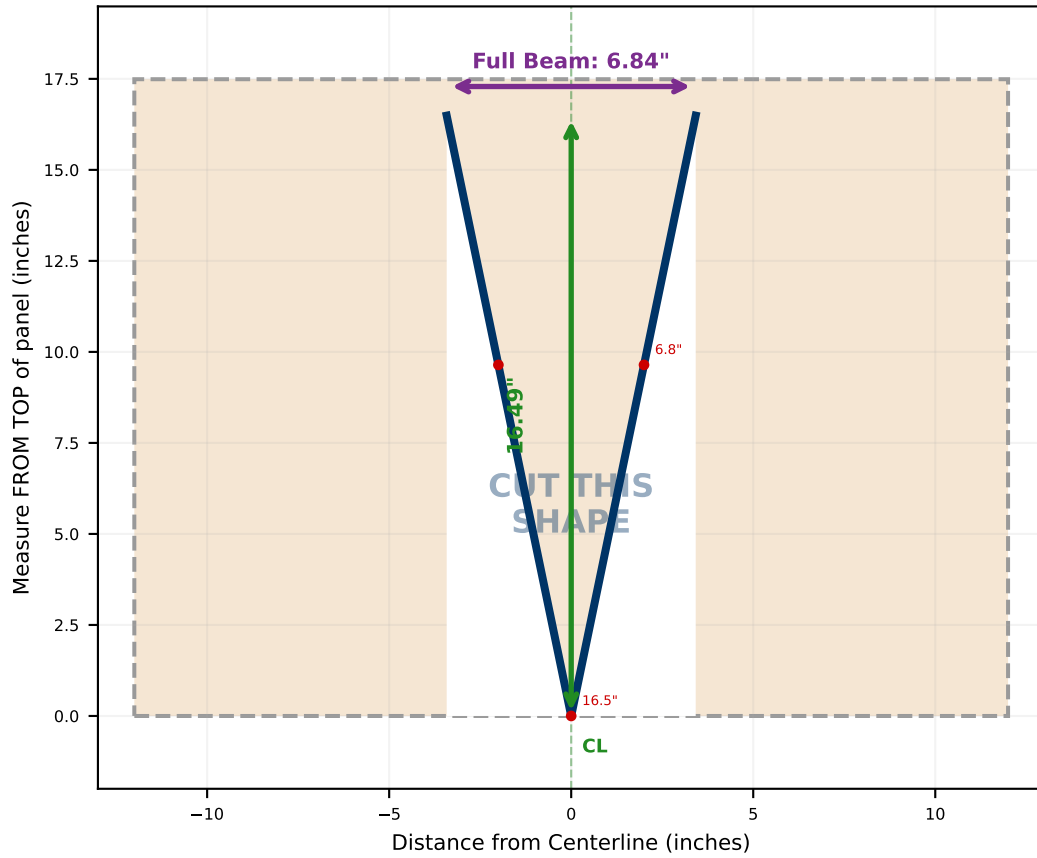
Half-breadth = 4.96" from CL at gunwale. Depth = 16.79" at centerline.

STATION Q

Almost keel-only | 96" from midship | 2 block(s) = 8 panels

COORDINATE TABLE

FROM CL	FROM TOP
0.0"	16.49"
2.0"	6.85"



Station Q

Full Beam: 6.84"

Depth: 16.49"

Blocks: 2

Almost keel-only

Half-Breadth: 3.42"

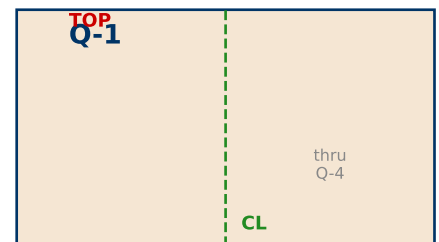
Distance from Mid: 96"

Panels: 8

CUTTING APPROACH

Barely any width. This is nearly two lines meeting at a point. Score deeply, snap.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

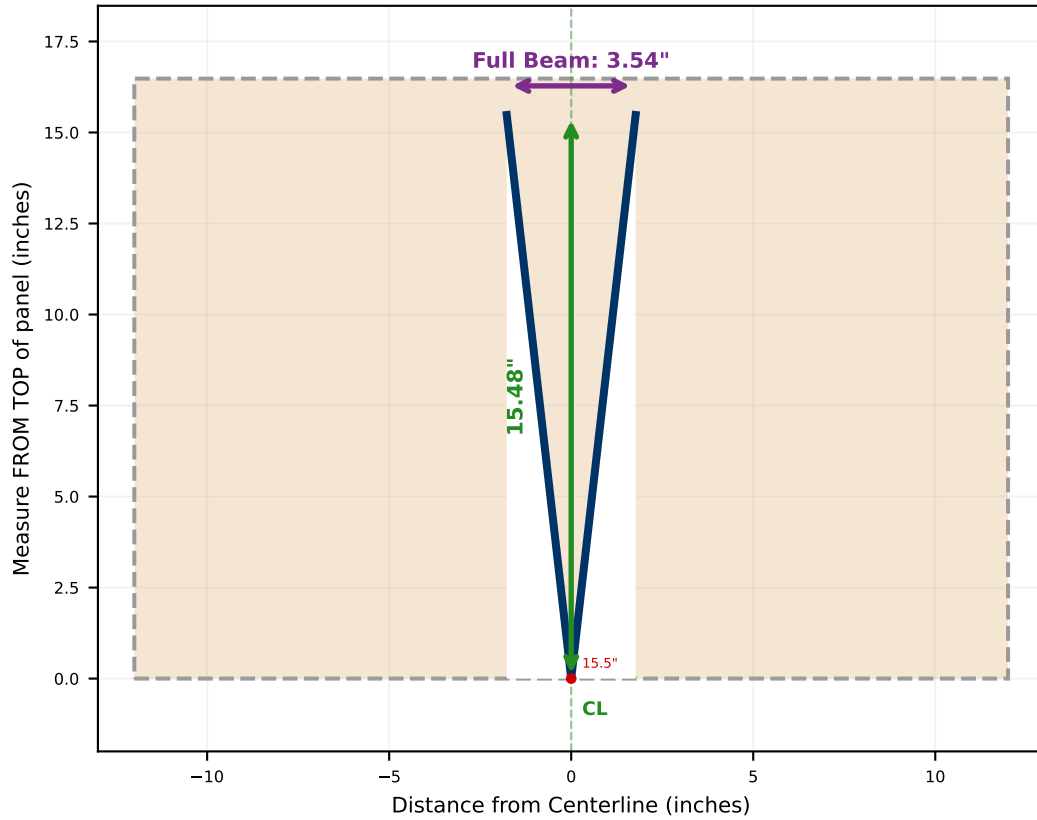
VERIFY:

Half-breadth = 3.42" from CL at gunwale. Depth = 16.49" at centerline.

STATION R

Vestigial width | 102" from midship | 2 block(s) = 8 panels

COORDINATE TABLE



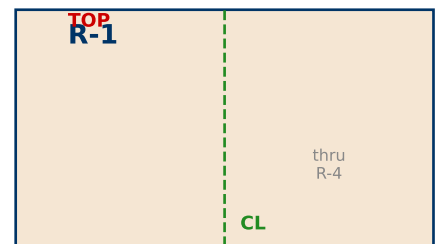
FROM CL	FROM TOP
0.0"	15.48"

Station R	Full Beam: 3.54"	Depth: 15.48"	Blocks: 2
Vestigial width	Half-Breadth: 1.77"	Distance from Mid: 102"	Panels: 8

CUTTING APPROACH

Barely any width. This is nearly two lines meeting at a point. Score deeply, snap.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

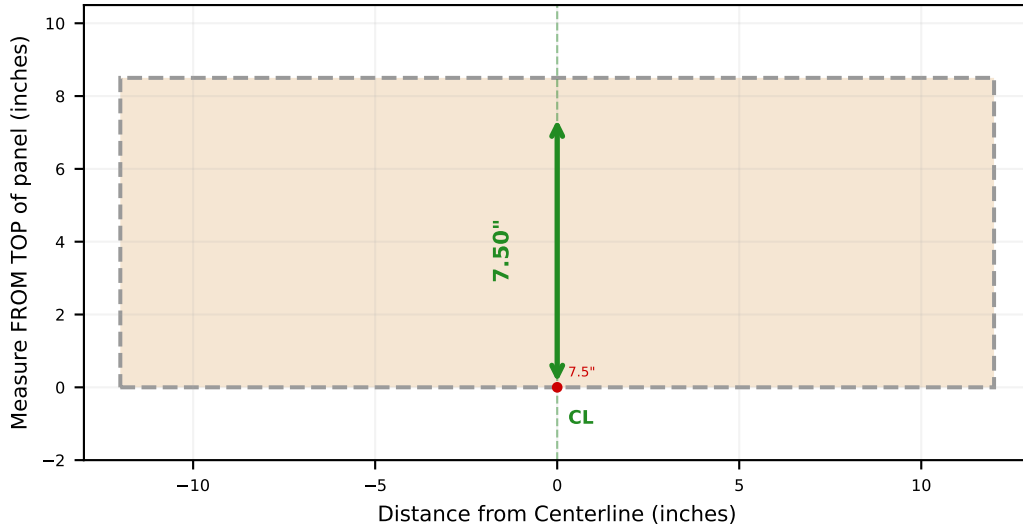
Half-breadth = 1.77" from CL at gunwale. Depth = 15.48" at centerline.

STATION S

Keel point only | 108" from midship | 2 block(s) = 8 panels

COORDINATE TABLE

FROM CL	FROM TOP
0.0"	7.50"

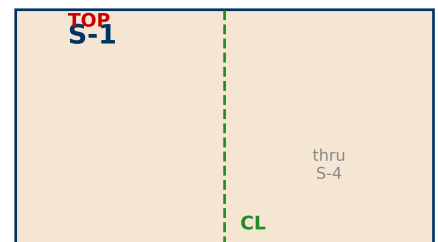


Station S	Full Beam: 0.00"	Depth: 7.50"	Blocks: 2
Keel point only	Half-Breadth: 0.00"	Distance from Mid: 108"	Panels: 8

CUTTING APPROACH

Zero width -- just a vertical slot 7.5" deep. Score and snap, or hand-carve.

LABELING



QC CHECK:

Stack all 4 cut panels for this block. Profiles must align within 1/8". Re-cut any outlier.

VERIFY:

Half-breadth = 0.00" from CL at gunwale. Depth = 7.50" at centerline.

MASTER TRACKING CHECKLIST

Check off each panel as cut. Check block when glued. Record date.

Station	P1	P2	P3	P4	P5	P6	P7	P8	Glued?	Date	
A (32.0"x18.5")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	--	--	--	--	<input type="checkbox"/>	_____	
B (31.9"x18.5")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
C (31.6"x18.5")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
D (31.1"x18.5")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
E (30.5"x18.5")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
F (29.6"x18.5")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
G (28.5"x18.4")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
H (27.3"x18.3")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
I (25.8"x18.2")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
J (24.1"x18.1")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
K (22.3"x17.9")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
L (20.2"x17.7")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
M (17.9"x17.5")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
N (15.5"x17.3")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
O (12.8"x17.1")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
P (9.9"x16.8")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Q (6.8"x16.5")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
R (3.5"x15.5")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
S (0.0"x7.5")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
TOTALS	148 panels								37 blocks		

37 blocks x 4 panels = 148 panels total | 40 sheets x 4 panels = 160 panels available | 12 spare panels for re-cuts

SECTION 6

Shop Drawings — Detailed Construction Sheets

20 pages follow

NAU ASCE CONCRETE CANOE 2026

DESIGN A — CONSTRUCTION SHOP DRAWINGS

Female Mold Process | U-to-V Hybrid Hull | 216" LOA



PROFILE

216" LOA x 32" BEAM x 18.5" DEPTH



PLAN

KEY SPECIFICATIONS

Hull Length	216" (18'-0")
Maximum Beam	32" (2'-8")
Maximum Depth	18.5"
Wall Thickness	0.5" (nominal)
Hull Form	U-to-V Hybrid (flat midship → V bow/stern)
Number of Stations	19 unique (A-S) @ 6" spacing
Midship Station	Station A (widest)
Symmetry	Bow/Stern mirror about Station A
Concrete Density	58.6 PCF (Mix 3)
Reinforcement	Basalt mesh + PVA fibers
Mold Material	EPS foam (2 lb/ft ³)
Strongback	3/4" MDF, 36" x 216"

GENERAL NOTES

- ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
- CONCRETE DENSITY: 58.6 PCF (MIX 3), LIGHTWEIGHT MIX DESIGN.
- WALL THICKNESS: 0.5" NOMINAL, TOLERANCE ±0.0625".
- EPS FOAM: 2 LB/FT³ EXPANDED POLYSTYRENE.
- MOLD ORIENTATION: FEMALE (HULL INVERTED, LAYUP ON INSIDE).
- ALL STATION CROSS-SECTIONS ARE SYMMETRIC ABOUT CENTERLINE.
- HULL IS SYMMETRIC BOW-TO-STERN ABOUT STATION A (MIDSHIP).
- REINFORCEMENT: SINGLE LAYER BASALT MESH + PVA FIBERS IN MIX.
- DO NOT SCALE DRAWINGS - USE FIGURED DIMENSIONS ONLY.
- U-TO-V HULL: FLAT BOTTOM AT MIDSHIP, V-SHAPE AT BOW/STERN.

DRAWING INDEX

SH-01	Title Sheet & Drawing Index
SH-02	Bill of Materials
SH-03	Strongback Assembly
SH-04	Foam Nesting Layout
SH-05	Station Templates (A-D, Midship)
SH-06	Station Templates (E-H)
SH-07	Station Templates (I-L)
SH-08	Station Templates (M-P)
SH-09	Station Templates (Q-S, Bow/Stern)
SH-10	Mold Assembly Sequence
SH-11	Surface Fairing & Release Agent
SH-12	Basalt Mesh Cutting Pattern
SH-13	Concrete Lift 1 (0.20")
SH-14	Mesh Placement & Lift 2 (0.30")
SH-15	Curing Setup & Schedule
SH-16	Demolding Procedure
SH-17	Finishing & Graphics
SH-18	Hull Lines Plan (3-View)
SH-19	Waterline & Load Diagram
SH-20	QC Checklist & Assembly Overview

NAU ASCE CONCRETE CANOE 2026

Northern Arizona University
American Society of Civil Engineers

DESIGN A — CONSTRUCTION DRAWINGS

TITLE SHEET & DRAWING INDEX

216" L x 32" B x 18.5" D | 0.5" Wall | U-to-V Hybrid Hull | 19 Stations (A-S) @ 6" Spacing

SHEET 01 OF 20

DATE: 2026-02-22

REV: A

SCALE: AS NOTED

BILL OF MATERIALS — DESIGN A CONSTRUCTION

ITEM	DESCRIPTION	QTY	SIZE / SPECIFICATION	VENDOR	UNIT \$	TOTAL \$
A. MOLD MATERIALS						
A1	EPS Foam Sheets (2 lb/ft ³)	20	1.5" x 48" x 96"	Henry R-5.7B	\$28.00	\$560.00
A2	MDF Sheet (Strongback)	1	3/4" x 36" x 216"	Home Depot	\$75.00	\$75.00
A3	Gorilla Glue (Foam Adhesive)	4	18 oz bottle	Gorilla	\$8.50	\$34.00
A4	PVA Mold Release Agent	2	1 quart	Partall	\$18.00	\$36.00
A5	Sandpaper Assortment	1	80/120/220 grit pack	3M	\$24.00	\$24.00
A6	Drywall Screws (Alignment)	1	#8 x 2", 100-pk	GRK	\$8.00	\$8.00
A7	Shims & Leveling Wedges	2	8-pk composite	Nelson	\$6.00	\$12.00
A8	Plastic Sheeting (Mold Wrap)	1	6 mil, 10' x 25'	Husky	\$15.00	\$15.00
B. CONCRETE & REINFORCEMENT						
B1	Portland Cement Type III	60	lb (1 bag)	Quikrete	\$12.00	\$12.00
B2	Poraver Expanded Glass	40	lb (0.25-0.5mm grade)	Poraver	\$45.00	\$45.00
B3	Class F Fly Ash	15	lb	Boral	\$8.00	\$8.00
B4	Silica Fume (Densified)	8	lb	Norchem	\$12.00	\$12.00
B5	Basalt Fiber Mesh	3	yd ² (4mm grid)	Sudaglass	\$28.00	\$84.00
B6	PVA Fibers (3/4" chopped)	2	lb	Nycon	\$18.00	\$36.00
B7	HRWR Admixture (Superplast.)	1	1 quart	Fritz-Pak	\$22.00	\$22.00
B8	Air Entrainer	1	8 oz	Fritz-Pak	\$15.00	\$15.00
B9	Concrete Sealer (Penetrating)	1	1 quart	Aqua-X	\$32.00	\$32.00
B10	Latex Paint (NAU Blue/Gold)	2	1 quart each	Sherwin-Williams	\$16.00	\$32.00
C. TOOLS & EQUIPMENT						
C1	Margin Trowels (Assorted)	4	3",4",6" widths	Marshalltown	\$9.00	\$36.00
C2	Mixing Buckets (5 gal)	4	5-gallon	Homer	\$4.00	\$16.00
C3	Orbital Sander	1	5" random orbit	DEWALT	\$65.00	\$65.00
C4	Utility Knife / Bread Knife	2	For cross-section cutting	Stanley	\$15.00	\$30.00
C5	Spray Bottles	4	32 oz	Generic	\$3.00	\$12.00
C6	Mixing Drill + Paddle	1	1/2" drill w/ paddle	Milwaukee	\$0.00	OWNED
C7	Levels (2' and 4')	2	Aluminum	Stanley	\$0.00	OWNED
C8	Tape Measures	3	25' steel	Stanley	\$0.00	OWNED
C9	Safety Equipment (PPE)	1	Kit: goggles, gloves, masks	3M	\$35.00	\$35.00
C10	Curing Blankets (Burlap)	2	3' x 12' rolls	Mutual Ind.	\$12.00	\$24.00
ESTIMATED GRAND TOTAL						\$1,131.00

NAU ASCE CONCRETE CANOE 2026

- Items marked "OWNED" are existing tools - no additional cost.
- Quantities include 10-15% waste/contingency factor.
- Prices based on Feb. 2024 estimates, confirm before purchasing.
- Quantities are approximate and subject to change based on site conditions.

Northern Arizona University

American Society of Civil Engineers

DESIGN A — CONSTRUCTION DRAWINGS

BILL OF MATERIALS

216" L x 32" B x 18.5" D | 0.5" Wall | U-to-V Hybrid Hull | 19 Stations (A-S) @ 6" Spacing

SHEET 02 OF 20

DATE: 2026-02-22

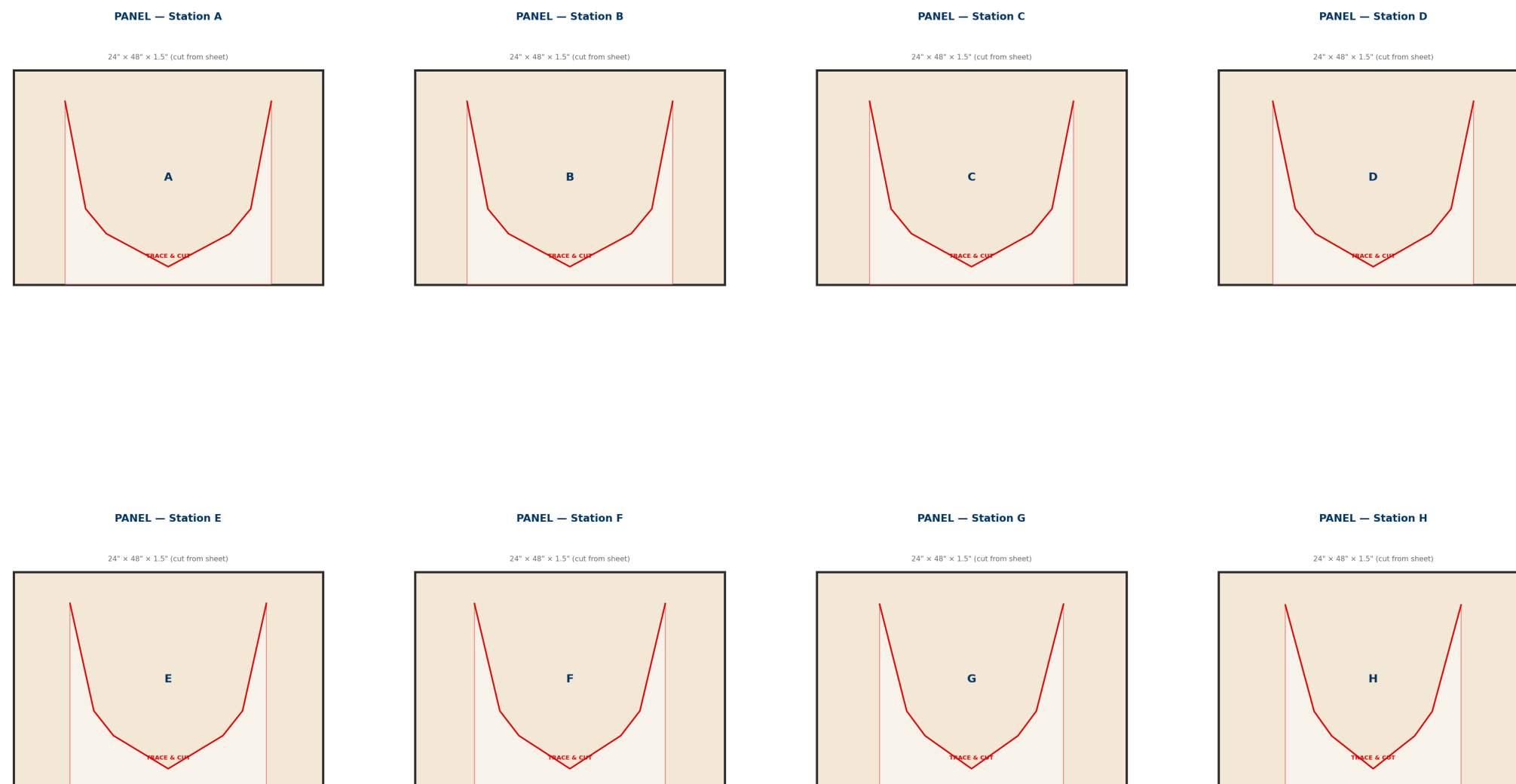
REV: A

SCALE: AS NOTED

5. EPS foam: 48"x96" sheets cut into 24"x48" panels, cross-section traced & cut, 4 panels glued face-to-face = 6" block.

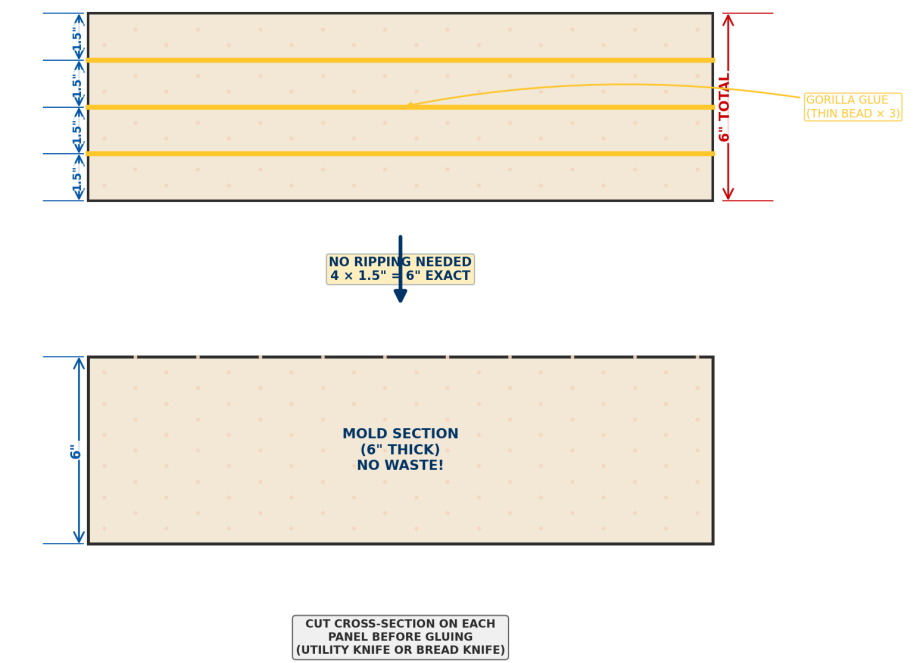
PANEL LAYOUT (40 SHEETS → 160 PANELS, 148 NEEDED, 12 SPARES)

Each 48"×96" sheet → 4 equal 24"×48" panels | Trace template on panel → cut with utility knife → glue 4 panels = 6" block



LAMINATION DETAIL

SCALE: 1" = 1" (1:1)

