by David Frane

TRANSIT TIPS

A transit is more accurate than a level for plumbing tall walls, aligning posts, and laying out trim and cabinets

CAROLYN BATES

Most carpenters frame and trim whole houses with nothing more than a 4- or 6-foot spirit level to find plumb and level. But a level is a poor tool for plumbing tall walls and columns, for laying out long horizontal runs of trim, and for aligning window heads. Mistakes made while framing walls resurface later when you frame the roof; sloppy installation of windows and doors fouls up the alignment of frieze boards and clapboard courses; and small leveling errors accumulate into major installation problems with interior trim and cabinets.

In each of these cases, a transit is much more accurate. While it may seem like a lot of extra trouble to set up a transit to do something that could be done with a level (see "Transit Basics," page 73), the finished product is never any better than the layout you worked from. Properly used, a transit will guarantee that everything you build is straight, level, and plumb.

Using Transits for Framing

On many building sites, the excavation is the last time you see a transit. That's too bad, because transits are very useful during framing.

Leveling decks. The tops of foundation walls aren't always as level as they should be. You can use a transit both to check the wall for level and to correct any errors in the concrete while framing the deck.

To check the top of the concrete wall for level, take elevation readings at all corners and at regular intervals along the wall — every 10 to 12 feet should be adequate. The difference between the lowest and highest readings tells you how much the top of the wall is out of level. Be sure to set up the transit far enough away from the excavation to get a clear view of the whole foundation. Stay away from material storage and delivery areas, because once the transit is set up and leveled, a small bump or vibration can throw it out of whack.

