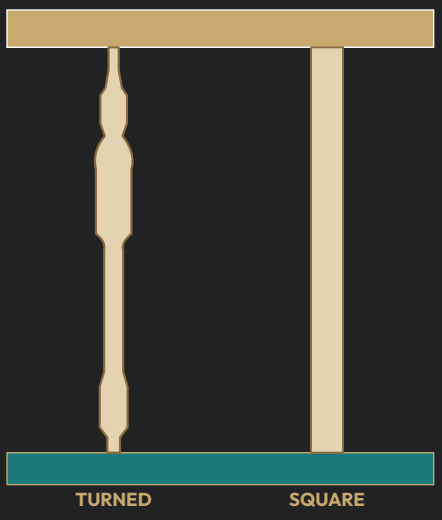
STAIR PARTS · TURNED & SQUARE WOOD

Wood *Baluster*
Installation Guide

Two systems, one guide. Turned wood balusters (UW-5015 / 5342 and the primed turned line) with the dowel-into-mortise method, and square wood balusters (UW-5060 / 5360 / 5160) with the plowed-rail-and-fillet method — both special order through Tanner Rd.



TWO DISTINCT INSTALLS

Turned dowels *or plowed rail.*

Wood balusters fall cleanly into two install systems with no overlap. Turned balusters have preformed round dowel pins at top and bottom — they drop into mortise holes drilled in the tread and the handrail underside. Square balusters have no dowels — they ride in a square channel routed into the underside of a plowed handrail, locked in by fillet pieces between each baluster. Pick the system first, then follow the install path for that system.

WHAT THIS GUIDE COVERS

- Turned wood balusters with preformed dowel pins — UW-5015 and 5342 in oak, plus the primed turned line.
- Square wood balusters — UW-5060 / 5360 / 5160 — installed in plowed handrail (UW-6010P, 6210P) with fillet milled to match.
- IRC R311.7.8 and R312 code applied to wood balusters (height, spacing, sphere rule).
- Layout — per-run divide method for level rail; the rake-spacing pitfall (4" sphere tighter on the slope).
- Drilling round mortises for turned balusters — tread + handrail.
- Plowed-rail prep, fillet cut, install sequence for square balusters.
- Joining wood balusters to wood newels (post-to-post) — see the Handrail & Newel Installation Guide.
- Field finishing, troubleshooting, code-compliance checklist.

WHAT THIS GUIDE DOES NOT COVER

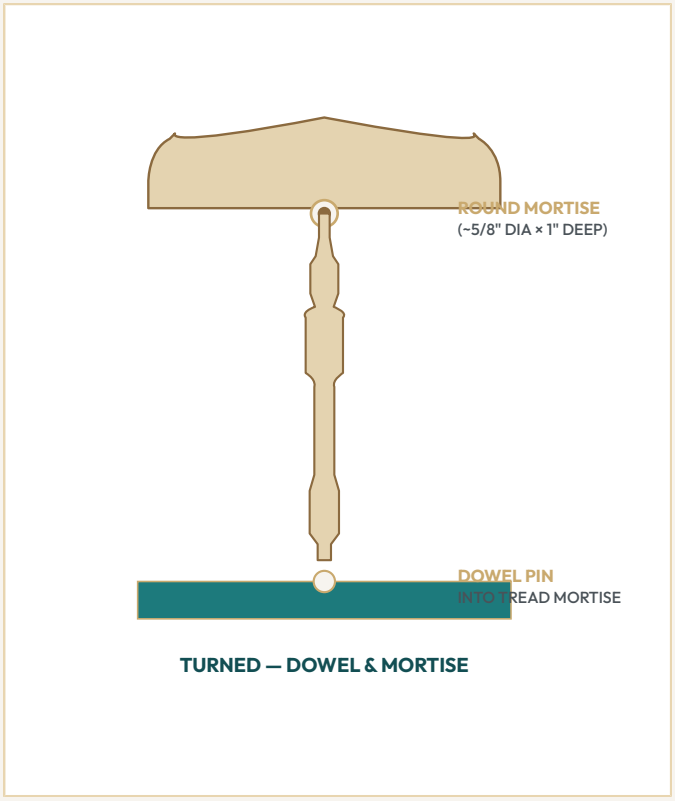
- Iron balusters — see the UWP Iron Baluster Installation Guide (epoxy-set UW M-series, separate method).
- Wood newel install — see the Handrail & Newel Installation Guide for box and turned newel anchor methods.
- Custom shop-fabricated balusters or non-stock profiles — quote-on-request.
- Over-the-post fittings — covered in a separate appendix; pin-top newels run a different baluster geometry.
- Curved-stair baluster runs — radial spacing on curved guards needs its own layout treatment.