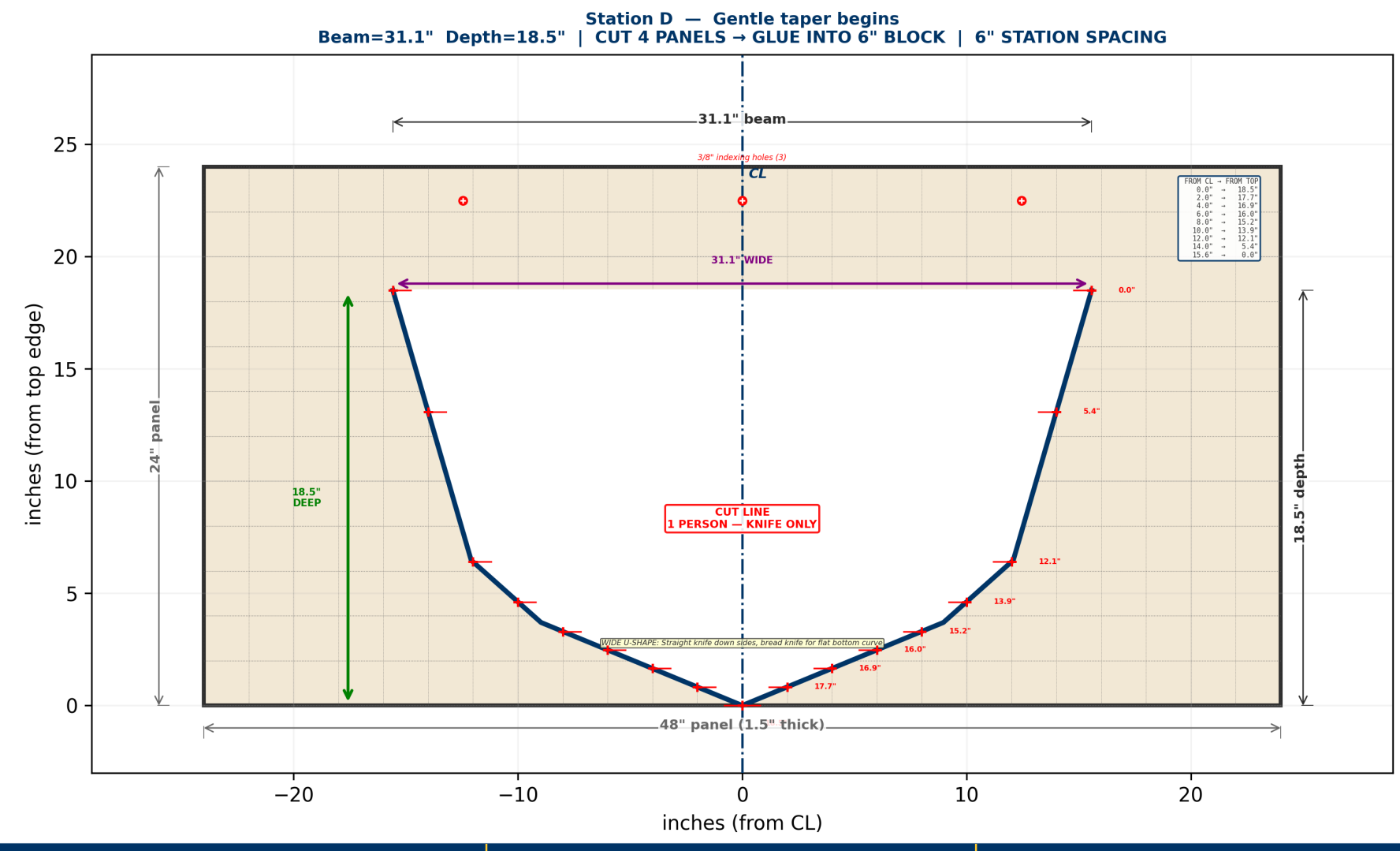
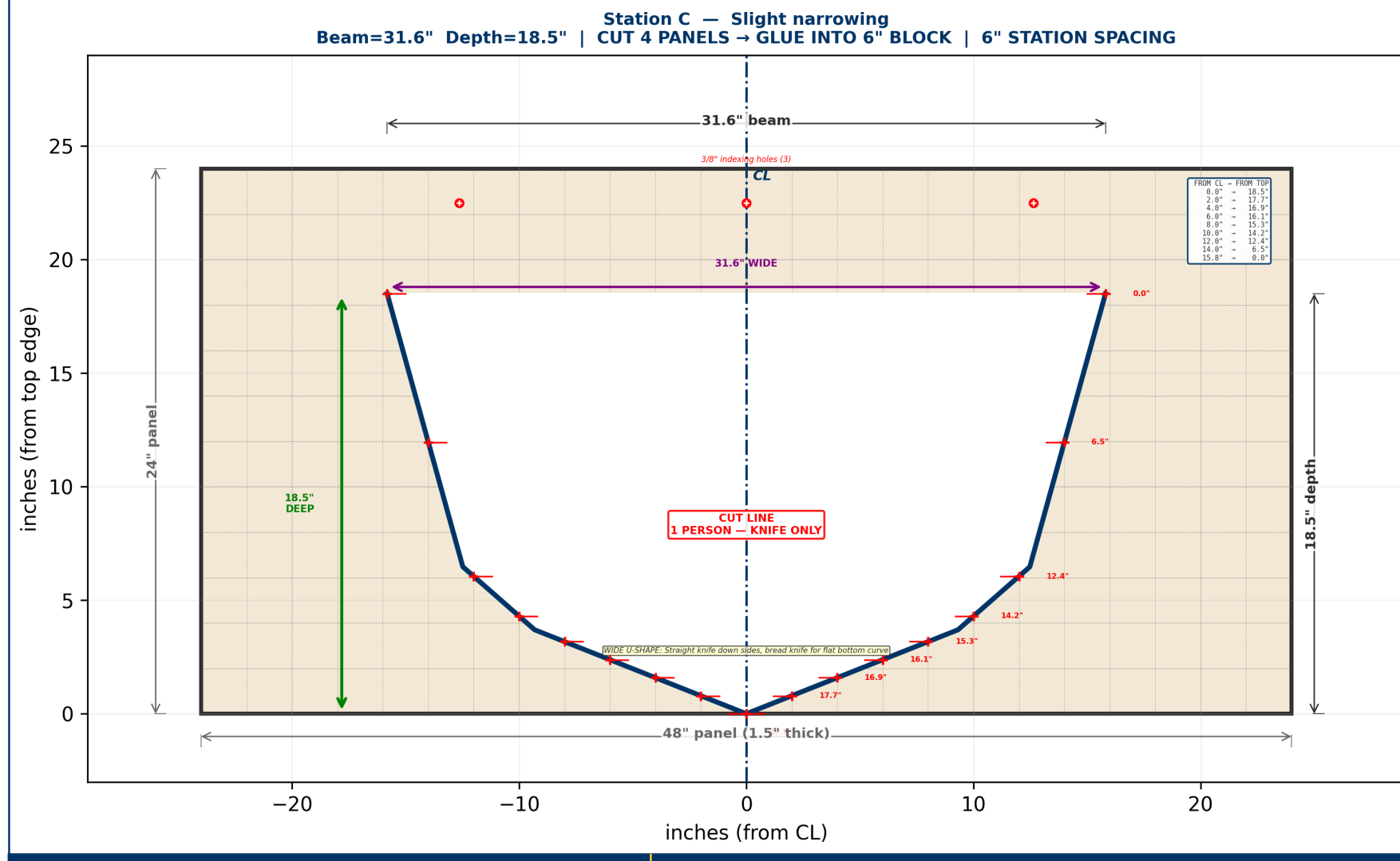
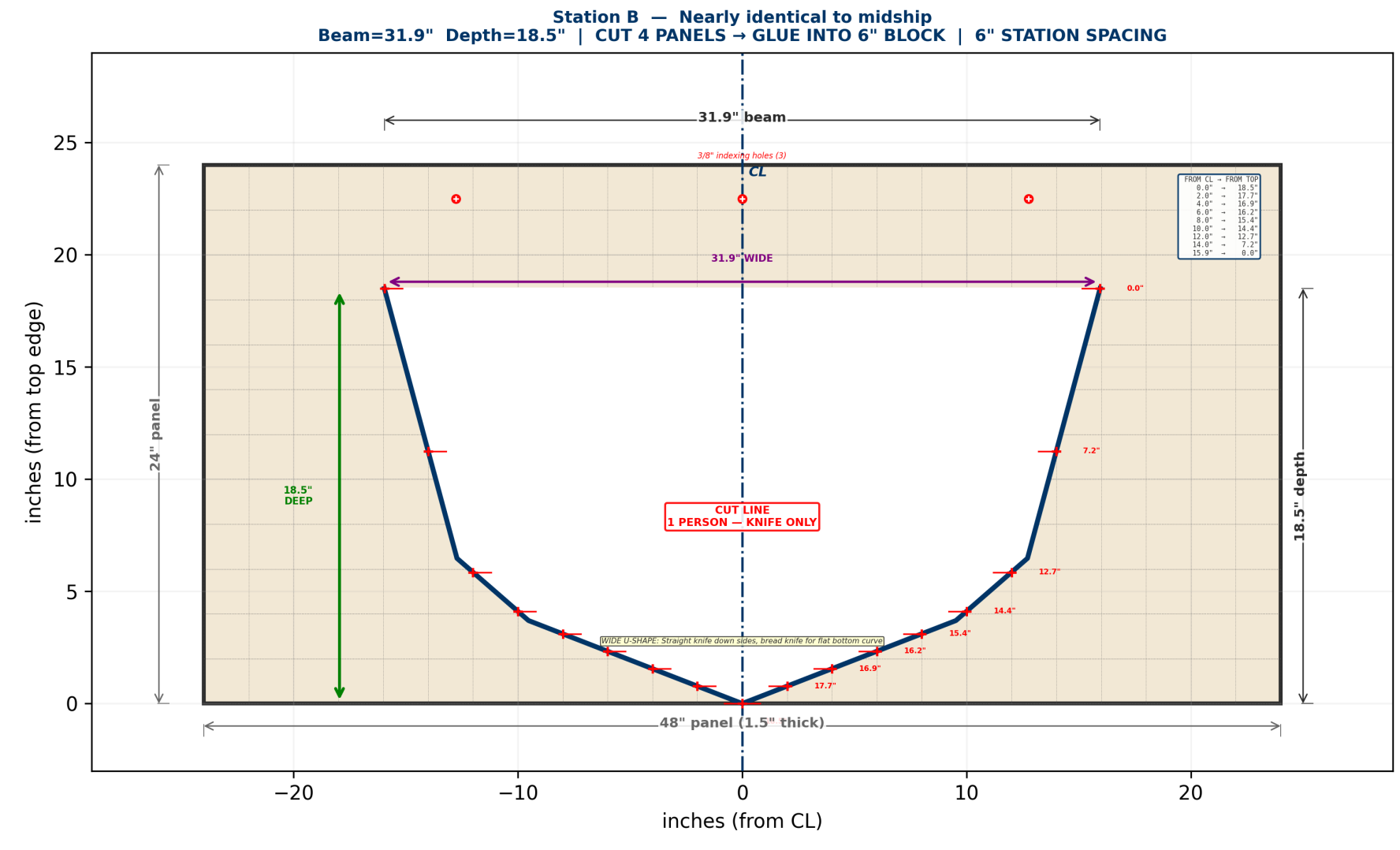
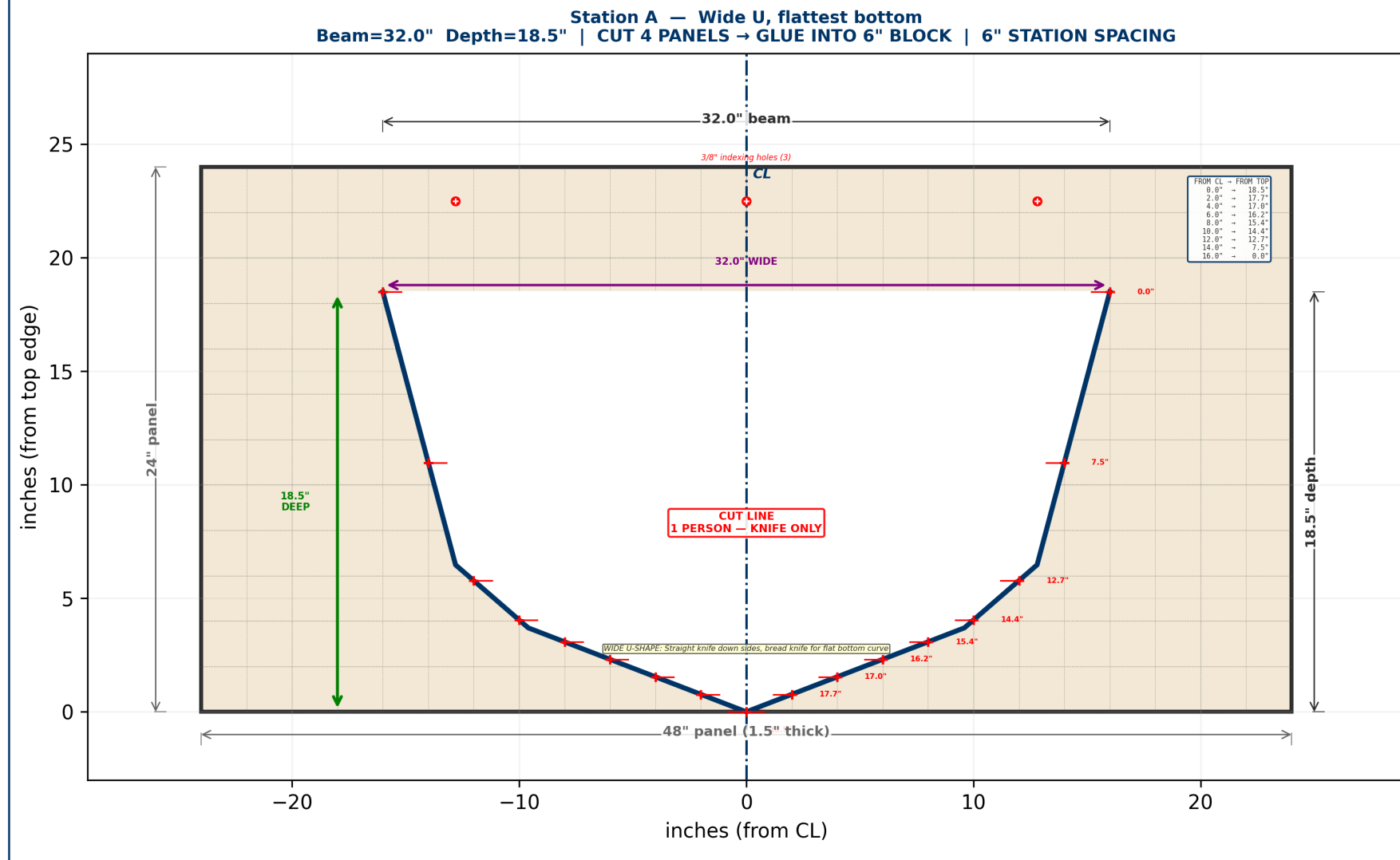


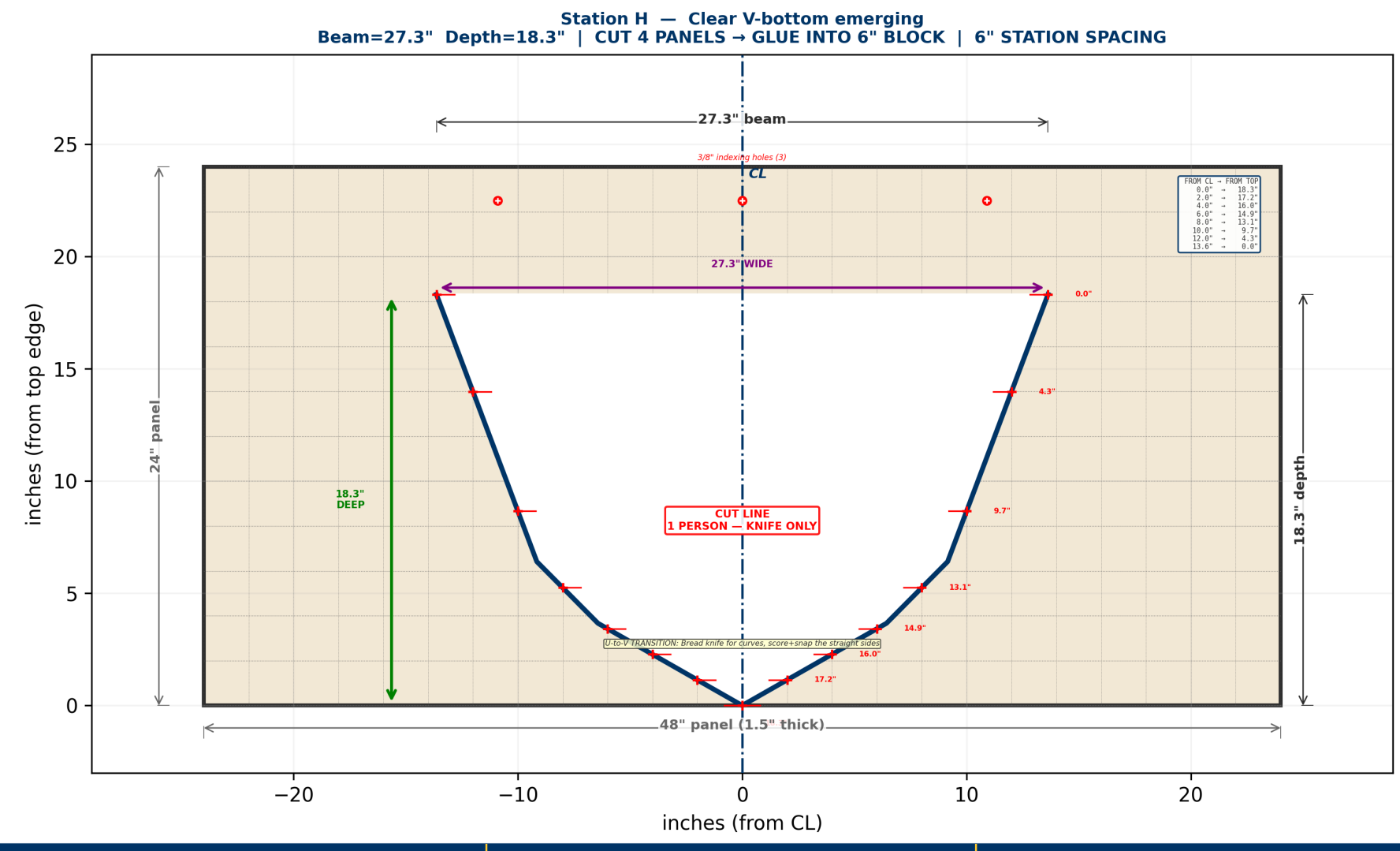
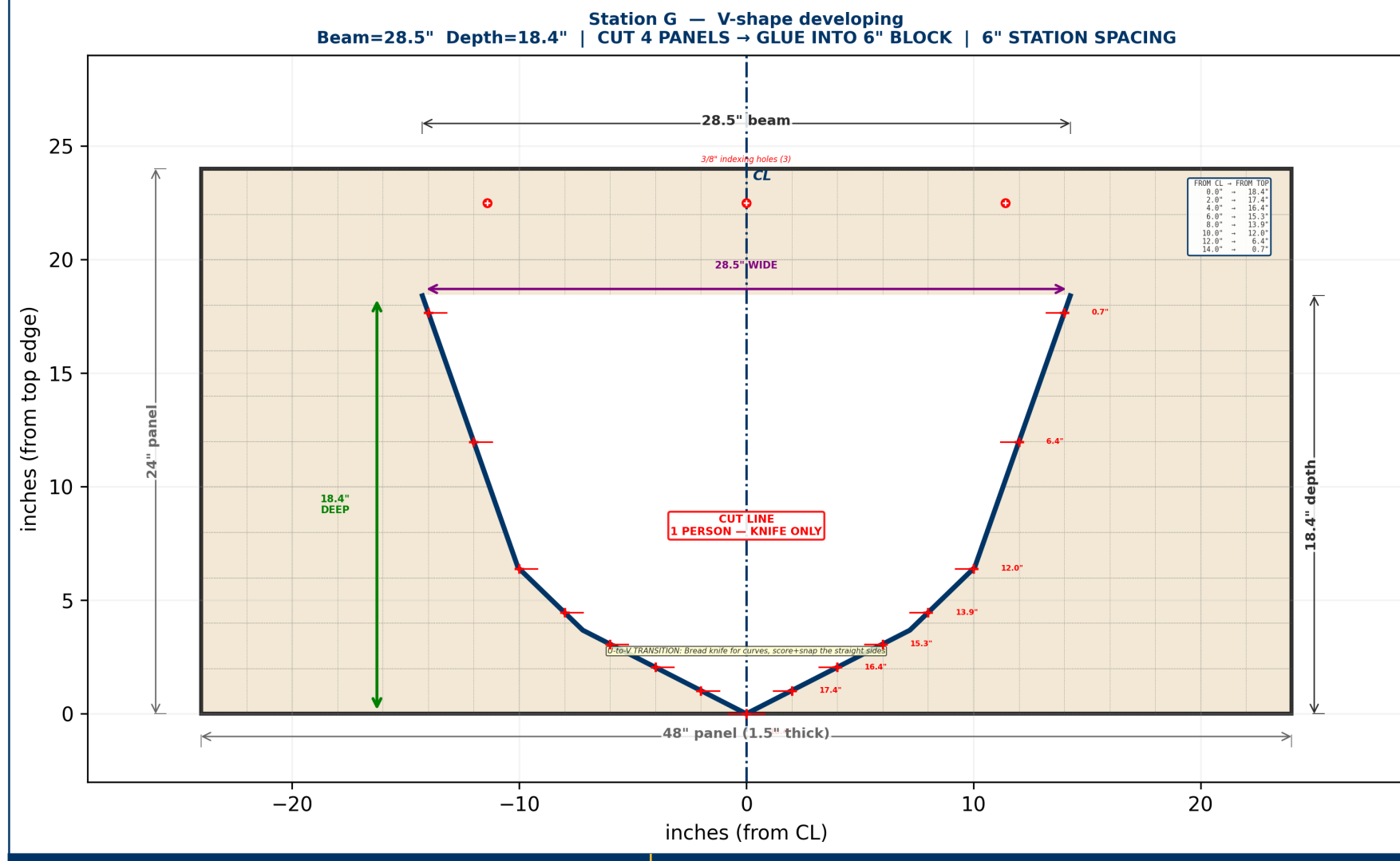
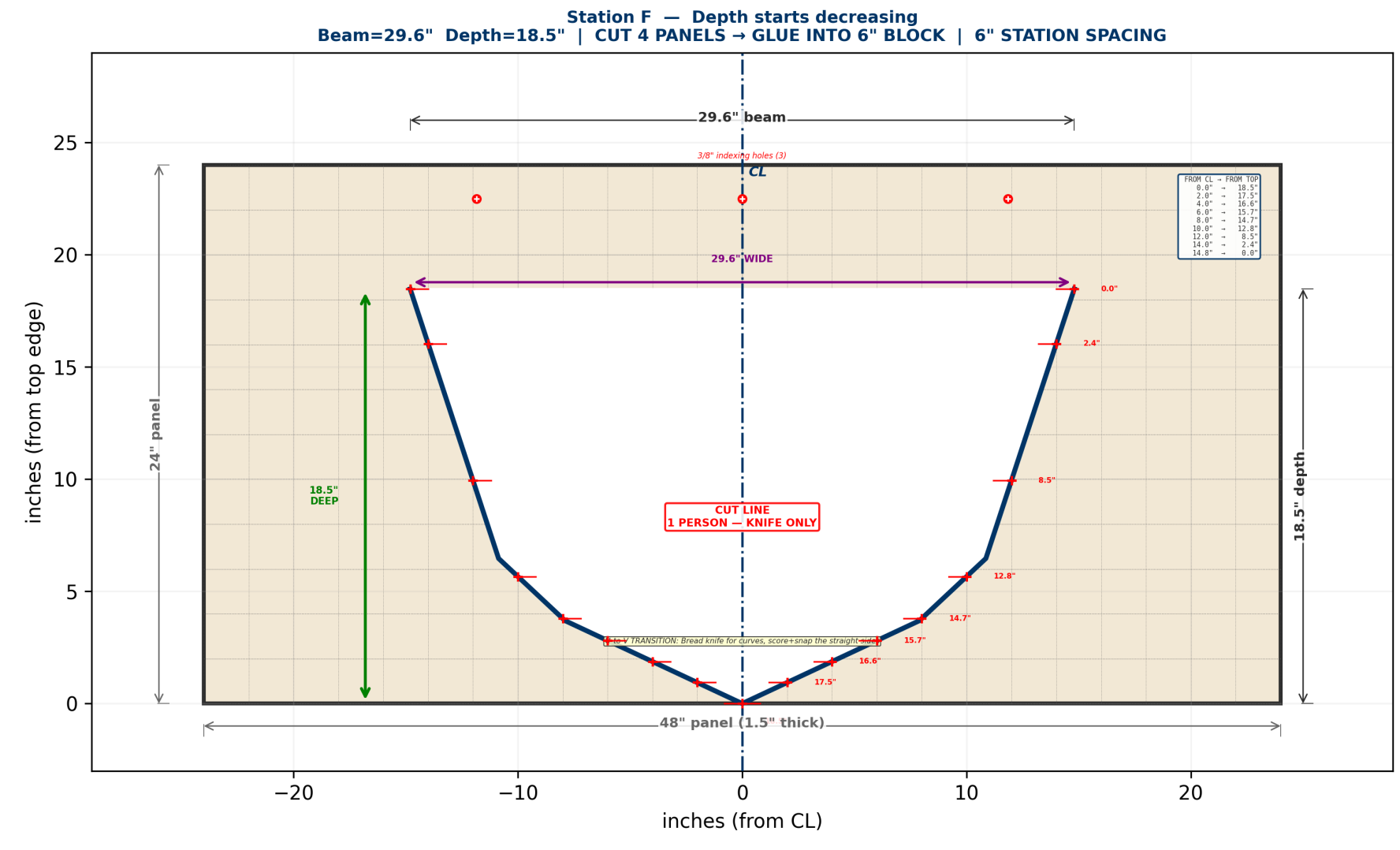
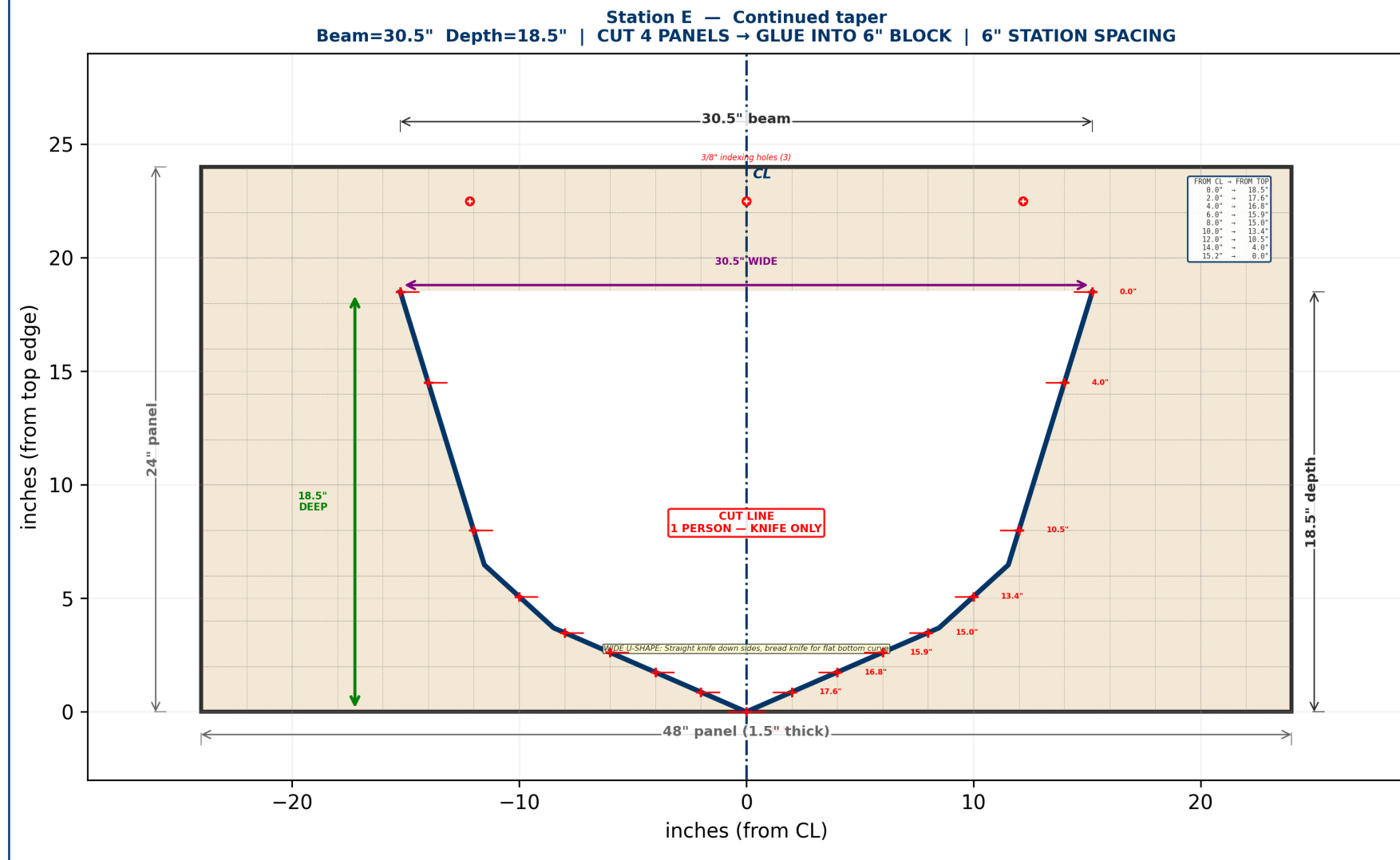
48"×96" SHEET → 4 PANELS (24"×48") → TRACE & CUT PROFILE → GLUE 4 PANELS = 6" BLOCK

