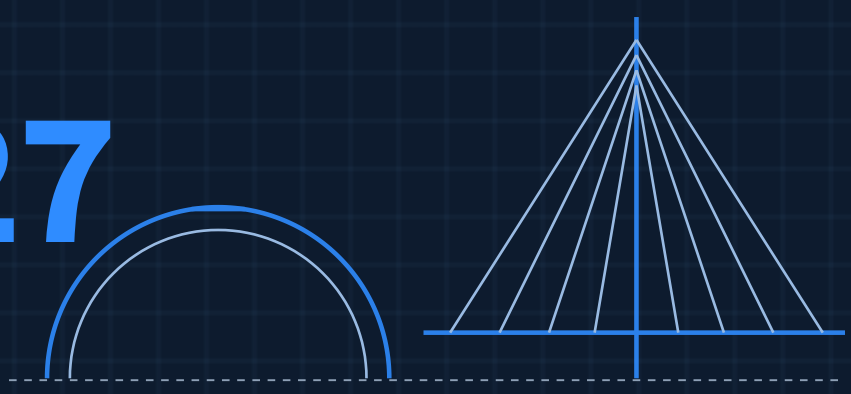
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TWELVE SHEETS, TABLOID 11 × 17 IN

Engineer's Calendar 2027

Twelve major structures. How the force travels, how each one is built, and what to watch for on the jobsite.



READ THE DRAWING

Each month draws one structure. The letters A, B, C follow the order the force travels or the work is built, and the notes use the same letters.

LEARN IT ON THE JOBSITE

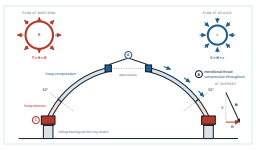
Every sheet ends with three jobsite lessons and one calculation to check yourself, the kind you can do with a pencil in the site trailer.

PLAN THE WEEK

Write in the ruled day boxes, or type on screen where notes stay in your browser. Switch on date alarms to color and flash key dates. Weeks start on Sunday; week 1 is the week that contains January 1. Federal holidays are shown, with the observed day when a holiday falls on a weekend.

January 01

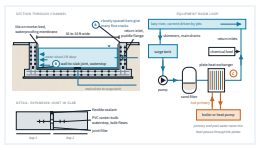
Dome rings



Wk	S	M	T	W	T	F	S
1						1	2
2	3	4	5	6	7	8	9
3	10	11	12	13	14	15	16
4	17	18	19	20	21	22	23
5	24	25	26	27	28	29	30
6	31						

February 02

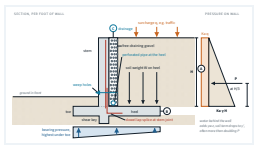
Heated lazy river



Wk	S	M	T	W	T	F	S
6		1	2	3	4	5	6
7	7	8	9	10	11	12	13
8	14	15	16	17	18	19	20
9	21	22	23	24	25	26	27
10	28						

March 03

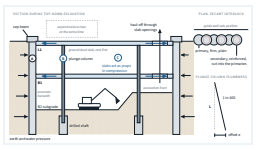
Cantilever retaining wall



Wk	S	M	T	W	T	F	S
10		1	2	3	4	5	6
11	7	8	9	10	11	12	13
12	14	15	16	17	18	19	20
13	21	22	23	24	25	26	27
14	28	29	30	31			

April 04

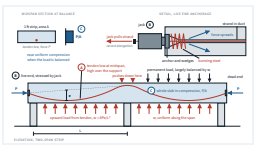
Top-down basement



Wk	S	M	T	W	T	F	S
14					1	2	3
15	4	5	6	7	8	9	10
16	11	12	13	14	15	16	17
17	18	19	20	21	22	23	24
18	25	26	27	28	29	30	

May 05

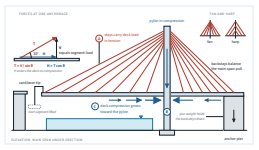
Post-tensioned slabs



Wk	S	M	T	W	T	F	S
18							1
19	2	3	4	5	6	7	8
20	9	10	11	12	13	14	15
21	16	17	18	19	20	21	22
22	23	24	25	26	27	28	29
23	30	31					

June 06

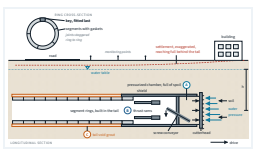
Cable-stayed bridges



Wk	S	M	T	W	T	F	S
23			1	2	3	4	5
24	6	7	8	9	10	11	12
25	13	14	15	16	17	18	19
26	20	21	22	23	24	25	26
27	27	28	29	30			

July 07

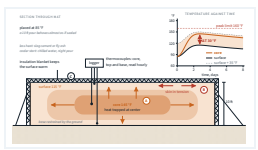
EPB tunnelling



Wk	S	M	T	W	T	F	S
27					1	2	3
28	4	5	6	7	8	9	10
29	11	12	13	14	15	16	17
30	18	19	20	21	22	23	24
31	25	26	27	28	29	30	31

August 08

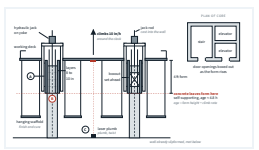
Mass concrete mat



Wk	S	M	T	W	T	F	S
32	1	2	3	4	5	6	7
33	8	9	10	11	12	13	14
34	15	16	17	18	19	20	21
35	22	23	24	25	26	27	28
36	29	30	31				

September 09

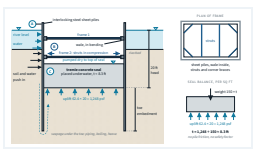
Slipformed core



Wk	S	M	T	W	T	F	S
36				1	2	3	4
37	5	6	7	8	9	10	11
38	12	13	14	15	16	17	18
39	19	20	21	22	23	24	25
40	26	27	28	29	30		

October 10

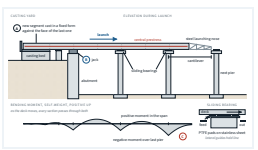
Sheet pile cofferdam



Wk	S	M	T	W	T	F	S
40						1	2
41	3	4	5	6	7	8	9
42	10	11	12	13	14	15	16
43	17	18	19	20	21	22	23
44	24	25	26	27	28	29	30
45	31						

November 11

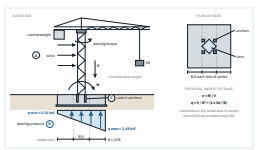
Incremental launching



Wk	S	M	T	W	T	F	S
45		1	2	3	4	5	6
46	7	8	9	10	11	12	13
47	14	15	16	17	18	19	20
48	21	22	23	24	25	26	27
49	28	29	30				

December 12

Tower crane foundation



Wk	S	M	T	W	T	F	S
49				1	2	3	4
50	5	6	7	8	9	10	11
51	12	13	14	15	16	17	18
52	19	20	21	22	23	24	25
53	26	27	28	29	30	31	

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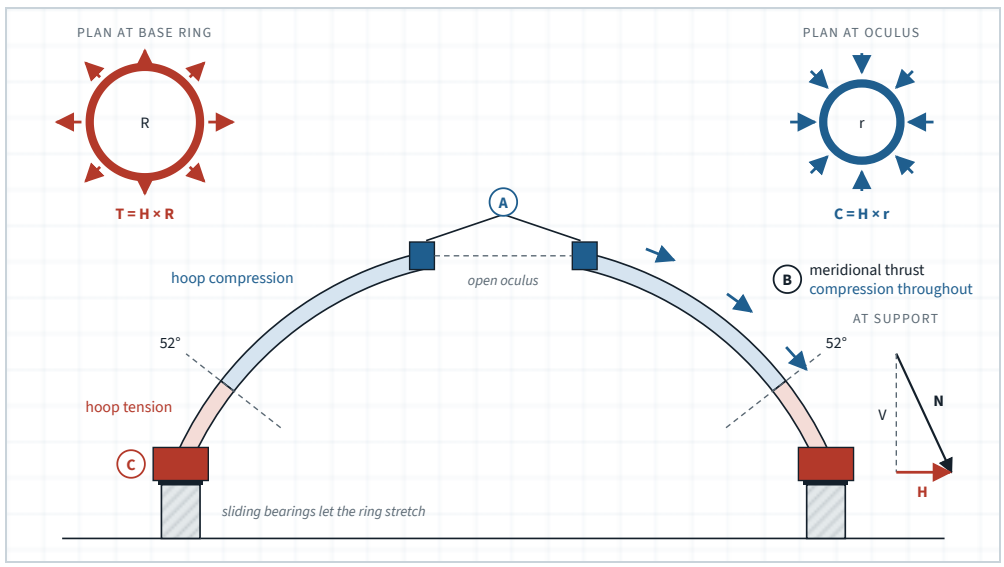
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01 # January 2027

SUBJECT		
Dome rings: how a dome holds itself together		
SCALE	REV	DRAWN
NTS	**A**	**AMELIE·AI**



Compression Tension Fig. 01. Section through a concrete dome with an oculus, not to scale

The 52° boundary is the textbook value for a complete hemispherical shell under its own weight. An oculus, a lantern or a flatter profile moves it, so the designer's analysis governs.

