Setting stringline for slipform pavers

By **Dennis Clausen**

Accurate stringline ensures tight tolerances

Accuracy in setting stringline is one of the most important elements of a slipform paving operation. The slipformer places concrete by electronically referencing the sensor stringline for alignment and grade.

The basic steps for setting stringline are the same for all electronically controlled slipform pavers. Though setting stringline is easy, it does require patience and attention to detail. Skipping a step or performing it incorrectly can result in finished concrete at the wrong elevation or alignment.

Survey required

Grade hubs, set by the survey crew, are the most important reference guide to properly setting stringline. Grade hubs are stakes driven into the ground to serve as a reference elevation. The elevation is usually referenced from the top of the hub, but sometimes the elevation is referenced from a crayon mark or nail on the side or top of the stake.

Hubs usually are placed 3 to 4 feet behind the finished concrete and at every 50 feet along the length of the project. For accurate stringline setting, place a hub every 25 feet to correspond to typical stringline stake spacing. A nail driven into the top of the hub or some other form of reference mark on the hub represents the point over which the stringline must be set for proper alignment.

Behind each hub is a flat stake marked by the survey crew to provide the grade and alignment. The flat stakes are coded with the information necessary to set the stringline at the proper line and elevation (Figure 1). For instance, 4' TBC indicates that the hub is placed 4 feet from the top of the back curb (TBC). On some jobs, the top of the hub is driven to the elevation of the finished concrete product. This isn't practical for most jobs, so grade in- formation also is provided on the flat stakes accompanying the grade hubs.

Accurate stringline setting for both straight and radius sections is a critical step in achieving the correct elevation of finished concrete.

Level elevation with the top of the hub and the finished product is specified by a code of 0^{00}. If a cut is to be made, a code such as CO^{25} appears on the stake. This indicates that the top of the concrete is 0.25 feet below the top of the hub. For a fill, a code such as $F1^{45}$ appears on the stake. This indicates that the top of the concrete is 1.45 feet higher than the top of the hub.

The stake also can specify the location. A code of 295 + 50 indicates that the stake marks 29,550 feet along the project.

Materials and tools needed

The materials needed to set stringline include:

- 1/8-inch-diameter sensor line
- Steel stringline stakes, typically ¾ inch in diameter and 4 feet long
- Steel stringline rods, 3/8-inch in diameter by 18 inches long, with a notch to hold the stringline
- InstaJust stringline rod-clamps
- A winch to tighten the stringline

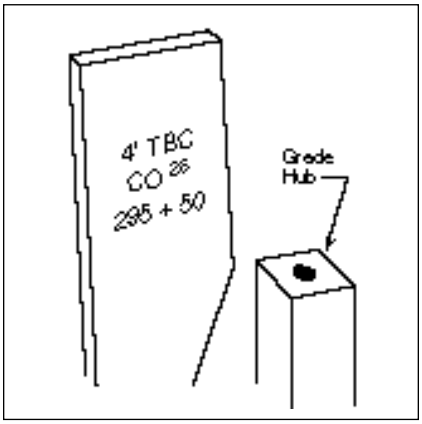

Figure 1. *The survey crew sets grade hubs and marks elevation and alignment to serve as references when setting stringline. Make sure this information is accurate. A poor survey results in a poor stringline setup.*

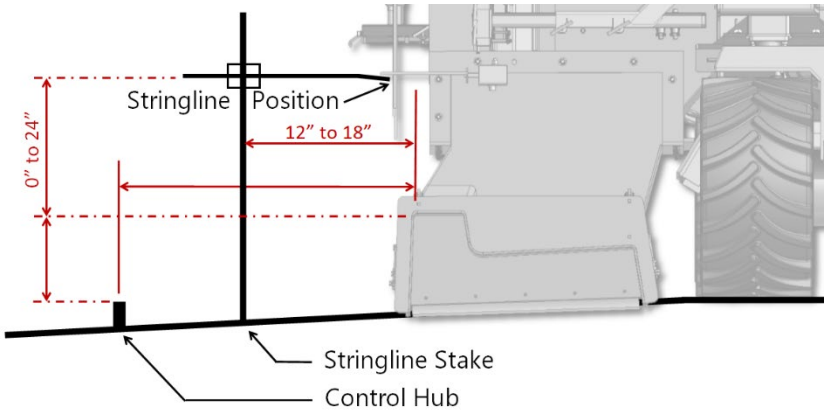

Figure 2. *Before driving stakes, plan the stringline location. Determine how far the stringline should be from the edge and the top of the finished concrete.*