QUICK DECISION

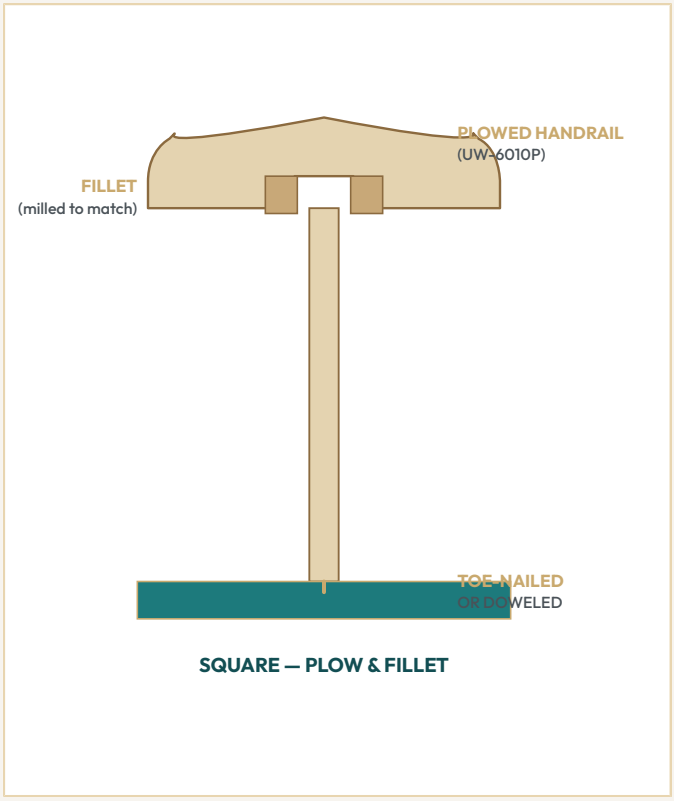
Already have plowed handrail in the room? Use square balusters and fillet. Already have solid handrail? Use turned balusters with mortise drilling. Either choice works on any stair — pick based on the rail you already have, the aesthetic you want, and which install method the carpenter is comfortable with.

DIFFERENT RAILS, DIFFERENT INSTALLS

Two systems *side by side.*



TURNED SYSTEM · PREFORMED DOWEL INTO DRILLED MORTISE



SQUARE SYSTEM · SQUARE BALUSTER IN PLOWED RAIL, FILLET BETWEEN

WHY THIS MATTERS AT ORDER TIME

Order the handrail and the balusters together. A solid handrail (UW-6010) goes with turned balusters; a plowed handrail (UW-6010P) goes with square balusters and fillet. Mixing — square balusters with a solid rail, or turned balusters with a plowed rail — leaves you with handrail you cannot use. Verify the rail spec at the counter before ordering balusters.

THE LATHE-TURNED PROGRAM

Turned baluster *inventory.*

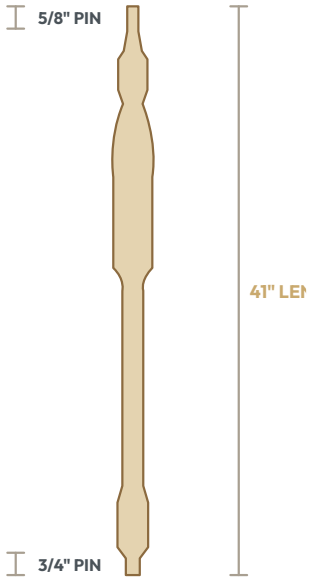
Turned balusters are lathe-cut to a fixed profile — typically a colonial, traditional, or transitional silhouette with a turned ball, vase, or pin-top detail. Most balusters in the 5xxx family have preformed dowel pins at top and bottom; some pin-top variants need the top dowel cut to length on-site. Stock is usually red oak; specify WO at order for white oak.

STANDARD TURNED PROFILES

UW-5015	Colonial turned baluster, oak	34" / 36" / 39" / 42"
UW-PR5015	Colonial turned, primed	34" – 43"
UW-5342	Turned, 1-3/4" base, oak	42"
UW-PR5067	Turned, primed	34" – 41"
UW-PR5141	Turned, primed	34" – 41"
UW-P5315	Turned, poplar	34" – 42"
UW-PR5005	Turned, primed	36" / 42"
UW-PR5090	Turned, primed	36" / 42"
UW-PR5241	Turned, primed	41"

STANDARD LENGTHS

Lengths vary by profile — most balusters come in 31", 34", 36", 39", 41", or 43" depending on the family. Verify length needed (rail height + rail thickness ÷ 2 + tread depth + safety margin) before ordering.