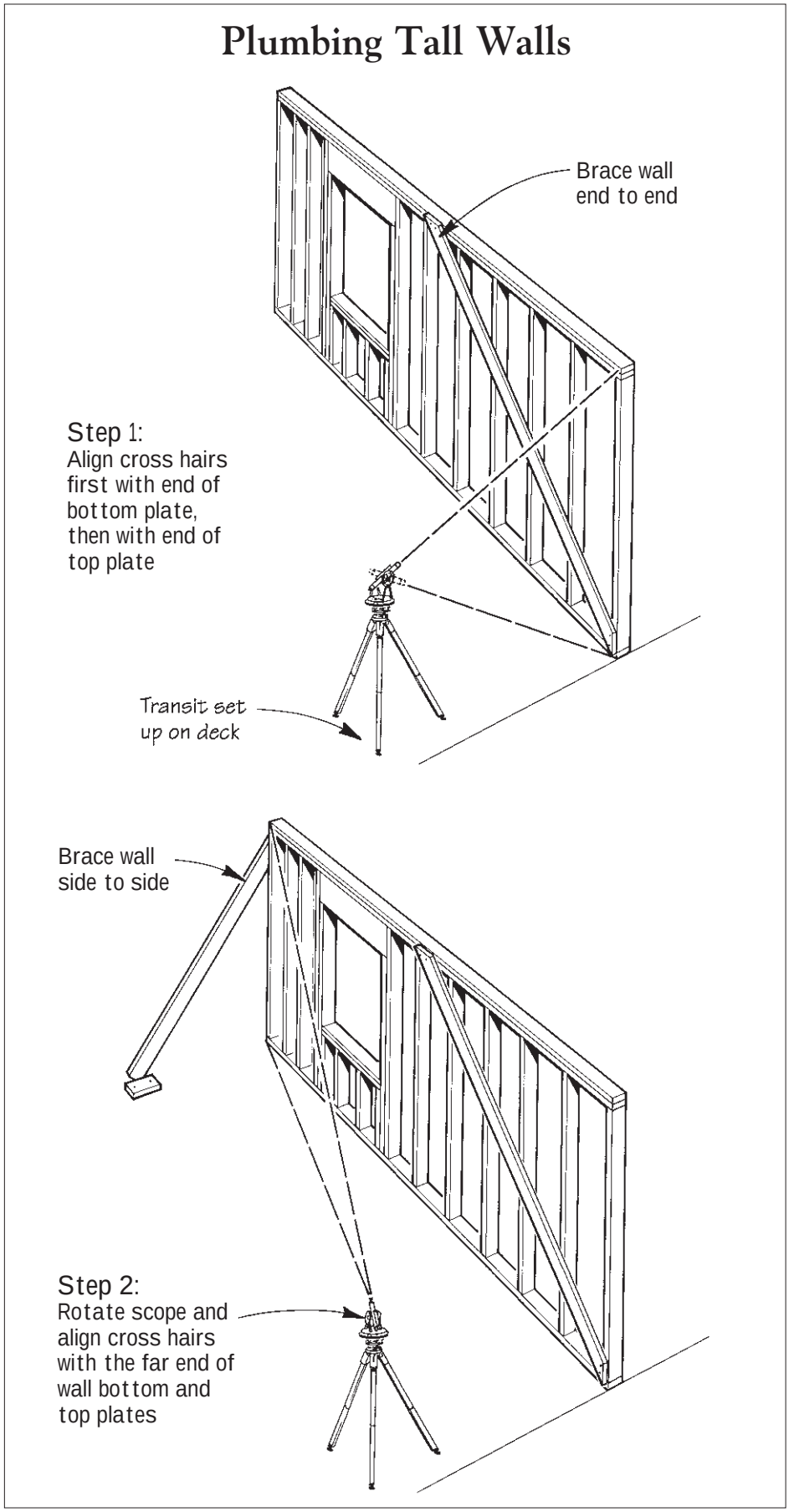

Figure 1. *To plumb a tall wall, set up the transit near one end of the wall and align the cross hairs with the end of the bottom plate. Raise the scope and jockey the wall until the cross hairs intersect the end of the top plate. Brace the wall in this position. Next, rotate the scope and take the same two readings at the far end of the wall, then brace.*

If the foundation walls are out of level by more than 1/4 inch, you can ensure a level deck by using the transit to level the joists. This would be tedious if done one joist at a time, but you can build the whole first-floor joist system without fastening it down to the foundation, then use the transit to shoot elevations at regular intervals along the perimeter of the rim joist. Once you know where the low spots are, raise each joist to the proper elevation, either by shimming between the rim joist and the sill or by packing structural grout under the sills. When the deck is level, tighten the anchor bolts and fasten the rim joists to the sill.

Plumbing tall walls. It's difficult enough to plumb an 8-foot-high wall using a 4-foot level, but bowed studs and tall walls compound the problems. Again, the transit can do the job easily. The safest way to ensure that a tall wall is plumb in both directions is to set up the transit twice. But it can be done with one setup if you pay careful attention to the details.

The procedure is simple. Set up the transit near the end of the wall (square to the end is ideal, but not necessary), and far enough away to be able to pivot the scope to sight both the bottom and top plates. (Most transit scopes will pivot 60 degrees up and down, so depending on the height of the wall, 4 to 6 feet away should be enough.) While a helper steadies the wall, find the near end of the bottom plate in the cross hairs, then pivot the scope until the near end of the top plate is in the cross hairs (see Figure 1). This plumbs the wall end to end. (If you've already squared and sheathed the wall on the deck before raising it, skip this step.)

To plumb the wall side to side, rotate the scope horizontally until the far end of the bottom plate is in the cross hairs. Now pivot the scope up until the end of the top plate is in the cross hairs. Since the transit is so close to the wall, the wall will be plumb when these two sightings match. To double-check, repeat the procedure with the near end of the wall.

Aligning columns. To align a series of columns, first snap a line on the deck through the center of all of the columns (for piers or posts in the soil, use a dry line attached to stakes). Snap a second line parallel to the first, but offset by half the thickness of the columns. This line

Transit Basics

A transit consists of a telescopic site, or scope, mounted on a pair of round horizontal plates that are usually marked with a 360-degree vernier scale (see Figure A). The scope can rotate fully around a vertical axis and can be locked at any position on the scale. The scope also pivots up and down on a horizontal axis, and can be locked at any angle. The scope has a positive stop that locks it into position parallel with the plates.