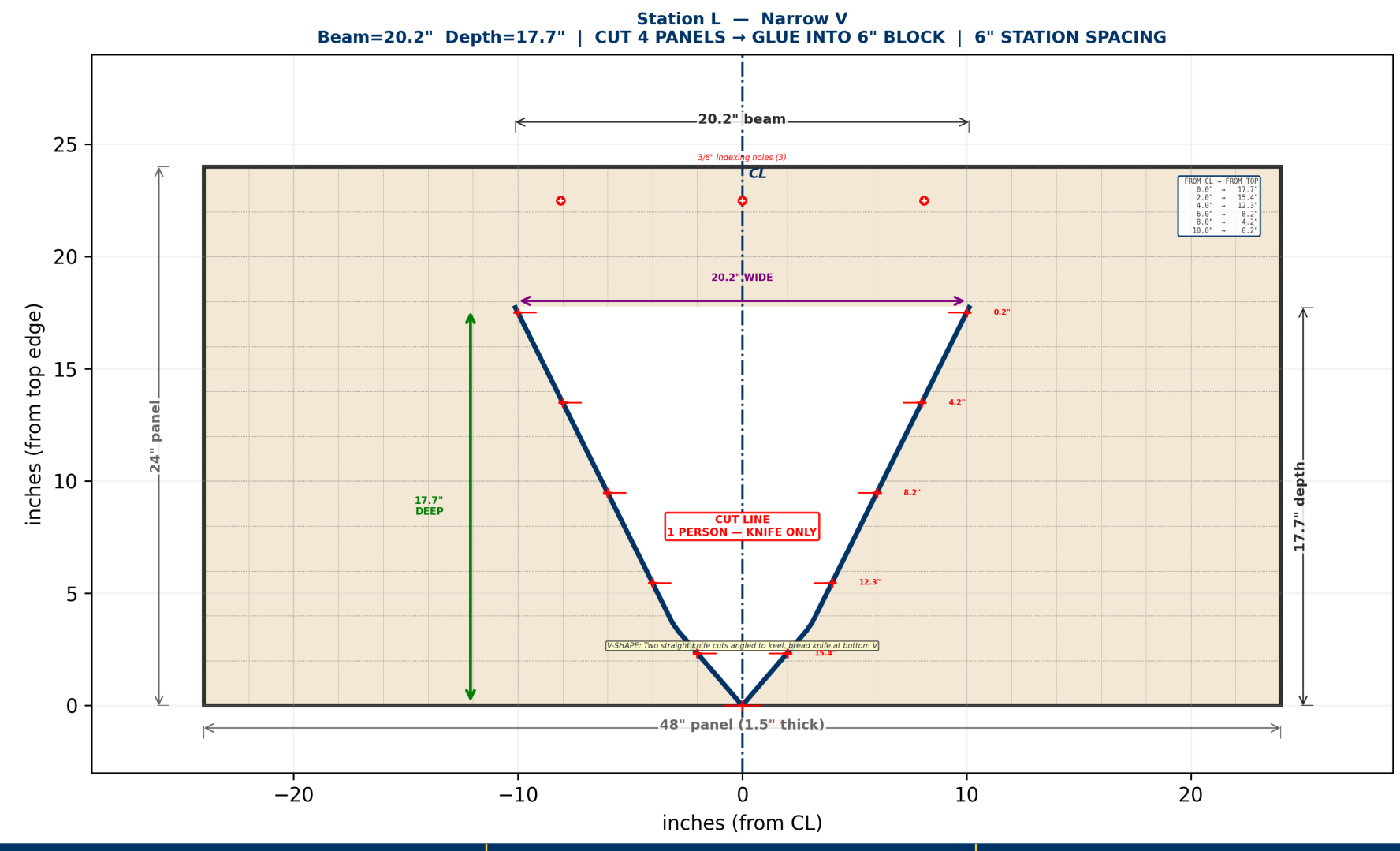
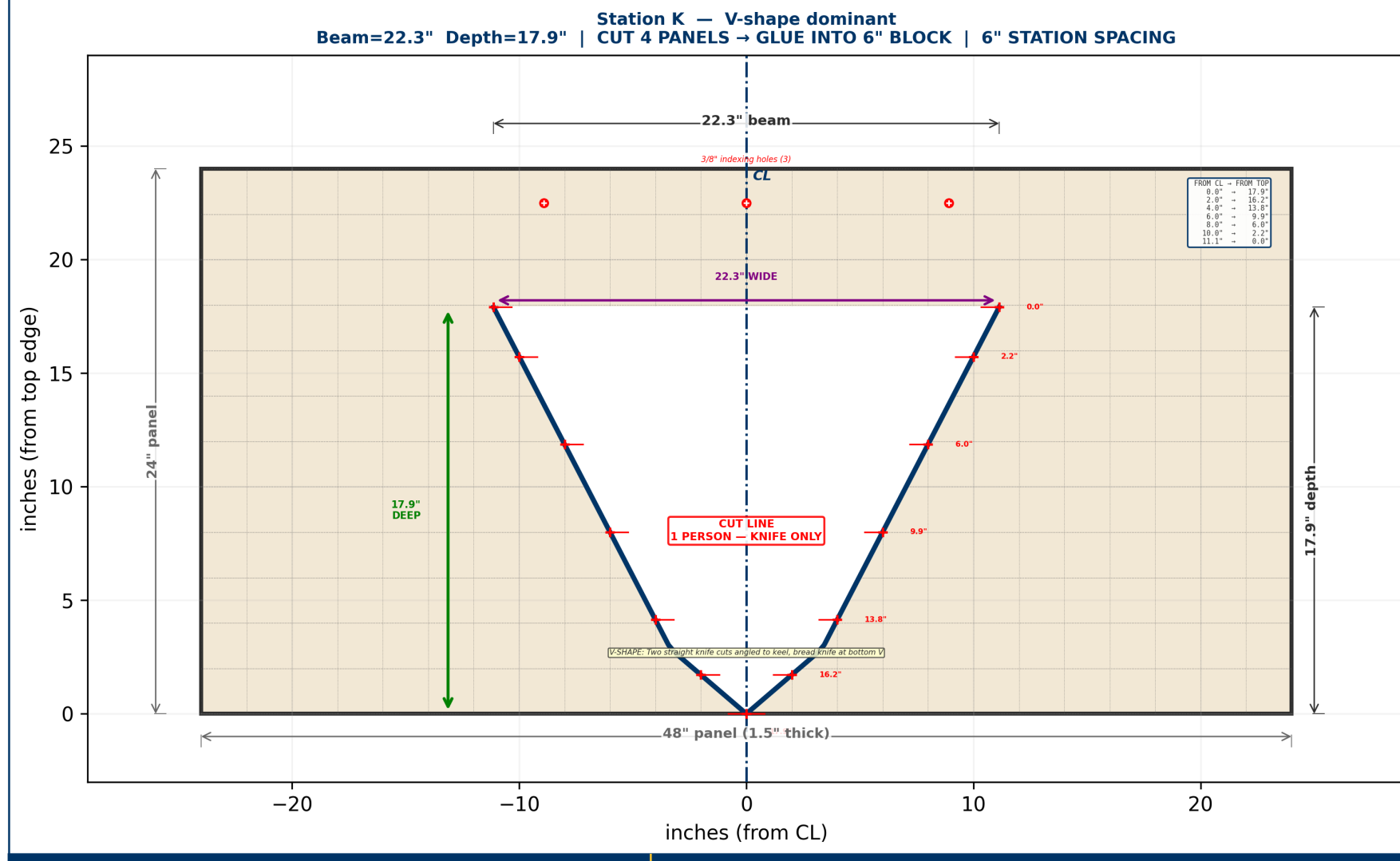
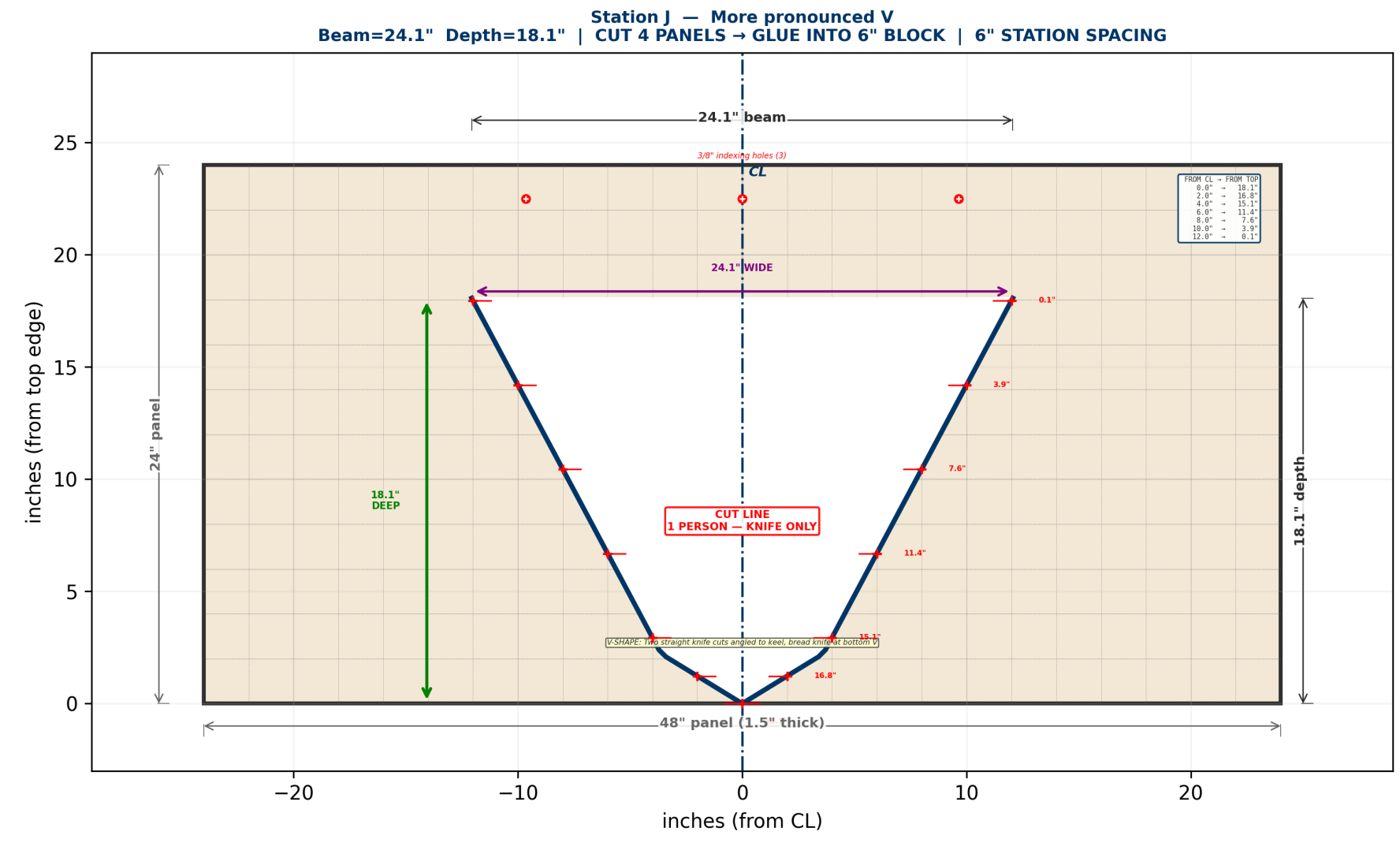
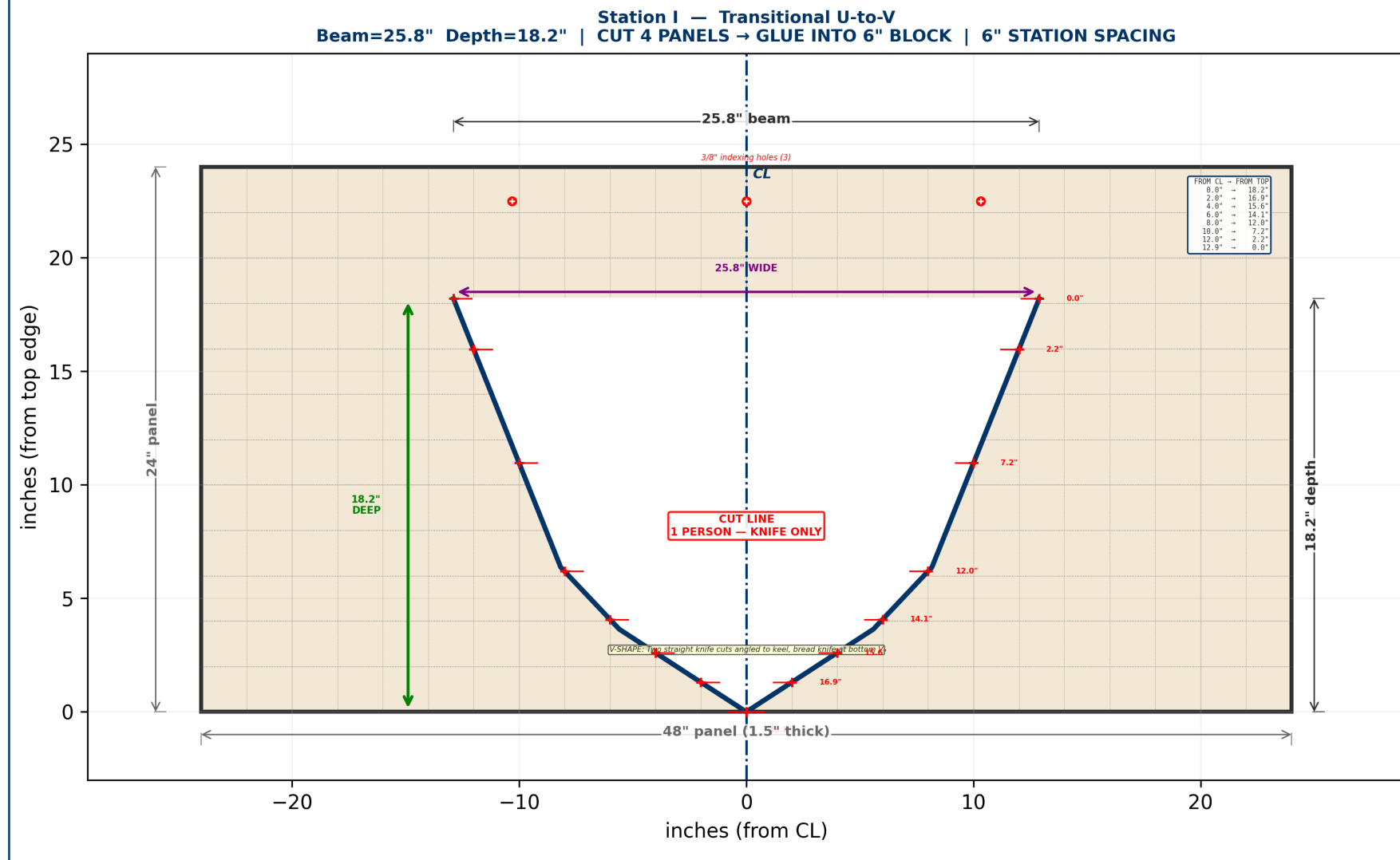
FOAM CUTTING SCHEDULE

ITEM	QUANTITY	DIMENSIONS	YIELD	NOTES
EPS Foam Sheets	40	48" × 96" × 1.5"	160 panels	Cut each sheet into 4 equal panels
Cut Panels	148	24" × 48" × 1.5"	37 blocks	Trace template, cut cross-section with knife
Glued Blocks	37	24" × 48" × 6"	222" mold	4 cut panels glued face-to-face per block
Spare Panels	12	24" × 48" × 1.5"	Backup	Extra panels for mistakes or repairs
Mold Length	222"	37 blocks × 6"	+ 3" flanges × 2	Flanges at bow & stern ends

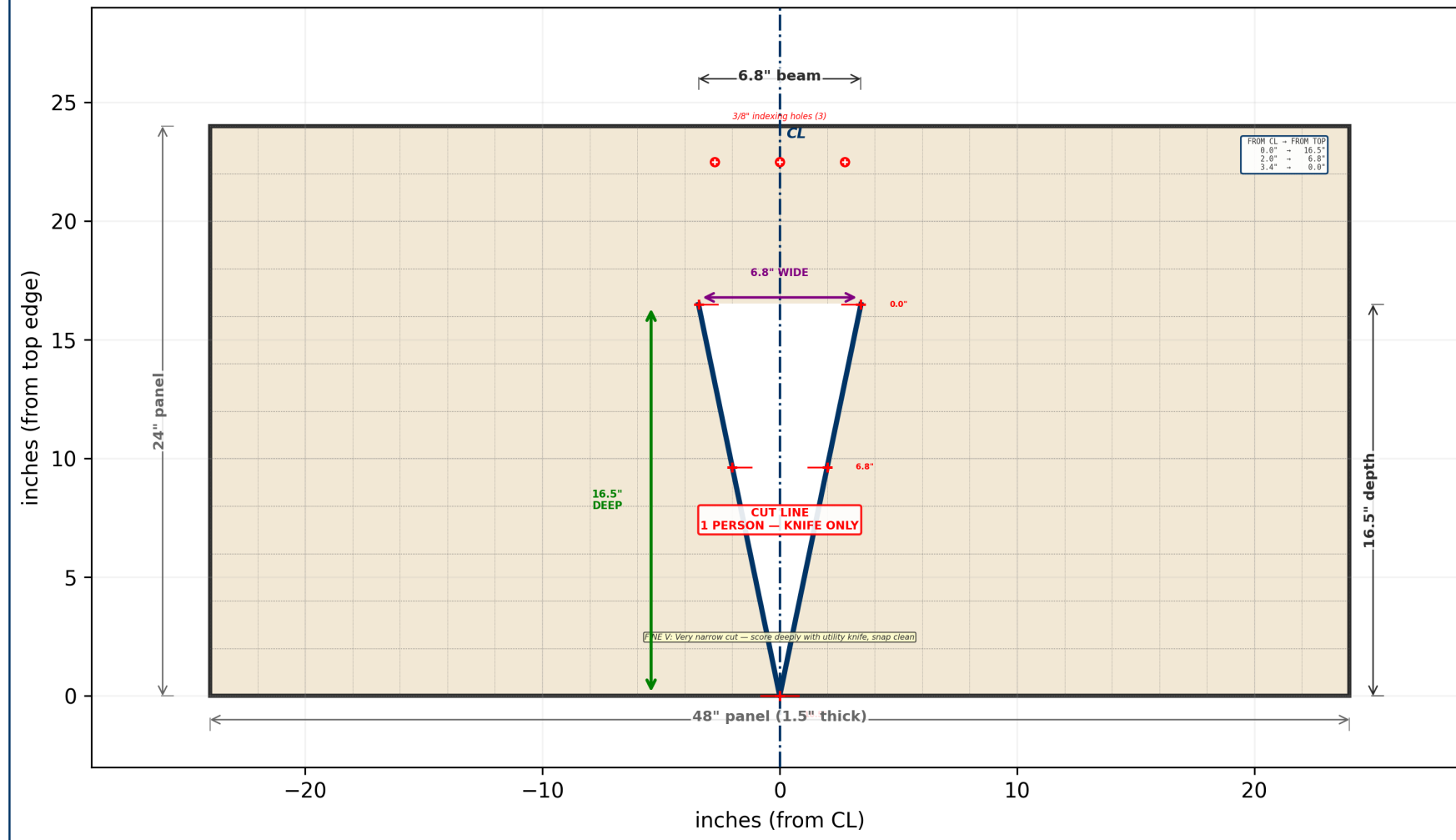
TOTAL: 40 SHEETS → 160 PANELS (148 NEEDED + 12 SPARES) | 37 BLOCKS × 4 PANELS = 6" EACH | MOLD LENGTH: 222" (37×6" + 3" FLANGES EACH END) | CUT WITH UTILITY KNIFE OR BREAD KNIFE



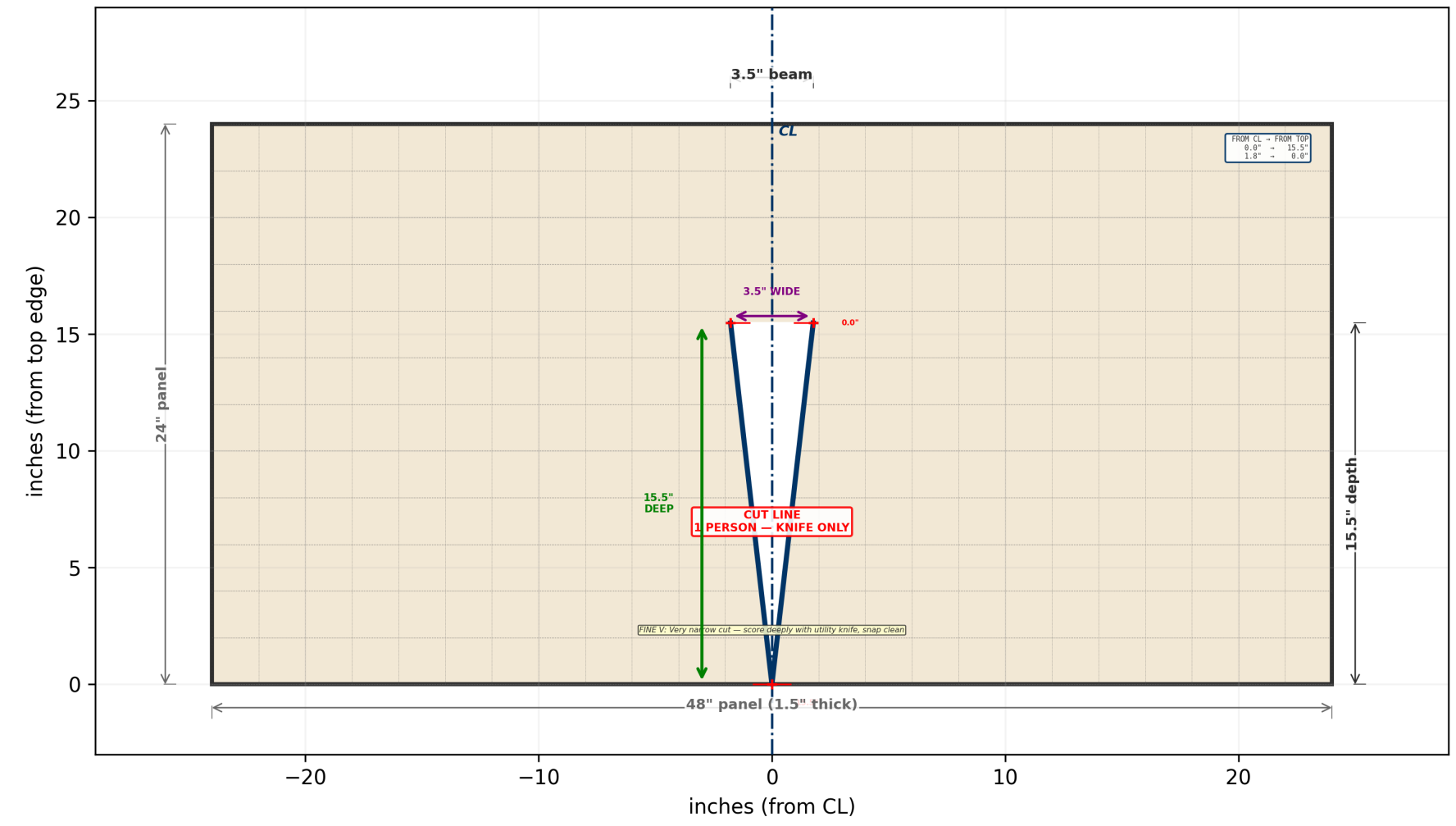




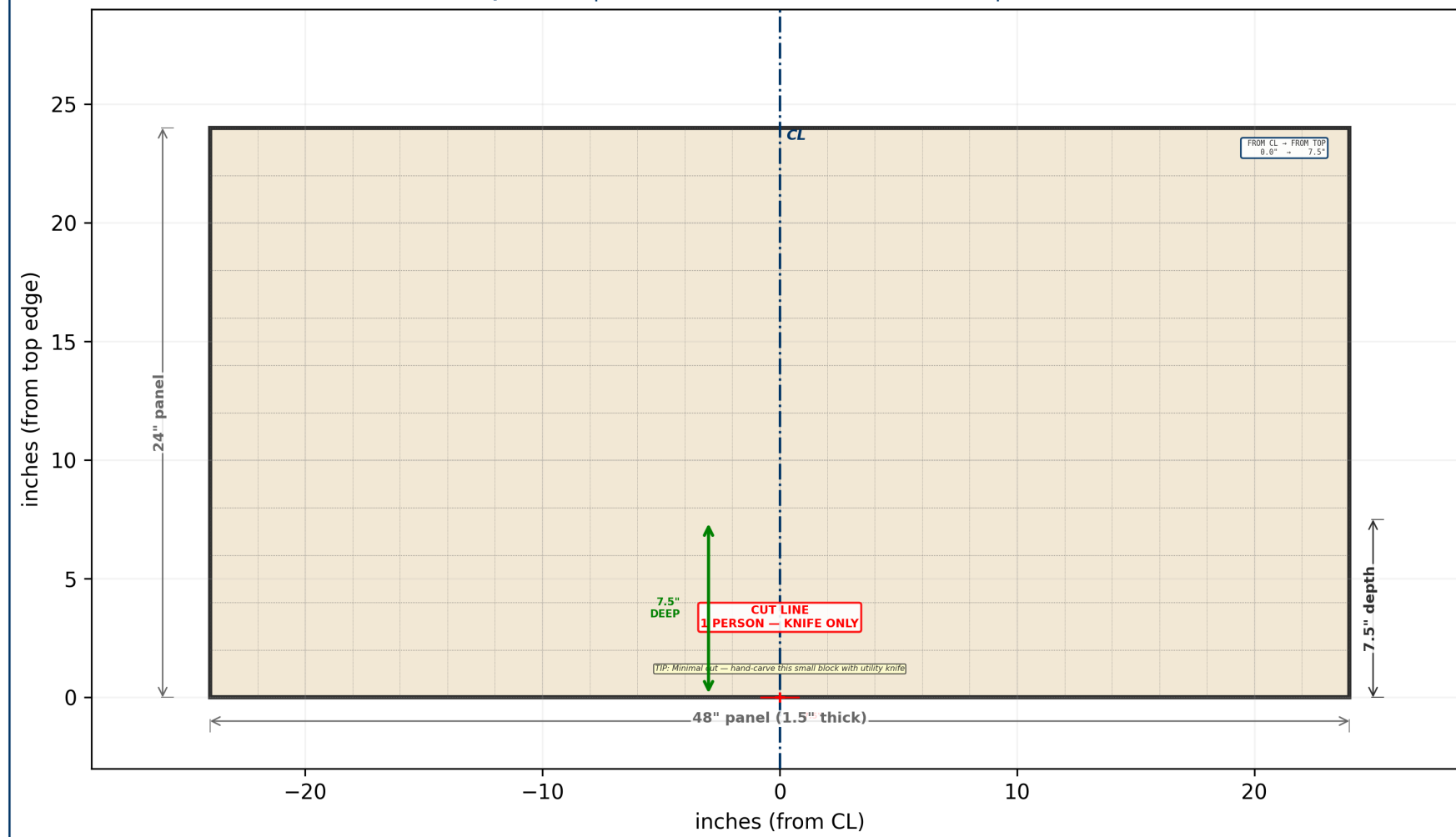
Station Q — Almost keel-only
 Beam=6.8" Depth=16.5" | CUT 4 PANELS → GLUE INTO 6" BLOCK | 6" STATION SPACING

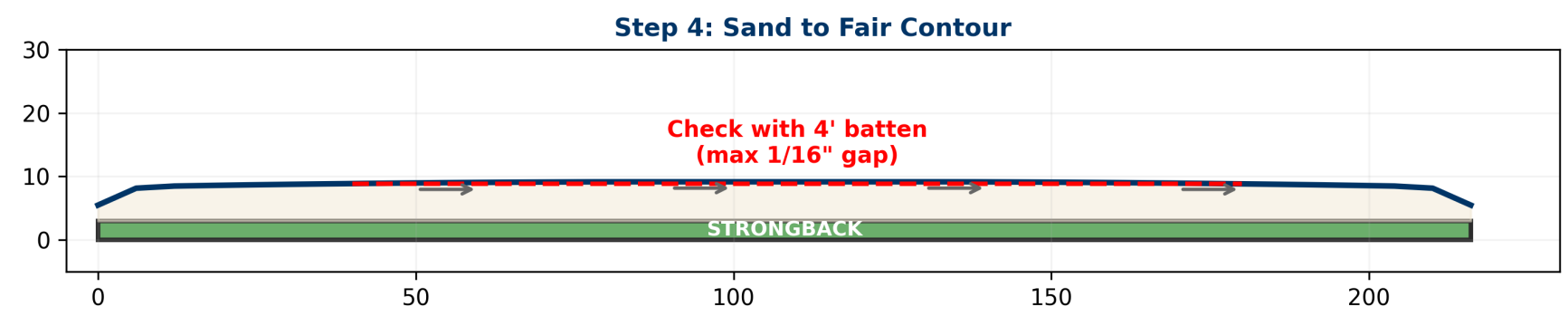
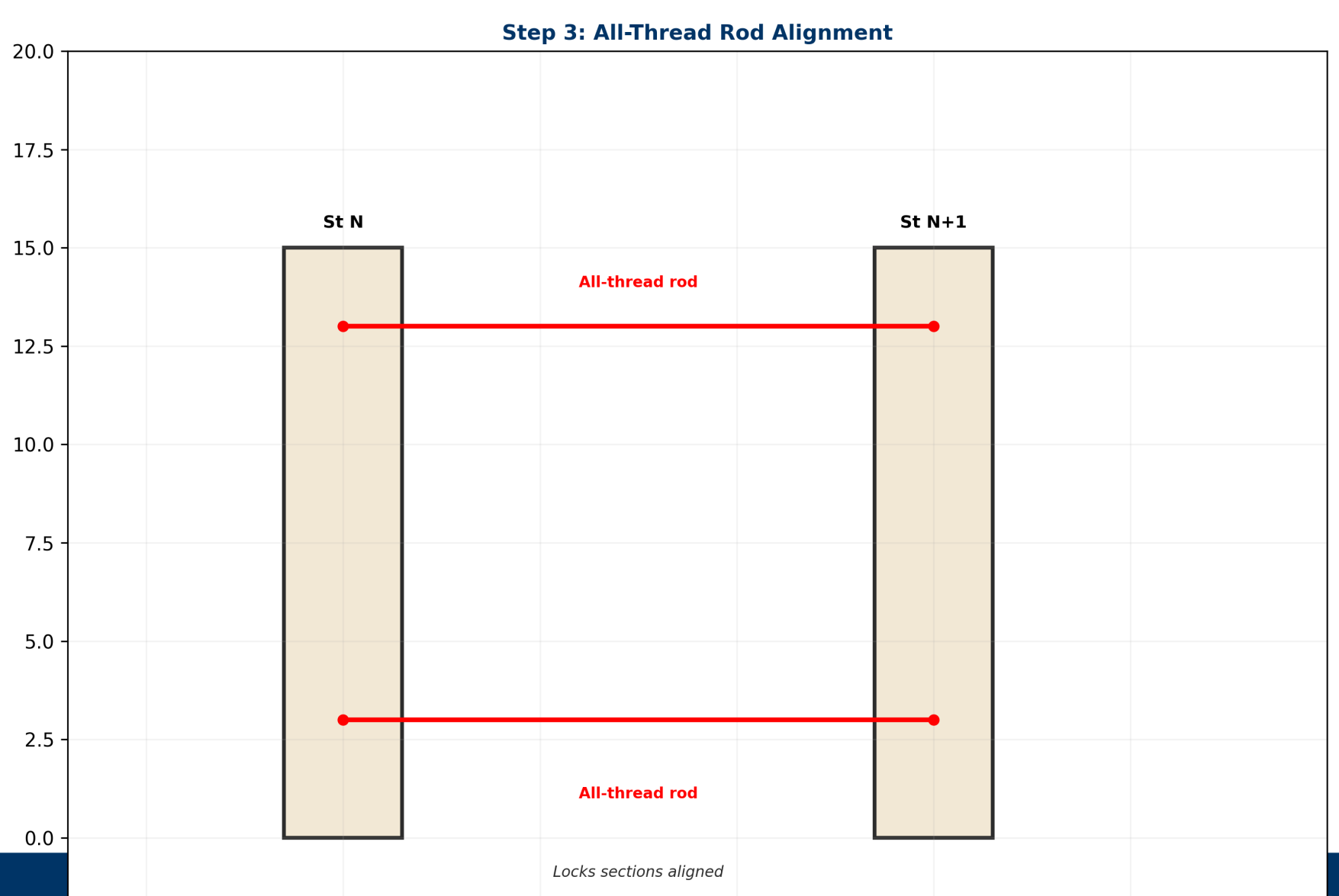
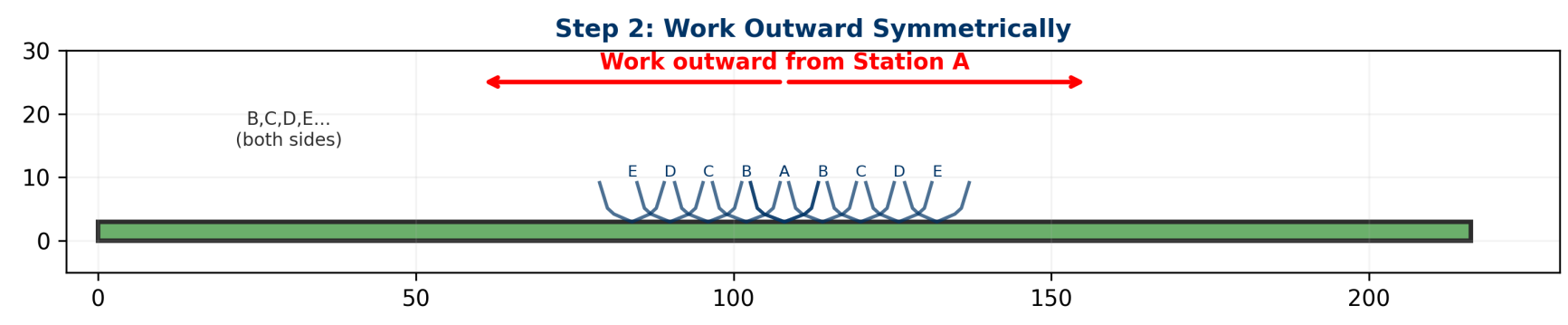
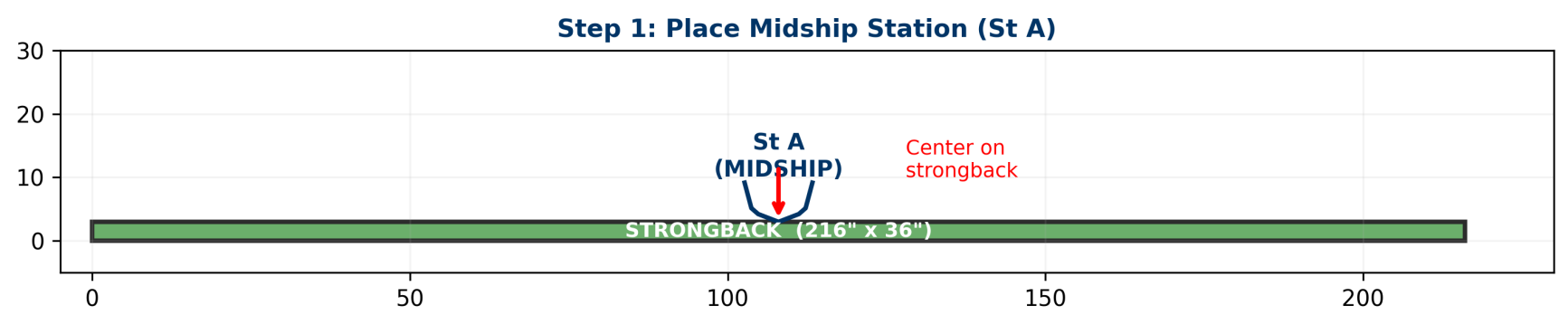