PIN-TOP VARIANT NOTE

Pin-top balusters ship with an oversized top dowel that you cut to fit the rake of the stair. Standard balusters have a fixed-length top dowel — cut the bottom to fit, not the top. Confirm which type each profile is at the counter, and mark the family on each piece before installing to avoid confusion at the saw.

THE SQUARE WOOD PROGRAM

Square balusters *and fillet.*

Square balusters are dimensional stock — 1", 1-1/4" or 1-3/4" square — milled long and cut to fit on-site. They ride in a plowed handrail (UW-6010P, 6210P) and lock in place with fillet pieces between each baluster. The fillet is what sets the spacing and finishes the underside of the rail.

SQUARE BALUSTER STOCK

UW-5060	1-1/4" sq. oak baluster	42" · primed 36" / 41"
UW-5360	1-3/4" sq. oak baluster	42" · primed 36" / 42"
UW-PR5160	1" sq. primed baluster	36" / 42"

PLOWED HANDRAIL TO PAIR

Match the plow width to the baluster:

- 1-1/4" sq. baluster: 1-1/4" plow (UW-6010P standard)
- 1-3/4" sq. baluster: 1-3/4" plow (special order)

FILLET STOCK

Fillet is milled to the plow width in the rail species and quoted with the handrail.

FILLET CUT MATH

Each baluster needs one fillet on each side at the rail (two fillets per baluster) plus matching fillets in the tread plow if the tread is also plowed.

Order linear-feet of fillet = number of balusters × 2 × open distance between balusters, plus ~15% for cut waste and trim.

MATCH THE SPECIES

Fillet shows in the finished assembly — order the same species as the handrail and balusters for an even stain.

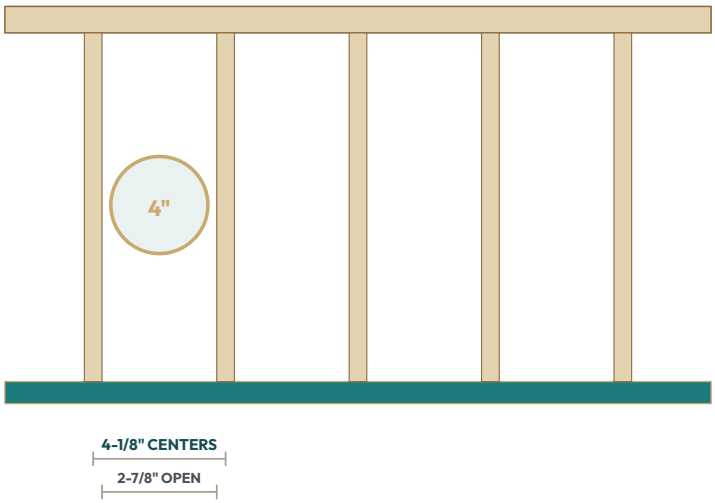
1-1/4" VS 1-3/4" — WHICH TO USE

1-1/4" sq. is the standard for residential interior stairs — slim profile, more open guard. 1-3/4" sq. (UW-5360) is for heavier traditional styles or commercial-look interiors; 1" sq. (UW-PR5160) is the slim paint-grade option. Verify the handrail plow width before ordering — the rail and the baluster have to match exactly. Order both from the same shipment for grain match.

QUICK CODE REFERENCE

The 4" sphere *sets the spacing.*

Wood balusters carry the same IRC code that applies to all guard systems — height, sphere rule, and load. The active constraint on a baluster install is the 4" sphere rule: nothing between balusters that lets a 4" ball through. Spacing math comes from this rule. Handrail height (R311.7.8.1) and guard load (R301.5) are handled by the rail and newel install — see the UWP Handrail & Newel Installation Guide for those rules.



BALUSTER SPACING — 4" SPHERE CANNOT PASS BETWEEN

R312.1.3 — 4" SPHERE RULE · SPACING MATH

R312.1.3 — SPHERE RULE

4" sphere maximum opening between balusters. Two exceptions (R312.1.3): on the open side of a stair the balusters may pass up to a 4-3/8" sphere, and the triangular space formed by the tread, riser and bottom rail must not pass a 6" sphere.

R312.1.2 — GUARD HEIGHT

36" minimum from tread leading edge at stairs. 42" at landings or floor openings ∃30" above grade. Set by rail and newel, not the baluster.

R301.5 — LOAD

200 lb concentrated load at any point along the guard. Wood balusters with proper dowel/mortise depth or fillet engagement transfer this load to the rail and tread.