ON THE JOBSITE

- The dome is not stable until both rings are complete. Keep the shoring until cylinder breaks show removal strength, then lower it evenly to the shoring engineer's sequence, never one side first.
- Stagger lap splices in the ring rebar or use mechanical splices. A ring has no alternative load path, so one weak section is a weak ring.
- Let the ring move. Sliding or elastomeric bearings allow it to stretch under load and temperature, so the walls see mainly vertical load.

THIS MONTH **DOME RINGS**

Two rings that hold a dome together

A dome carries its weight to the supports along curved lines called meridians. The shell is thin, so it works almost entirely in direct force, compression or tension, with very little bending. Follow the load from the top down.

A **Compression ring at the oculus**

Cutting a hole in the crown removes what propped each meridian, so they lean in on its edge. A stiff ring gathers that thrust as uniform compression, an arch keystone turned through 360°. Ring force **C = H × r**, H being the thrust per foot at this ring. The Pantheon's oculus, about 27 ft across on a 142 ft dome, has worked this way since its rebuilding in AD 118 to 128.

B **The shell**

Meridional force is compression all the way down. Hoop force, acting around the dome, is compression near the crown but turns to tension below about 52° from the crown. Below that line the shell wants to split along its meridians, which is why old masonry domes crack vertically near the base. St. Peter's in Rome had extra iron rings fitted in the 1740s for exactly this.

C **Tension ring at the base**

At the support the thrust *N* leans outward. Resolve it into *V*, taken by walls or columns, and *H*, which tries to push the supports apart. A steel or post-tensioned concrete ring beam holds *H* as hoop tension, **T = H × R**. With R = 60 ft and H = 3.5 kip/ft, the ring carries 210 kip.

CHECK YOURSELF

A base ring has R = 50 ft and the shell thrust gives H = 3 kip/ft. What hoop tension must the ring carry?

ANSWER $T = 3 \times 50 = 150$ kip

WK	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
WK 1	27 DEC	28 DEC	29 DEC	30 DEC	31 DEC	1 FRI *New Year's Day*	2 SAT
WK 2	3 SUN	4 MON	5 TUE	6 WED	7 THU	8 FRI	9 SAT
WK 3	10 SUN	11 MON	12 TUE	13 WED	14 THU	15 FRI	16 SAT
WK 4	17 SUN	18 MON *Martin Luther King Jr. Day*	19 TUE	20 WED	21 THU	22 FRI	23 SAT
WK 5	24 SUN	25 MON	26 TUE	27 WED	28 THU	29 FRI	30 SAT
WK 6	31 SUN	1 FEB	2 FEB	3 FEB	4 FEB	5 FEB	6 FEB

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02 **February** 2027

SUBJECT		
Heated lazy river: a watertight channel and its equipment		
SCALE **NTS**	REV **A**	DRAWN **AMELIE·AI**

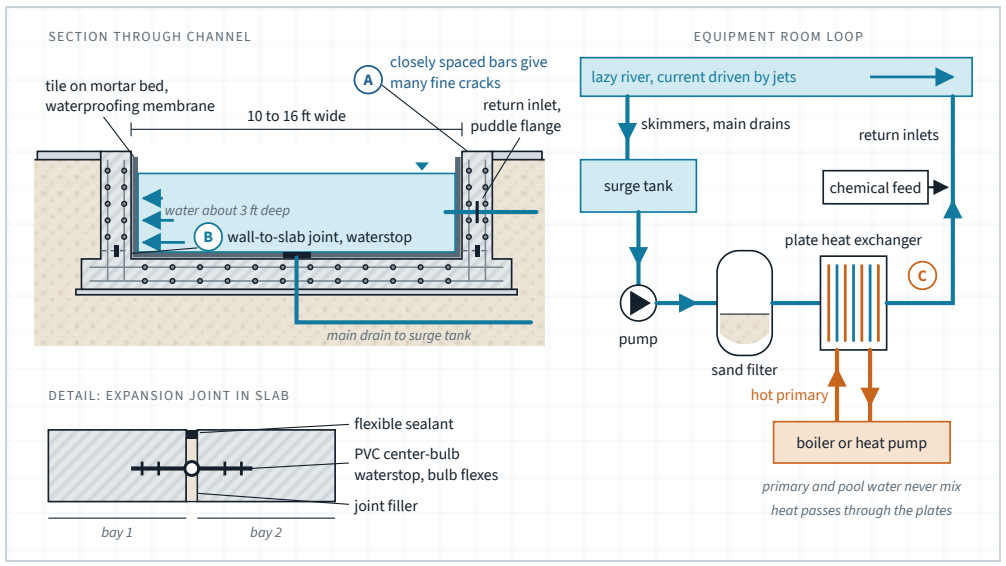


Fig. 02. Section through channel and equipment schematic, not to scale

Crack control, waterstop types and equipment sizes are set by the engineer of record and the pool consultant for each project. Heat losses from the surface and piping add substantially to the warm-up figure.

ON THE JOBSITE

- Leak test the shell before any finishes: fill it, let the level stabilize, then measure the drop over several days, allowing for evaporation, and walk the outside faces looking for damp spots.
- Support waterstops so they stay centered and straight during the pour. Use factory corner and tee fittings or welded splices, and consolidate the concrete well around them. A folded waterstop is a leak.
- Seal every pipe through the shell with a cast-in puddle flange. Set the pipes before the pour and never core through the wall afterward without an approved sealing detail.

THIS MONTH **HEATED LAZY RIVER**

Holding warm water and keeping it moving

A lazy river is a long, shallow concrete channel that must hold water for decades without leaking, while an equipment room filters, heats and treats that water and drives a gentle current around the loop.

A **A liquid-containing channel**

Design the channel as a liquid-containing structure to ACI 350. It controls cracking by limiting the service stress in the rebar and by calling for more shrinkage and temperature steel than ACI 318. Closely spaced bars spread early thermal and shrinkage movement into many fine, tight cracks instead of a few wide ones that leak.

B **Watertight joints and finish**

Construction joints, such as the wall-to-slab joint, take a hydrophilic strip that swells on contact with water, or a cast-in PVC waterstop. Expansion joints take a PVC center-bulb waterstop, whose bulb flexes as the joint opens. The finish is tile on a mortar bed over a waterproofing membrane, or pool plaster or a membrane. It backs up the concrete, never replaces it.

C **Circulation and heating loop**

Skimmers, gutters and main drains feed a surge tank. Pumps push the water through sand filters, then a plate heat exchanger: hot primary water from a boiler or heat pump on one side, pool water on the other, never mixing. Chemical feed follows, then return inlets. Jets or booster pumps drive the current. Heat needed **Q = m × c × ΔT**.

CHECK YOURSELF

The river holds 120,000 gal of water. How much heat raises it by 1 °F? Take 1 gal = 8.34 lb and c = 1 Btu/lb·°F, and ignore losses.