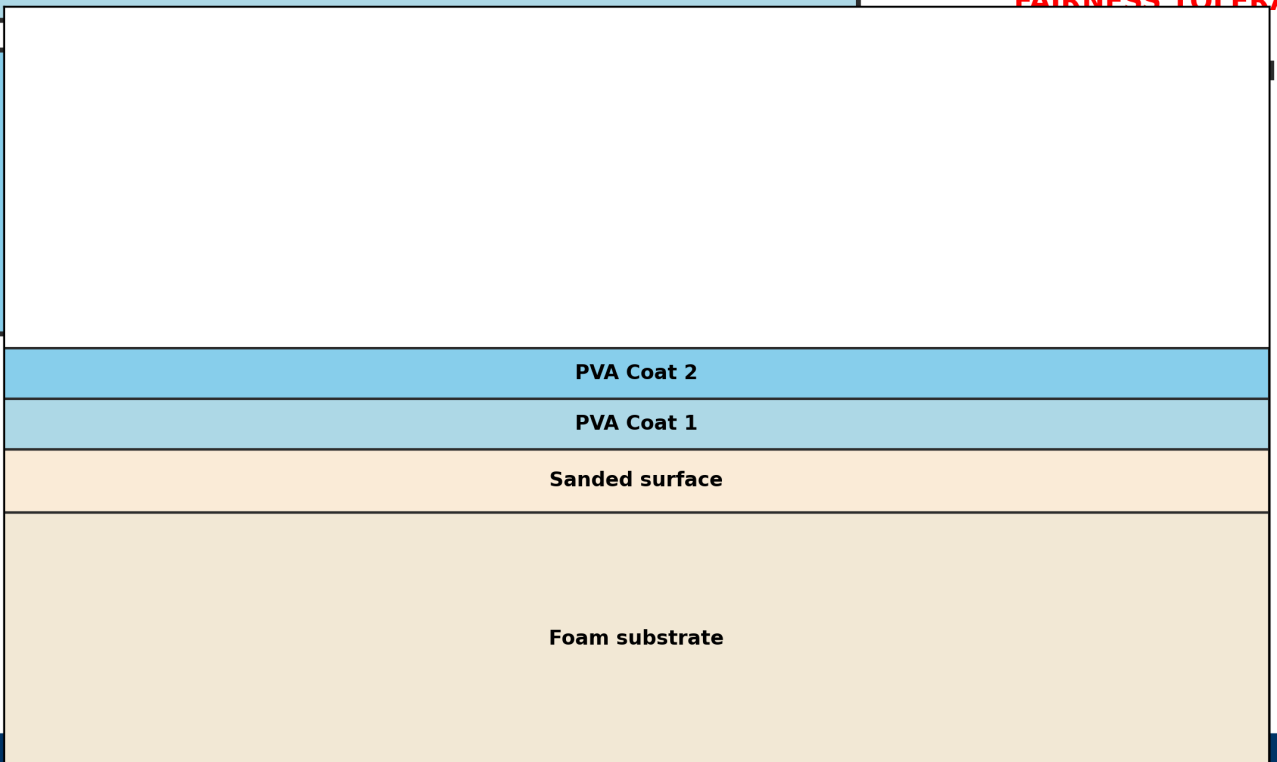
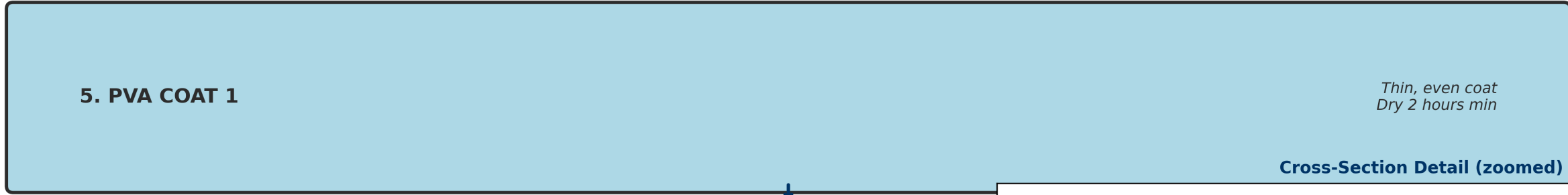
Station R — Vestigial width
 Beam=3.5" Depth=15.5" | CUT 4 PANELS → GLUE INTO 6" BLOCK | 6" STATION SPACING



Station S — Keel point only
 Beam=0.0" Depth=7.5" | CUT 4 PANELS → GLUE INTO 6" BLOCK | 6" STATION SPACING



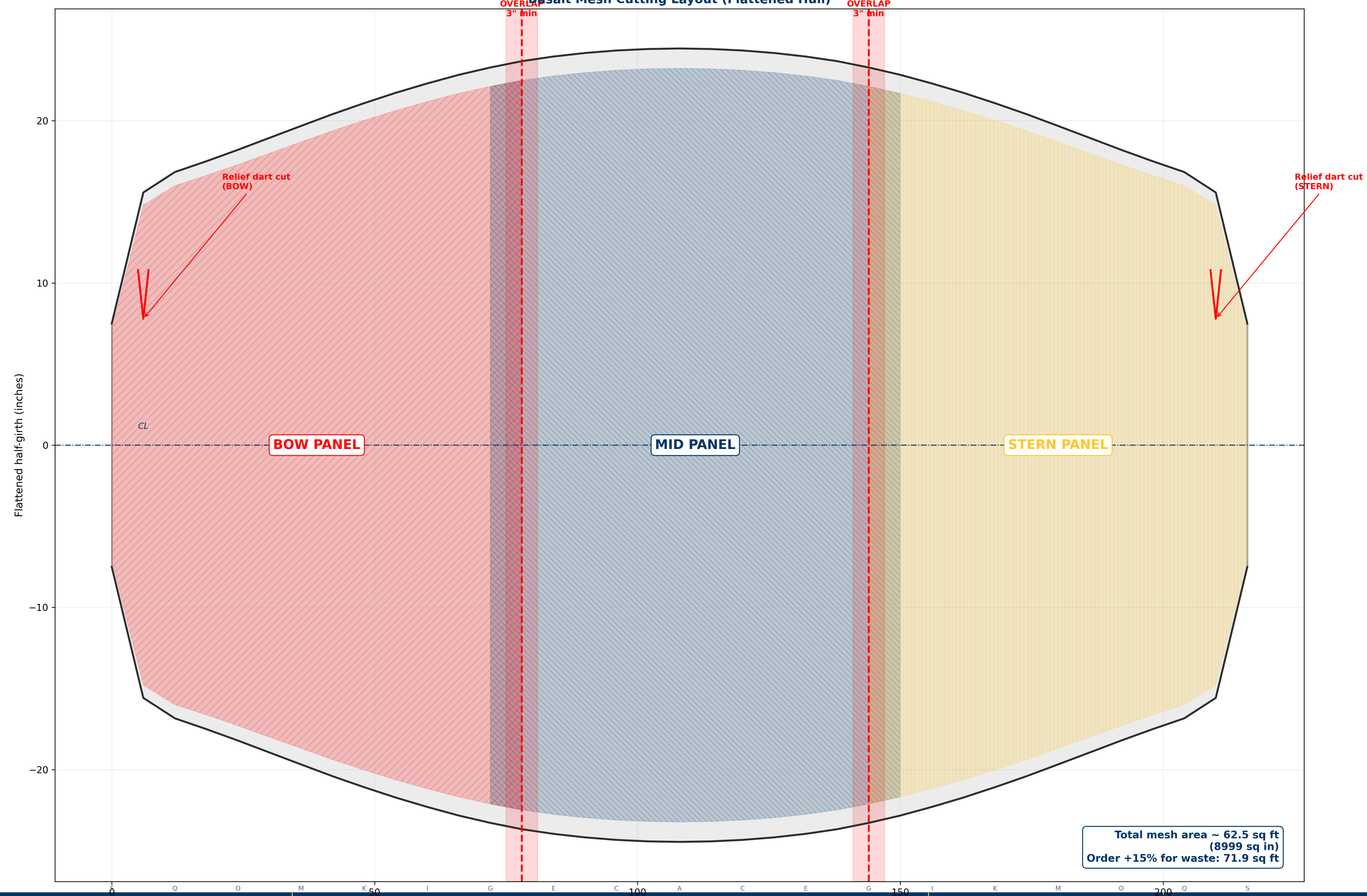




TIMING NOTES:

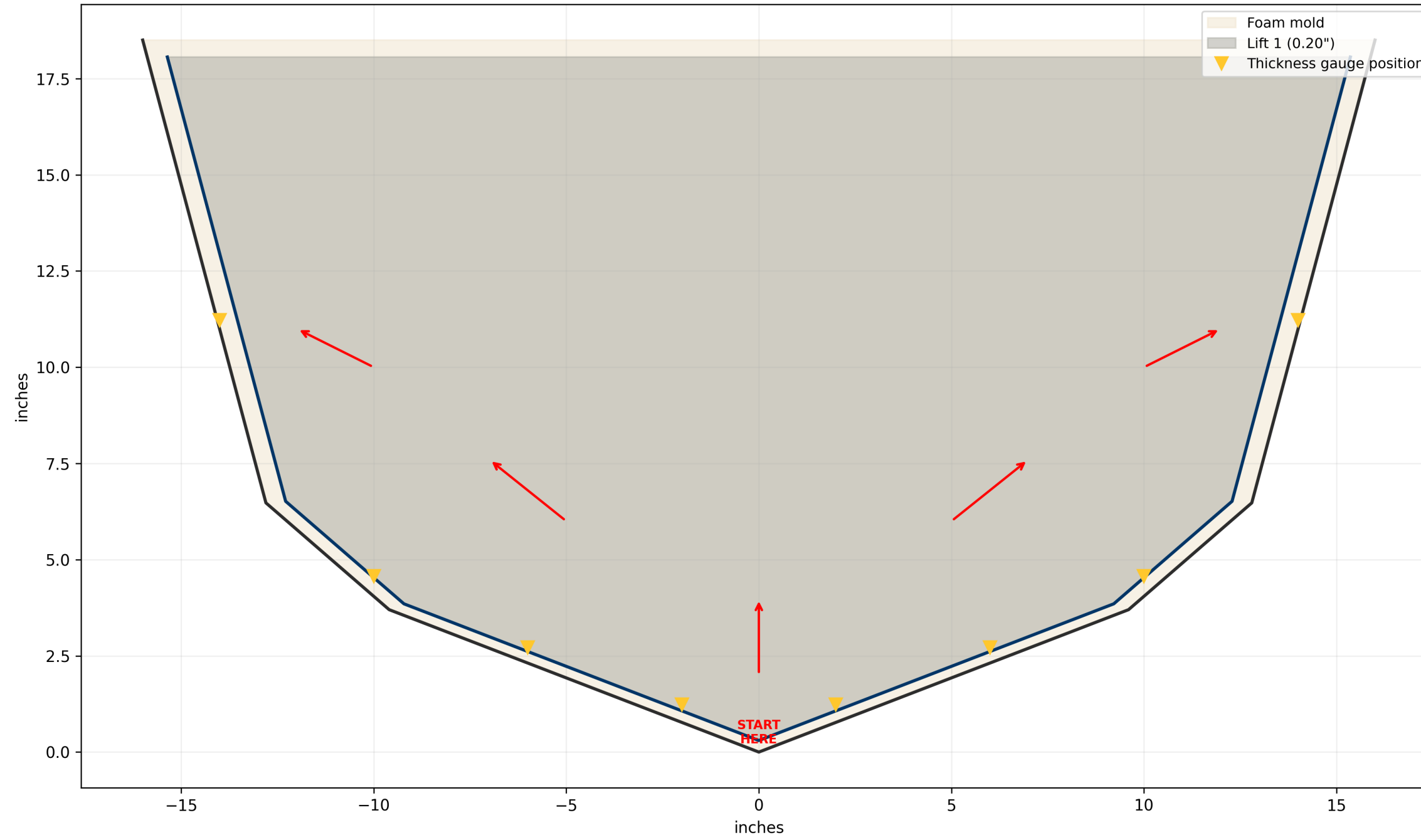
2 hrs drying between PVA coats
Apply PVA at 65-75°F
Total surface prep: ~8 hrs

Basalt Mesh Cutting Layout (Flattened Hull)



**Total mesh area ~ 62.5 sq ft
(8999 sq in)
Order +15% for waste: 71.9 sq ft**

Cross-Section at Midship (St A) - Lift 1 Placement



FIRST LIFT NOTES

- Target thickness: 0.20"
- Mix batch size: ~2 gallons
- Working time: 45 min/batch
- Apply with rubber float

APPLICATION ORDER:

1. Keel centerline first
2. Work up both sides equally
3. Finish at gunwale edge
4. Check thickness at every gauge point before moving on

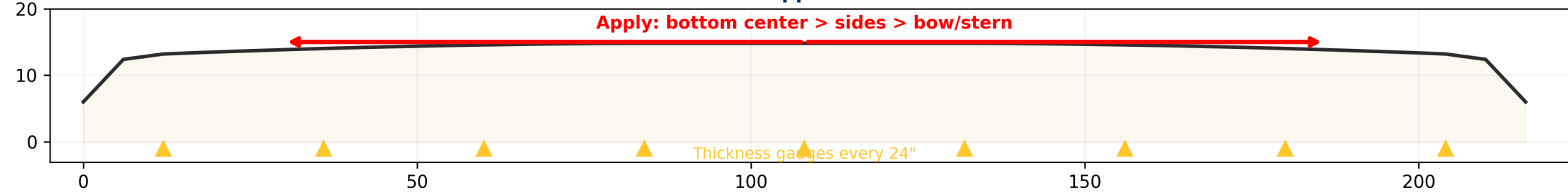
ENVIRONMENTAL:

- Temperature: 65-80 deg F
- Humidity: >50% preferred
- No direct sunlight

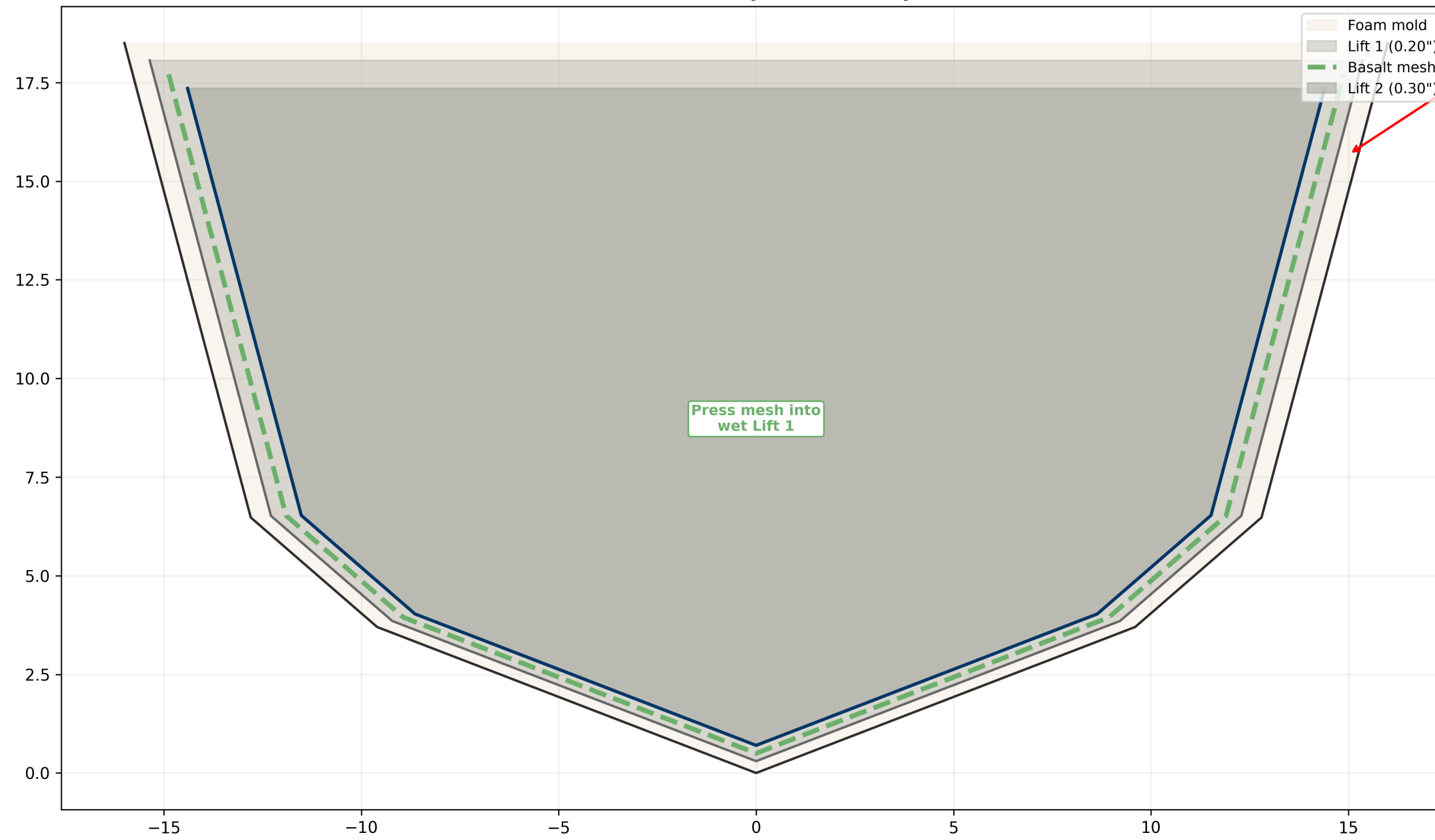
QUALITY CHECK:

- No voids or bare spots
- Uniform gray color
- Thickness: 0.20" +/- 0.05"

Side View - Application Direction



Cross-Section: All Layers at Midship (St A)



SECOND LIFT NOTES

- Mesh into wet Lift 1
- Overlap mesh seams 3" min
- Lift 2 thickness: 0.30"
- Total wall: 0.50"

GUNWALE THICKENING:

- Build up to 0.625-0.75"
- Extra mesh strip at gunwale
- Smooth transition to wall

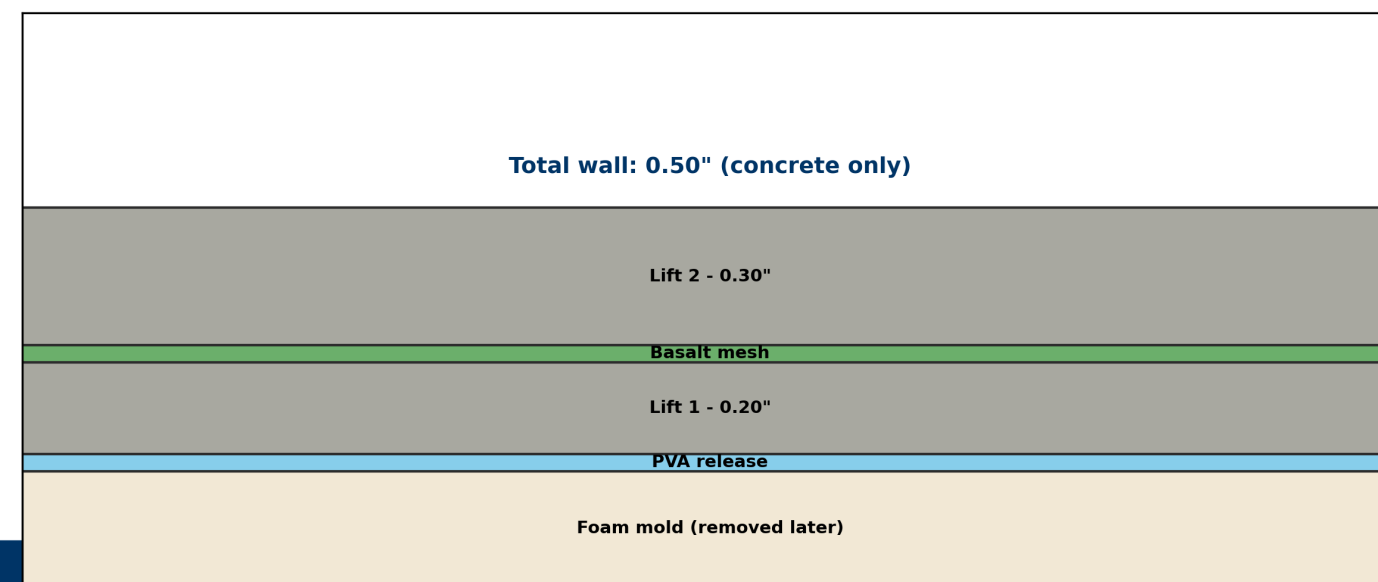
TROWEL FINISHING:

- Rubber float for interior
- Smooth, no ridges
- Wet trowel for final pass

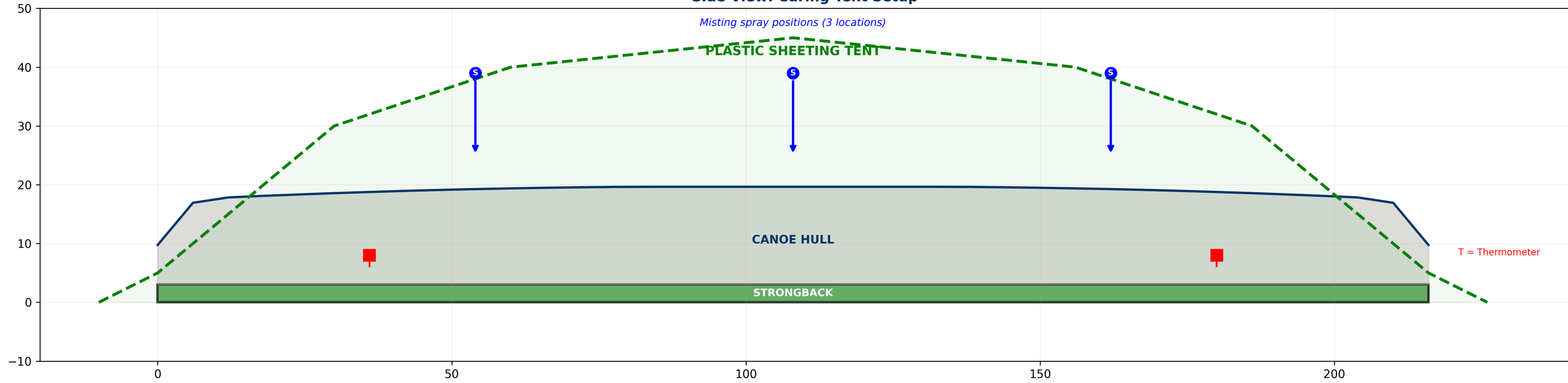
TIMING:

- Mesh within 30 min of Lift 1
- Lift 2 within 15 min of mesh
- Finish within working time

Wall Cross-Section Detail



Side View: Curing Tent Setup



7-Day Curing Schedule

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Mist 6AM	Mist 6AM	Mist 6AM	Mist 6AM	Mist 6AM	Mist 6AM	Mist 6AM
Mist 6PM	Mist 6PM	Mist 6PM	Mist 6PM	Mist 6PM	Mist 6PM	Mist 6PM
CRITICAL	CRITICAL	CRITICAL				

TEMPERATURE CONTROL

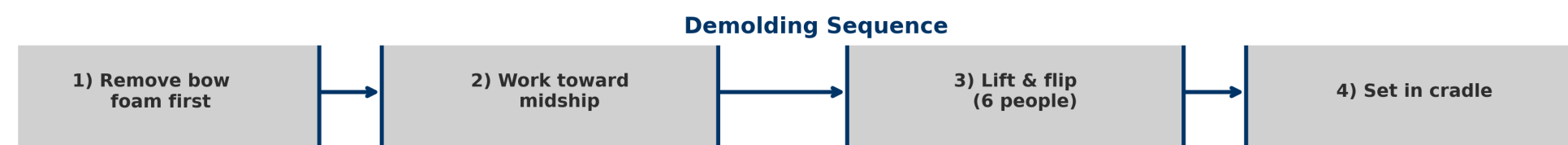
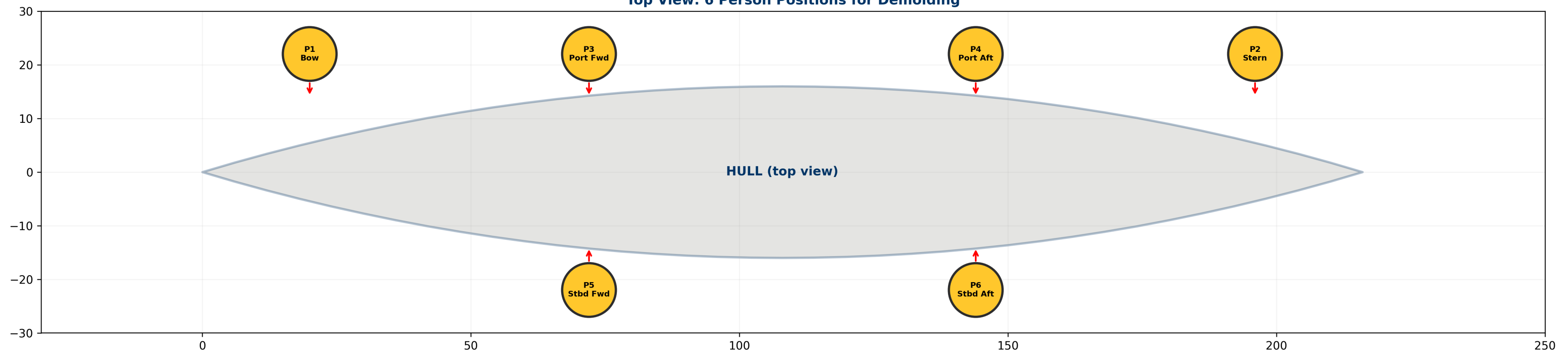
Acceptable range: 60-80 deg F

- Below 60F: Add space heater inside tent (not on hull)
- Above 80F: Increase misting frequency to every 8 hrs
- Record temp at each misting

Mist every 12 hours | Keep tent sealed between misting

DO NOT REMOVE TENT

Top View: 6 Person Positions for Demolding



SUPPORT CRADLE
60" long x 20" wide x 12" tall

WEIGHT DISTRIBUTION

Estimated hull: ~153 lbs
Per person: ~26 lbs

LIFTING NOTES:

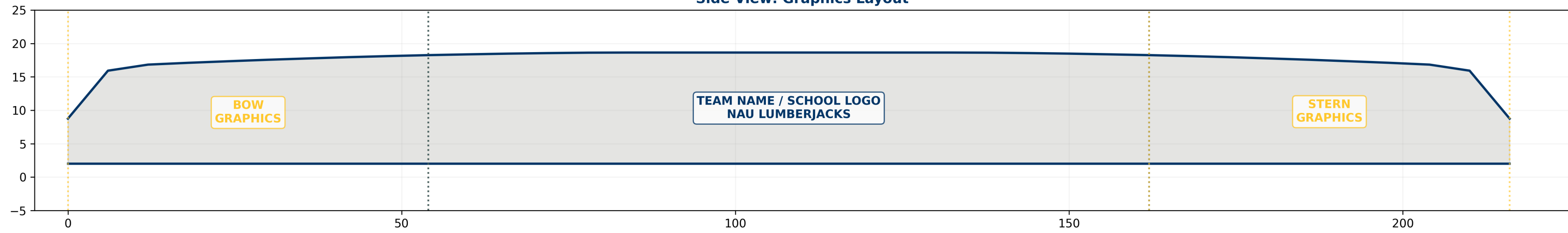
- Lift on count of 3
- Keep hull level
- Bow/stern persons guide, not lift
- Support at gunwale only

CRADLE DIMENSIONS:

- Length: 60"
- Width: 20"
- Height: 12"

- Paddler contact points

Side View: Graphics Layout



Sanding & Sealer Schedule

INTERIOR SANDING

- | | |
|------------------|-------------------------------------|
| 1. 120-grit pass | <i>Remove surface imperfections</i> |
| 2. 220-grit pass | <i>Smooth finish</i> |

EXTERIOR SANDING

- | | |
|------------------|-------------------------------------|
| 1. 220-grit only | <i>Light touch, don't thin wall</i> |
|------------------|-------------------------------------|

SEALER APPLICATION

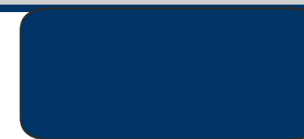
- | | |
|----------------------|--------------------------------|
| 1. Coat 1 (exterior) | <i>Even, thin coat</i> |
| 2. Dry 24 hours | |
| 3. Coat 2 (exterior) | <i>Perpendicular to coat 1</i> |
| 4. Dry 24 hours | |

PAINT (GRAPHICS)

- | | |
|--------------------------|-------------------------------|
| 1. Mask layout | <i>Use painter's tape</i> |
| 2. NAU Blue base | <i>2 coats, 4 hrs between</i> |
| 3. NAU Gold accents | <i>1 coat, detail brush</i> |
| 4. Clear seal over paint | <i>Protect graphics</i> |

FINAL WEIGHT TARGET

153 lbs +/- 15 lbs



NAU Blue (#003466)

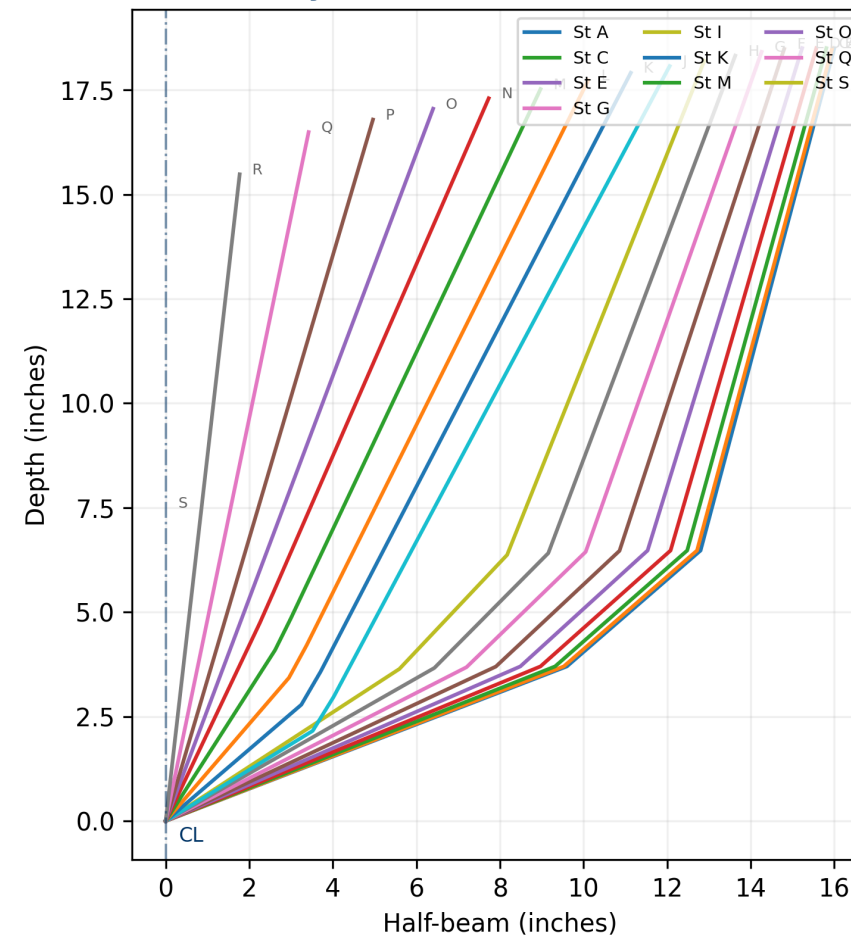


NAU Gold (#FFC72C)