DIFFERENT TOOLS FOR EACH SYSTEM

Tools & *materials.*

TURNED-SYSTEM TOOLS

- 5/8" and 3/4" Forstner bits — round mortises in tread and rail
- Self-centering drill jig — keeps mortise hole on baluster centerline
- Drill press OR cordless drill with bit guide
- Depth-stop on the bit (~1" deep mortise — never blow through)
- Combination square — set bit perpendicular to the rake
- Pitch block (from the Handrail & Newel guide) — for cut angles
- Compound miter saw — top-cut on pin-top balusters
- Block plane for fine dowel-fit adjustment

SQUARE-SYSTEM TOOLS

- Pin nailer (23 ga) — fillet tacks; almost no visible hole
- Coping saw or small handsaw — fillet trim at the baluster face
- Sharp 3/4" chisel — clean plow corners, trim fillet ends
- Combination square — fillet length transfer
- Pencil + masking tape — fillet length marks

ADHESIVES

- Wood glue (Titebond III or II) — main bonding agent, both systems
- Polyurethane glue — gap-filling option for loose-fit mortises
- Construction adhesive — for fillet beads in the plow (sub to wood glue, not above)

WHY NOT EPOXY

Iron balusters use epoxy for steel-to-wood bond. Wood balusters use wood glue — PVA wets the wood fibers and creates a chemical bond that's actually stronger than the wood itself. Epoxy on wood is overkill, doesn't penetrate, and looks worse if it shows.

FASTENERS

- 15-ga finish nails — for toe-nailing square balusters at tread (if no tread plow)
- 23-ga pin nails — fillet tacks, position-only
- Wood screws #6 × 1-1/4" — alternative to toe-nails at tread for square
- Color-matched putty stick for nail hole touch-up

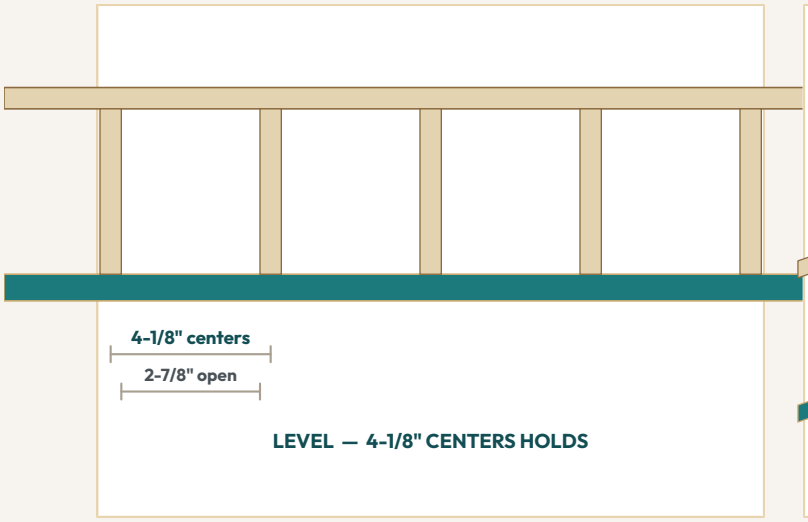
PRE-FINISH IF YOU CAN

Wood balusters are nearly impossible to finish in place — no painter's tool reaches between them, and the underside of the handrail telegraphs every brush stroke. Pre-finish (stain + topcoat) all balusters on saw horses before install. Touch-up after install with color-matched putty and a soft brush. The difference in finish quality is visible from across the room.

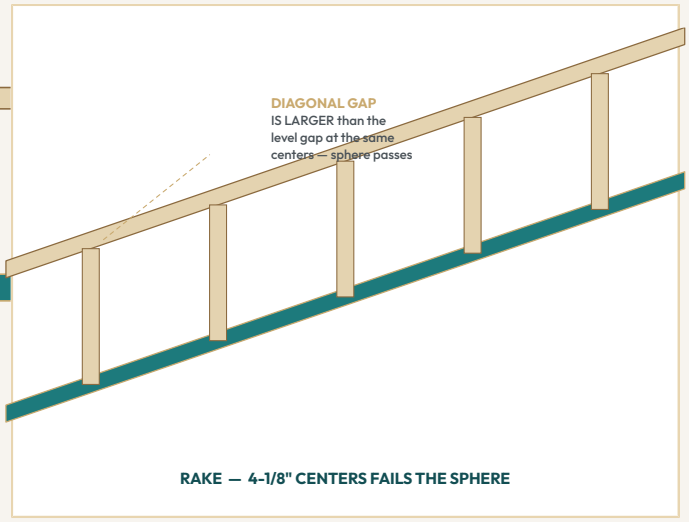
TWO DISTANCES PER RUN

Spacing — and *the rake catch.*

On a level guard (landing, balcony, level run between newels), 4-1/8" center-to-center spacing with a 1-1/4" baluster gives 2-7/8" open — well under the 4" sphere. On a stair rake, the same 4-1/8" centers measured horizontally creates a diagonal opening larger than 4" — the sphere passes between two balusters at the slope angle. Tighten the centers on the rake to keep the diagonal gap under 4".