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Figure A. *A transit scope can rotate 360 degrees around a vertical axis and nearly 60 degrees up and down. When all of the bubble vials read level, a scope locked into position at zero degrees elevation will describe a level line no matter which direction it is pointing.*

The frame that holds the plates and the scope is supported by three or four "feet" that can be raised or lowered using leveling screws. The feet clamp the frame to a foot plate that threads on to the tripod. For a transit to work properly, the scope must be perfectly level when locked into position parallel with the frame. Depending on the design of the instrument, this process involves adjusting the leveling screws until the spirit level vials, or azimuth bubbles, read level. If there are two vials mounted to the base plate at 90-degree angles to each other, you can level the base plate without moving the scope. A transit with a single vial attached to the scope, however, requires a series of leveling adjustments with the scope alternately rotated 90 degrees to the starting position and back again. Check the instruction manual for the transit you are using for proper procedures.

Fiddling with the leveling screws can be frustrating the first few times you try it. Leveling the scope always requires raising one leveling screw while lowering another. To avoid confusion, remember this rule: With the leveling screws grasped between thumb and forefinger, your thumbs will always be moving either toward or away from each other. This ensures that one screw will be loosened while the other is tightened.

With most transits, the final check comes after the bubble vials read level. The usual procedure is to rotate the scope 180 degrees and check the vials once more for level. If the bubbles are out of level, you can fine-tune the vial mountings, then repeat the set-up procedure from the beginning. Again, transits differ, so consult the instructions to find out how to fine-tune the vials.

When the transit has been properly leveled and the scope locked at zero degrees elevation, the cross hairs in the scope will always be level no matter which direction you rotate the scope. In effect, you can use multiple readings to describe a level plane. Also, when the scope pivots up or down, it will always describe a plumb line.

Aligning over a point. Most transits have a plumb bob, or plummet, that hangs through a hole in the exact center of the base plate. By shifting the transit frame around on the foot plate, you can fine-tune the alignment of the plummet directly over a point or line (Figure B). This feature comes in handy when you need to project a particular point or line over a distance, as when transferring a staked reference line into an excavation. (Some transits have an optical site instead of a plummet. When the reference point below the tripod is in the cross hairs of the scope, the head is properly aligned.)

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Figure B. *The plumb bob, or plummet, attaches to the exact center of the transit frame. It can be used to set up the transit directly over a point or line.*

Stable tripod. To speed setup, always arrange the tripod so the mounting plate is nearly level. Spread the legs of the tripod wide enough to provide a stable base. Most tripods also have telescoping legs that can be adjusted to irregular surfaces.

Tripods are usually equipped with pointed steel tips that can be easily anchored in soft soil. When set up on a hard surface like rock or concrete, however, the legs can slide out of position easily if bumped. Be careful not to jostle the tripod until you've taken all of your readings.

When a transit is set up inside a building, any deflection of the floor while you are making a reading will also spoil the reference mark. Make sure the transit is on a stiff, stable section of floor. If Laurel and Hardy were making indoor transit shots, I'd make sure Laurel was on the transit; Hardy would make the floor bow when he stood by the transit.

Storage and maintenance. Transits are delicate instruments and can be easily thrown out of adjustment. When transporting the transit, always use the padded case; never transport the transit in your truck bed while it is still attached to the tripod.

The transit body should move freely. If you need to apply more than light finger pressure to rotate the transit body, don't force it; it's probably locked in position. Find and loosen the locked knob and try again.

Finally, if you ever drop the transit or give it a hard knock, have it recalibrated before using it again. Most tool repair shops will be able to do this work for you.

— D.F.