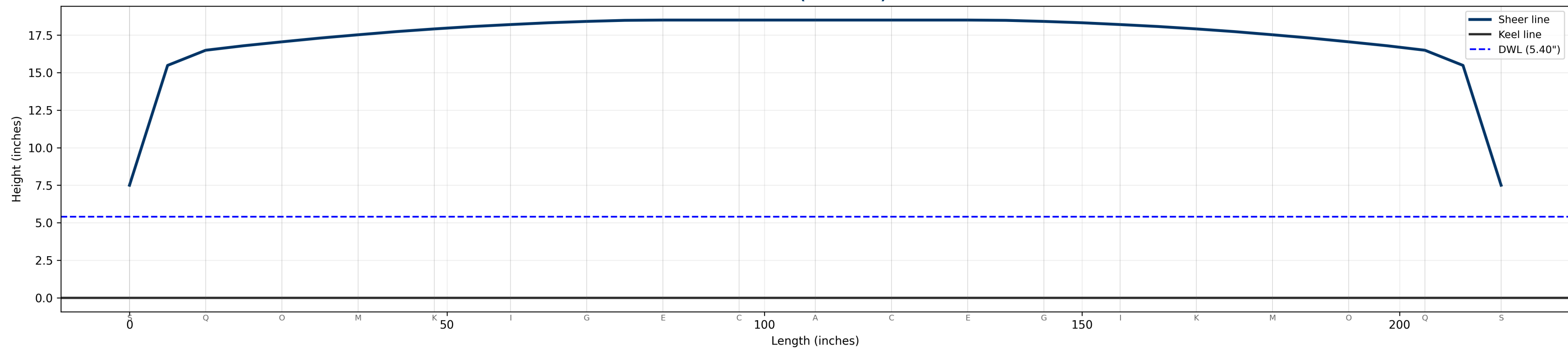


Concrete Gray (#A8A8A0)

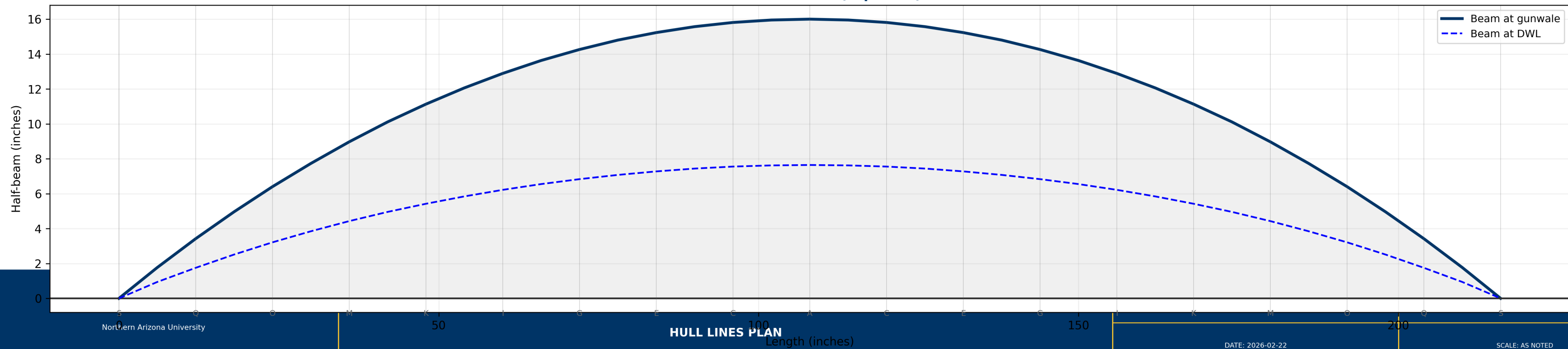
Body Plan (Port Side Sections)

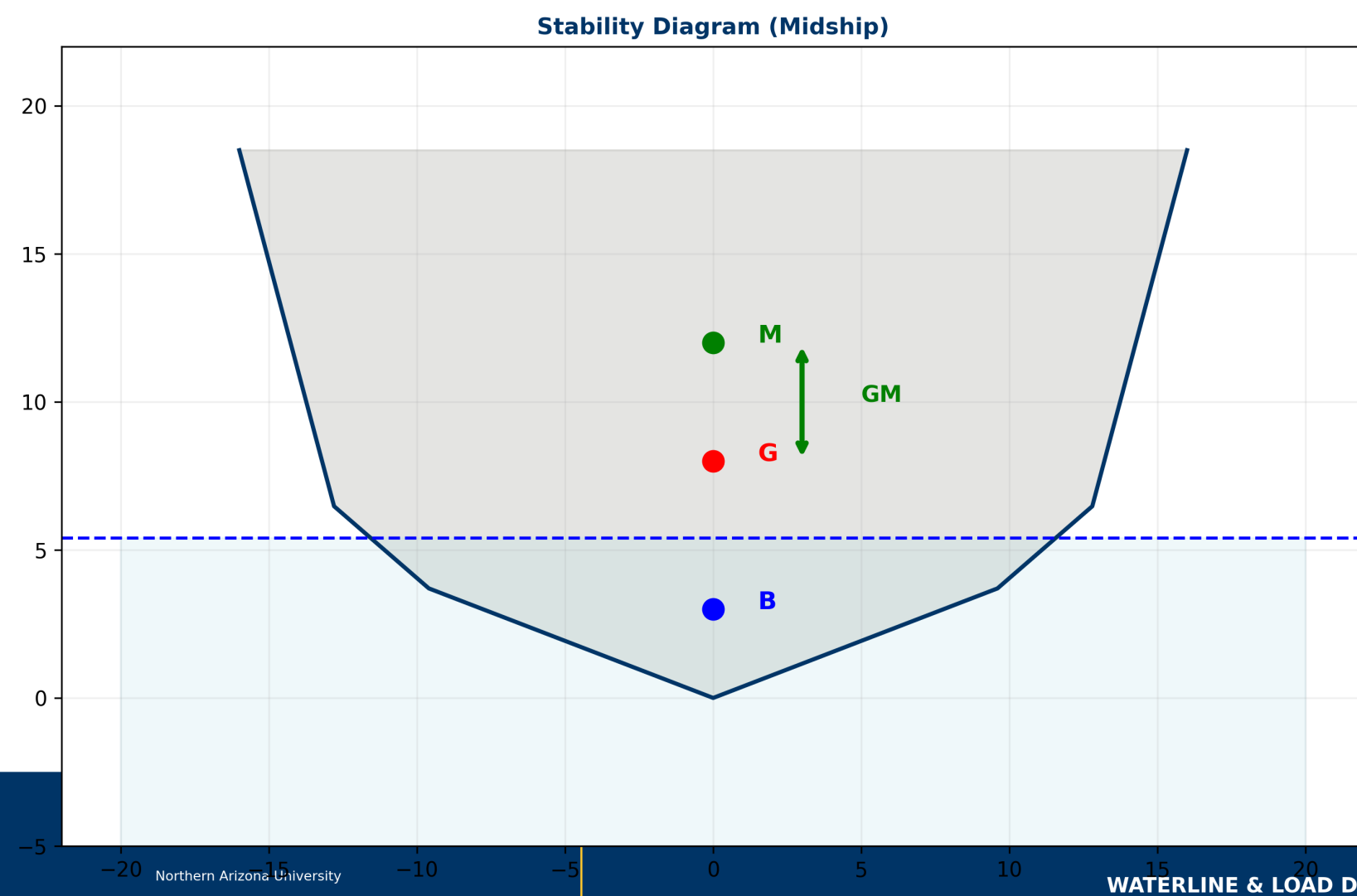
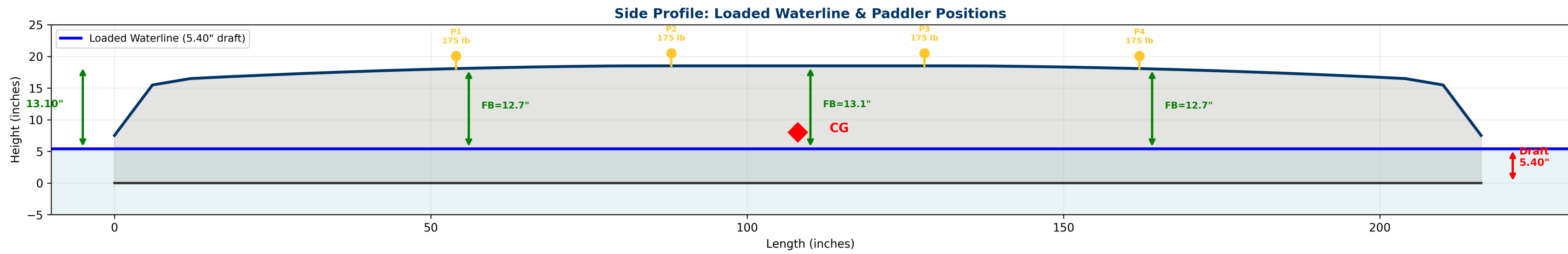


Profile (Side View)



Half-Breadth Plan (Top View)





LOAD SUMMARY

Hull weight: ~153 lbs
 Crew (4 paddlers): 700 lbs
 Total displaced: 853 lbs

Draft (loaded): 5.40"
 Freeboard (mid): 13.10"
 Freeboard (min): >6"

STABILITY:

B (buoyancy): ~1.8" above keel
 G (gravity): ~9.25" above keel
 M (metacenter): ~17.3" above keel
 GM = 8.07" (positive = stable)

All 4 paddlers kneeling,
 evenly spaced about midship

DRAWINGS

SHEET 19 OF 20

REV: A

1 MOLD ASSEMBLY

- Stations aligned +/-1/8"
- Strongback level +/-1/16"
- All gaps filled

PASS **FAIL**

2 SURFACE PREP

- Fairness: <1/16" under 4' batten
- PVA 2 coats applied
- No bare spots

PASS **FAIL**

3 MESH PLACEMENT

- 3" min overlap at seams
- Relief cuts at bow/stern
- Mesh lies flat, no bunching

PASS **FAIL**

4 LIFT 1 (0.20")

- Thickness 0.20" +/-0.05"
- No voids or bare spots
- Uniform color/texture

PASS **FAIL**

5 LIFT 2 (0.30")

- Thickness 0.30" +/-0.05"
- Gunwale 0.625"-0.75"
- Smooth trowel finish

PASS **FAIL**

6 CURING

- Tent sealed 7 days
- Misted every 12 hrs
- Temp 60-80 deg F logged

PASS **FAIL**

7 DEMOLDING

- No cracks or chips
- Clean separation from mold
- Support in cradle immediately

PASS **FAIL**

8 FINISHING

- Wall thickness +/-0.1"
- Weight 153 +/-15 lbs
- Fairness +/-1/16"
- Photo documentation complete

PASS **FAIL**

SECTION 7

Mold Construction Manual — Days 1-8

0 pages follow

Hull cross-section transition from U to V shape — 6 stations from midship to tip

Figure 1: Hull cross-section transition from U to V shape — 6 stations from midship to tip

NAU Concrete Canoe 2026 — EPS Foam Mold Construction Manual

PLUTO JACKS | Design A: 216” × 32” × 18.5” × 0.5” Wall

Document Version: 1.0 (Feb 21, 2026) **Scope:** Mold construction ONLY (Days 1–8 of the 21-day build schedule) **Source Geometry:** SolidWorks 19-station lines plan, scaled to 32” beam **Companion Doc:** CONSTRUCTION_GUIDE_v3.md covers concrete, curing, and demolding (Days 9–21)

Table of Contents

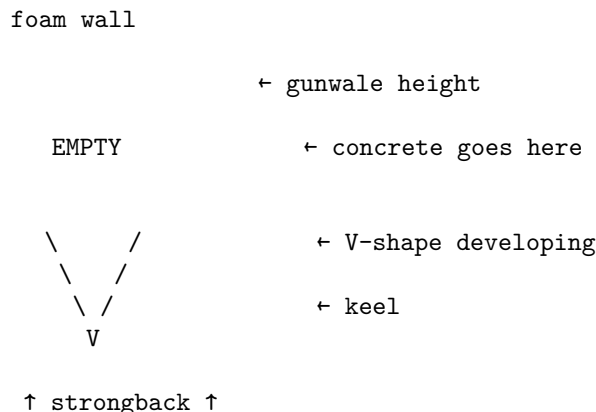
1. Overview — What You’re Building
 2. Materials List
 3. Tool List
 4. Strongback Construction
 5. Foam Lamination
 6. Template Making
 7. Foam Cutting
 8. Mold Assembly
 9. Gap Filling & Rough Shaping
 10. Surface Fairing
 11. PVA Mold Release
 12. Final QC Checklist
 13. Troubleshooting
 14. Crew Coordination & Schedule
-

1. Overview

What Is a Female Mold?

A female mold is a hollow trough that you lay concrete INTO. The mold’s inner surface shapes the canoe’s outer surface directly, so you get a smooth, fair hull without extensive finishing.

Cross-section looking at the bow (Station Q):



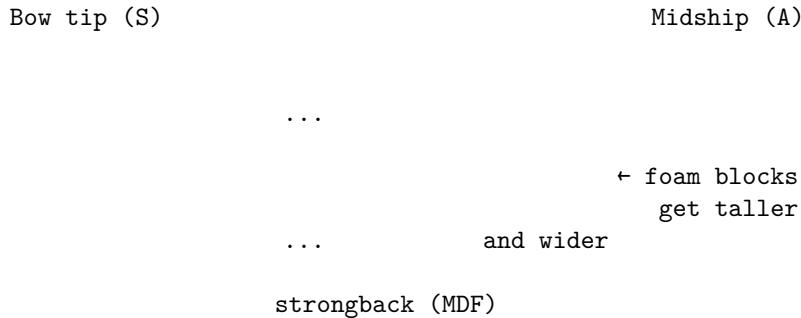
3D wireframe of mold trough showing all 19 station cross-sections

Figure 2: 3D wireframe of mold trough showing all 19 station cross-sections

How the Mold Is Built

You're stacking EPS foam sheets into blocks, carving the hull shape out of each block, then lining up 37 carved blocks on a flat spine (the strongback) to form a continuous trough.

Side view (half the mold, bow to midship):



The hull is symmetric bow-to-stern. You build 19 unique templates (Stations A through S), but cut most of them twice — one for the bow side, one for the stern side. Station A (midship) is used only once at the center.

Key Dimensions

Parameter	Value
Hull length (LOA)	216" (18 ft)
Max beam (Station A)	32.00"
Max depth (Station A)	18.50"
Mold length (with flanges)	222" (37 × 6")
Stations	19 unique (A–S), 37 pieces total
Station spacing	6" (uniform from midship outward)
Foam type	EPS, 2 lb/ft ³ , 1.5" sheets
Panels per block	4 (4 × 1.5" = 6")

Station Offset Table (32" Beam)

Scaled from SolidWorks CAD at 31" to 32" beam. Scale factor on half-breadths: $16.0 / 15.5 = 1.032\times$.

Station	Position from Midship (in)	Half-Breadth (in)	Full Beam (in)	Depth (in)	Shape
A (mid-ship)	0	16.00	32.00	18.50	Wide U, flattest bottom
B	6	15.95	31.90	18.50	Nearly identical to mid-ship

Station	Position from Midship (in)	Half-Breadth (in)	Full Beam (in)	Depth (in)	Shape
C	12	15.81	31.62	18.50	Slight narrow-
D	18	15.57	31.14	18.50	ing Gentle taper
E	24	15.23	30.46	18.50	begins Continued
F	30	14.80	29.60	18.48	taper Depth starts
G	36	14.26	28.52	18.41	de- creas- ing V-
H	42	13.63	27.26	18.32	shape devel- oping Clear
I	48	12.89	25.78	18.20	V- bottom emerg- ing Transitional
J	54	12.06	24.12	18.07	U-to-V More pro-
K	60	11.13	22.26	17.91	nounced V V-
L	66	10.11	20.22	17.73	shape domi- nant Narrow
M	72	8.97	17.94	17.52	V Sharp V,
N	78	7.73	15.46	17.30	narrow Very narrow
O	84	6.40	12.80	17.05	Near- bow section
P	90	4.96	9.92	16.79	Fine entry
Q	96	3.42	6.84	16.49	Almost keel-
R	102	1.77	3.54	15.48	only Vestigial width
S (tip)	108	~0	~0	7.50	Keel point only

Notes: - Position is measured from midship (Station A) outward toward bow/stern - Hull is symmetric: bow shape = stern shape. Total length = $2 \times 108'' = 216''$ - Depths are unchanged from original CAD (scaling only affects half-breadths)

2. Materials List

EPS Foam — The Mold Body

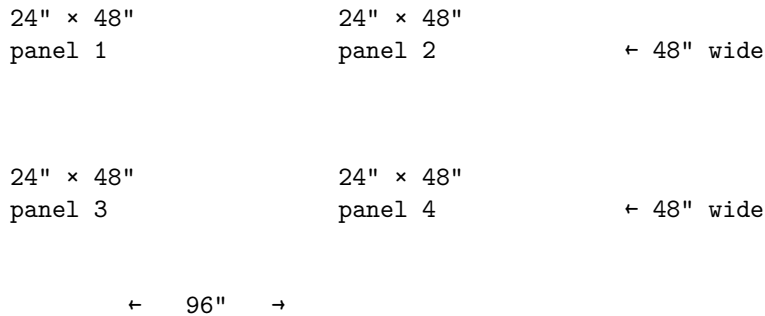
Item	Spec	Qty	Unit Cost	Total	Where to Buy
EPS foam sheets	Henry R-5.78, 1.5" × 48" × 96", 2 lb/ft ³	40 sheets	\$28	\$1,120	Home Depot, insulation aisle

How the sheet count is derived:

The mold is 222" long (37 blocks × 6"). Each block = 4 panels glued face-to-face ($4 \times 1.5'' = 6''$). Total panels needed: $37 \times 4 = 148$ panels.

Each 48" × 96" sheet is cut into **4 equal panels** of 24" × 48":

48" × 96" sheet → 4 equal panels:



Panel orientation in each block: - **48" dimension = width** (covers Station A's 32" beam with 16" margin) - **24" dimension = height** (covers the 18.50" max trough depth with 5.5" margin) - **1.5" dimension = fore-aft** (4 panels glued = 6" per station block)

Yield: 4 panels per sheet. $148 \text{ panels} \div 4 = 37$ sheets minimum. Team purchased **40 sheets** (160 panels) — 12 spares for mistakes and practice cuts.

Narrow station efficiency: Stations O–S (beam < 13") are small enough that multiple station panels can be cut from one 24" × 48" panel, further extending the spare count.

Adhesives, Fillers, Release

Item	Spec	Qty	Cost	Notes
Construction adhesive	PL Premium polyurethane	5 tubes (28 oz each)	\$38	Foam lamination + assembly. Expands slightly — don't over-apply

Item	Spec	Qty	Cost	Notes
Spray foam	Great Stuff Gaps & Cracks (NOT Big Gap)	3 cans	\$18	Gap filling between stations. Thin bead expands to fill
Auto body filler	Bondo (or lightweight spackle)	2 quart cans	\$25	Surface fairing — filling dips and voids
PVA mold release	Partall PVA No. 10 (or equivalent)	1 quart	\$25	3 coats at ~200 ft ² /qt/coat. See Section 11
Sandpaper 80 grit	9" × 11" sheets	20 sheets	\$15	Rough shaping
Sandpaper 120 grit	9" × 11" sheets	15 sheets	\$12	Intermediate
Sandpaper 220 grit	9" × 11" sheets	15 sheets	\$13	Final surface
Tuck Tape (red sheathing tape)	2.5" wide roll	2 rolls	\$16	Seam taping between stations
Lightweight spackle	Pre-mixed, 1 gallon	1 tub	\$12	Surface skim coat (Amit's method)
Water-based latex primer	Interior/exterior	1 quart	\$10	Seal surface before PVA

Alignment Hardware

Item	Spec	Qty	Cost	Notes
All-thread rod	3/8"-16, 6-foot lengths	5 rods (join to 228")	\$25	Alignment rods through indexing holes
Coupling nuts	3/8"-16	10	\$8	Join rod lengths end-to-end
Hex nuts	3/8"-16	10	\$3	End caps on rods
Flat washers	3/8"	10	\$2	Prevent nut embedding in foam

Strongback

Item	Spec	Qty	Cost	Notes
MDF sheet	3/4" × 48" × 96"	3 sheets	\$120	Join for 19.5' total. Rip to 36" wide
Plywood splice plates	1/2" × 12" × 24"	2 pieces	\$10	Join MDF sheets end-to-end
Drywall screws	#8 × 2.5"	1 box (100)	\$10	Splice plates + foam attachment
Wood screws	#8 × 3"	1 box (50)	\$10	Strongback to sawhorses
Sawhorses	Adjustable, 30"-36"	5	\$0 (borrow)	Spaced ~44" apart for 222" span

Total Mold Materials Budget

Category	Cost
EPS foam (40 sheets)	\$1,120
Adhesives & fillers	\$81
Tuck Tape + spackle + primer	\$38
PVA release	\$25
Sandpaper	\$40
All-thread rod + hardware	\$38
Strongback lumber	\$140
Masonite/plywood for templates	\$30
Misc (Sharpies, tape, chalk)	\$10
Total	~\$1,522

3. Tool List

Organized by operation. Items marked \dagger are essential; others are helpful but not mandatory.

Measuring & Layout

Tool	Model / Spec	Use
Tape measure	25' Stanley FatMax	All measurements
Framing square	24" × 16"	Template squareness, perpendicularity
String line	100' mason's line + line level	Strongback leveling over 19'
Sharpie markers	Fine + Ultra Fine	Labeling stations, marking cut lines
Chalk line	Stanley + blue chalk	Strongback centerline
Laser level	Self-leveling rotary	Faster than string line if available

Foam Cutting

Tool	Model / Spec	Use
Utility knife	Stanley 10-099	Primary cutting tool — straight sections, scoring
Serrated bread knife	12"+ blade	Primary cutting tool — curved sections, sawing through 1.5" foam
Hot wire cutter	DIY nichrome wire or commercial	Optional/backup — useful for fine detail work if available
Reciprocating saw	With foam blade	Rough block sizing (fast but messy)

Cutting method: Each 24"×48" panel is only 1.5" thick — one person cuts each panel with a utility knife

(straight lines) and bread knife (curves) guided by a Masonite template. No expensive tools or 2-person coordination required. See §7 for the full procedure.

Shaping & Sanding

Tool	Model / Spec	Use
Surform rasp	Stanley 21-296 (flat, 10")	Knocking down high spots on foam
Sanding board	DIY: 24" × 3.5" MDF + adhesive sandpaper	Fair surface checking & sanding (see Section 10)
Random orbital sander	5" or 6"	Power sanding large flat areas
Drywall rasp	Perforated steel	Aggressive foam shaping
Sanding sponge	Medium/fine dual grit	Curved areas, detail work

Assembly & Clamping

Tool	Model / Spec	Use
Caulk gun	Standard 10 oz	PL Premium application
Bar clamps	24"+ opening, 6-8 clamps	Clamping foam layers during lamination
Weights	Concrete blocks, sand bags, books	Pressing layers flat during cure
Level	48" (4-foot)	Checking section alignment
Spring clamps	2"-3" opening, 12+	Temporary holds during assembly
Drill/driver	Cordless 18V	Screws into strongback

Template Making

Tool	Model / Spec	Use
Masonite / plywood	1/8" tempered hardboard or 1/4" plywood	Template material (rigid, reusable, drillable)
Jigsaw	Fine-tooth blade (20 TPI+)	Cutting Masonite templates
Drill + 3/8" bit	Drill press preferred	Indexing holes for all-thread rod alignment
Flexible curve	24" Staedtler or Alvin	Drawing smooth hull curves
Ruler / straightedge	36" steel rule	Plotting offset points

Tool	Model / Spec	Use
Compass or dividers	Large (12"+)	Marking curves, checking symmetry
Cardboard	Large sheets (appliance boxes)	Backup verification templates (not for cutting)

Safety

Item	Spec
N95 dust masks	3M 8210 or equivalent
Safety glasses	ANSI Z87.1 rated
Work gloves	Leather or mechanic's gloves
Shop vacuum	With HEPA filter — clean up EPS beads and dust
Fan / ventilation	Box fan minimum — good airflow for dust and adhesive fumes

4. Strongback Construction

Time: 6–8 hours | **Crew:** 2–3 people

The strongback is the flat, rigid spine that supports every foam section. If it's not straight and level, the mold will be twisted and your canoe will paddle in circles.

4.1 Join the MDF Sheets

You need approximately 19.5 feet of continuous flat surface (222" mold + working room). MDF comes in 4' × 8' sheets.

1. Lay three 3/4" × 48" × 96" MDF sheets end-to-end on the floor.
2. Rip each sheet to 36" wide using a circular saw with a straightedge guide. Save the 12" offcuts for splice plates.
3. Butt two sheets together (gives 192"). For the third sheet, cut a 36" section and butt it against the second (gives 228" total, enough for 222" mold + 3" overhang each end).
4. Flip the assembly over. Place a splice plate (12" × 24" × 3/4" MDF or 1/2" plywood) centered over each joint on the underside. Screw every 4" with #8 × 2.5" drywall screws.
5. Flip back over. Check the joints are flush on the top surface — sand any high spots.

4.2 Set on Sawhorses

1. Place 5 sawhorses evenly spaced (~44" apart).
2. Set the joined MDF on top. The working surface should be at waist height (~36" from floor). Adjust sawhorse legs if needed.
3. Center the MDF left-right on the horses.

4.3 Level — The String Line Method

This is the critical step. You need ±1/8" flatness over the full 19' length.

1. Drive a small nail at each end of the strongback, centered on the width.
2. Stretch a mason's line (thin nylon string) tightly between the nails. Hang a line level at the center.
3. Adjust the string until the line level reads perfectly centered.

4. Measure the gap between the string and the MDF surface at every sawhorse location. They should all be equal (within 1/8”).
5. Shim sawhorses with thin plywood, cardboard, or cedar shims until all gaps match.
6. Check crosswise too: place the 4’ level across the width at 3–4 locations. No twist allowed.
7. **Verify:** Slide the 4’ level along the full length in both the fore-aft and crosswise directions. Zero rocking.

4.4 Mark the Centerline

1. Measure 18” from each long edge at both ends. Mark with a pencil.
2. Snap a chalk line between the marks. This is the hull centerline — every foam section gets centered on it.

4.5 Mark Station Positions

Stations are marked from the bow end. The mold has 3” of flange before the first station (S at the bow tip).

Station	Distance from Bow End of Mold	Notes
(flange start)	0”	Mold edge
S (bow tip)	3”	Keel point only
R	9”	
Q	15”	
P	21”	
O	27”	
N	33”	
M	39”	
L	45”	
K	51”	
J	57”	
I	63”	
H	69”	
G	75”	
F	81”	
E	87”	
D	93”	
C	99”	
B	105”	
A (midship)	111”	Center of mold
B’	117”	Mirror of B
C’	123”	Mirror of C
D’	129”	
E’	135”	
F’	141”	
G’	147”	
H’	153”	
I’	159”	
J’	165”	
K’	171”	
L’	177”	
M’	183”	
N’	189”	
O’	195”	
P’	201”	
Q’	207”	

Foam lamination — 4 pre-cut EPS panels glued face-to-face into a 6” block

Figure 3: Foam lamination — 4 pre-cut EPS panels glued face-to-face into a 6” block

Station	Distance from Bow End of Mold	Notes
R'	213”	
S' (stern tip)	219”	Keel point only
(flange end)	222”	Mold edge

1. Starting from the bow end, measure and mark each station distance using the table above.
2. At each mark, draw a line across the full 36” width of the MDF using a framing square (ensures perpendicular to centerline).
3. Label each line with its station letter using a Sharpie (large, readable from 3 feet away).

QC Gate — Strongback: - [] Level within $\pm 1/8$ ” over full 19’ length (string line test) - [] No twist (4’ level across width at 5 locations) - [] Centerline is straight (sight down it from one end) - [] All 37 station marks present and correctly spaced (6” between each) - [] Station labels legible

5. Foam Lamination

Time: 6–8 hours (spread over 2 days for glue cure) | **Crew:** 1–2 people

Each station block is 6” deep (fore-aft), made by gluing 4 pre-cut panels face-to-face ($4 \times 1.5” = 6”$). The critical difference from other methods: **each panel has the hull cross-section already cut out BEFORE gluing.** This means you cut through only 1.5” of foam at a time (easy with a knife), rather than trying to cut through a thick laminated block.

5.1 Why 4 Panels?

- Station spacing: 6” (uniform from midship outward)
- EPS sheet thickness: 1.5”
- Panels per block: $6.00 \div 1.50 = 4$ **panels exactly**
- Glue joints per block: **3** (between panels 1-2, 2-3, and 3-4)

5.2 Panel Count Table by Station

Every station uses exactly 4 panels per block. The panel size is the same for all stations (24” x 48” x 1.5”), but the hull cross-section cut from each panel varies by station.

Station	Trough Depth (in)	Full Beam (in)	Panels per Block	Notes
A	18.50	32.00	4	Widest cross-section
B	18.50	31.90	4	
C	18.50	31.62	4	
D	18.50	31.14	4	
E	18.50	30.46	4	
F	18.48	29.60	4	
G	18.41	28.52	4	
H	18.32	27.26	4	
I	18.20	25.78	4	
J	18.07	24.12	4	

Station	Trough Depth (in)	Full Beam (in)	Panels per Block	Notes
K	17.91	22.26	4	
L	17.73	20.22	4	
M	17.52	17.94	4	
N	17.30	15.46	4	
O	17.05	12.80	4	Narrow — multiple cuts from one panel
P	16.79	9.92	4	
Q	16.49	6.84	4	
R	15.48	3.54	4	
S	7.50	~0	4	Bow/stern tip — keel point only

Total panels: 37 blocks × 4 panels = **148 panels** (from 40 sheets = 160 panels, 12 spares).

5.3 Build Sequence: Cut First, Then Glue

Important: The panels are cut to the hull cross-section shape BEFORE lamination. See §7 for the full cutting procedure. This section covers the gluing step that follows cutting.

The workflow for each station block is: 1. Cut the hull cross-section into all 4 panels for that station (see §7) 2. Glue the 4 cut panels face-to-face with PL Premium (this section) 3. Weight/clamp, cure 24 hrs 4. Mount the finished 6" block on the strongback (see §8)

5.4 Adhesive Application — The Bead Pattern

PL Premium polyurethane adhesive is the standard for EPS foam lamination. It bonds EPS, cures with moisture, and expands slightly to fill small gaps.

Application pattern for each panel face (3 glue joints per block):

- ← perimeter bead (1/4" from edge)
- ← zigzag across face
- ← perimeter bead

(panel with hull cross-section already cut out)

1. Lay the cut panel flat on a clean surface, cut-side up.
2. Run a continuous 1/4"-diameter bead around the perimeter, 1/4" in from the outer edge.
3. Run a zigzag bead across the face, spacing peaks ~2" apart.
4. **Do NOT spread the adhesive.** PL Premium needs the bead shape to cure properly (it cures via moisture contact at bead surfaces).
5. Press the next cut panel on immediately, aligning the cross-section cutouts. You have about 5 minutes of open time.
6. Repeat for all 4 panels (apply adhesive to 3 faces total).