LEVEL RUN — STRAIGHTFORWARD MATH



STAIR RAKE — DIAGONAL OPENS UP

THE RULE OF THUMB ON THE RAKE

For a typical 7-3/4" rise / 10" run stair, multiply the level center-spacing by ~0.78 to get the rake center-spacing that holds the same diagonal gap. So a 4-1/8" level center becomes about 3-1/4" on the rake. Most installers run 3-1/2" centers on the rake to be safe — verify with a 4" sphere (or a 4" hole saw test plug) at the tightest layout point.

1 *Compute the level spacing.*

Open space + baluster width = center spacing. For 1-1/4" baluster, target 2-7/8" open ’4-1/8" centers. Walks under code.

2 *Compute the rake spacing.*

Multiply level spacing by cos(stair angle). For a 7-3/4" / 10" stair, angle = atan(7.75/10) = 37.8°. cos(37.8°) ≈ 0.79. So 4-1/8" level ’~3-1/4" on rake. Round to a clean construction number.

3 *Per-run divide for the layout.*

On the level run: (length between newels − baluster width) ÷ center spacing, rounded UP to a whole number. Recompute spacing with the rounded count. On the rake: (sloped length between newels − baluster width) ÷ rake center spacing, rounded UP.

4

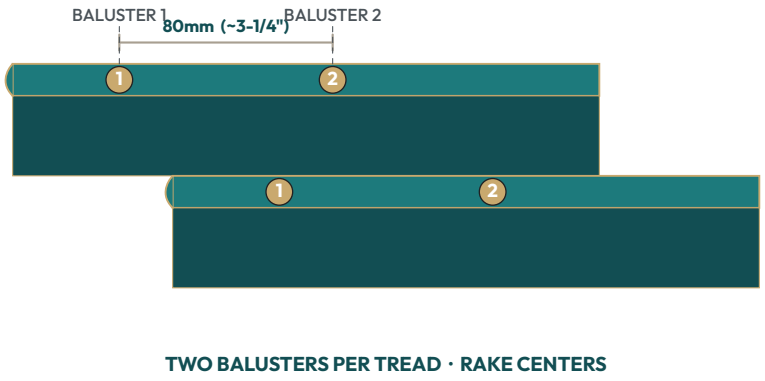
Verify with a sphere.

Lay out one baluster pair to the computed spacing; test with a 4" hole saw test plug or a printed 4" circle. If it passes between, tighten centers by 1/8" and recompute the run total.

TWO PER TREAD, ALMOST ALWAYS

Tread-level *placement.*

On a standard residential stair, the layout is two balusters per tread — one near the front (about 1/3 of the way back from the bullnose) and one near the back. The center-to-center distance follows the rake math from page 8. Treads with closer baluster spacing (three per tread) are sometimes specified for thinner balusters or a tighter aesthetic; verify against the sphere rule at order.



STANDARD LAYOUT — TWO BALUSTERS PER TREAD

1

Mark from the front nosing.

Measure from the front edge of the tread back to the position for Baluster 1 — typically 1/3 of the tread depth from the front. For a 10" tread, that's ~3" from the nosing. Mark with a pencil dot on the tread surface, centered side-to-side on the tread's open edge.

2

Compute Baluster 2 position.

Baluster 2 is at Baluster 1 position + rake center spacing (e.g., 3-1/4"). For the standard 10" tread, that places Baluster 2 about 6-1/4" from the front nosing — roughly 2/3 of the way back. Mark identically.

3

Repeat on every tread.

Use the same offsets on every tread. The handrail rake plus the consistent tread-level placement creates the pleasing visual rhythm of evenly-spaced balusters running up the stair.

4

Mark the rail underside.

Plumb up from each tread mark to the underside of the handrail. Mark each plumb point with a pencil dot. These become the mortise centers for turned balusters or the fillet positions for square balusters.

DRILL, DRY-FIT, GLUE

Turned baluster *install.*

Turned balusters install in a fixed sequence: drill the tread mortises first, drill matching handrail mortises (plumb to the tread marks), dry-fit every baluster to verify length, then glue and set. The mortises do the structural work — get the depth and the alignment right and the install holds for decades.