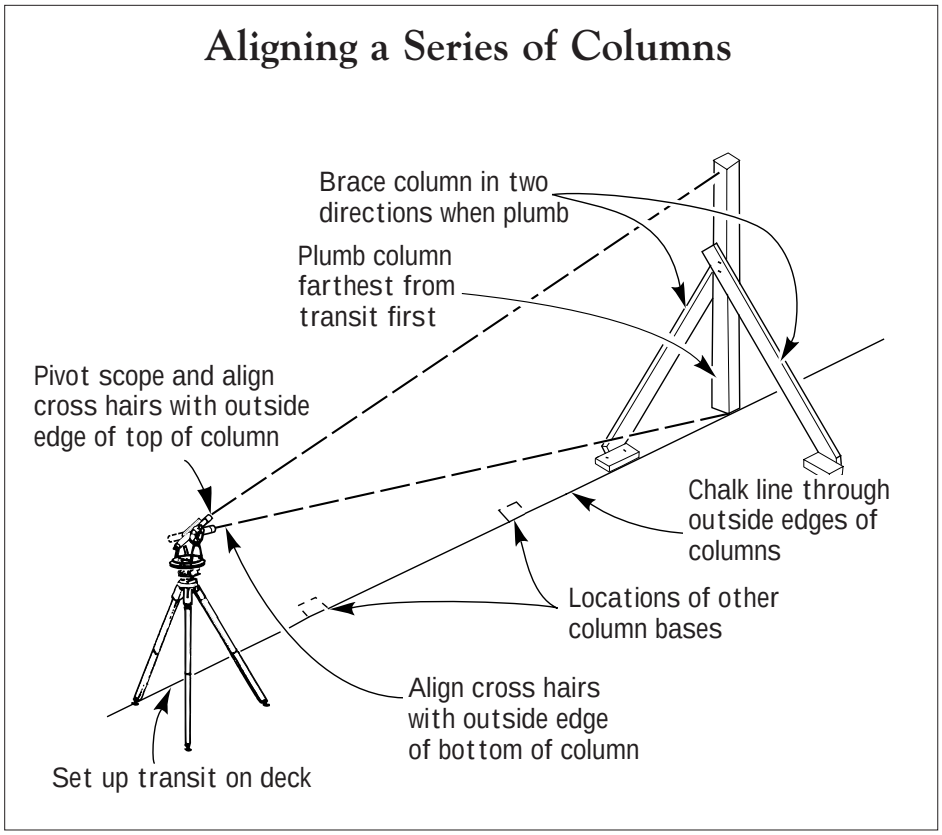

Figure 2. *To align a series of columns, snap a line on the deck to mark the outside edges of the columns. With the transit set up directly over one end of the line, align the bottom of the column farthest away from the transit with the cross hairs. Then pivot the scope to align the top outside column edge with the cross hairs. Brace the column in this plumb position, and repeat the procedure for the next column.*

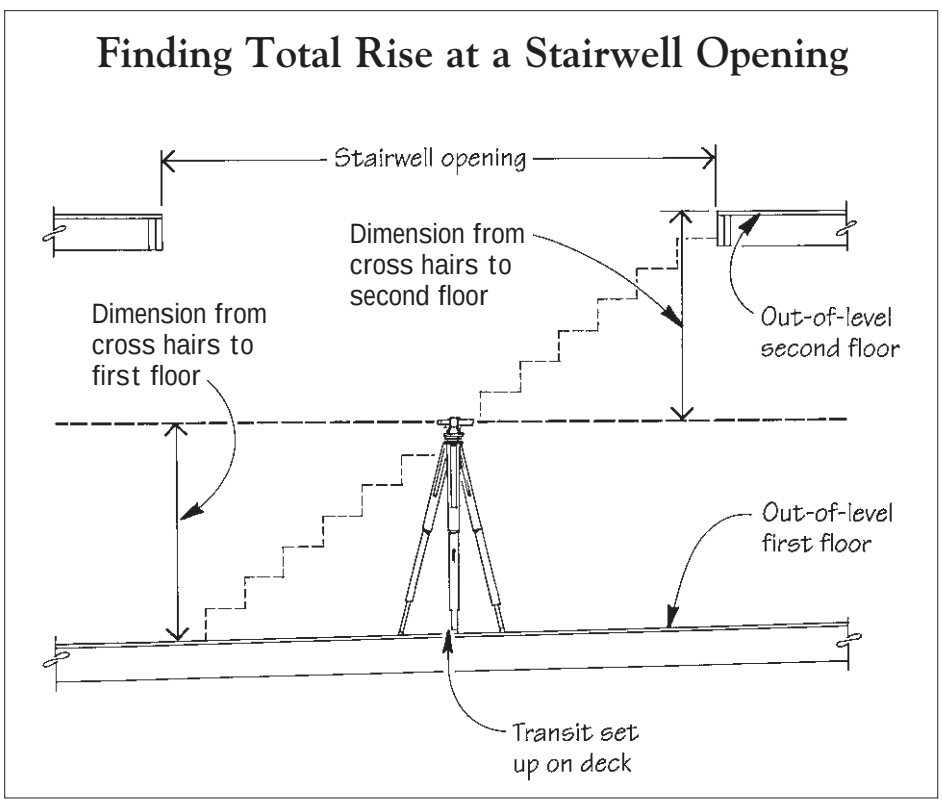

Figure 3. *To find the true total rise at stairwell openings when the existing floors are out of level, take a transit reading at each end of the opening. At the lower end of the opening, measure from the cross hairs down to the first floor; at the upper end, measure up from the cross hairs. Add the two dimensions together to get the total rise.*