5.5 Clamping Method

EPS is soft and crushes easily. You can't use heavy clamp pressure.

Method A — Weighted stack (preferred): 1. Stack all 4 cut panels for one station on a flat surface (floor or table), with adhesive between each pair. 2. Align the cross-section cutouts by sighting through the trough cavity or using the Masonite template as a guide. 3. Place a flat board (plywood or MDF scrap) on top of the 4-panel stack. 4. Place 20–30 lbs of distributed weight on the board (concrete blocks, books, sand bags). 5. The weight presses panels flat without crushing the foam. 6. Let cure **24 hours** before handling.

Method B — Bar clamps with cauls: 1. Place MDF caul boards on top and bottom of the 4-panel stack. 2. Apply bar clamps every 12” along the length. 3. Tighten just until the caul contacts the foam evenly — **do not over-tighten**. 4. Let cure 4–6 hours minimum.

5.6 Cure Verification

Before assembly, verify the lamination is solid:

1. **Lift test:** Pick up the laminated block by one end. It should not flex or separate at any glue line.
2. **Tap test:** Tap the side with your knuckle. A solid, dull thud = good bond. A hollow rattle = delamination.
3. **Pry test (destructive, one sample only):** Try to separate two panels with a putty knife at a corner. The foam should tear before the glue joint fails. If the joint opens cleanly, the adhesive didn’t bond — re-glue with fresh adhesive and ensure surfaces are dust-free.

5.7 Batch Strategy

With 37 blocks at 4 panels each, you have **148 panels** to cut and glue (only 111 glue joints total). Work in batches:

Day 1 — Cut and laminate stations A through J (10 unique stations (A–J), 19 blocks (A×1 + B–J×2), 76 panels): - Morning: Cut all panels for A–J (see §7 for cutting procedure) - Afternoon: Apply adhesive and stack 4-panel blocks. Weight everything.

Day 2 — Cut and laminate stations K through S (8 unique × mostly 2 copies = 16 blocks, 64 panels): - Morning: Cut all panels for K–S - Afternoon: Apply adhesive and stack. Weight everything. - Meanwhile: Day 1 blocks have cured → move to assembly station (§8).

6. Template Making

Time: 4–6 hours | **Crew:** 1–2 people (detail-oriented)

Templates are full-size cutouts of each station’s cross-section. They guide the knife cuts on each panel, serve as verification gauges throughout assembly, and provide **indexing holes** for all-thread rod alignment.

Amit’s method (competition-proven): Use **1/8” Masonite (hardboard) or 1/4” plywood** instead of cardboard. Masonite templates are rigid, reusable, and don’t warp with humidity. They also accept drilled indexing holes cleanly.

6.1 Materials

- **1/8” Masonite (tempered hardboard) or 1/4” plywood** (preferred — rigid, reusable, drillable)
 - Cardboard is acceptable for verification copies but NOT for cutting templates
- 24” flexible curve (bendable ruler)
- 36” steel straightedge
- Framing square
- Fine-point Sharpie
- Jigsaw with fine-tooth blade (for cutting Masonite/plywood templates)
- **Drill press or hand drill with 3/8” bit** (for indexing holes — see §6.5)

6.2 Step-by-Step: Plotting a Template

We'll walk through Station J as an example (half-breadth 12.06", depth 18.07", V-shape).

Step 1 — Draw the baseline and centerline:

centerline

(foam block
outline)

← baseline
(bottom of block)

1. Cut a piece of Masonite slightly larger than the panel size (Station J: 28" wide × 24" tall).
2. Draw a horizontal baseline near the bottom (this represents the bottom of the foam block, which sits on the strongback).
3. Draw a vertical centerline at the exact center of the Masonite.

Step 2 — Plot the key points of the hull cross-section:

From the offset table, Station J has: - Half-breadth: 12.06" (measure left and right from centerline at the top of the trough) - Depth: 18.07" (measure down from the trough opening to the keel)

Mark these points: - **Point K (keel)**: On the centerline, 18.07" down from the top of the block (leave 2.93" of margin above the trough opening for the foam wall) - **Point G-left (gunwale, left)**: 12.06" left of centerline, at the trough opening height (2.93" below top of block) - **Point G-right (gunwale, right)**: 12.06" right of centerline, same height

Step 3 — Plot intermediate curve points:

The hull cross-section is NOT a simple V — it's a smooth curve that transitions from a rounded bilge at the bottom to nearly vertical sides at the gunwale. You need intermediate points.

For a U-to-V transitional hull, estimate these intermediate points at roughly equal depth intervals:

Depth Below Gunwale	Width from Centerline (approx)	Notes
0" (gunwale)	12.06"	From offset table
3"	11.80"	Nearly vertical sides
6"	11.30"	Sides start curving inward
9"	10.30"	Bilge curve begins
12"	8.70"	In the bilge radius
15"	5.50"	Lower V emerging
18.07" (keel)	0"	Centerline, keel point

These intermediate values are approximations based on the U-to-V hull form. If you have the SolidWorks cross-section drawings, measure directly from those instead.

Step 4 — Connect the dots with a smooth curve:

1. Mark all points (left and right side — the curve is symmetric about the centerline).
2. Bend the flexible curve to pass through all points on one side.
3. Hold the flexible curve in place and trace along it with a Sharpie.
4. Repeat for the other side, ensuring symmetry.
5. Check symmetry: measure from the centerline to the curve at several depths. Left and right should match within 1/8".

Female mold cross-section showing indexing holes

Figure 4: Female mold cross-section showing indexing holes

Step 5 — Draw the block outline:

Draw a rectangle around the curve representing the foam block: - Width = full beam + 4" (2" margin each side) - Height = 24" (panel height) - The curve should be centered in the rectangle with 2" of foam on all sides.

Step 6 — Cut and verify:

1. Cut out the template along the block outline with a jigsaw.
2. Cut out the trough curve with a jigsaw. Save both pieces — the outer piece is the template, the inner cutout can be used to verify the trough shape.
3. **Verify dimensions:** Measure trough width at the top (should match full beam from offset table $\pm 1/4"$). Measure depth (should match offset table $\pm 1/4"$).

6.3 Template Set

You need 19 unique templates (A through S). Make each one from fresh Masonite — don't try to modify an adjacent station's template, as the shapes change subtly.

Label each template prominently: - Station letter - Full beam dimension - Depth dimension - "TOP" arrow pointing up - Centerline marked

6.4 Indexing Holes for All-Thread Rod Alignment

Every template gets **5 indexing holes** drilled at identical positions. These holes accept 3/8" all-thread rod during mold assembly, locking all stations into perfect alignment (see §8).

Hole positions (identical on every template):

Hole	Location	Purpose
1	Top-left corner (2" in from edges)	Gunwale alignment, port
2	Top-right corner (2" in from edges)	Gunwale alignment, starboard
3	Bottom-left corner (2" in from edges)	Base alignment, port
4	Bottom-right corner (2" in from edges)	Base alignment, starboard
5	Bottom center (on centerline, 1" from bottom)	Keel alignment

Drilling procedure: 1. Make a **master jig** — a scrap piece of Masonite with all 5 holes drilled precisely. Use this jig to mark and drill every template. 2. Drill with a **3/8" bit** (matching the all-thread rod diameter, with slight clearance). 3. **Verify:** Slide a 12" piece of all-thread rod through multiple stacked templates. They should align perfectly with no binding.

6.5 Pro Tips

- **Work from CAD prints if available.** If someone can print the SolidWorks cross-sections at 1:1 scale on a plotter, glue them directly to Masonite. Much faster and more accurate than plotting by hand.
- **Nest narrow templates inside wide ones** to save material.
- **Make two copies of stations B–R** (one stays clean as a verification gauge, one gets used for cutting and accumulates marks).
- **Masonite cuts cleanly with a jigsaw** — use a fine-tooth blade (20 TPI+) and cut just outside the line, then sand to the line with a drum sander or hand file.

7. Foam Cutting

Time: 8–12 hours (2 days) | **Crew:** 1 person can do all cutting solo

Key concept — **CUT PANELS INDIVIDUALLY, THEN GLUE:** You cut the hull cross-section out of each 24"×48"×1.5" panel one at a time using a knife. Then you glue 4 cut panels face-to-face to form a 6" block (see §5). Cutting through 1.5" of foam is trivial with a utility knife — no expensive tools, no 2-person coordination.

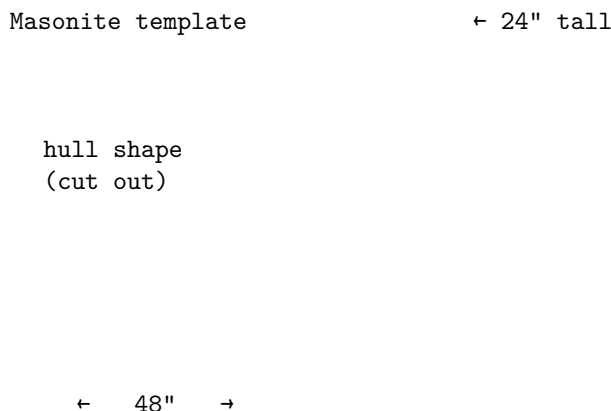
7.1 Knife Cutting — The Primary Method

Each panel is only 1.5" thick. A utility knife and a serrated bread knife are all you need. One person can cut every panel solo.

Setup: 1. Lay a 24"×48" panel flat on a workbench or clean floor. 2. Pin or clamp the Masonite template on top of the panel. 3. Align the template centerline with the panel centerline (measure 24" across and mark the midpoint at 12").

Step-by-step cutting procedure:

24" × 48" panel with Masonite template pinned on top:



1. **Pin Masonite template** to the 24"×48" panel, centered.
2. **Trace hull cross-section outline** with a Sharpie, following the template edge.
3. **Remove template.** You now have a Sharpie outline of the hull cross-section on the panel.
4. **Cut along the line:**
 - **Straight sections** (gunwale sides): Score deeply with utility knife along a straightedge, then snap. Or make 2–3 passes to cut through the full 1.5" thickness.
 - **Curved sections** (bilge, keel): Use the serrated bread knife to saw through the foam, following the Sharpie line. The bread knife's teeth grip EPS cleanly. Keep the blade perpendicular to the panel face.
5. **Score and snap technique** (for straight lines): Score 1/2" deep with the utility knife, then bend the panel along the score line. It snaps cleanly. Trim any rough edges with the bread knife.
6. **Remove the inner hull-shape piece.** Save it — use it later to verify fit against the template and as packing material.
7. **Label the panel** with a Sharpie:
 - Station letter (large, 2"+)
 - Panel number (1 of 4, 2 of 4, etc.)
 - "TOP" arrow pointing up

- “BOW” or “STERN” (for paired pieces B–S)
8. **Repeat for all 4 panels** of this station, using the same template each time.
 9. **Glue the 4 cut panels** face-to-face with PL Premium (see §5.4 for adhesive pattern).
 10. **Weight/clamp. Cure 24 hrs** before handling.

7.2 Key Advantages of Panel Cutting

- **One person, one knife.** No expensive hot wire cutter, no 2-person coordination.
- **148 cuts total**, each taking ~3 minutes through 1.5” foam. Total cutting time: ~7–8 hours.
- **Mistakes are cheap.** A bad cut wastes one 24”×48” panel (1/4 of a \$28 sheet = \$7). You have 12 spare panels.
- **Consistent results.** The same Masonite template is used for all 4 panels per station, so they align perfectly when glued.
- **No glue line interference.** Unlike cutting through a pre-laminated block, each panel is a single piece of foam with no glue lines to fight through.

7.3 Tips for Clean Cuts

Technique	When to Use	Notes
Utility knife + straightedge	Straight gunwale sides	Score 2–3 passes, or score and snap
Bread knife (sawing)	All curved sections (bilge, keel)	Keep blade perpendicular, slow steady strokes
Surform rasp (cleanup)	After cutting, to smooth rough edges	Light passes only — foam removes fast
Sandpaper on block	Final edge cleanup	80 grit on a flat block, 2–3 passes

Common problems and fixes:

Problem	Cause	Fix
Ragged, torn edge	Blade too dull or moving too fast	Fresh blade in utility knife; slow down with bread knife
Cut wandered from line	Blade tilted or line not visible	Re-cut with bread knife staying on the Sharpie line. Fill small deviations with spackle during fairing
Panel cracked/broke	Bent panel too sharply during snap	Use bread knife to saw through instead of snapping. Only snap straight, deeply scored lines
Uneven thickness through cut	Blade not perpendicular to face	Hold knife/blade at 90 degrees. Check by sighting along the edge

7.4 Accuracy Verification

After cutting each panel:

Mold assembly sequence — 4-step process from midship to faired surface

Figure 5: Mold assembly sequence — 4-step process from midship to faired surface

1. **Template check:** Lay the Masonite template over the cut panel. The cutout should match the template shape with no more than 1/4" gap anywhere.
2. **Width check:** Measure the cutout width at the top (gunwale level). Compare to full beam in the offset table.
3. **Depth check:** Measure the cutout depth at the centerline. Compare to the offset table.
4. **Symmetry check:** Measure from centerline to each side of the cutout at 3 depths. Left and right should match within 1/4".
5. **Stack check:** After cutting all 4 panels for a station, stack them and sight through the cutouts. They should align — if one panel is off, re-cut or trim with the bread knife.

7.5 Labeling

On BOTH faces of every cut panel, write with a Sharpie: - Station letter (large, 2"+) - Panel number (1-4) - "BOW" or "STERN" (for paired pieces B-S) - "TOP" arrow - Centerline mark on the top edge

7.6 Cutting Order

Cut in order from largest to smallest. If you make a mistake on a large station, the panel can sometimes be re-cut for a smaller station.

1. Station A (largest, only 1 needed — practice piece, 4 panels)
2. Stations B, C, D (wide, nearly flat U — easiest)
3. Stations E, F, G (U-to-V transition — moderate)
4. Stations H, I, J, K (clear V — moderate)
5. Stations L, M, N (narrow V — harder, less margin for error)
6. Stations O, P, Q (very narrow — precision required)
7. Station R (almost just a keel groove)
8. Station S (tip — may be carved by hand from a small block)

QC Gate — Foam Cutting: - [] All 148 panels cut and labeled (37 stations × 4 panels each) - [] Each panel passes template check ($\pm 1/4"$) - [] Midship (A) cutout is exactly 32.00" wide at top $\pm 1/4"$ - [] Cutouts get progressively narrower from A to S - [] All 37 blocks glued (4 panels each) and cured

8. Mold Assembly

Time: 6–8 hours | **Crew:** 3–4 people

8.1 All-Thread Rod Alignment System

Amit's method (replaces glue-and-screws-only): All stations are threaded onto 3/8" all-thread rods that pass through the indexing holes drilled in §6.4. The rods lock every section into perfect alignment automatically — no shimming, no plumb bobs, no guesswork.

Materials needed: - 3/8" all-thread rod (hardware store), cut to mold length + 6" (228" total). Need **5 rods** (one per indexing hole position) - 3/8" nuts and washers (10 of each — 2 per rod, one per end) - PL Premium adhesive (for bonding stations face-to-face)

8.2 Start at Midship

Station A is the reference section. Everything else aligns to it.

1. Center Station A on the strongback at the 111" mark (from the bow end of the mold).

2. Align the trough centerline with the strongback centerline.
3. Check that the station is perpendicular to the strongback centerline (framing square on both sides).
4. **Thread all 5 all-thread rods through Station A's indexing holes.** Station A sits at the center of the rod length. The rods extend equally toward bow and stern.
5. Apply a bead of PL Premium to the bottom of the foam block.
6. Press down onto the strongback. Drive two #8 × 2.5" drywall screws up through the MDF into the foam from below (pre-drill the MDF).
7. Check level across the top of the foam block with the 4' level.

8.3 Work Outward in Pairs

Install stations symmetrically: B and B' together, then C and C', etc.

For each pair:

1. Apply PL Premium to the mating face of Station B (the face that contacts Station A).
2. **Slide Station B onto the all-thread rods** — the 5 indexing holes guide it into perfect position automatically.
3. Push Station B snug against Station A. Stations butt directly face-to-face — the 6" spacing refers to station centerline distance, which equals the 6" block thickness.
4. Verify alignment:
 - **Centerline:** Trough centerline should align with the strongback chalk line. (The rods handle this, but verify visually.)
 - **Level:** Top of Station B should be level with top of Station A.
 - **Perpendicular:** Framing square against the strongback edge.
5. Glue bottom to strongback (PL Premium + screws from below).
6. Repeat for Station B' (stern side of A).
7. Continue with C/C', D/D', etc.
8. **After all stations are mounted:** Thread nuts and washers onto both ends of each rod. Snug (do NOT overtighten — you'll crush the foam). This locks the entire assembly rigid.

8.4 Alignment Method at Each Station

Top view (looking down):

centerline on strongback

S' R' Q' ... B' A B ... S

At each station, verify: 1. **Centerline alignment:** Drop a plumb bob from the trough centerline to the strongback centerline. They must coincide. 2. **Height alignment:** Place a straightedge across the tops of 3-4 adjacent stations. No station should be proud (high) or recessed (low) by more than 1/16". 3. **Width alignment:** Measure from the strongback centerline to each side of the trough opening. Left and right should match within 1/8".

8.5 Tip Section Handling (Stations Q, R, S)

The bow and stern tips are small and fragile. Special handling:

- **Station S** is essentially a pointed keel block. Hand-carve it from a small laminated block if needed.
- **Station R** has only a 3.54"-wide trough. The foam walls on each side are thin (~1.5"). Handle gently.
- Glue tip sections carefully. They don't need screws — the adhesive bond to adjacent stations holds them.
- Consider gluing S, R, and Q together as a sub-assembly on a flat surface before mounting to the strongback.

QC Gate — Mold Assembly: - [] All 37 stations mounted on strongback - [] Centerline alignment verified at every station - [] Height is continuous (straightedge test, no steps > 1/16") - [] Symmetric — beam measured at both sides of centerline at 5+ stations - [] Overall length: 216" between tip stations (S to S')

9. Gap Filling & Rough Shaping

Time: 4-6 hours | **Crew:** 2-3 people

Even with all-thread alignment, there will be gaps, steps, and rough areas between sections. This step creates a continuous surface.

9.1 Seam Taping (Amit's Method — Fastest)

Tuck Tape method: Before filling gaps, apply **Tuck Tape (red sheathing tape) or duct tape** over every station-to-station seam on the mold interior. This bridges small gaps instantly and creates a smoother base for spackle.

1. Run a strip of Tuck Tape lengthwise along each seam (fore-aft direction).
2. Press firmly with a plastic squeegee or credit card to eliminate air bubbles.
3. Overlap tape strips by 1/2" where they meet.
4. This step alone handles gaps up to ~1/4". For larger gaps, proceed to spray foam below.

9.2 Filling Larger Gaps

Spray foam method (for gaps 1/4" to 1"):

1. Use **Great Stuff Gaps & Cracks** (NOT Big Gap Filler — that formula expands too aggressively and will push foam sections apart).
2. Shake the can vigorously for 60 seconds.
3. Apply in thin beads (~1/4" diameter) into the gap. Fill to about 2/3 of the gap depth.
4. The foam will expand to fill the remaining 1/3. If you overfill, it balloons out and takes forever to carve back.
5. Let cure 4-8 hours (until firm to touch and no longer tacky).
6. Carve flush with a serrated knife, then surform rasp.

Foam strip method (for gaps > 1"):

1. Cut thin strips of scrap EPS to fit the gap.
2. Apply PL Premium to all contact surfaces.
3. Press the strip into the gap. Hold with spring clamps or tape for 2 hours.
4. Carve and rasp flush after cure.

9.3 Rough Shaping

After all gaps are filled, rough-shape the entire mold interior to a continuous surface.

Surform rasp technique: - Hold the Stanley 21-296 flat rasp at a shallow angle (~15° to the surface). - Stroke direction: always **fore-aft** (bow to stern), never crosswise. Fore-aft strokes follow the hull's natural fairness. Cross strokes create ridges. - Use long, overlapping strokes. Each stroke should span at least 2-3 station widths. - The rasp removes EPS quickly — take light passes. You can always remove more but can't add it back.

Where to focus: 1. Station-to-station transitions (the steps between sections) 2. The keel line (bottom centerline) — this should be a smooth, continuous curve 3. The gunwale line (top edge) — should also be smooth and continuous 4. Bilge radius areas where the bottom transitions to the sides

Sanding progression — 80, 120, 220 grit with batten test

Figure 6: Sanding progression — 80, 120, 220 grit with batten test

9.4 Surface Treatment — Spackle and Primer (Amit’s Method)

After rough shaping, apply a surface treatment for a professional-quality mold:

1. **Lightweight spackle** (not Bondo): Spread a thin skim coat of lightweight spackle over the entire trough interior. Spackle is easier to sand than Bondo, cheaper, and sufficient for EPS molds.
 - Apply with a 6” drywall knife in smooth, overlapping passes.
 - Fill all remaining pits, tape edges, and surface imperfections.
 - Let dry 2–4 hours (spackle dries white when ready).
2. **Sand spackle smooth** with 120-grit on the sanding board (see §10).
3. **Water-based primer** (optional but recommended): Apply 1–2 coats of water-based latex primer over the spackled surface before PVA release.
 - Primer seals the porous EPS/spackle and creates a smoother base for PVA.
 - Use a roller for even coverage. Let dry 1 hour between coats.
 - **Do NOT use oil-based primer** — it dissolves EPS foam.

9.5 Check as You Go

After every 15–20 minutes of rasping: 1. Run your hand along the surface. Feel for steps, bumps, or ridges. 2. Lay the 4’ level along the surface at various angles. Look for gaps. 3. Sight down the mold from one end. The surface should look like a continuous curve, not a staircase.

10. Surface Fairing

Time: 12–16 hours (plan 2 full days) | **Crew:** 2–4 people

This is the most time-consuming step in mold construction. Every imperfection in the mold surface transfers directly to the canoe’s outer hull. A poorly faired mold makes a slow canoe.

10.1 What “Fair” Means

A fair surface is one where the curvature changes smoothly and gradually — no sudden bumps, dips, flat spots, or wavy patches. When you lay a flexible strip along a fair surface, it touches everywhere with no gaps.

Think of it this way: if you could roll a marble along the mold surface, it should accelerate and decelerate smoothly, never bouncing or chattering.

10.2 The Sanding Board

Your primary fairing tool is a long sanding board — a rigid, flat board with sandpaper attached. It bridges low spots and shaves high spots, automatically creating fairness.

How to make one:

1. Cut a piece of 3/4” MDF or hardwood to 24” × 3.5” × 3/4”.
2. Glue a piece of 1/4”-thick cork or rubber to the bottom face (this provides slight cushion and helps the sandpaper grip).
3. Cut a sheet of sandpaper to the same dimensions. Attach with spray adhesive (3M Super 77) or double-sided tape.

4. Screw or bolt a handle (a door pull or simple wooden block) to the top.

Using the sanding board:

- **Always stroke fore-aft** (bow-to-stern direction). Never sand side-to-side. The hull fairness is fore-aft; crosswise sanding creates ridges.
- **Long strokes:** Each stroke should be 18"–24", overlapping the previous stroke by half.
- **Light pressure:** Let the board do the work. Pressing hard digs into the foam and creates hollows.
- **Watch the scratch pattern:** The sandpaper leaves visible scratches. On high spots, scratches appear first (because the board contacts there first). Low spots stay unscratched. This tells you exactly where material needs to come off.

10.3 Three-Grit Progression

Each grit level has a specific purpose. **Do not skip grits.**

Pass 1: 80 Grit — Shape Correction (4–6 hours) Purpose: Remove remaining steps, bumps, and gross imperfections from the rough shaping step. This is where you fix the shape.

Technique: 1. Attach 80-grit paper to the sanding board. 2. Start at midship (Station A) and work toward the bow. Then do midship to stern. 3. Sand with fore-aft strokes, overlapping. Cover the entire trough surface. 4. After every 10 minutes: vacuum the dust, run your hand over the surface, and check with the sanding board held flat (it should rock only slightly on any high spots). 5. **Time estimate:** 4–6 hours for the full mold interior. This is the hard work.

What to look for: - Scratch marks appear evenly across the surface → surface is flat/fair at this scale. - Scratch marks only on ridges between stations → those ridges are still high. Sand more there. - Low spots remain shiny (unscratched) → don't try to sand them down. Fill them later with Bondo.

When to stop 80 grit: When the sanding board lies flat against the surface everywhere and you can slide it without rocking. Small low spots (< 1/4" deep) are OK — they'll be filled with Bondo.

Fill Low Spots — Bondo Application Between 80 and 120 grit, fill any remaining dips or voids:

1. **Identify low spots:** Lay the sanding board flat on the surface. Anywhere the board rocks or has daylight underneath is a low spot. Mark these with a Sharpie circle.
2. **Mix Bondo:** Follow the can instructions. Mix only what you can use in 5 minutes — it sets fast. Use a ratio of about 1" ribbon of hardener per golf-ball-size blob of filler.
3. **Apply:** Spread a thin layer of Bondo into the low spot with a flexible plastic spreader. Overfill slightly (Bondo shrinks slightly as it cures).
4. **Cure time:** 15–20 minutes until rock-hard.
5. **Sand flush:** The 120-grit pass will take care of this.

Pass 2: 120 Grit — Smoothing (3–4 hours) Purpose: Remove the 80-grit scratch pattern and refine the surface. Sand the Bondo fills flush with the surrounding foam.

Technique: 1. Attach 120-grit paper to the sanding board. 2. Same fore-aft stroke pattern as 80 grit. 3. This pass goes faster because the surface is already fair — you're just smoothing. 4. Pay extra attention to Bondo patches — they should blend seamlessly into the surrounding foam. Run your fingertip across the edge of each patch. You should not feel a step.

When to stop 120 grit: Surface feels smooth to the palm (no bumps or ridges), Bondo patches are invisible to touch, and the sanding board glides without catching.

Pass 3: 220 Grit — Final Surface (2–3 hours) Purpose: Create a surface smooth enough for the PVA mold release to form a uniform film. This is the "paintable" surface.

Technique: 1. Switch to 220-grit paper on the sanding board. 2. Lighter pressure than previous passes. 3. Full coverage — every square inch of the trough interior. 4. For concave areas (bilge radius, keel), use a sanding sponge instead of the board. The sponge conforms to curves.

When to stop 220 grit: The surface looks uniformly matte (no shiny spots or rough patches). Running your hand over it feels like smooth drywall. No individual scratch marks visible from 12” away.

10.4 The Batten Test — Your Final Fairness Check

What you need: - A batten: 1/4” × 1” × 96” clear pine strip (get from a lumber yard — avoid knotty pieces that have stiff spots) - A helper - A Sharpie - A flashlight

How to do the batten test:

1. **Set up:** One person holds one end of the batten against the mold surface at the keel line, midship. The other person holds the other end 48” toward the bow.
2. **Press the batten gently** against the surface so it conforms naturally to the mold’s fore-aft curve. The batten should touch the surface continuously.
3. **Check for gaps:** Shine a flashlight behind the batten from the side. Look for daylight between the batten and the mold surface.
4. **Tolerance:** Maximum gap anywhere: **1/16” (1.5mm)**. If you can slide a dime under the batten, the gap is too big.
5. **Mark defects:** Circle any gap locations with a Sharpie. Note “H” for high spot (batten bridges over it) or “L” for low spot (batten can’t reach it).
6. **Repeat:** Move the batten 6” to the side and test the next fore-aft strip. Continue until you’ve tested the entire trough surface — keel, bilge, sides, gunwale.
7. **Also test crosswise** at midship and at stations E, J, and O. Crosswise fairness matters too.

Fixing batten test failures: - **High spot:** Sand it down with 120 grit on the sanding board, then re-smooth with 220. - **Low spot:** Fill with a skim of Bondo, sand flush, then re-smooth with 220. - **Re-test** the fixed area.

10.5 Summary of Time Estimates

Step	Time	Grit	Notes
Sanding board making	30 min	—	One-time setup
Pass 1 (shape correction)	4–6 hrs	80	The hardest work
Bondo filling	1–2 hrs	—	Mix, apply, cure
Pass 2 (smoothing)	3–4 hrs	120	
Pass 3 (final surface)	2–3 hrs	220	
Batten test + corrections	1–2 hrs	—	May add time if many corrections
Total	12–16 hrs		Plan 2 full days

11. PVA Mold Release

Time: 4–5 hours (including drying time between coats) | **Crew:** 1–2 people

11.1 Product

Partall PVA No. 10 (or equivalent PVA mold release). PVA = polyvinyl alcohol. It’s a water-soluble film that goes on like paint and dries to a glossy, slippery barrier between the foam and concrete.

Key specs: - Coverage: ~200 sq ft per quart per coat - Mold interior surface area: ~60 sq ft (rough estimate for a 216" × 32" trough) - Coats needed: 3 - PVA needed: $60 \times 3 \div 200 = \sim 1$ **quart** (with some to spare)

11.2 Preparation

1. Vacuum the entire mold interior thoroughly. Every speck of EPS dust or Bondo powder will be trapped under the PVA film and transfer to the canoe surface.
2. Wipe down with a slightly damp cloth. Let dry completely.
3. **Do not touch the sanded surface with bare hands** after cleaning. Skin oils contaminate the surface and can cause the PVA to bead up.
4. Wear clean latex or nitrile gloves from this point forward.

11.3 Application — Three Coats

Coat 1 — Horizontal strokes (side to side, crosswise):

1. Pour PVA into a clean container.
2. Using a 3"-4" foam brush (NOT bristle — bristles leave marks), dip and apply a thin, even coat across the mold surface.
3. Work in horizontal (crosswise) strokes across the trough.
4. Coverage should be thin — you should see the foam color through the wet PVA. If it pools or runs, you've applied too much. Spread it out.
5. Start at one end and work systematically to the other end. Don't go back over partially dry areas.
6. **Drying:** Let dry 1-2 hours at room temperature. The PVA changes from milky/white to clear/glossy when dry. In humid conditions (>70% RH), drying may take up to 3 hours.

Coat 2 — Vertical strokes (fore-aft, bow to stern):

1. Apply the second coat in the perpendicular direction to the first (fore-aft strokes).
2. This crosshatch pattern ensures no thin spots where the brush might have missed.
3. Same thin application as Coat 1.
4. Dry 1-2 hours until clear and glossy.

Coat 3 — Horizontal strokes again:

1. Apply a third coat, returning to the crosswise direction.
2. This coat provides extra insurance, especially important on your first build.
3. Dry 1-2 hours.