1 *Drill tread mortises.*

At each marked baluster position, drill a 5/8" or 3/4" diameter mortise (match the dowel pin diameter — typically 3/4" for standard turned balusters) ~7/8" deep into the tread. Use a Forstner bit with a depth stop. Drill perpendicular to the tread surface, not plumb to ground. Clean the hole of chips with compressed air.

2 *Drill handrail mortises.*

Plumb up from each tread mortise to mark the rail underside. Drill a 5/8" mortise ~1" deep into the rail underside. Drill perpendicular to the handrail axis (NOT plumb to ground — perpendicular to the rake) using a self-centering jig or a square-aligned bit. The handrail mortise should be slightly oversize compared to the top pin to allow dry-fit adjustment.

3 *Dry-fit every baluster.*

Set each baluster bottom dowel into its tread mortise, then guide the top dowel into the rail mortise. The baluster should drop in cleanly to about 1/8" of full seat — that 1/8" is your glue allowance. Check plumb in both directions (front-back and side-side). For pin-top balusters, mark the top dowel where it meets the rail mortise mouth — that's your cut line; cut on the bench, dry-fit again.

4 *Glue and set.*

Pull each baluster out one at a time. Apply slow-set wood glue (Titebond III preferred) inside both mortises — a generous bead, not just a dab. Reset the baluster: bottom dowel into tread mortise first, then top dowel into rail mortise. Wipe glue squeeze with a damp rag immediately. Verify plumb one last time. The baluster should feel snug; if it rocks, the mortise is oversized — switch to PU glue for foam-fill or shim with a slim wedge.

5 *Cure and clean.*

Leave undisturbed for 24 hr minimum. The glue cures fastest where it's squeezed thinnest, slowest where the dowel meets the mortise bottom. After cure, run a finger over every mortise mouth to check for residual glue ridges; sand any high spots with 220 grit.

PIN-TOP VARIANTS — THE CUT

> Pin-top balusters ship with a 4" long oversize top dowel that you cut to fit the rake. Set the baluster in its tread mortise, mark the top dowel where it meets the rail mortise mouth, subtract 7/8" (to seat the dowel ~7/8" into the rail), cut on the miter saw. Cut perpendicular to the dowel axis — square cut, not pitch-block angle.

CUT, FIT, FILLET

Square baluster *install.*

Square balusters install in the opposite order from turned: start by setting all balusters dry into the plowed rail and tread, verify spacing, then cut and install fillet pieces to lock the spacing and finish the underside. The fillet does the structural work of holding the spacing — get the fillet cuts right and the balusters can never shift.

1

Cut baluster length.

For each baluster: measure from the floor of the tread plow (or the tread top if no tread plow) up to the floor of the handrail plow. The baluster cut length equals this distance minus 1/16" for a snug fit. The bottom cut is square (perpendicular to baluster axis); the top cut matches the rake angle (use the pitch block on the miter saw fence). Cut all balusters at once for consistent length.

2

Dry-set all balusters.

Drop each baluster into position — bottom into the tread plow at the marked position, top into the handrail plow. The baluster should be tight in the plow with no wobble side-to-side. Verify plumb in both directions. Adjust the rail plumb-marks if any baluster is leaning. Do this for all balusters in the run before any fillet goes in.

3

Toe-nail or fasten bottoms.

For each baluster, drive one 15-ga finish nail at a 45° angle through the back face of the baluster into the tread, or use a #6 × 1-1/4" wood screw if the tread plow is exposed and you'll cover with fillet. Pre-drill if the species is splitty (red oak does; poplar doesn't). The bottom is now anchored.

4

Cut and install fillet — bottom (tread plow).

Measure the open space between two adjacent baluster bottoms (face-to-face). Cut a fillet piece to that exact length — square cuts both ends. Apply a thin bead of wood glue in the tread plow, drop the fillet into the plow, tap snug between balusters. Pin-nail with one 23-ga pin nail through the fillet centerline into the tread. Repeat for every gap.

5

Cut and install fillet — top (handrail plow).