should pass through the outside edge of each column. Using the plummet, set up the transit over one end of the second line (Figure 2). Adjust the horizontal plates so that as you look through the scope, you can see the chalk line in the cross hairs at every point along its length. Now lock the plate into place.

Install the column farthest away from the transit first, making sure the column's edge is over the chalk line. Pivot the transit scope until the outside edge of the top of the column is in the cross hairs. Brace the column. Repeat this procedure, always plumbing the column that is next farthest away.

Stair openings. When you frame stairs, you have to know the total rise between the floor below the bottom riser and the floor above the top riser. If one or both of the floors are out of level, however, measurements taken at the upper and lower end of the stairwell opening may not agree. Since code only allows 3/16-inch variation between risers, it's important to know how much the floors slope in each direction.

Instead of using a 4-foot level, take two readings with the transit (Figure 3). First, measure from the cross hairs to the first-floor deck at the lower end of the stair. Now measure up from the cross hairs to the second floor at the upper end of the opening. Add these two dimensions together to get the total rise.

Exterior Finish

An out-of-whack frame can make it difficult to install exterior trim and siding that's level and plumb. If you use a transit to shoot a level reference line around the perimeter of a building, you can index your story pole to this line and all of your trim will be perfect. You can also use a transit to shoot plumb lines on the outside walls of a building (to set tall corner boards, for example).

Running trim. I once used a transit to shoot a level reference line around the outside of an 18,000-square-foot house. The building was on a hill, and the perimeter had all sorts of zigs and zags in it. It took quite a few transit setups for my partner and me to work our way around the outside of the building, but we were very pleased with ourselves when we got back to the starting point and were within 1/8 inch of where we had started.