11.4 Drying Verification

Before proceeding to concrete:

1. **Visual:** The entire surface should be uniformly glossy with a slight bluish tint. No milky or cloudy patches (those are still wet).
2. **Touch test (glove only):** Lightly touch with a gloved finger. The surface should feel dry and slick, not tacky.
3. **Scratch test:** Gently scratch with a fingernail (gloved). The PVA film should resist scratching. If it scrapes off easily, apply another coat.

11.5 Common Mistakes

Mistake	Result	Prevention
Too thick per coat	PVA cracks when dry, rough surface	Apply thin, even coats — see foam through wet PVA
Not enough drying time	Coats merge, film too thick in spots	Wait until fully clear before next coat

Mistake	Result	Prevention
Missed spots	Concrete bonds to foam there → canoe breaks during demolding	Use a headlamp at a raking angle to inspect — glossy spots glow, dry spots are matte
Applied on dusty surface	Dust trapped under film, bumpy texture	Vacuum + damp wipe before first coat
Touched with bare hands	Fingerprints = non-stick failure zones	Gloves always after cleaning

12. Final QC Checklist

Before moving on to concrete application (Day 9 in the v3 guide), every item below must pass. The QC Checker signs off.

Dimensional Checks

Check	Method	Tolerance	Actual	Pass?	Initials
Mold overall length (S to S')	Tape measure	216" ± 1/2"	_____"	[]	_____
Mold overall length with flanges	Tape measure	222" ± 1"	_____"	[]	_____
Midship beam (trough width at A)	Tape measure	32.00" ± 1/4"	_____"	[]	_____
Midship depth (trough depth at A)	Depth gauge	18.50" ± 1/4"	_____"	[]	_____
Beam at Station E	Tape measure	30.46" ± 1/4"	_____"	[]	_____
Beam at Station J	Tape measure	24.12" ± 1/4"	_____"	[]	_____
Beam at Station O	Tape measure	12.80" ± 1/4"	_____"	[]	_____
Symmetry (centerline to left vs right)	Tape measure at 5 stations	± 1/8"	_____"	[]	_____
Strongback still level	String line	± 1/8" over full length	_____	[]	_____

Surface Quality

Check	Method	Tolerance	Pass?	Initials
Batten test — keel line	96" batten + flashlight	1/16" gap	[]	_____
Batten test — bilge (both sides)	96" batten + flashlight	1/16" gap	[]	_____
Batten test — crosswise at midship	96" batten + flashlight	1/16" gap	[]	_____
Surface smoothness	220-grit finish, hand feel	No scratches felt at 12"	[]	_____
No delamination visible	Visual + tap test	No hollow sounds	[]	_____

PVA Mold Release

Check	Method	Tolerance	Pass?	Initials
Three coats applied	Visual log	3 coats, alternating direction	[]	_____
Surface uniformly glossy	Raking light inspection	No matte/dry patches	[]	_____
No dust trapped under film	Visual at 6" distance	No bumps or speckles	[]	_____
Touch test	Gloved finger	Dry, slick, not tacky	[]	_____

Sign-Off

Role	Name	Date	Signature
Lead Builder	_____	____/____/____	_____
QC Checker	_____	____/____/____	_____
Faculty Advisor	_____	____/____/____	_____

If any check fails: Fix the issue and re-check. Do NOT proceed to concrete application with a failed QC item. Concrete is expensive and non-reversible.

13. Troubleshooting

Foam-Specific Failure Modes

#	Problem	Symptoms	Cause	Fix
1	Delamination	Layers separating, hollow sound when tapped, visible gap at glue line	Insufficient adhesive, dusty surfaces, or didn't clamp	Cut out the delaminated section. Clean surfaces, re-glue with fresh PL Premium, clamp 24 hrs. If extensive, re-laminate the entire station block
2	Knife cut wandering	Cut deviates from template line by >1/4"	Blade not following Sharpie line, dull blade, or moving too fast	Slow down. Use a fresh blade. Re-trace with template if line is lost. If cut wandered badly, re-cut the panel from a spare or fill small deviations with spackle during fairing
3	Ragged cut edge	Foam tears instead of cutting cleanly	Dull utility knife blade or bread knife sawing too fast	Replace blade, slow down. Clean up ragged edges with surform rasp
4	Spray foam over-expanding	Foam balloons out of gaps, pushes station pieces apart	Used Big Gap Filler instead of Gaps & Cracks, or overfilled	Use ONLY Gaps & Cracks formula (less expansion). Fill to 2/3 of gap. If already over-expanded: let cure fully, then carve back with serrated knife. Check that stations didn't shift — re-align if needed

#	Problem	Symptoms	Cause	Fix
5	Spray foam won't cure	Still soft and tacky after 8+ hours	Too thick an application, too cold, or too dry (spray foam needs humidity)	Mist the surface with water (spray foam cures with moisture). If temp <50°F, move indoors. For very thick fills, let it cure 24 hrs
6	Bondo cracking	Filled area develops cracks after a few hours	Mixed too much hardener, or applied too thick (>1/4" in one pass)	Dig out cracked Bondo. Re-apply in thinner layers (1/8" max per pass). Use the correct ratio of hardener
7	Bondo not bonding to foam	Bondo pops off cleanly when sanded	Dusty surface, or surface was too smooth (Bondo needs tooth)	Vacuum surface, rough up with 80 grit before applying. For large fills, key the surface with cross-hatch scratches
8	PVA won't dry	Still milky/white after 3+ hours	High humidity (>80%), cold temps, or applied too thick	Increase ventilation (point a fan at the mold). If temp <60°F, warm the room. If too thick, the bottom layer may never dry — wipe off and reapply thinner

#	Problem	Symptoms	Cause	Fix
9	PVA beading up (fish eyes)	PVA rolls into droplets instead of forming a film	Surface contaminated with oil/grease (fingerprints), or silicone residue	Wipe surface with isopropyl alcohol, let dry. Re-apply PVA. If persistent, lightly sand with 320 grit to remove contamination, then clean and re-apply
10	Station block crumbling	Foam breaks apart when handling or cutting	EPS density too low (<1 lb/ft ³), or sheet was damaged before purchase	Use 2 lb/ft ³ EPS minimum (the Henry R-5.78 is correct at 2 lb/ft ³). Inspect sheets for damage when buying. If a block crumbles, re-laminate from fresh sheets
11	Mold warping/twisting	Trough is visibly twisted, batten test fails in multiple directions	Strongback not level, differential temperature (sun on one side), or uneven adhesive expansion	Re-level strongback. If foam has warped: remove affected stations, re-level, re-install. Store mold indoors away from temperature gradients

8-day Gantt chart — crew assignments by role

Figure 7: 8-day Gantt chart — crew assignments by role

#	Problem	Symptoms	Cause	Fix
12	Gunwale line not straight	Top edges of trough are wavy or uneven	Station heights vary, or foam blocks weren't laminated to uniform height	Trim all gunwale tops to a level string line using a long sanding board. Accept $\pm 1/4''$ variation — the gunwale area gets extra concrete anyway
13	Keel line not smooth	Bottom centerline has bumps or sudden angle changes	Station troughs weren't cut to consistent depth, or gap fill is uneven	Sand the keel with the sanding board (fore-aft strokes only). Fill low spots. This is the most visible line on the hull — spend extra time here

14. Crew Coordination & Schedule

14.1 Crew Roles (4–6 People)

Role	Person	Responsibilities
Lead Builder	_____	Oversees all operations, makes decisions on fit and alignment, manages schedule
Template Maker	_____	Plots all 19 templates from offset data, verifies dimensions, maintains template set
Foam Cutter	_____	Cuts all station panels with utility knife + bread knife, responsible for cut accuracy
Assembler	_____	Handles adhesive application, mounts stations to strongback, manages gap filling
Fairer	_____	Responsible for all surface fairing — rasping, sanding, Bondo, batten tests
QC Checker	_____	Independent verification of all dimensions and quality gates. Does NOT do the building — just checks it

Notes: - The Lead Builder and QC Checker should be different people. The builder is biased toward “good

enough” — the QC Checker enforces standards. - The Foam Cutter can work solo (knife cutting through 1.5” panels requires only one person). Pairing with the Template Maker is helpful for verification. - Everyone helps with sanding during Pass 1 (80 grit) — it’s the longest physical task.

14.2 Eight-Day Daily Schedule

Day	Hours	Primary Task	Who	Deliverable
1	8 hrs	Strongback: join MDF, set on horses, level, mark centerline + all 37 stations	Lead Builder + Assembler + 1 helper	Strongback complete, QC Gate passed
2	8 hrs	AM: Cut foam layers for Stations A–J. PM: Laminate (glue + weight) A–J blocks	Foam Cutter + Assembler (cutting), Template Maker starts plotting templates A–E	All A–J blocks laminating under weights
3	8 hrs	AM: Cut + laminate Stations K–S. PM: Template Maker finishes all 19 templates. Verify A–J blocks cured	Foam Cutter + helper (cutting), Template Maker (templates)	All blocks laminating. Full template set ready
4	8 hrs	Knife cutting: Stations A–J panels (76 panels). Verify each against template. Glue into blocks	Foam Cutter (cutting), QC Checker (verifying)	19 station blocks cut, glued, curing
5	8 hrs	AM: Knife cutting: Stations K–S panels (64 panels), glue into blocks. PM: Begin mold assembly — mount A, B/B’, C/C’ through J/J’	Foam Cutter (AM), Lead Builder + Assembler (PM)	All 37 blocks cut and glued. Core assembly started
6	8 hrs	AM: Complete assembly (K–S stations). PM: Gap filling (spray foam + foam strips). Begin rough shaping	Lead Builder + Assembler (assembly), Fairer + helpers (gap filling)	Mold fully assembled, gaps filled, rough shape started
7	8 hrs	Surface fairing: 80-grit pass (full day — everyone sands). Bondo fills. Start 120-grit pass	Everyone	80-grit complete, Bondo applied, 120-grit started

Day	Hours	Primary Task	Who	Deliverable
8	6 hrs	AM: Finish 120-grit, do 220-grit pass. Batten test. Fix defects. PM: Vacuum, clean, apply 3 coats PVA mold release	Fairer + helpers (sanding), Lead Builder (PVA), QC Checker (batten test + final QC)	Mold complete. Final QC checklist signed. Ready for concrete

14.3 Daily Standup Format (5 minutes, start of each day)

1. **Yesterday:** What got done, any issues encountered
2. **Today:** What's planned, who's doing what
3. **Blockers:** Anything that could stop progress (missing materials, broken tools, schedule conflicts)
4. **QC update:** Any checks failed yesterday that need re-work today

14.4 Material Staging

Have these ready BEFORE Day 1:

- All 40 EPS foam sheets delivered and stored flat indoors
- MDF sheets for strongback
- 5 sawhorses available
- PL Premium adhesive (5 tubes)
- Utility knives (2+) with extra blades + serrated bread knife (12"+)
- All sandpaper (80/120/220 grit, 50 sheets total)
- Bondo (2 cans)
- Great Stuff Gaps & Cracks (3 cans)
- PVA mold release (1 quart)
- Masonite/plywood for templates
- All hand tools from Section 3

14.5 Contingency Time

The 8-day schedule has no slack. If something goes wrong (bad foam cut, delamination, weather delay), here's where to recover:

- **Overtime:** Extend Days 4–5 to 10-hour days to catch up on cutting.
- **Compress fairing:** If the assembly is very clean, fairing may only take 8–10 hours instead of 12–16. This gives back half a day.
- **Skip Day 8 afternoon:** PVA application can be done on the morning of concrete day (Day 9 in the v3 schedule) if needed. Three coats take ~5 hours including drying. Start at 6 AM, concrete at 11 AM.
- **Critical path:** Foam lamination cure time (24 hours) cannot be compressed. If blocks aren't laminated by end of Day 3, everything shifts.

Appendix: Quick Reference Card

Print this and tape it to the wall of the workshop.

HULL: 216" × 32" × 18.5" × 0.5" wall
STATIONS: 19 unique (A-S), 37 pieces, 6" spacing
FOAM: 1.5" EPS, 4 panels = 6" block (cut before gluing)
MOLD LENGTH: 222" (37 blocks × 6"), 3" flanges each end
CUTTING: Utility knife (straight) + bread knife (curves)
ADHESIVE: PL Premium polyurethane (1/4" bead, 24 hr cure)
GAP FILL: Great Stuff Gaps & Cracks (NOT Big Gap)
SANDING: 80 → Bondo → 120 → 220
BATTEN TEST: 1/4"×1"×96" pine, max gap 1/16"
PVA RELEASE: 3 coats, alternate direction, dry between

TOLERANCES:

Strongback level: ±1/8" over 19'
Template accuracy: ±1/4"
Symmetry: ±1/8" (centerline to each side)
Batten test: 1/16" gap

CRITICAL NUMBERS:

Midship (A): 32.00" beam, 18.50" depth
Station E: 30.46" beam, 18.50" depth
Station J: 24.12" beam, 18.07" depth
Station O: 12.80" beam, 17.05" depth
Station S: ~0" beam, 7.50" depth (tip)

NAU ASCE Concrete Canoe Team 2026 — PLUTO JACKS Design A: 216" × 32" × 18.5" — Mold Construction Manual v1.0 Built from SolidWorks CAD geometry, scaled to 32" beam (GM = 8.07")

SECTION 8

Construction Guide — Days 9-21 (Concrete, Curing, Finishing)

0 pages follow

NAU Concrete Canoe 2026 — Construction Guide v3

PLUTO JACKS | Design A: 216" x 32" x 18.5" x 0.5"

Document Version: 3.0 (Feb 21, 2026) **Source Geometry:** SolidWorks construction drawings (19-station lines plan) **Mix Design:** Mix 3 (Optimized, 58.6 PCF, 1,774 psi predicted @ 28d)

DIMENSION AUDIT — Old Calculator vs Actual CAD

Before building anything, here's an honest comparison of what was in the Python calculator vs what your teammate actually drew in SolidWorks:

Parameter	Old Calculator	SolidWorks CAD	Delta	Impact
LOA	192" (16 ft)	216" (18 ft)	+24" (+12.5%)	Longer hull, more material needed
Beam	32"	32"	0" (0%)	Scaled from 31" CAD to 32" for optimal stability (GM=8.07")
Depth	17"	18.5"	+1.5" (+8.8%)	More freeboard, better stability
Wall Stations	0.5" 33 (interpolated)	0.5" 19 (A-S, from CAD)	Same Different	No change CAD stations are ground truth
Hull Form	Symmetric V assumed	U-to-V transition	Different	Midship is U-shaped, ends are V
Density	60 PCF (target)	58.6 PCF (Mix 3 actual)	-1.4	Lighter

What This Means

The old calculator was a *design tool* using simplified dimensions. The SolidWorks drawings are the *as-built geometry*. The CAD half-breadths have been scaled from 31" beam to **32" beam** (scale factor $16.0/15.5 = 1.032\times$) for optimal stability (GM = 8.07").

Calculator Results at Construction Dimensions (216" x 32" x 18.5" x 0.5")

Metric	@ 58.6 PCF	@ 60 PCF	ASCE Requirement	Status
Hull Weight	153.2 lbs	156.9 lbs	237 lbs	34% under limit
Freeboard	13.10"	13.07"	6.0"	+7.1" margin
GM (Stability)	8.07"	8.02"	6.0"	PASS (+2.07" margin)
Safety Factor	2.95	2.93	2.0	PASS
Overall	PASS ALL	PASS ALL		

Hull lines plan — profile and plan view of 216” hull

Figure 1: Hull lines plan — profile and plan view of 216” hull

Design Decision: 32” Beam

The SolidWorks CAD originally drew a 31” beam. Scaling to 32” (a 3.2% increase in half-breadths) improves GM from 6.73” to 8.07” — a 1.34” stability margin gain — at a cost of only ~2.5 lbs additional hull weight. This tradeoff is unambiguously favorable.

STATION OFFSET TABLE — Scaled to 32” Beam

Scaled from SolidWorks CAD (31” beam) to 32” beam. Scale factor on half-breadths: $16.0 / 15.5 = 1.032\times$. Depths unchanged.

Station	Position (in)	Half-Breadth (in)	Full Beam (in)	Depth (in)	Shape
A-A (mid-ship)	0	16.00	32.00	18.50	Wide U, flattest bottom
B-B	6	15.95	31.90	18.50	Nearly identical to midship
C-C	12	15.81	31.62	18.50	Slight narrowing
D-D	18	15.57	31.14	18.50	Gentle taper begins
E-E	24	15.23	30.46	18.50	Continued taper
F-F	30	14.80	29.60	18.48	Depth starts decreasing
G-G	36	14.26	28.52	18.41	V-shape developing
H-H	42	13.63	27.26	18.32	Clear V-bottom emerging
I-I	48	12.89	25.78	18.20	Transitional U-to-V
J-J	54	12.06	24.12	18.07	More pronounced V
K-K	60	11.13	22.26	17.91	V-shape dominant

Station	Position (in)	Half-Breadth (in)	Full Beam (in)	Depth (in)	Shape
L-L	66	10.11	20.22	17.73	Narrow V
M-M	72	8.97	17.94	17.52	Sharp V, narrow
N-N	78	7.73	15.46	17.30	Very narrow
O-O	84	6.40	12.80	17.05	Near-bow section
P-P	90	4.96	9.92	16.79	Fine entry
Q-Q	96	3.42	6.84	16.49	Almost keel-only
R-R	102	1.77	3.54	15.48	Vestigial width
S-S (tip)	108	~0	~0	7.50	Keel point only

Notes: - Position is measured from midship (Station A) outward toward bow/stern - Hull is symmetric: bow shape = stern shape - Total hull length = $2 \times 108'' = 216''$ (18 ft) - Station spacing: 6'' uniform from midship outward - Mold overall length = 222'' ($37 \times 6''$, includes 3'' flanges each end) - **For detailed mold construction instructions, see MOLD_CONSTRUCTION_MANUAL.md**

MATERIAL QUANTITIES — Updated for 216'' Hull

Concrete (Mix 3)

Ingredient	Per Cubic Yard (lbs)	Estimated for Hull*	Role
White Portland Cement (Type I)	97.21	~19.4	Early strength, binder
Slag Cement	149.21	~29.8	Long-term strength, durability
Fly Ash (Class F)	59.78	~12.0	Workability, cost
Hydrated Lime	9.72	~1.9	Plasticity
Poraver (1-2mm)	131.23	~26.2	Lightweight aggregate
Perlite (0.1-1mm)	88.22	~17.6	Void filler
K1 Glass Bubbles	38.89	~7.8	Strength/density
Master Fiber 150 (PVA)	4.34	~0.9	Crack resistance
Water (w/cm = 0.36)	~113.7	~22.7	Hydration
TOTAL	~692	~138	

*Hull concrete volume 0.20 yd³ (based on 150 lbs at 58.6 PCF = 2.56 ft³ = 0.095 yd³, plus 100% waste/overfill margin)

Admixtures: - MasterGlenium 7500 (HRWR): 6 fl oz per 100 lbs cementitious - MasterAir AE 200: 1.5 fl oz per 100 lbs cementitious

Per-Batch Recipe (5-Gallon Bucket, ~0.67 ft³)

Mix in small batches so it stays workable. Each batch covers roughly 15-20 ft² at 0.25" thick.

Ingredient	Amount per Batch	Measuring Method
Portland cement	3.1 lbs	Kitchen scale
Slag cement	4.8 lbs	Kitchen scale
Fly ash	1.9 lbs	Kitchen scale
Hydrated lime	0.3 lbs	Kitchen scale
Poraver (1-2mm)	4.2 lbs	Kitchen scale
Perlite	2.8 lbs	Kitchen scale
K1 Glass Bubbles	1.2 lbs	Kitchen scale
PVA fibers	0.1 lbs (1.6 oz)	Kitchen scale
Water	3.6 lbs (0.43 gal)	Measuring cup
HRWR	~0.4 fl oz	Syringe
AE 200	~0.1 fl oz	Syringe

Batch procedure: 1. Weigh all dry ingredients into bucket 2. Mix dry for 30 seconds with drill paddle 3. Add 80% of water + HRWR 4. Mix 2 minutes 5. Add remaining water + AE 200 6. Mix 1 minute 7. Add PVA fibers last, mix 30 seconds (don't overmix — breaks fibers)

Make 10-12 batches total. Some will be wasted.

Mold Materials

Item	Qty	Cost	Notes
EPS foam sheets (1.5" x 48" x 96", 2 lb/ft ³)	40 sheets (cut into 160 panels, 24" x 48" each)	~\$1,120	Henry R-5.78, Home Depot. 148 panels needed, 12 spares.
MDF strongback (3/4" x 48" x 96")	3 sheets	~\$140	Rip to 36" wide, join end-to-end with splice plates for 228" total.
Construction adhesive (PL Premium)	5 tubes	\$38	Extra tube for longer hull
Spray foam (Great Stuff Gaps & Cracks)	3 cans	\$18	Gap filling between stations
Tuck Tape + spackle + primer	Assorted	\$38	Seam taping, skim coat, surface seal
All-thread rod + hardware (3/8")	5 rods + nuts/washers	\$38	Alignment rods through indexing holes
Masonite/plywood for templates	Sheets	\$30	1/8" tempered hardboard
PVA mold release agent	1 quart	\$25	Partall PVA No. 10
Sandpaper (80/120/220 grit)	50 sheets	\$40	
Bondo / spackle	2 cans	\$25	Surface fairing

Mold assembly sequence — from strongback to faired surface

Figure 2: Mold assembly sequence — from strongback to faired surface

Item	Qty	Cost	Notes
Misc (Sharpies, tape, chalk, screws)	Assorted	\$10	
Basalt fiber mesh (4 oz/yd ² , 40" wide)	7 yards	\$140	Reinforcement for hull
Subtotal (mold)		~\$1,522	
Subtotal (concrete + materials)		~\$580	
TOTAL		~\$2,102	

CONSTRUCTION STEPS — 21-Day Build

STEP 1: Build the Strongback (Days 1-2)

The strongback is a flat, rigid table that supports the mold. It must be straight and level.

For 216" hull (222" mold):

1. Get three MDF sheets (3/4" x 48" x 96"). Rip to 36" wide, join end-to-end with plywood splice plates for 228" total (222" mold + overhang).
2. Set on 5 sawhorses spaced evenly (~44" apart). Top should be at waist height (~36").
3. Level it using a long level or string line. Shim sawhorses until dead flat. **Tolerance: ±1/8" over full length.**
4. Snap a chalk centerline at 18" from each edge.
5. Mark station locations from one end:

Station	Distance from Bow End	Notes
S (bow tip)	3" (flange)	Mold starts here
R	9"	
Q	15"	
P	21"	
O	27"	
N	33"	
M	39"	
L	45"	
K	51"	
J	57"	
I	63"	
H	69"	
G	75"	
F	81"	
E	87"	
D	93"	
C	99"	
B	105"	
A (midship)	111"	Center of mold
B'	117"	Mirror
C'	123"	Mirror

Station	Distance from Bow End	Notes
...
S' (stern tip)	219"	

The mold is symmetric about Station A (midship). Stations B through S repeat on both sides.

QC Gate 1: - [] Strongback level within 1/8" over 19' - [] Centerline straight - [] All 37 station marks accurate (19 + 18 mirror)

STEP 2: Make Templates & Cut Foam Sections (Days 2-5)

You need 19 unique templates (A through S). Since the hull is symmetric, stations on the bow side and stern side use the same template.

Template dimensions (from SolidWorks offset table):

For each station, cut a foam block with a U/V-shaped trough carved into the top. The trough is the *negative* of the hull cross-section.

Template	Block Width (in)	Trough Width at Top (in)	Trough Depth (in)	Shape of Trough
A (midship)	36	32.00	18.50	Wide U
B	36	31.90	18.50	Wide U
C	36	31.62	18.50	Wide U
D	36	31.14	18.50	U
E	35	30.46	18.50	U
F	34	29.60	18.48	U-to-V
G	33	28.52	18.41	V developing
H	32	27.26	18.32	V
I	30	25.78	18.20	V
J	28	24.12	18.07	V
K	27	22.26	17.91	V
L	24	20.22	17.73	V
M	22	17.94	17.52	Sharp V
N	20	15.46	17.30	Sharp V
O	17	12.80	17.05	Narrow V
P	14	9.92	16.79	Narrow V
Q	11	6.84	16.49	Keel
R	8	3.54	15.48	Keel
S (tip)	5	~0	7.50	Point

Block width = trough width + 4" (2" margin each side).

Cutting procedure (panel-and-glue method):

Each mold block is built from four individually cut 1.5" foam panels glued face-to-face into a 6" block ($4 \times 1.5" = 6"$). This eliminates the need for any special cutting equipment — one person can cut each panel with a utility knife or bread knife.

1. **Make Masonite templates** for all 19 stations (A through S). Draw the cross-section on Masonite using the half-breadth and depth values. The profile is a V-bottom with rounded bilge transitioning to vertical sides.

2. **Cut 48"×96" foam sheets into 4 equal 24"×48" panels** (straight cuts). This yields 4 panels per sheet.
3. **Trace the Masonite template** onto each 1.5" panel and cut the cross-section profile with a utility knife or bread knife. One person can do this — no special equipment needed.
4. **The trough is the NEGATIVE shape** — you're cutting the hull profile OUT of each panel.
5. **Glue 4 cut panels face-to-face** with PL Premium to form a 6" block (3 glue joints per block). Clamp or weight while adhesive sets (2-4 hours).
6. Repeat for all 4 panels needed for each station block.
7. Label every block on both faces with Sharpie.

Sheet & panel count: - 40 sheets × 4 panels per sheet = 160 panels total - 37 blocks × 4 panels per block = 148 panels needed - 12 spare panels for mistakes/re-cuts

You need: - 1 x Station A (midship, used once at center) - 2 each of Stations B through S (one for each side of midship) - **Total: 37 foam blocks (148 panels), 222" mold length, 3" flanges each end**

QC Gate 2: - [] All 19 unique templates match CAD dimensions within 1/4" - [] Midship (A) is exactly 32.00" wide at trough top - [] Sections get progressively narrower from A to S - [] Glued 6" blocks are solid (no delamination between panels)

STEP 3: Assemble the Mold (Days 5-7)

1. **Start at midship (Station A):** Center on strongback at the 111" mark. Glue bottom with PL Premium. Screw through bottom into MDF.
2. **Work outward:** Install B and B' next (one on each side), then C/C', etc. Each one:
 - Exactly 6" from adjacent station (face-to-face)
 - Centered on the chalk centerline
 - Level with tops of adjacent sections
3. **Near the tips (Q, R, S):** Station spacing remains 6" uniform. These blocks are small — handle with care during assembly.
4. **All-thread rod alignment:** Drill 5 indexing holes through each block using template jig. Thread 3/8" all-thread rods through all blocks for precise alignment. Secure with nuts + washers.
5. **Glue between sections** with PL Premium. Clamp or weight while glue sets (2-4 hours).
6. **Fill gaps between sections:** Use spray foam (Great Stuff), then carve flush with a surform rasp. Or glue foam strips and carve.
7. **Fair the surface** — This is the most critical and time-consuming step:
 - Surform rasp to knock down high spots
 - Long sanding board (2' straightedge + sandpaper) to check fairness
 - Work from 80 grit to 120 grit to 220 grit
 - The trough surface must be smooth with zero bumps between sections
 - Lay a flexible batten along the surface — max 1/16" gap anywhere
 - Fill dips with Bondo or spackle

QC Gate 3: - [] All sections firmly attached, no wobble - [] Surface is fair — batten test passes (< 1/16" gaps) - [] Interior dimensions: 216" long, 32" wide at midship, 18.5" deep - [] Symmetric — measure beam on both sides of centerline at every station

STEP 4: Prepare Mold Surface (Day 8)

If you skip this, the concrete sticks to the foam and the canoe breaks during demolding.

1. Final sand with 220 grit over entire interior. Vacuum all dust.
2. **PVA mold release — Coat 1:** Thin, even coat over entire trough surface with foam brush. Let dry 1-2 hours until clear/glossy. Don't touch with bare hands.

3. **PVA mold release — Coat 2:** Perpendicular direction to first coat. Dry 1-2 hours.
4. **Coat 3 (recommended for first build):** Extra insurance.

QC Gate 4: - Surface uniformly glossy - No dry spots, fingerprints, or smudges - Release agent extends to top edges (gunwale area)

STEP 5: Cut & Dry-Fit Reinforcement (Day 9)

Material: Basalt fiber mesh, 4 oz/yd², 40” wide roll.

1. **Pre-cut mesh pieces:**
 - Hull is 216” long. Cut 2-3 pieces each ~222” long (allow overlap).
 - At 40” wide, each piece covers the trough width from gunwale to gunwale at midship (32” + some overlap up the sides).
 - Overlap between pieces: minimum 3” in all directions.
2. **Dry-fit into mold:** Lay mesh into trough WITHOUT concrete. Make sure it conforms to shape.
3. **Relief cuts:** At bow/stern where the trough narrows, the mesh bunches up. Make small darts (cuts) so it lies flat. Overlap cut edges by 2”.
4. **Remove and set aside.**

QC Gate 5: - Mesh covers entire trough interior - No gaps > 1” between pieces - Overlaps 3” everywhere - Mesh lies flat, no severe bunching

STEP 6: Mix & Apply Concrete — First Lift (Day 10)

TEST BATCH FIRST. Mix one batch (Step per “Per-Batch Recipe” above), make a test panel on scrap, and verify: - Workability: Spreads with trowel but not runny - Set time: Workable for 45+ minutes - Consistency: Same every batch

First Lift Application:

1. Mix in 5-gallon buckets, 2 gallons at a time. Use drill with mixing paddle.
2. Start at bottom center of trough, midship area. Work toward bow and stern.
3. **Target thickness: 0.20” (5mm).** Use a marked gauge stick (Popsicle stick with a line at 0.20”).
4. Work up the sides. Concrete will sag — apply thin, let it tack up before adding more.
5. Press firmly with trowel to eliminate air bubbles. Work in one direction.
6. **While first lift is still wet/tacky,** lay the pre-cut basalt mesh into it. Press gently so it’s embedded but not pushed to the mold surface.
7. Use a roller or trowel to press mesh into concrete. You should see concrete squeezing through the weave.

QC Gate 6: - First lift covers entire trough interior - Thickness approximately 0.20” (check with gauge every 2 feet) - Mesh fully embedded in first lift - No dry spots or areas where mesh doesn’t contact concrete - No visible large air bubbles

STEP 7: Apply Concrete — Second Lift (Day 10-11)

Timing: Apply while first lift is still wet or “green” (firm but not hard). Ideally within 2-4 hours. If overnight, mist surface with water first.

1. Mix fresh concrete — same recipe.
2. Apply over the mesh from bottom up. **Target: 0.30” (7-8mm).**
3. **Total wall = 0.50”** (Lift 1: 0.20” + mesh + Lift 2: 0.30”).
4. Smooth inner surface with flexible steel trowel dampened with water.

5. **Build up gunwales:** Add extra concrete along top rim for 0.625"-0.75" total thickness.
6. After 30-60 min, do a final trowel pass — firm pressure, long smooth strokes.