ANSWER $Q = 120{,}000 \times 8.34 \times 1 \times 1 \approx 1{,}000{,}000$ Btu, about 10 therms or 293 kWh

WK	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
WK 6	31 JAN	1 MON	2 TUE	3 WED	4 THU	5 FRI	6 SAT
WK 7	7 SUN	8 MON	9 TUE	10 WED	11 THU	12 FRI	13 SAT
WK 8	14 SUN	15 MON *Washington's Birthday (Presidents' Day)*	16 TUE	17 WED	18 THU	19 FRI	20 SAT
WK 9	21 SUN	22 MON	23 TUE	24 WED	25 THU	26 FRI	27 SAT
WK 10	28 SUN	1 MAR	2 MAR	3 MAR	4 MAR	5 MAR	6 MAR

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03 March 2027

SUBJECT		
Cantilever retaining wall: earth pressure, footing, drainage		
SCALE	REV	DRAWN
NTS	A	AMELIE·AI

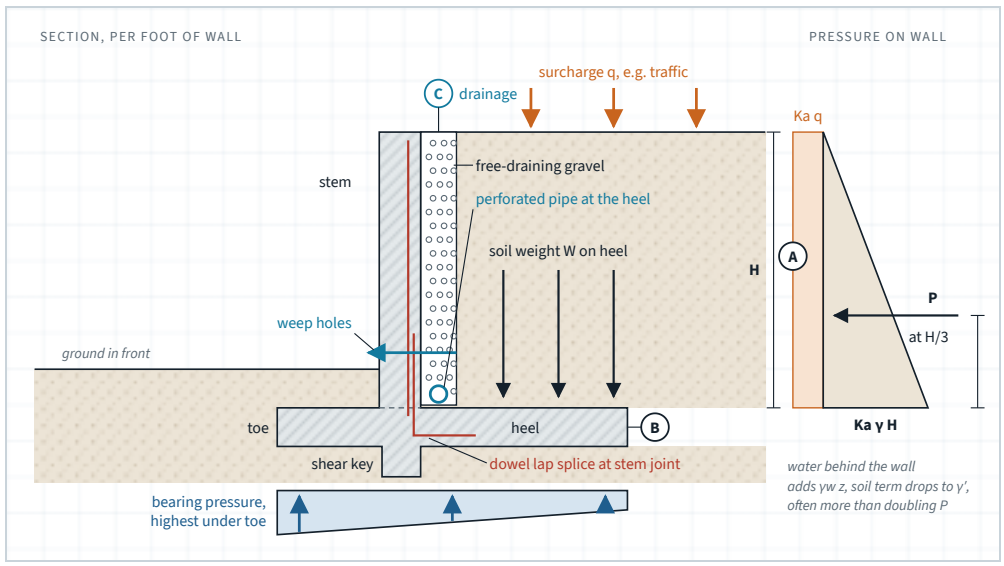


Fig. 03. Section through a cantilever retaining wall, not to scale

Ka = 0.33 matches a level, cohesionless backfill with a friction angle of about 30°. Sloping fill, cohesive soil, wall friction or a stiff, braced wall change the pressure, so the engineer of record's figures govern.

ON THE JOBSITE

- Keep heavy rollers away from the wall. Within about 6 ft of the stem, or what the specs set, use plate compactors or walk-behind rollers, as heavy equipment locks in pressures well above active.
- Backfill only after cylinder breaks show the wall has reached its specified strength, and place fill in thin compacted lifts, bringing the gravel up with it. Never dump full-height fill against a green wall.
- Check the dowels at the stem to footing joint: lap splice length, cover and position, before the footing pour. Keep weep holes and drains clear, and flush them at turnover so the outlet is proven to run.

THIS MONTH **CANTILEVER RETAINING WALL**

Holding back the ground with an inverted T

A cantilever retaining wall is a reinforced concrete stem fixed into a footing. The soil behind pushes the stem over; the soil sitting on the heel holds it down. Follow the load from the retained ground into the foundation.

A **Active earth pressure**

As the wall yields slightly, the soil behind mobilizes active pressure, rising linearly with depth: **p = Ka × γ × z**. The resultant per foot of wall is **P = 0.5 Ka γ H²**, at H/3 above the base. A surcharge q adds Ka × q, resultant at H/2. For stability take H to the bottom of the footing. The stem bends as a cantilever, tension on the soil face.

B **The footing and the three checks**

The heel runs under the retained soil, whose weight holds the wall down and resists overturning. The toe spreads the load and keeps bearing pressure within what the ground can take. A shear key below the footing adds passive resistance against sliding. Check sliding, overturning about the toe, and bearing pressure, keeping the resultant within the middle third of the footing.

C **Drainage behind the wall**

Water pressure acts on the full height at γw = 62.4 pcf and is not reduced by Ka. A saturated, undrained backfill can more than double the horizontal load. Free-draining gravel against the stem, a perforated pipe at the heel to a storm drain or daylight outlet, and weep holes through the stem keep the water table down, so the wall sees only its design earth pressure.

CHECK YOURSELF

A wall retains H = 12 ft of soil with Ka = 0.33 and γ = 120 pcf, no surcharge or water. Find the resultant per foot of wall and where it acts.

ANSWER *P = 0.5 × 0.33 × 120 × 12² ≈ 2,850 lb/ft (2.85 klf), acting at 12/3 = 4 ft above the base*

WK	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
WK 10	28 FEB	1 MON	2 TUE	3 WED	4 THU	5 FRI	6 SAT
WK 11	7 SUN	8 MON	9 TUE	10 WED	11 THU	12 FRI	13 SAT
WK 12	14 SUN	15 MON	16 TUE	17 WED	18 THU	19 FRI	20 SAT
WK 13	21 SUN	22 MON	23 TUE	24 WED	25 THU	26 FRI	27 SAT
WK 14	28 SUN	29 MON	30 TUE	31 WED	1 APR	2 APR	3 APR

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04 April 2027

SUBJECT		
Top-down basement inside a secant pile wall		
SCALE	REV	DRAWN
NTS	A	AMELIE·AI

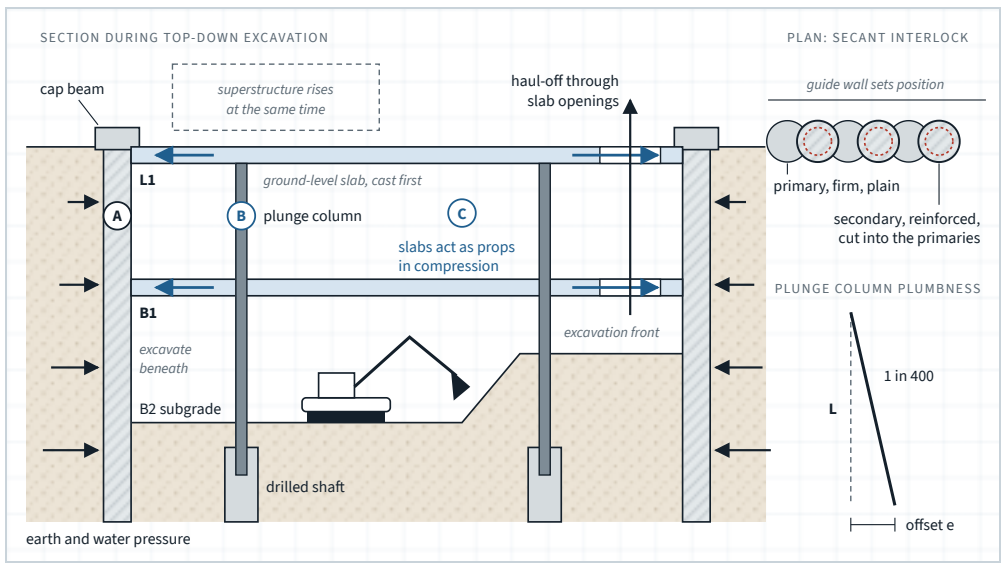


Fig. 04. Section through a top-down basement, not to scale

Pile sizes, interlock and plumbness limits vary with depth and ground, and secant walls are not fully watertight. The engineer's monitoring plan and threshold levels govern.

ON THE JOBSITE

- Monitor the walls throughout with inclinometers and survey targets on the cap beam and neighboring buildings. Compare each reading with the engineer's threshold and action levels, and act at once on an alert.
- Seal leaks at secant joints as soon as excavation reveals them, by grouting or local repair, before fines wash out and leave a void behind the wall.
- Plan haul-off through the slab openings from day one: crane or conveyor, truck routes and haul times. Below the slab, provide forced ventilation, air monitoring and lighting at every work face.