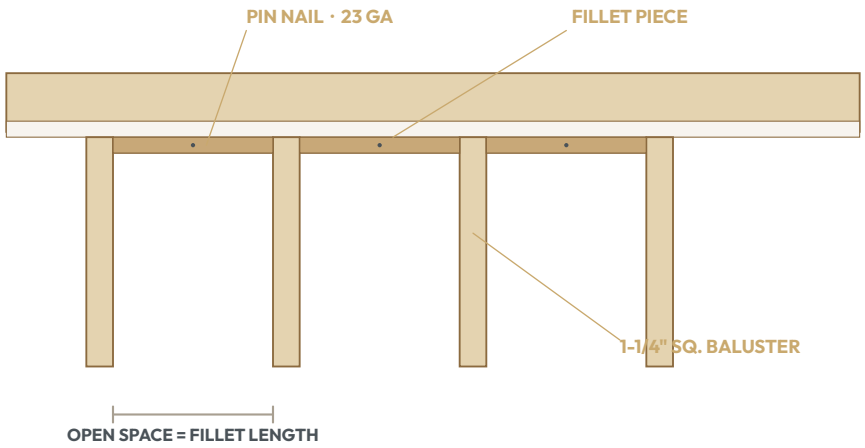
Measure the open space at the handrail (which differs from the tread space because of the rake angle on the rail). For each top fillet, the cut length matches the open space at the rail level. Apply glue to the plow, drop fillet in, pin-nail. Be especially careful with finish here — the top fillet is the most visible piece in the assembly.

> **FILLET ENDS — LEAVE THEM SQUARE**
>
> Both ends of every fillet piece are square cuts (perpendicular to the fillet axis). The baluster face is also square. The two surfaces meet with no miter — just butt joints. Trying to miter the fillet ends is a mistake; the spacing math goes off and the fillets won't lock the balusters. Trust the square butt joint.

THE PIECE THAT DOES THE WORK

Fillet *detail.*

The fillet — a thin strip of wood matching the plow width — is what makes the square-baluster system work. Each fillet piece sits in the plow between two balusters, glued and pin-nailed. It locks the baluster spacing structurally and finishes the rail underside visually. Every gap between balusters gets a fillet at the rail; matching fillets in the tread plow if applicable.



FILLET DETAIL · underside of handrail plow

PLOW + FILLET — RAIL UNDERSIDE ELEVATION

PRE-FINISH FIRST

Stain and topcoat the fillet stock in 8' lengths BEFORE cutting and installing. Field-finishing fillets in place is brutal — no brush access.

GLUE, NOT JUST NAILS

The pin nail only holds the fillet in place while the glue sets. Structural hold comes from glue between fillet face and plow floor. Skip the glue, the fillet pulls free in 6 months.

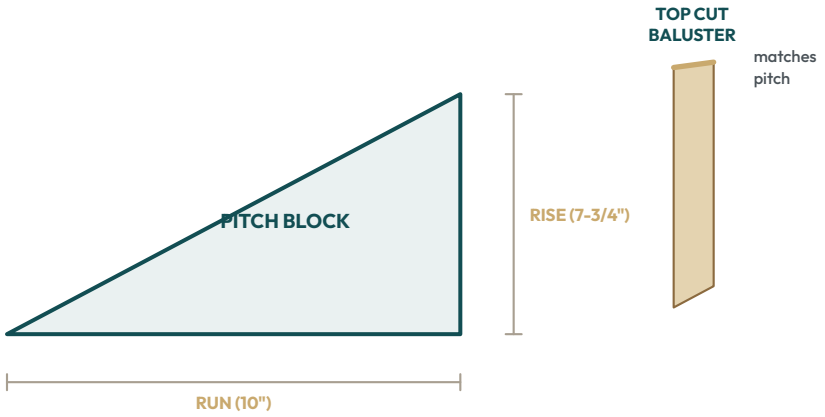
PIN CENTERLINE

One pin per fillet, dead-center, perpendicular to the rail. The pin should not show under finish — 23-ga is invisible under stain; 18-ga shows.

THE PITCH BLOCK DOES THE ANGLES

Cuts and *angles.*

Baluster cuts depend on the system. Turned balusters with fixed-length top dowels need only a square cut on the bottom dowel (if it ships long). Pin-top turned balusters get the top dowel cut square to the dowel axis (not the rail rake — square). Square balusters need a top cut matching the rail rake on the rake-run and a square cut on level runs. Same pitch block as the handrail install (from the UWP Handrail & Newel guide).



PITCH BLOCK ON MITER SAW FENCE · BALUSTER TOP MATCHES RAIL RAKE

1

Set the pitch block.

Make a pitch block from 2x scrap as in the Handrail & Newel Installation Guide — the rise (riser height) as the short leg and the run (tread depth) as the long leg. The hypotenuse is the rake angle. Place the block on the miter saw fence: long leg flat against the fence, short leg horizontal.

2

Turned bottom — square cut.

If the bottom dowel ships at full length, no cut needed — drop into mortise. If the bottom dowel needs shortening for a specific tread depth, cut perpendicular to the dowel axis (square cut, no pitch block). The dowel doesn't care what angle is below it — only the depth of seating matters.

3

Pin-top turned — square cut of top dowel.

Pin-top variants ship with an oversize top dowel. Mark the dowel where it exits the rail mortise mouth at final dry-fit position, subtract the desired seat depth, cut square (perpendicular to dowel axis) on the miter saw. Re-fit and adjust if needed.