QC Gate 7: - Total wall thickness ~0.50" everywhere (check with gauge at 10+ locations) - Gunwales 0.625"-0.75" thick - Inner surface smooth and even - No exposed mesh fibers on inner surface - No cracks or separation between lifts

STEP 8: Curing (Days 11-18)

Concrete gains strength through hydration. If it dries out, it becomes weak and cracks.

Standard Curing:

Day	Action
0 (placement)	Wait 2-4 hours until surface firm to light touch
0 + 4 hrs	Mist surface with spray bottles. Cover with 6-mil plastic sheeting.
1-7	Mist morning + evening. Keep surface damp. Plastic stays on.
7	Remove plastic, inspect surface.
7-10	Optional: continue mist curing for extra strength.

Environment: - Temperature: 65-75 degrees F (CRITICAL). Don't let it freeze. Don't bake in sun. - Humidity: Keep 85% under the plastic - Don't touch, poke, bump, or move the mold during cure

CO2 Curing (Optional — Big Advantage If Available):

If you have access to CO2 (e.g., professor's carbon capture system):

1. Build a simple enclosure: 4x4 lumber frame around the mold + 6-mil plastic on all sides
2. CO2 inlet tube at bottom, outlet hole at top (NOT airtight — need humidity + O2)
3. Start CO2 at Day 1-2 after casting
4. Duration: 24-48 hours continuous OR 2-3 hours daily for 5-7 days
5. CO2 concentration: 0.5-1.0% by volume
6. Maintain 70-90% humidity, 65-75 degrees F
7. Continue standard mist curing after CO2 phase

CO2 benefit: Achieves 28-day strength in ~14 days. Hull becomes self-supporting faster, safer to demold.

Timeline	Without CO2	With CO2
7-day strength	273 psi	400-500 psi
14-day strength	800-900 psi	1,100-1,300 psi
28-day strength	1,774 psi	1,900-2,000 psi
Competition-ready	April 7 (tight)	March 7 (comfortable)

QC Gate 8: - Plastic sealed entire cure period - Surface never dried out - Temperature stayed 60-80 degrees F - Nobody bumped or moved the mold - Day 7: no visible cracks

STEP 9: Demolding (Day 19)

You need minimum 6 people. Schedule in advance.

1. Prepare landing zone: padded area with foam blocks + moving blankets.

2. Set entire mold + canoe on the ground (on padding).
3. Start peeling foam from the outside at bow or stern (smallest sections first).
4. Use putty knife to work between foam and concrete. PVA release should let foam separate cleanly.
5. Work progressively toward midship. Don't rush. If stuck, use more putty knife work or a rubber mallet (gentle taps).
6. For stubborn spots: low-heat heat gun softens foam. Or score foam with utility knife and peel in pieces.
7. Once all foam removed, flip canoe right-side-up with 6-person team. Lift simultaneously, support the middle — don't let it flex.
8. Clean outer surface with plastic scraper. Acetone dissolves stubborn EPS residue (test small area first).

QC Gate 9: - [] Canoe out of mold in one piece — no cracks - [] Outer surface smooth (female mold advantage) - [] No structural damage from demolding - [] Sits level on cradle - [] Wall thickness uniform (check with calipers at 10+ points)

STEP 10: Finishing (Days 19-21)

Surface Prep: 1. Sand inner surface: 120 grit (knock down trowel marks) then 220 grit. Wet sanding preferred. 2. Sand outer surface: Light 220 grit only (should already be smooth from mold). 3. Fill pinholes/voids with thin cement paste (cement + water + acrylic admixture). 4. Round gunwale edges with 120 grit — prevents chipping, feels better to hold.

Sealing: 1. Apply penetrating concrete sealer to entire exterior. Brush/roller. Soak 15 min, wipe excess. 2. Second coat: 24 hours later. 3. Seal interior too — prevents water absorption (weight gain during races).

Graphics & Branding: 1. Painter's tape to mask areas for team logo, "PLUTO JACKS", NAU branding. 2. Acrylic latex paint — multiple thin coats, not one thick coat. 3. Optional clear coat spray over graphics for durability.

WEIGHT TRACKING LOG

CRITICAL: Weigh at every phase. If actual weight exceeds 207 lbs (237 limit - 30 lb margin), stop and reassess.

Phase	Date	Measured Weight (lbs)	Expected (lbs)	Pass?	Notes
Mold complete (empty)	//____	_____	0 (mold only)	N/A	
After Lift 1 + mesh	//____	_____	~60-70		
After Lift 2	//____	_____	~140-155		Target: 150 lbs
After curing (Day 18)	//____	_____	~145-155		Water loss during cure
After de-molding	//____	_____	~145-155		Foam residue removed
After finishing/sealing	//____	_____	~148-158		Sealer adds 1-3 lbs

Phase	Date	Measured Weight (lbs)	Expected (lbs)	Pass?	Notes
Final weight	//____	_____	155		Must be 237

If over 190 lbs: Investigate — wall too thick somewhere? Extra concrete in gunwales? **If over 207 lbs:** Extended CO2 curing (removes water weight), or reduce gunwale thickness. **If over 237 lbs:** Does not pass ASCE. Redesign required.

QC TESTING PROTOCOL

Cylinder Breaks

Cast test cylinders alongside the hull. These verify your actual concrete strength matches predictions.

Sample	Cylinders	Test Date	Expected Result	Action if Fail
7-day	3 cylinders (4"x8")	Day 17	250 psi (wet)	Don't panic — slag is slow. Wait for 14d.
14-day	3 cylinders	Day 24	800 psi (wet)	If <750, extend cure. Consider CO2.
28-day	3 cylinders	Day 38	1,500 psi	If fail, consult Dr. Lamer.

Cylinder procedure: - Cast in ASTM C31 standard 4"x8" cylinder molds - Cure alongside the hull (same conditions) - Test per ASTM C39 (compression) - Record peak load, failure mode, specimen condition (wet/dry)

Density Check

- Weigh a cured sample of known volume (e.g., the test panel from Step 6)
- Target: 55-65 PCF
- If >65 PCF: aggregate proportions may be off (too much cement, not enough Poraver)
- If <50 PCF: may be too porous (check air content)

Thickness Measurement

After demolding, measure wall thickness at 20+ points with calipers: - 5 points along keel (bottom centerline) - 5 points each side at waterline height - 5 points each at gunwale

Target: 0.50" ± 0.05" everywhere, 0.625"-0.75" at gunwales.

FLOAT TEST PROTOCOL

After finishing:

1. **Weigh the canoe** (should be ~150 lbs)
2. **Fill a pool or pond** (or use a water tank)
3. **Carefully set canoe in water** with 2 people (one each end)
4. **Measure empty draft:** Should be ~2-3" (hull sits very high)
5. **Measure empty freeboard:** Should be ~16"+ (the full 18.5" depth minus draft)
6. **Load incrementally:**

- Add 175 lbs (1 paddler equivalent) — measure draft and freeboard
 - Add 350 lbs (2 paddlers) — measure again
 - Add 525 lbs (3 paddlers)
 - Add 700 lbs (4 paddlers) — **this is the design load**
7. **At 700 lbs crew load:**
- Expected draft: ~5.6”
 - Expected freeboard: ~12.9” (must be 6.0”)
 - Canoe should be level (not listing to one side)
8. **Stability test:** Have someone carefully rock the canoe side-to-side. It should resist tipping and self-right. If it feels tippy, crew COG is too high.
9. **Document everything:** Photos and video for ASCE presentation.

21-DAY BUILD TIMELINE

Day	Phase	Tasks	Duration	QC Gate
1	Strongback	Build MDF spine, level, mark stations	8 hrs	Gate 1
2	Strongback + Templates	Finish strongback, start Masonite templates	8 hrs	
3	Foam Cutting	Cut panels for stations A-J (4 panels each), glue into 6” blocks	8 hrs	
4	Foam Cutting	Cut panels for stations K-S, glue blocks, label all pieces	8 hrs	Gate 2
5	Mold Assembly	Install midship (A), work outward to J/J’	8 hrs	
6	Mold Assembly	Install K-S and mirrors, glue, fill gaps	8 hrs	
7	Surface Fairing	Rasp, sand (80-120-220), fill voids	8 hrs	Gate 3
8	Mold Release	Final 220-grit sand, apply 3 coats PVA	6 hrs	Gate 4
9	Mesh Prep	Cut and dry-fit basalt mesh	4 hrs	Gate 5
10	CONCRETE DAY	Mix, apply Lift 1, embed mesh, apply Lift 2	10 hrs	Gates 6 & 7
11	Cure Day 1	Mist + cover plastic. Cast test cylinders.	1 hr	

Day	Phase	Tasks	Duration	QC Gate
12-16	Cure Days 2-6	Mist 2x daily. (CO2 curing if available)	30 min/day	
17	Cure Day 7	Remove plastic. 7-day cylinder break test.	2 hrs	Gate 8
18	Cure Day 8	Optional extra cure day.	30 min	
19	DEMOLD DAY	6-person team. Peel foam, flip, clean.	6 hrs	Gate 9
20	Finishing	Sand, fill, seal (coat 1), weigh	8 hrs	
21	Finishing	Seal (coat 2), graphics, float test	8 hrs	Final QC

Critical path: Day 10 (concrete day) is the single most important day. Have all materials staged, all team members present, all tools ready. No interruptions.

TROUBLESHOOTING

Problem	Likely Cause	Fix
Concrete sticks to mold	Insufficient PVA release	Heat gun to soften foam. Apply more coats next time.
Cracks during curing	Dried out too fast	Mist immediately, re-cover. Seal cracks with cement slurry.
Canoe too heavy	Wall too thick or concrete too dense	Sand down thick spots. Check density on test panel.
Canoe too light/fragile	Wall too thin	Patch with additional mesh + concrete.
Surface rough/bumpy	Poor mold fairness	Extensive sanding. Fill with cement paste.
Uneven wall thickness	Inconsistent application	Measure more frequently during application.
Warping after demolding	Uneven curing or demolding stress	Support in cradle 24-48 hrs. May self-correct.

Problem	Likely Cause	Fix
Concrete won't spread	Mix too dry	Add HRWR in small increments. Do NOT just add water (weakens it).
Concrete slumps off sides	Mix too wet	Let first layer tack up before adding more.

SAFETY

1. **Cement is caustic:** Latex/nitrile gloves ALWAYS with wet concrete. Skin contact = chemical burns. Wash with vinegar then water immediately.
2. **Dust kills lungs:** N95 mask when mixing dry cement or sanding cured concrete. Work outdoors or with ventilation.
3. **Foam cutting fumes:** If using a hot wire cutter (optional), EPS produces styrene fumes. Do it outside or with fan. Knife cutting produces no fumes.
4. **CO2 curing hazard:** CO2 displaces oxygen. NEVER enter the curing enclosure. Ventilate before opening. Use a CO2 monitor.
5. **Heavy lifting:** Canoe weighs 150+ lbs. ALWAYS lift with a team. Bend at knees. 6 people minimum for demolding.
6. **Power tools:** Eye protection + hearing protection when sanding. Keep cords away from water.

SUMMARY OF KEY NUMBERS

Parameter	Value	Source
LOA	216" (18 ft)	SolidWorks CAD
Max Beam	32.00"	SolidWorks scaled (2 × 16.00" half-breadth)
Max Depth	18.50"	SolidWorks (Station A)
Wall Thickness	0.50"	Design spec
Hull Weight (calculated)	153.2 lbs @ 58.6 PCF	Calculator v2.2 (32" beam)
Hull Weight (budget)	155 lbs (target)	With sealer + finishing
ASCE Weight Limit	237 lbs	ASCE 2026 Rules
Freeboard (loaded)	13.10"	Calculator (6.0" required)
GM (stability)	8.07"	Calculator (6.0" required)
Safety Factor	2.95	Calculator (2.0 required)
Mix Density	58.6 PCF	Mix 3 tested
28-day Strength	1,774 psi (predicted)	Mix 3 analysis
Crew Load	700 lbs (4 x 175)	ASCE 2026 Rules
Stations	19 (A through S)	SolidWorks
Mold Length	222" (37 × 6", hull + 3" flange each end)	SolidWorks
Build Time	21 days	This schedule
Budget	~\$2,102	Materials estimate

NAU ASCE Concrete Canoe Team 2026 — PLUTO JACKS Design A: 216" x 32" x 18.5" — Target Weight: 153 lbs Construction Guide v3 — Built from SolidWorks CAD geometry

SECTION 9

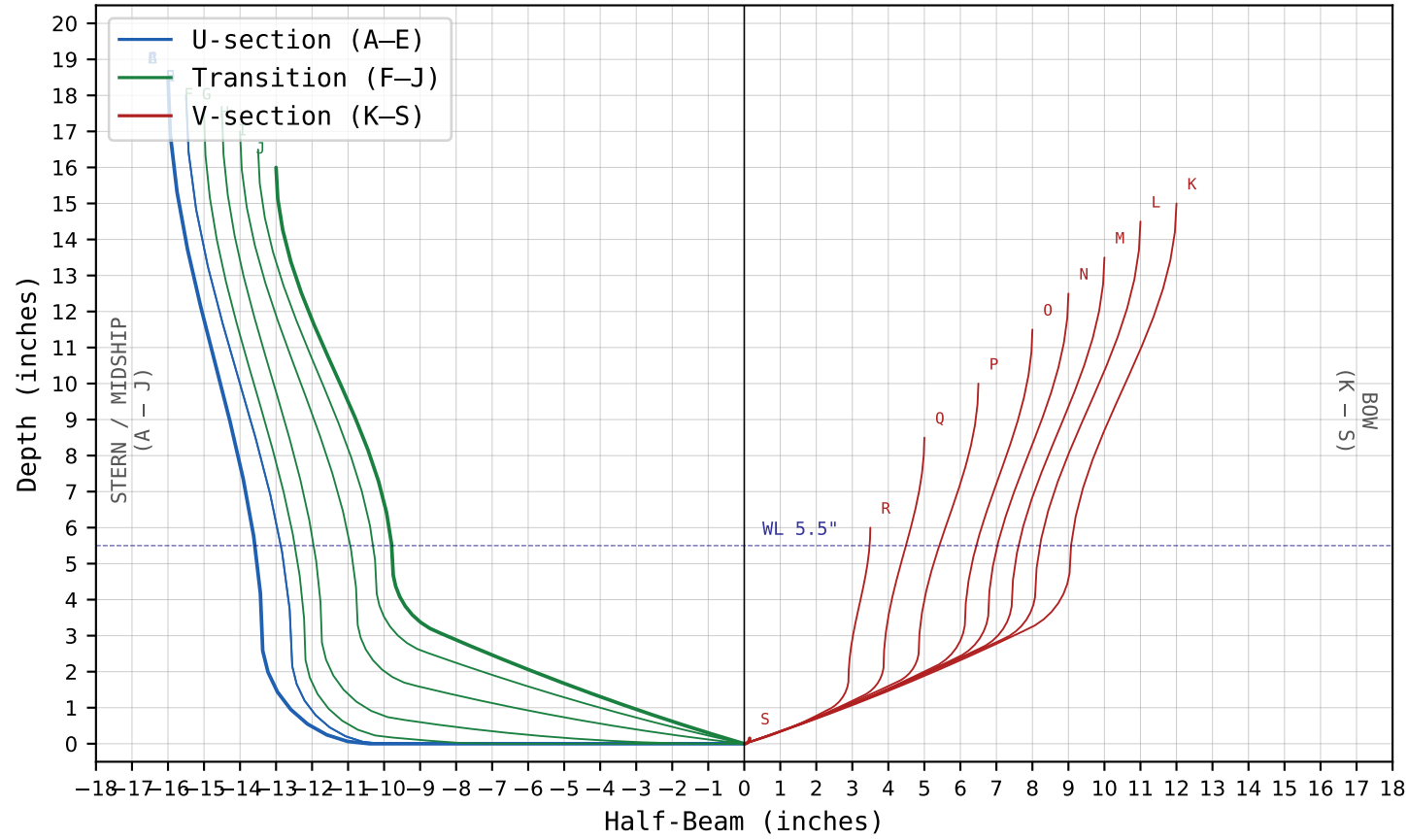
Cross-Section Drawings — Detailed Section Views

0 pages follow

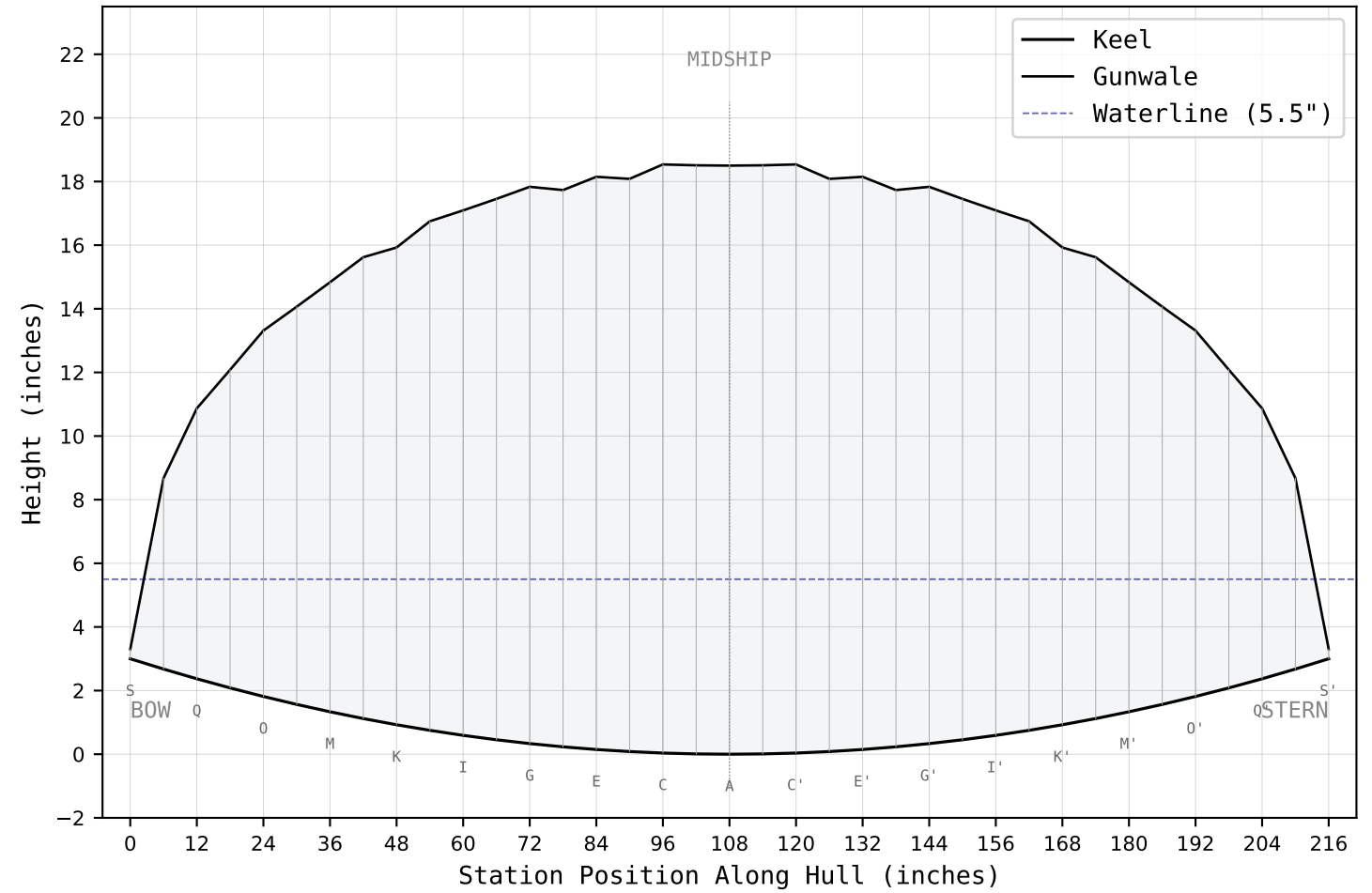
NAU ASCE Concrete Canoe 2026

PLUTO JACKS – Design A

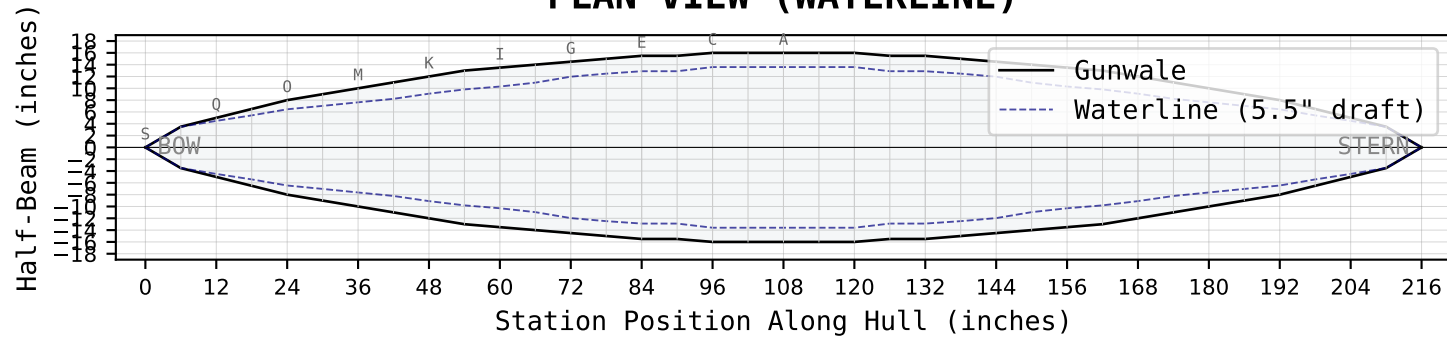
BODY PLAN – Design A (216" × 32" × 18.5")



PROFILE VIEW



PLAN VIEW (WATERLINE)



STATION DIMENSIONS TABLE

Station	Offset (in)	Beam (in)	Depth (in)	PLC Bottom (in)	Cadrise (°)	Rocker (in)	Bilge R (in)
A	0.0	32.0	18.5	10.0	0	0.00	3.0
B	6.0	32.0	18.5	9.0	0	0.01	3.0
C	12.0	32.0	18.5	8.0	0	0.04	3.0
D	18.0	31.0	18.0	6.0	0	0.08	2.5
E	24.0	31.0	18.0	4.0	0	0.15	2.5
F	30.0	30.0	17.5	1.0	1	0.23	2.5
G	36.0	29.0	17.5	0.0	4	0.33	2.5
H	42.0	28.0	17.0	0.0	10	0.45	2.0
I	48.0	27.0	16.5	0.0	16	0.59	2.0
J	54.0	26.0	16.0	0.0	20	0.75	2.0
K	60.0	24.0	15.0	0.0	22	0.93	2.0
L	66.0	22.0	14.5	0.0	22	1.12	1.5
M	72.0	20.0	13.5	0.0	22	1.33	1.5
N	78.0	18.0	12.5	0.0	22	1.56	1.5
O	84.0	16.0	11.5	0.0	22	1.81	1.5
P	90.0	13.0	10.0	0.0	22	2.08	1.0
Q	96.0	10.0	8.5	0.0	22	2.37	1.0
R	102.0	7.0	6.0	0.0	22	2.68	1.0
S	108.0	0.0	0.3	0.0	22	3.00	0.9

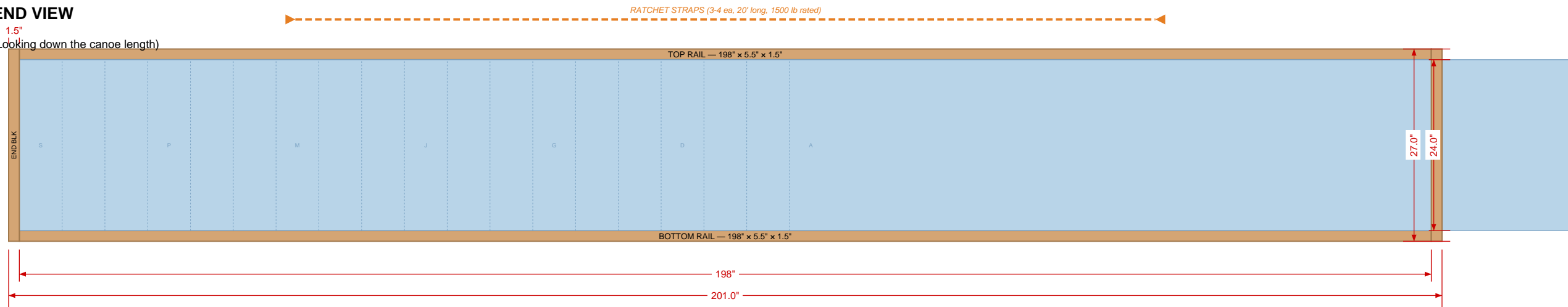
SECTION 10

Clamping & Sanding Frame — Shop Drawing

2 pages follow

END VIEW

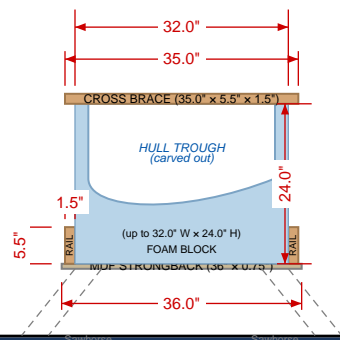
1.5"
(Looking down the canoe length)



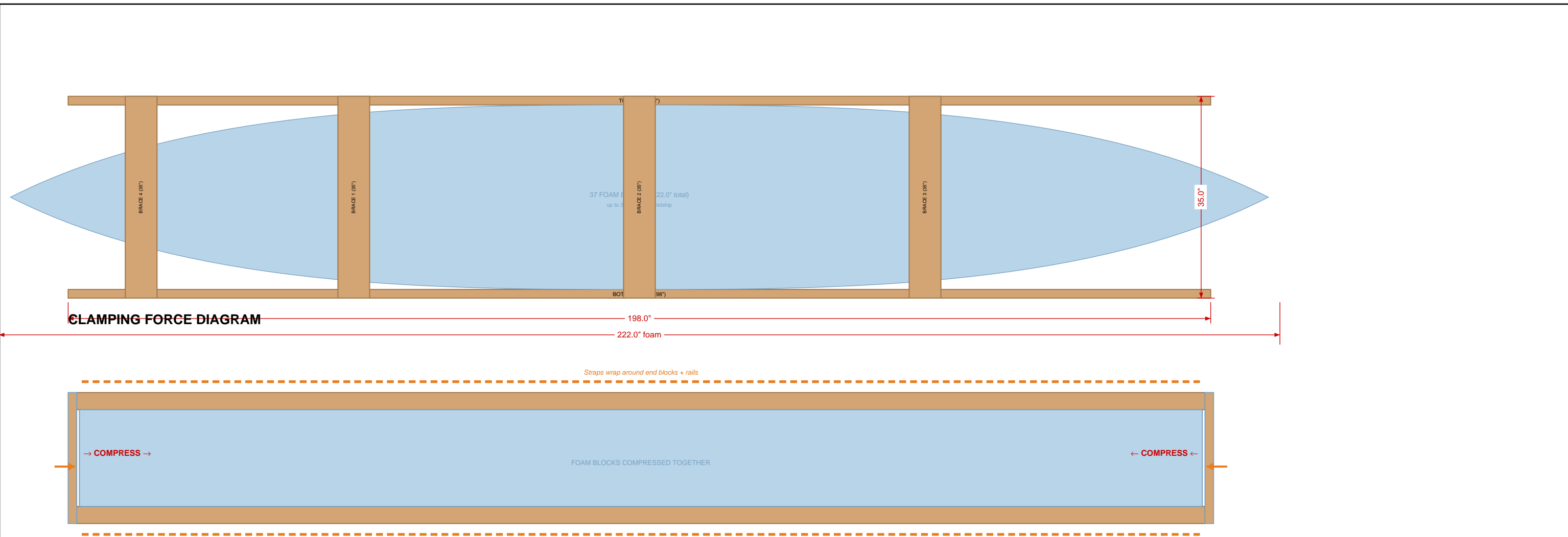
CUT LIST

Source Board	Piece	Length	Qty	Purpose
16.5' board #1	Top rail	198"	1	Upper lengthwise rail
16.5' board #2	Bottom rail	198"	1	Lower lengthwise rail
92.5" board #1	Cross brace	35"	2	Span across top of mold
	End piece	10"	1	Vertical end wall / clamp block
	(waste)	~12.5"	-	Shims / spacers
92.5" board #2	Cross brace	35"	2	Span across top of mold
	End piece	10"	1	Vertical end wall / clamp block
	(waste)	~12.5"	-	Shims / spacers
End clamping	End block	1.5"	2x2	Force distribution at ends

TOTALS: 2 rails (198") + 4 cross braces (35") + 2 end pieces (10") + 4 end blocks (1.5")



(Looking down at the frame from above)



ASSEMBLY SEQUENCE

1. **LAY RAILS** Place both 198" boards flat. Mark center (99") and quarter points (49.5", 148.5").
2. **CUT PIECES** From each 92.5" board: 2x cross braces @ 35" + 1x end piece @ 10".
3. **BOTTOM FRAME** Set bottom rail on sawhorses. Screw cross braces at quarter points (2x 3" screws each).
4. **SET FOAM** Place MDF strongback on bottom rail. Stack 37 foam blocks with PL Premium adhesive.
5. **WAX PAPER** Line rails with wax paper/plastic so glue doesn't bond wood to foam.
6. **END BLOCKS** Place 1.5" end blocks against first and last foam blocks.
7. **TOP RAIL** Set top rail on foam, aligned with bottom. Screw top cross braces.
8. **CLAMP** Run 3-4 ratchet straps lengthwise around end blocks + rails. Tighten evenly.
9. **CURE 24H** Let PL Premium cure 24 hours under clamping pressure.
10. **SAND** Remove straps. Sand as one unit: Surform rasp → 80 → 120 → 220 grit.

HARDWARE & MATERIALS (NOT included in lumber)

- 4-6 ratchet straps, 20' long minimum, 1,500 lb rated
- 16x deck screws, 3" x #10 (cross brace connections)
- Wax paper or plastic sheet (between foam and rails — prevent glue bond)
- PL Premium polyurethane adhesive (foam-to-foam bonding)
- Carpenter's square (verify cross braces are 90° to rails)

IMPORTANT NOTES

1. Rails are 198" (24" shorter than 222" foam). Center rails; 12" of foam overhangs each end.
2. Overhanging bow/stern tips (Stations R, S) are small — hold with separate bar clamps if needed.
3. Cross braces sit ON TOP of rails (not flush). This keeps them above the foam for sanding clearance.
4. Tighten ratchet straps slowly and alternately to keep compression even — no bowing.
5. Frame doubles as sanding cradle — leave assembled after glue cure for fairing operations.