THIS MONTH **TOP-DOWN BASEMENT**

Building a basement from ground level down

On a tight urban site the basement can be built downward. The perimeter wall goes in first, the floors are cast one by one as the ground is dug out beneath them, and each new slab braces the walls.

A — The secant pile wall

A shallow reinforced guide wall fixes the pile positions. Primary piles, in firm unreinforced concrete (soft mixes suit temporary walls only), are cast first at a gap. Secondary piles, reinforced and in full-strength concrete, are drilled between them, cutting into each primary to form an interlocking, largely water-resisting wall. A cap beam ties the pile heads together.

B — Plunge columns

Before any digging, drilled shafts are cast inside the basement footprint. While the concrete is still wet, a steel column is plunged into each one, using a frame or guidance system to hold it to a tight plumbness tolerance. These columns carry the slabs and the rising building during construction, and are often encased later to become the permanent columns.

C — The top-down sequence

Cast the ground-level slab first, on grade, with openings for haul-off. It becomes a stiff brace across the site. Excavate beneath it to the next level, cast that slab to brace the wall again, and repeat to final subgrade. The slabs are very stiff props placed before each dig, so the walls deflect far less than on temporary shoring, and the superstructure can rise meanwhile.

CHECK YOURSELF

An 80 ft plunge column must be plumb to 1 in 400. What is the largest allowed offset at the bottom?

ANSWER $e = 80 \times 12 \div 400 = 2.4$ in

WK	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
WK 14	28 MAR	29 MAR	30 MAR	31 MAR	1 THU	2 FRI	3 SAT
WK 15	4 SUN	5 MON	6 TUE	7 WED	8 THU	9 FRI	10 SAT
WK 16	11 SUN	12 MON	13 TUE	14 WED	15 THU	16 FRI	17 SAT
WK 17	18 SUN	19 MON	20 TUE	21 WED	22 THU	23 FRI	24 SAT
WK 18	25 SUN	26 MON	27 TUE	28 WED	29 THU	30 FRI	1 MAY

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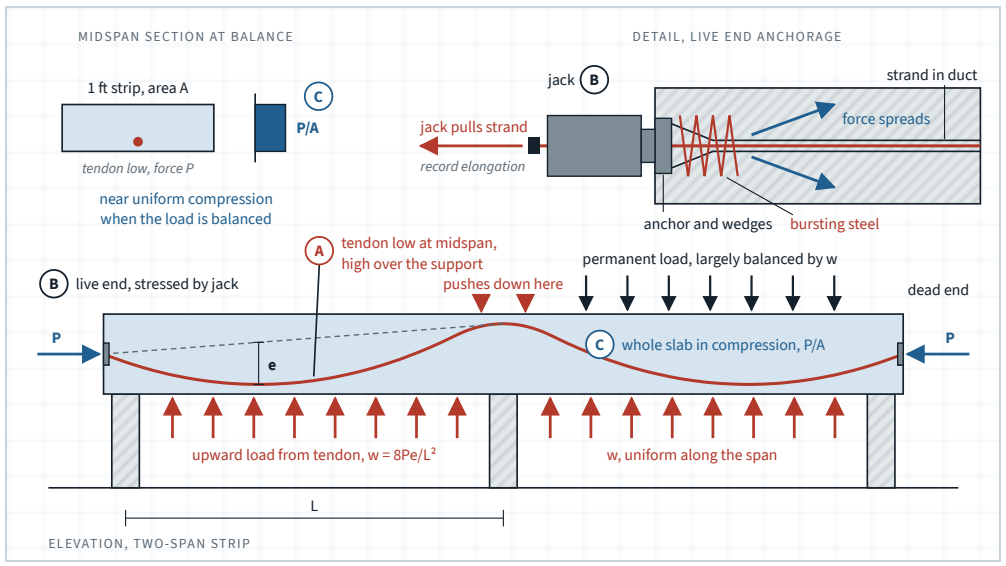
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05 May 2027

SUBJECT		
Post-tensioned floor slab: load balancing tendons		
SCALE	REV	DRAWN
NTS	**A**	**AMELIE·AI**



Compression · Tension, tendon · Anchor and jack

Fig. 05. Elevation of a two-span slab strip, vertical scale exaggerated

$8Pe/L^2$ assumes one parabola between high and low points and ignores friction and long-term losses, which reduce P along the tendon. The designer's profile and loss calculation govern.

THIS MONTH **POST-TENSIONED SLABS**

A curved tendon that holds the slab up

A post-tensioned slab contains steel strand that is stressed after the concrete has hardened. The tendon is draped so that, once stressed, it pushes up on the slab and squeezes it along its length. Follow the force from the jack into the concrete.

A The draped tendon

The tendon sits high over the supports and low at midspan. Stressed to force *P*, the curved strand presses up on the concrete in each span and down over the supports, where its curve reverses. A parabolic drape *e* over span *L* gives a uniform upward load $\mathbf{w = 8Pe / L^2}$. The designer sets *P* and *e* so that *w* balances much of the permanent load.

B Live and dead anchorages

At the live end a jack grips the strand, pulls it to the specified force and locks it off with wedges. The dead end is cast in and is not jacked. Each anchor drives a concentrated force into the slab edge, so spirals or hairpin bars behind it carry the bursting tension. Strand runs in ducts grouted after stressing (bonded) or as greased, plastic-sheathed monostrand (unbonded).

C The slab in compression

Anchored at both ends, the tendon squeezes the whole slab with an average stress $\boldsymbol{\sigma = P / A}$. Where the drape balances the load, that stress is close to uniform through the depth. Compression keeps cracks closed and cuts deflection, so slabs can be thinner and spans longer. With *P* = 18 kip/ft on a 10 in slab, σ = 150 psi, above the 125 psi minimum ACI 318 sets for two-way slabs.

ON THE JOBSITE

- Check tendon heights on the chairs against the profile drawing before the pour. A quarter inch at a high or low point changes the drape and the balancing load. Tie chairs so the pour cannot shift them.
- Stress only when cylinder breaks show the specified transfer strength. Record each elongation against the calculated value and report any outside tolerance before strand tails are cut.
- Never core or drill a PT slab without scanning and marking the tendons first. Reshores stay in place until the engineer of record releases them.

CHECK YOURSELF

A slab strip carries P = 18 kip per foot of width with a parabolic drape e = 6 in over a span L = 30 ft. What uniform upward load does the tendon apply?

ANSWER $w = 8 \times 18 \times 0.5 / 30^2 = 72 / 900 = 0.080$ ksf = 80 psf

WK	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
WK 18	25 APR	26 APR	27 APR	28 APR	29 APR	30 APR	1 SAT
WK 19	2 SUN	3 MON	4 TUE	5 WED	6 THU	7 FRI	8 SAT
WK 20	9 SUN	10 MON	11 TUE	12 WED	13 THU	14 FRI	15 SAT
WK 21	16 SUN	17 MON	18 TUE	19 WED	20 THU	21 FRI	22 SAT
WK 22	23 SUN	24 MON	25 TUE	26 WED	27 THU	28 FRI	29 SAT
WK 23	30 SUN	31 MON *Memorial Day*	1 JUN	2 JUN	3 JUN	4 JUN	5 JUN

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06 **June** 2027

SUBJECT		
Cable-stayed bridge: stays, pylon and deck		
SCALE	REV	DRAWN
NTS	**A**	**AMELIE·AI**