4

Square baluster top — pitch-block cut.

For square balusters on a stair rake, the top cut matches the rail underside angle, which is the pitch. Place the baluster top-up against the miter saw fence with the pitch block beside it; cut along the pitch block hypotenuse line. The baluster top now fits cleanly into the plow.

5

Square baluster bottom — square cut.

Bottom cut is always square — perpendicular to the baluster axis. The baluster sits plumb (vertical) so the bottom needs to rest flat in the tread plow. No pitch-block angle here.

YOU WILL NOT REACH IN THERE LATER

Pre-finish *before install.*

A baluster run has 20+ balusters spaced 3 inches apart. No paint brush, no rag, no sanding sponge reaches between them once the run is installed. The only way to deliver a clean finished baluster run is to finish every piece before it goes up. Touch-up after install is for nail holes and joint plugs only — the main finish is set on saw horses.

PRE-FINISH SEQUENCE

1. Sand all balusters 120 '180 '220 on horses, in the shop or driveway.
2. Mask the dowel pins with painter's tape (turned system) — keeps glue surface raw for bonding.
3. Stain in even strokes along the axis. Wipe back to set the color tone.
4. Topcoat 2–3 coats of polyurethane, sanding between with 320.
5. Remove masking from dowels. Install. Touch up nail holes after.

IF YOU MUST FIELD-FINISH

Spray, not brush — HVLP gun on a low-pressure setting reaches between balusters where brushes can't. Spray all sides of each baluster from at least two angles.

Mask the surrounding finish heavily (treads, rail, wall). Drop cloth the room.

Result is rarely as clean as pre-finish. Consider it the fallback, not the plan.

1 *Touch-up nail holes.*

Pin nail holes (23 ga) are essentially invisible — no fill needed for most stain colors. For deeper toe-nail or screw holes at baluster bottoms, fill with color-matched putty stick after install. Wipe excess with a clean rag while still soft.

2 *Address dowel-mortise residue.*

After turned-baluster install, glue squeezes around the mortise mouth on both ends. Scrape with a sharp chisel held at high angle, sand the mortise mouth area with 220, blend with a touch of stain.

3 *Top fillet check.*

On square-baluster runs, the top fillet is the most-seen finish. Sight-check from across the room under daylight — any reflection mismatch, pin nail showing, or glue residue gets touched up here.

4 *Final wax.*

For premium installs, a clear wax over the cured topcoat — applied with a soft brush between balusters, buffed lightly with a soft cloth. Gives the run the same hand-feel as the handrail.

BEFORE THE AHJ WALKS THE JOB

Final *inspection.*

CODE & QUALITY CHECKLIST

- 4" sphere cannot pass between any two adjacent balusters (R312.1.3) — checked at the tightest layout point
- 6" sphere cannot pass at the triangular space at the bottom of the guard
- Stair guard height ≥34" from the nosings at every step (R312.1.2 — set by rail)
- Every turned baluster fully seated — no dowel visible at mortise mouth
- Every square baluster plumb (no lean)
- Every fillet glued and pin-nailed — no rattle when tapped
- All glue squeeze cleaned at mortise mouths
- Nail holes filled with color-matched putty
- No raw wood visible — pre-finish complete
- No sphere-test plug fits between any baluster pair

TROUBLESHOOTING

Baluster wobbles after cure (turned).

Mortise oversized OR glue didn't fill the gap. Re-drill mortise to next-size-up, install a sleeve dowel of matching species, glue and re-fit baluster. Or pull, refill mortise with PU foam glue, reset.

Fillet pulls free (square).

Pin nail only, no glue. Pull fillet, scrape plow clean, re-glue with wood glue, pin-nail back. The structural hold is glue, not nail.

Sphere passes the gap.

Code failure. Re-divide the run with one more baluster — pull existing balusters, re-mark, drill new mortises, re-set. Don't shim the gap to fix it; the spacing math has to be right.

Cut the wrong end (pin-top).

Pin-top balusters have a fixed-length bottom dowel — cutting it shorter is fine, but if you cut a non-pin-top model's top dowel by mistake, the baluster is now short. Use as a short baluster on a shorter section, or order a replacement.

Glue stain shows around mortise.

Glue migrated into the wood around the mortise mouth before set. Scrape with sharp chisel, sand with 220, blend with stain. Future jobs: wipe squeeze immediately with a damp rag during install, don't wait.

Top fillet sits proud of plow face.

Fillet stock was thicker than plow depth. Sand the fillet face flush with the rail underside before stain. Order matching plow-depth fillet next time.

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