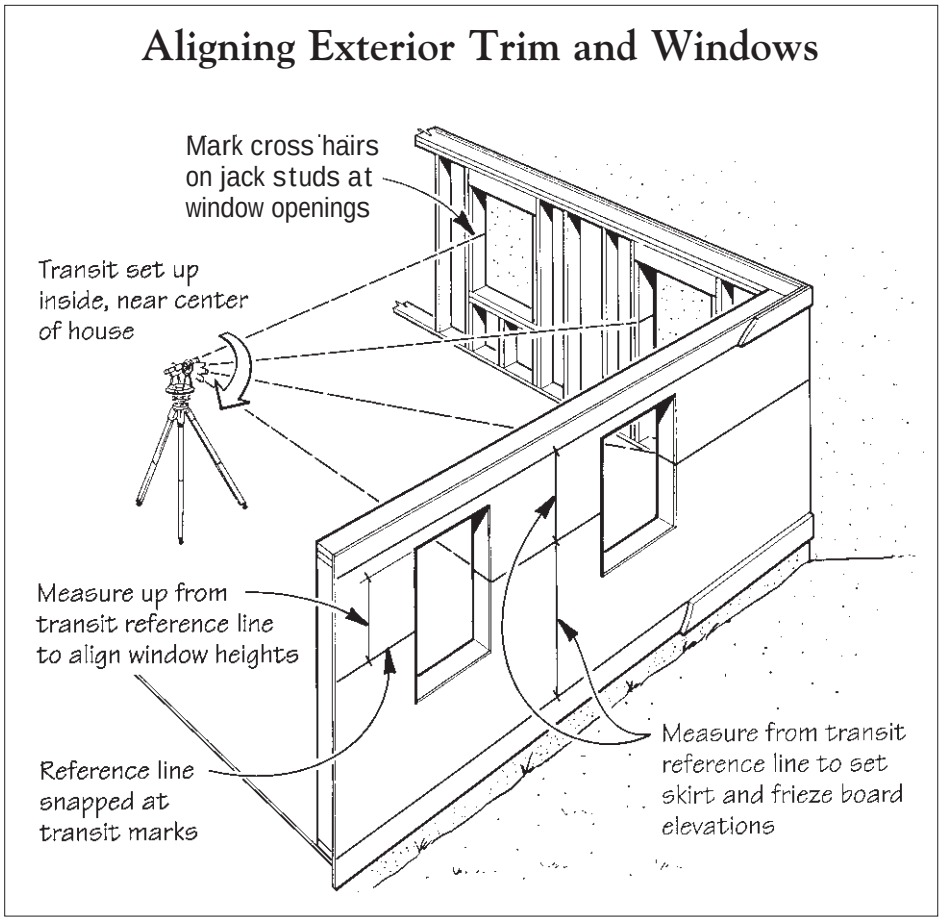

Figure 4. *To establish a level reference line for exterior running trim, set up the transit inside the house before the windows and nonbearing partitions are installed. Use the scope to project reference marks onto the window jack studs, then measure from these marks to snap a level line at the elevation of exterior trim. The same reference marks can also be used to align the heads of a series of windows.*

A couple years later, however, I found out I wasn't so smart when I saw a subcontractor use a much better method to set a level reference line. He shot it from *inside* the house before the windows were installed and before the nonbearing partitions were framed (Figure 4). He set the transit up in the middle of the house and shot reference marks onto the window jacks. He needed only one transit setup and no one had to hang off the side of the building on a ladder to take a reading.

Setting window head heights. A one-time transit setup in the middle of the house can also be used to align window heights, as shown in Figure 4. Mark the jack studs in each opening at the cross hairs, then measure off these marks to the desired window height. Set all of the windows to a line snapped through these marks and the heads will be perfectly aligned.

Interior Finish

Most carpenters set running trim, like baseboard and crown, without using a level. They assume that the floor and ceiling are flat and level and that if the trim runs parallel to either of these, it will look okay. The only time most carpenters use a level to set running trim is when they are installing chair rail or similar moldings that are set a couple of feet away from the floor or ceiling.

Unfortunately, in some houses the floors and ceilings are slightly out of level or have small undulations in them. That's why I prefer to set running trim off of level reference lines. A 4-foot level is fine for laying out trim in small rooms, but in large rooms or long hallways, the accumulated error can create problems. And flipping the level as you work your way around the room is no guarantee that you'll end up at the same height you started with. On the other hand, a long wall that requires five moves of a level will require only two shots from a transit, one at each end. It's also faster and more accurate to use a transit to lay out a room with lots of zigzags in the walls.

Dropped ceilings and soffits. In existing buildings, it's risky to build dropped ceilings and soffits parallel to the original ceiling, which may not be flat and level. A 4-foot level will work, but each time you slide the level to take a new reading, you can introduce a small error that may accumulate over long distances. A more accurate method is to use a transit to shoot a level reference line in rooms where you are framing ceiling drops. Set up and level the transit, then direct your partner to make marks where the cross hairs of the scope hit the studs. The line you snap through these marks will be level. Take all of your measurements from this reference line to ensure level soffits and ceilings.

Cabinet bases. I once worked on a kitchen that had a 25-foot run of cabinets. The cabinets came without bases and were to be set on a level site-built base. The carpenter doing the installation had only a 4-foot level, so he borrowed a 6-footer from another carpenter. Unfortunately, the level he borrowed was 1/8 inch out of whack. Bad technique made things worse. Instead of flipping the level end for end as he moved down the wall, this carpenter did the layout by making a mark, then sliding the level and making another mark, and so on. Each time he moved the level, the line got 1/8 inch higher. By the time he was done, his base was more than 1/2 inch off. It wasn't until he began to install cabinets on the base and couldn't get the tops of the boxes flush without racking them that he discovered the error. The whole installation would have gone more smoothly if he had first used a transit to shoot a level reference line.

Curved walls. It's almost impossible to lay out level lines on a curved wall using an ordinary level. If the wall is convex, only the center of the level will touch the surface; if the wall is concave, only the ends of the level will touch. With a transit, however, you can make a series of marks every 12 inches or so to create a level reference line, then measure up or down to transfer the marks to the location of the trim. ■

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