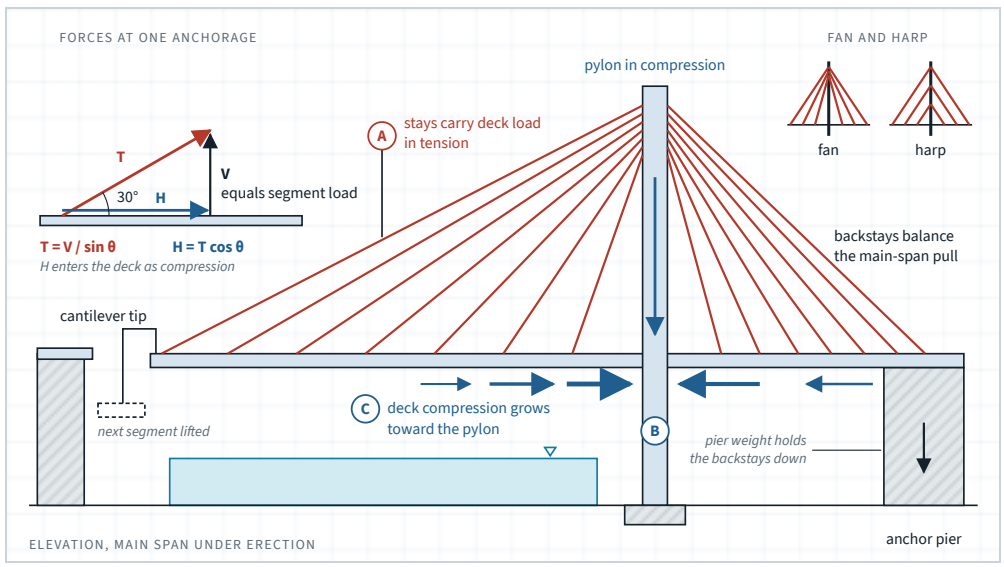


Fig. 06. Elevation of a single pylon cable-stayed bridge, not to scale

Real stays share load with the stiff deck and the pylon, and each is stressed to a planned force rather than a simple share of segment weight. The force triangle shows the principle; AASHTO LRFD governs the design.

ON THE JOBSITE

- Survey the deck and pylon at the same time of day and temperature each cycle, ideally early morning before the sun warms one face. Compare with the erection manual's predicted profile, not the final one.
- Stress each stay in the sequence the erection manual sets and record the force at every stage. Check forces with lift-off or load cells and report any stay outside the specified tolerance.
- Watch for wind and rain-wind induced stay vibration, and fit dampers as soon as the design allows. Protect stay sheathing from welding, grinding and impact damage during erection.

THIS MONTH **CABLE-STAYED BRIDGES**

Hanging a deck from one tall pylon

A cable-stayed bridge hangs its deck from straight stays anchored high on a pylon. Each stay lifts its share of deck weight, and its slope means it also pushes along the deck. Follow the load from a deck segment up to the pylon and back down.

A **Stays in tension**

Each stay picks up a length of deck at its lower anchorage and carries that weight up to the pylon in tension. Because the stay is inclined, its tension is larger than the load it lifts, **T = V / sin θ**. Flat stays work hard for little lift, which is why the outer stays of a long span are the heaviest.

B **Pylon and backstays**

The stays pull the pylon head toward the main span. Backstays on the other side, landing on the back span and its heavy anchor pier, pull it back so that the pylon is left carrying vertical compression with little bending. The anchor pier must hold the backstays down by its weight or by ground anchors.

C **Deck compression and erection**

The horizontal part of each stay force, **H = T cos θ**, pushes the deck toward the pylon, so deck compression builds up toward it. The deck is built as a cantilever, each cycle placing a segment, installing and stressing its stay, then checking geometry. A fan gathers stays near the pylon top; a harp keeps them parallel.

CHECK YOURSELF

A deck segment load V = 450 kip is carried by a stay at 30° to the horizontal. What is the stay tension, and how much compression does it put into the deck?

ANSWER *T = 450 / sin 30° = 450 / 0.5 = 900 kip; H = 900 × cos 30° ≈ 779 kip*

WK	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
WK 23	30 MAY	31 MAY	1 TUE	2 WED	3 THU	4 FRI	5 SAT
WK 24	6 SUN	7 MON	8 TUE	9 WED	10 THU	11 FRI	12 SAT
WK 25	13 SUN	14 MON	15 TUE	16 WED	17 THU	18 FRI *Juneteenth (observed)*	19 SAT *Juneteenth*
WK 26	20 SUN	21 MON	22 TUE	23 WED	24 THU	25 FRI	26 SAT
WK 27	27 SUN	28 MON	29 TUE	30 WED	1 JUL	2 JUL	3 JUL

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07 July 2027

SUBJECT		
Bored tunnel: earth pressure balance TBM		
SCALE	REV	DRAWN
NTS	**A**	**AMELIE·AI**

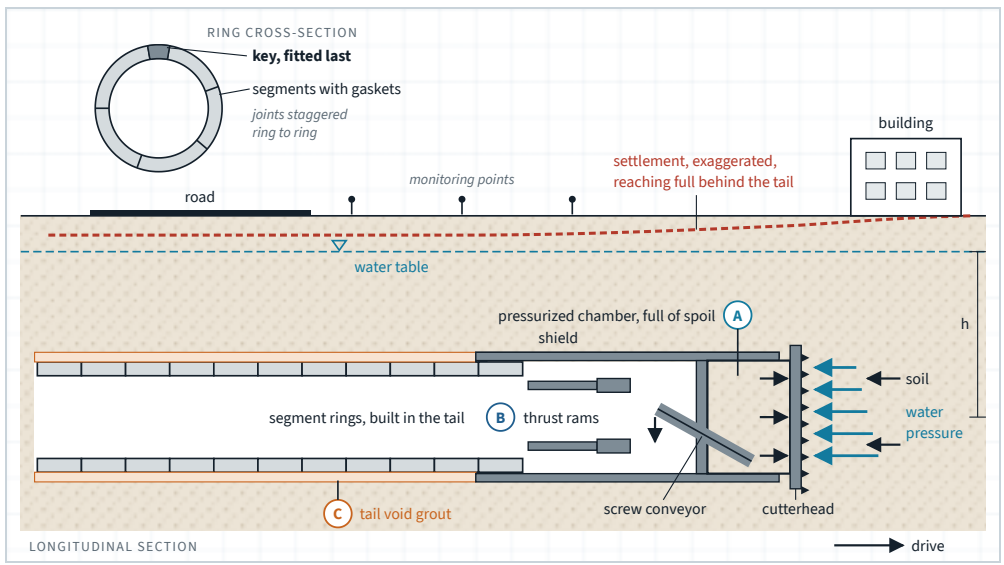


Fig. 07. Longitudinal section through an EPB tunnel drive, not to scale

The check covers groundwater only. Face pressure must also resist the soil's lateral pressure and allow for the pressure gradient over the face height, so the required range comes from the designer.

ON THE JOBSITE

- Read surface and building monitoring at the frequency the plan sets, and act on each trigger level, alert and action, exactly as the agreed response plan states, before the machine moves on.
- Check every ring for lippage, offsets and out-of-roundness as it is built, against the specified tolerances. Keep gaskets clean and undamaged; a torn gasket is a future leak.
- Store segments on level dunnage to the stacking plan and lift only with the approved gear. Inspect edges and corners before each segment goes down the shaft; chipped segments leak and crack.

THIS MONTH **EPB TUNNELLING**

Holding the face while the tunnel moves on

An earth pressure balance machine bores through soft ground below the water table without letting the face collapse or the ground flow in. It holds the face with its own spoil, builds the lining inside its tail and grouts behind it. Follow the ground from the face back to the finished ring.

A The face

The cutterhead loosens soil into a sealed chamber behind it. Packed and conditioned with foam, that spoil is held at a pressure that balances the earth and groundwater pressure on the face. The operator controls it with screw conveyor speed against advance rate: slow the screw and pressure rises. Groundwater alone gives $\mathbf{u = \gamma_w h}$.

B The ring

Inside the shield tail the erector places precast concrete segments to form a ring, with the key fitted last. Gaskets on every joint seal against groundwater. To advance, thrust rams push off the last completed ring, so the lining takes the jacking load in compression from the first day.

C Tail void grouting

The shield is larger than the ring, so it leaves an annular gap as it moves on. Grout is injected through the tail as the machine advances to fill that gap at once. Any void left lets the ground move in, and the surface settles in a trough centered over the tunnel. Volume loss is kept small by face pressure and prompt, full grouting.

CHECK YOURSELF

The tunnel axis is 60 ft below the water table. Roughly what groundwater pressure must the chamber resist at axis level?

ANSWER $u = 60 \times 62.4 = 3{,}744$ psf $= 3{,}744 / 144 = 26$ psi (about 1.8 bar)

WK	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
WK 27	27 JUN	28 JUN	29 JUN	30 JUN	1 THU	2 FRI	3 SAT
WK 28	4 SUN *Independence Day*	5 MON ***Independence Day (observed)***	6 TUE	7 WED	8 THU	9 FRI	10 SAT
WK 29	11 SUN	12 MON	13 TUE	14 WED	15 THU	16 FRI	17 SAT
WK 30	18 SUN	19 MON	20 TUE	21 WED	22 THU	23 FRI	24 SAT
WK 31	25 SUN	26 MON	27 TUE	28 WED	29 THU	30 FRI	31 SAT

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08 **August** 2027

SUBJECT		
Mass concrete: heat of hydration in a thick mat		
SCALE	REV	DRAWN
NTS	**A**	**AMELIE·AI**

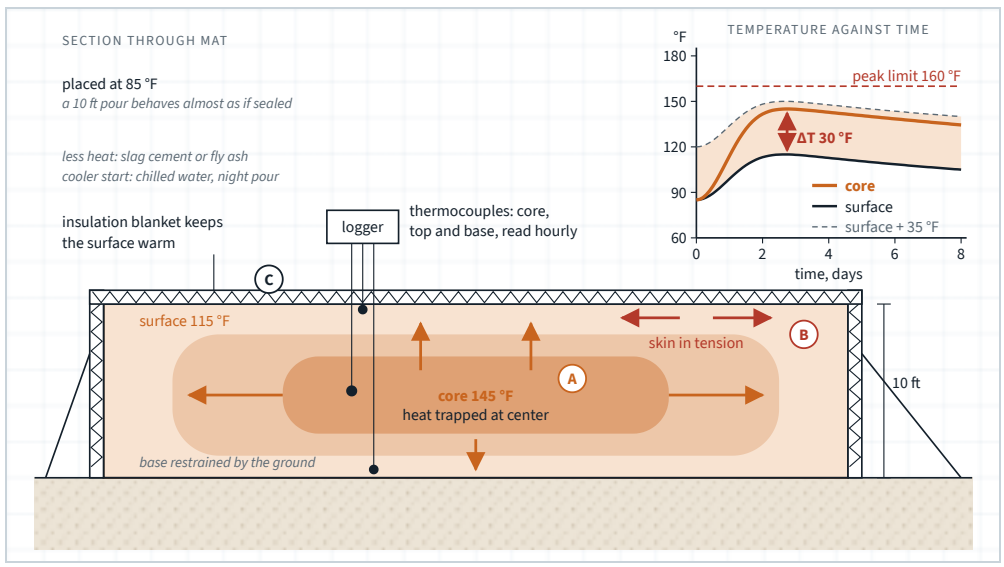


Fig. 08. Section through a 10 ft mat, not to scale; graph to scale

Project specifications can set other limits. Insulation narrows the difference but can raise the core peak slightly, so both are checked. Temperatures shown are typical for a hot weather pour placed at 85 °F.

ON THE JOBSITE

- Log thermocouple readings at set intervals through the night and weekend, with a named person responsible and an agreed action if the difference approaches the limit.
- Do not strip insulation early. Remove it gradually, in stages, only when the readings allow. A sudden exposure chills the surface and cracks it, often days after the pour.
- Plan the pour as continuous: backup pump and equipment, a second batch plant, lighting and relief crews. A cold joint in a mat is far worse than a slow pour.

THIS MONTH **MASS CONCRETE MAT**

Keeping the heat in a thick mat pour

A thick mat foundation is a large block of reacting cement. Heat builds up in the core faster than it can escape, while the surfaces lose heat to the air and ground. The job is to control the difference between core and surface, and the peak.

A **Hydration heats the core**

Cement gives off heat as it hydrates, most of it in the first few days. Concrete conducts heat poorly, so in a pour more than about 6 ft thick the core behaves almost as if sealed and can rise 50 to 90 °F above its placing temperature. The surfaces cool to air and ground. **Peak = placing temperature + rise**.

B **The difference cracks it**

The hot core expands more than the cooler surface, so the surface is pulled into tension and cracks early. Later, as the whole pour cools and shrinks against the ground, restraint can crack it deeper. Unless the project specifies otherwise, ACI 301 limits the core to surface difference to 35 °F, to control cracking, and the peak to 160 °F, to avoid delayed ettringite formation.

C **The controls**

Make less heat: replace part of the cement with slag cement or fly ash. Start cooler: chilled mix water or ice, shaded aggregates, night pours. Keep the surface warm with insulation blankets and insulated formwork, so it follows the core. Measure with thermocouples at core and surface. Very thick pours may also need embedded cooling pipes.

CHECK YOURSELF

Thermocouples read core 145 °F and surface 115 °F. The limits are a 35 °F difference and a 160 °F maximum. Is the pour within both?

ANSWER *ΔT = 145 − 115 = 30 °F, within 35 °F; peak 145 °F, below 160 °F. Within both.*

WK	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
WK 32	1 SUN	2 MON	3 TUE	4 WED	5 THU	6 FRI	7 SAT
WK 33	8 SUN	9 MON	10 TUE	11 WED	12 THU	13 FRI	14 SAT
WK 34	15 SUN	16 MON	17 TUE	18 WED	19 THU	20 FRI	21 SAT
WK 35	22 SUN	23 MON	24 TUE	25 WED	26 THU	27 FRI	28 SAT
WK 36	29 SUN	30 MON	31 TUE	1 SEP	2 SEP	3 SEP	4 SEP

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09 September 2027

SUBJECT		
Slipforming: a tall building core cast without joints		
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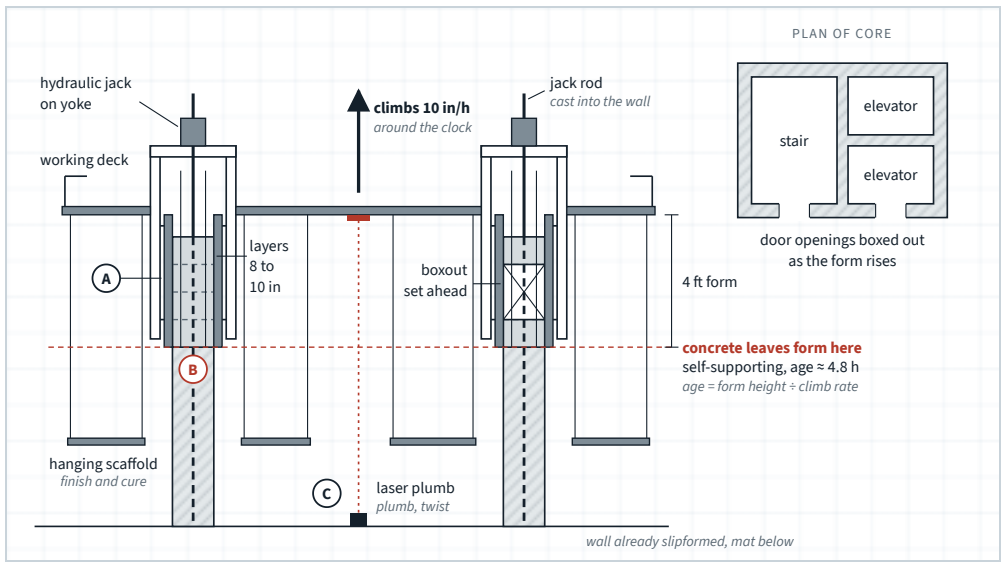


Fig. 09. Section through a pair of core walls, not to scale

Exit age is approximate: concrete is placed a little below the top of the form, and each layer takes time to place. The setting time of the actual mix at the actual temperature decides the rate.

THIS MONTH **SLIPFORMED CORE**

A form that climbs without stopping

A slipform casts a building core as one continuous wall. The form rises steadily on jacks while concrete is placed into its top and emerges from its bottom hard enough to stand. Rebar tying, placing, lifting and finishing all go on at once.

A The rig

Form panels about 3 to 5 ft high line both faces of every wall, held by yokes. A hydraulic jack on each yoke climbs a steel jack rod standing in the wall. The working deck on top carries rebar tying and concrete placing. A hanging scaffold below the form gives access to finish and cure the emerging face.

B Climb rate and setting

Concrete is placed in even layers, typically 8 to 10 in, all around the core. The climb rate is set so that concrete leaving the bottom of the form can support itself, yet is still soft enough to finish. Rates of 6 to 12 in per hour are common. Age at exit $t = H \div v$, form height over climb rate.

C Control as it rises

Plumb and twist are checked continuously with laser plumbs or survey, and corrected gently by adjusting the jacks. Boxouts, embed plates and door openings are set and secured in the rebar ahead of the concrete. The operation runs around the clock, so supply, crews and survey must too.

ON THE JOBSITE

- Match the concrete to the climb rate with trial batches, at the temperatures expected by day and night. Setting time and supply rate decide the safe speed, not the jacks.
- Plan for stoppages. If the climb must halt, keep lifting the form a fraction of an inch at intervals so the concrete does not bond to the panels, and agree the restart procedure beforehand.
- Check boxout, embed and opening layout against the drawings on the deck before it disappears into the wall. A missed embed means coring and post-installed anchors later.

CHECK YOURSELF

A slipform is 4 ft high and climbs at 10 in per hour. How old is the concrete when it leaves the bottom of the form?

ANSWER $t = 48\ in \div 10\ in/h = 4.8\ hours$

WK	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
WK 36	29 AUG	30 AUG	31 AUG	1 WED	2 THU	3 FRI	4 SAT
WK 37	5 SUN	6 MON *Labor Day*	7 TUE	8 WED	9 THU	10 FRI	11 SAT
WK 38	12 SUN	13 MON	14 TUE	15 WED	16 THU	17 FRI	18 SAT
WK 39	19 SUN	20 MON	21 TUE	22 WED	23 THU	24 FRI	25 SAT
WK 40	26 SUN	27 MON	28 TUE	29 WED	30 THU	1 OCT	2 OCT

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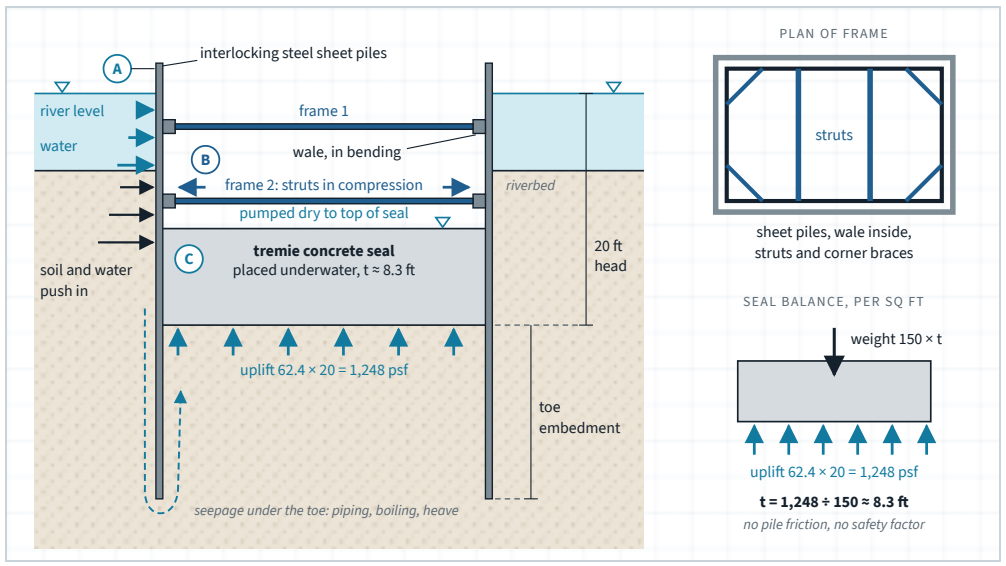
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10 October 2027

SUBJECT		
Cofferdams: a dry box built in a river		
SCALE	REV	DRAWN
NTS	**A**	**AMELIE·AI**



Water · Compression · Seal concrete · Steel · Soil

Fig. 10. Section through a sheet pile cofferdam, not to scale

In practice the seal is often thinner, because friction and bond to the piles, or tension piles, help resist uplift. The designer applies a factor of safety against uplift.

ON THE JOBSITE

- Install each strut frame before digging or pumping below it, and never dig ahead of the frames. Each frame gains load as the dig goes on below it and is often most loaded just before the next frame goes in.
- Watch the interlocks during driving. A pile that comes out of interlock leaves a gap that will leak or let soil run. Check alignment and plumb, and seal small leaks before pumping down further.
- If the base starts to boil or heave, stop pumping and flood the cofferdam to balance the water. Pumping harder only steepens the flow and speeds the failure.

THIS MONTH **SHEET PILE COFFERDAM**

Keeping a river out of the excavation

A cofferdam is a temporary box of steel sheet piles that lets a pier or foundation be built dry below water. The piles hold back the sides, internal frames hold the piles apart, and the base must resist water trying to come up from below.

A The sheet pile wall

Interlocking steel sheet piles are driven to a design toe elevation well below the excavation. Outside, water and soil push inward, and the pressure grows with depth. Water pressure alone at depth h ft is $\boldsymbol{p = 62.4 \times h}$ **psf**, so it is greatest at the base, just when the excavation is deepest.

B Wales and struts

Each frame is a ring of wales around the inside of the piles, held apart by struts and corner braces. The wales span between struts and work in bending; the struts carry the load across in compression. Frames go in from the top down, each one placed before any digging or pumping below it.

C The base

Water flows down outside the piles, under the toe and up inside. Too steep a flow lifts the soil: piping, boiling or base heave. Deeper toe embedment and dewatering reduce it. A tremie concrete seal, placed underwater, plugs the base and must balance uplift by its weight, $\boldsymbol{150 \times t \geq 62.4 \times h}$, in pcf and ft, h to the seal underside.

CHECK YOURSELF

The underside of a tremie seal is 20 ft below river level. Concrete weighs 150 pcf. What seal thickness balances uplift, ignoring pile friction and any safety factor?

ANSWER $u = 20 \times 62.4 = 1{,}248$ psf; $t = 1{,}248 \div 150 \approx 8.3$ ft

WK	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
WK 40	26 SEP	27 SEP	28 SEP	29 SEP	30 SEP	1 FRI	2 SAT
WK 41	3 SUN	4 MON	5 TUE	6 WED	7 THU	8 FRI	9 SAT
WK 42	10 SUN	11 MON *Columbus Day*	12 TUE	13 WED	14 THU	15 FRI	16 SAT
WK 43	17 SUN	18 MON	19 TUE	20 WED	21 THU	22 FRI	23 SAT
WK 44	24 SUN	25 MON	26 TUE	27 WED	28 THU	29 FRI	30 SAT
WK 45	31 SUN	1 NOV	2 NOV	3 NOV	4 NOV	5 NOV	6 NOV

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11 November 2027

SUBJECT		
Incremental launching: pushing a concrete deck out		
SCALE	REV	DRAWN
NTS	A	AMELIE·AI

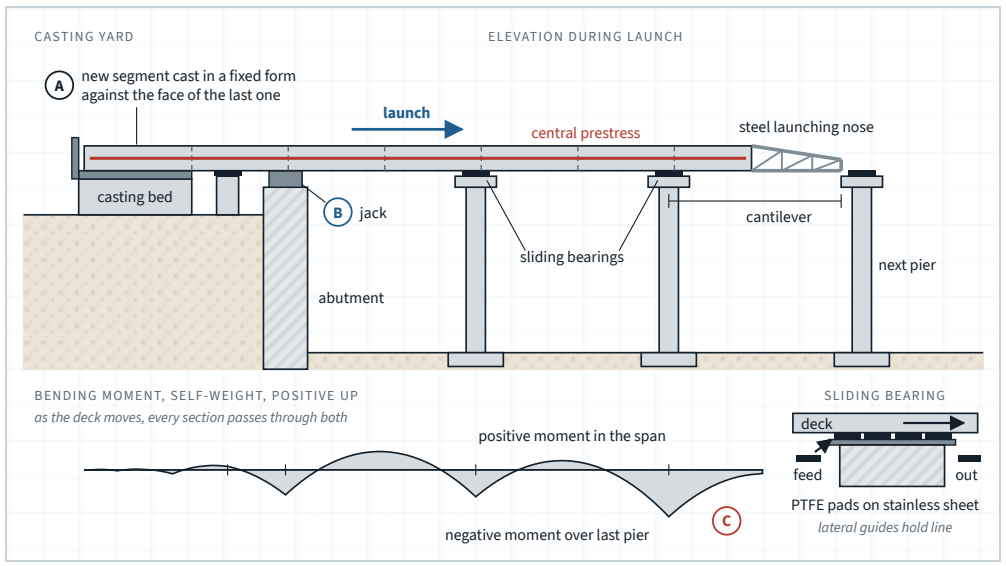


Fig. 11. Elevation at one launch stage, not to scale

The moment sketch is for self-weight at one stage only. Grade, horizontal curvature, starting friction and pier flexibility all change the forces, so the launch designer's stage-by-stage analysis governs.

ON THE JOBSITE

- Drill the pad feeding team. Pads go in at every bearing, every push, right side up and facing the right way. A missed pad lets the soffit drag on the bearing and damages the deck.
- Survey line and grade at the nose and at agreed points after every push. Compare with the predicted values before the next push and correct line with the guides early, in small steps.
- On a downhill grade the deck wants to run away. Provide brakes or restraint that hold the deck at every stage, to the launch engineer's design, and test them before the first push.

THIS MONTH **INCREMENTAL LAUNCHING**

Cast behind the abutment, pushed over the piers

An incrementally launched deck is built in one place and moved into position. Segments are cast in a yard behind the abutment and the growing deck is jacked forward over the piers, one segment length at a time.

A **Casting yard and fixed form**

Each segment, typically 50 to 100 ft long, is cast in a fixed form on a stiff bed behind the abutment. It is cast directly against the end face of the previous segment, so the joint matches and rebar or couplers run through. Once it has reached strength it is stressed to the deck, and the whole deck is pushed forward one segment length. The form never moves.

B **Jacking over sliding bearings**

Hydraulic jacks at the abutment push or pull the whole deck. It slides on temporary bearings, PTFE pads riding on stainless steel, with lateral guides holding line. Friction is low, so on the flat **F = μ × W**. A steel nose, far lighter than the deck, reduces the cantilever moment until it lands on the next pier.

C **Negative and positive moment in turn**

As the deck moves, every section passes over supports, where it hogs (negative moment), and through midspans, where it sags (positive moment). Launch prestress is therefore central (concentric), giving near uniform compression that covers both. The worst negative moment is over the last pier while the front cantilevers. Continuity tendons are added after the launch.

CHECK YOURSELF

A deck weighing 10,000 kip slides on PTFE bearings with μ = 0.03. What jacking force is needed on the flat, ignoring grade and starting friction?

ANSWER $F = 0.03 \times 10{,}000 = 300$ kip

WK	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
WK 45	31 OCT	1 MON	2 TUE	3 WED	4 THU	5 FRI	6 SAT
WK 46	7 SUN	8 MON	9 TUE	10 WED	11 THU *Veterans Day*	12 FRI	13 SAT
WK 47	14 SUN	15 MON	16 TUE	17 WED	18 THU	19 FRI	20 SAT
WK 48	21 SUN	22 MON	23 TUE	24 WED	25 THU *Thanksgiving Day*	26 FRI	27 SAT
WK 49	28 SUN	29 MON	30 TUE	1 DEC	2 DEC	3 DEC	4 DEC

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12 **December** 2027

SUBJECT		
Tower crane foundation: keeping the crane standing		
SCALE	REV	DRAWN
NTS	**A**	**AMELIE·AI**

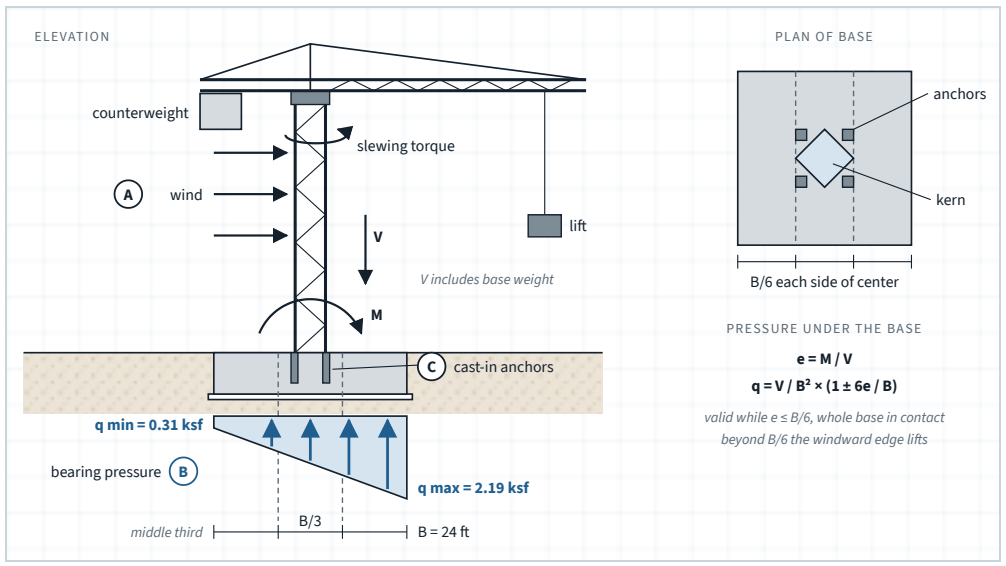


Fig. 12. Elevation and plan of a free-standing crane base, not to scale

The pressure formula assumes a rigid base turning about one axis. Wind on the diagonal gives a higher corner pressure, and the kern there reaches only B/(6√2), 2.83 ft here, so check it too.

THIS MONTH **TOWER CRANE FOUNDATION**

A heavy block that keeps a crane upright

A tower crane is a tall, slender mast with a big moment at its foot. A free-standing crane relies on a mass concrete or reinforced base to stop it overturning and to spread its load safely into the ground.

A Loads from the crane

The base receives vertical load from the mast, jibs and counterweight, a large overturning moment from the lift or from wind, and a slewing torque. Out of service the crane is left free to weathervane, but a storm on the full height of mast and jib often gives the governing moment. The manufacturer gives the base loads for each configuration and mast height.

B Weight resists overturning

The base holds the crane down with its own weight and the crane's, so V includes both. The resultant sits at **e = M / V** from the center. If e ≤ B/6 it lies in the middle third, the whole base bears, and for a square base turning about one axis **q = V / B² × (1 ± 6e / B)**. Beyond B/6 part of the base lifts and q max rises fast.

C The connection and the ground

The mast is fixed through cast-in anchor bolts, anchor legs or an embedded mast section, to the manufacturer's pattern. A template holds them to tight tolerances of elevation and position, because a mast that starts out of plumb only gets worse with height. On weak ground the base sits on piles, which take the moment as push and pull, so some piles need tension capacity.

ON THE JOBSITE

- Treat the base as a temporary structure. A registered professional engineer designs it from the manufacturer's base loads for the actual mast height, jib length and wind, and it is checked independently.
- Before the pour, survey anchor elevation and position against the template and record it. Check bearing at subgrade before the mud mat; soft spots are overexcavated and replaced, not covered over.
- Keep the base drained so water cannot soften the subgrade; OSHA 29 CFR 1926 Subpart CC sets crane ground condition duties. Allow no later excavation or utility trenches near it without the engineer's approval.

CHECK YOURSELF

A 24 ft square crane base, 6 ft thick, carries V = 720 kip, including its own weight of about 520 kip, and M = 2,160 kip-ft. Find e, q max and q min.

ANSWER *e = 2,160 / 720 = 3.0 ft ≤ 24 / 6 = 4.0 ft. q = 720 / 576 × (1 ± 6 × 3.0 / 24) = 1.25 × (1 ± 0.75), so q max ≈ 2.19 ksf and q min ≈ 0.31 ksf*

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WK 50	5 SUN	6 MON	7 TUE	8 WED	9 THU	10 FRI	11 SAT
WK 51	12 SUN	13 MON	14 TUE	15 WED	16 THU	17 FRI	18 SAT
WK 52	19 SUN	20 MON	21 TUE	22 WED	23 THU	24 FRI *Christmas Day (observed)*	25 SAT *Christmas Day*
WK 53	26 SUN	27 MON	28 TUE	29 WED	30 THU	31 FRI *New Year's Day 2028 (observed)*	1 JAN

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