Be sure to estimate the amount of materials needed for the job. For stringline stakes set at the recommended spacing of every 15 to 20 feet, 50 stakes are needed for each 1,000 lineal feet. Add more stakes to support the winch (optional-usually two stakes per winch) and to tie off the stringline at each end of every 1,000 feet. Use one winch to tighten no more than 1,000 feet of line. Therefore, for each 1,000 feet of string-line, bring 50 stakes, 50 clamps, 50 line rods, and one winch.

Besides the stringline materials, don't forget some basic hand tools. You'll need a 4-foot level, an 8-pound sledgehammer, and an engineer's rule or measuring tape.

Setting straight stringline

Determine stringline position. Don't start pounding stakes without a plan. First, decide where you want the string-line (Figure 2). Position the stringline stakes about 1 foot in-front of each grade hub. The stringline should then be 12 to 18 inches away from the edge of the concrete. Also, locate the stringline 0 to 24 inches above the top of the concrete. Within these limits, the most appropriate location of the stringline is determined by the type of pour, type of slipformer used, and site conditions.

Drive stakes. Before driving stakes, use a clamp to attach a line rod to each stake. If the stake is driven first, the head of the stake spreads (mushrooms), pre-venting the clamp from sliding down over the stake. After attaching the line rods, drive a stake in front of each grade hub. Drive the stake as vertical as possible. If stakes are not vertical, alignment will be affected when grade is adjusted, or grade will be affected when alignment is adjusted.

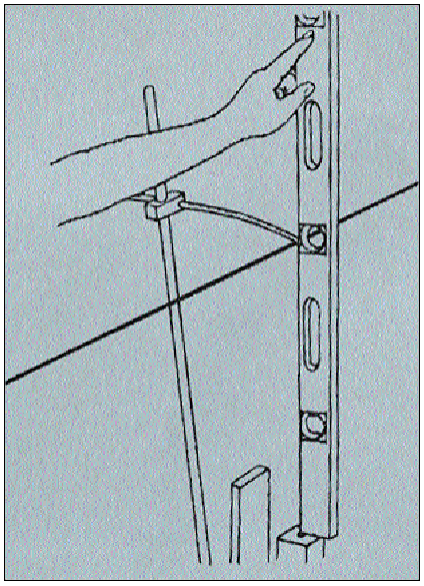

Figure 3. *Use a level to plumb the stringline from the grade hub reference. Adjust the stringline in or out by squeezing the InstaJust clamp tabs together and moving the stringline rod. Then adjust the string height in the same manner.*

If possible, also drive a stake and rod assembly 15 to 20 feet before the first and past the last grade hub. These extra stakes maintain line and grade before the beginning and past the end of concrete placement.

Set the winch. Place the winch (optional) about 4 feet in front of the first stake. To do this, drive a stake into the ground, place the hole in the winch mounting plate over the stake, and secure by tightening the set screw. Drive a second stake through the slot in the mounting plate. Set the winch to the same height as the finished string- line, then secure the winch to the stake by driving the wedge plate in tight.

Uncoil the stringline. Attach the end of the stringline to the winch drum. Winch about 5 feet of string onto the drum. Then walk down the line, uncoiling the length of string needed. Drive a stake at an angle, about 4 feet beyond the last stake. Tie off the stringline to the stake at the same height as the finished stringline. Any excess stringline can be left on the ground.

Set the stringline. Winch the stringline tight. A loose stringline affects alignment and grade. To test line tightness, grab the stringline with your hand and turn your wrist. If the stringline can be twisted more than 45 degrees, it's too loose.

Make sure the line is tight before placing it in the line holder rod. Otherwise, the line can catch in the rod notch and affect tensioning.

After the stringline is properly tensioned, place the line in the notch located at the end of each line rod. The notch is specially designed to hold the line in

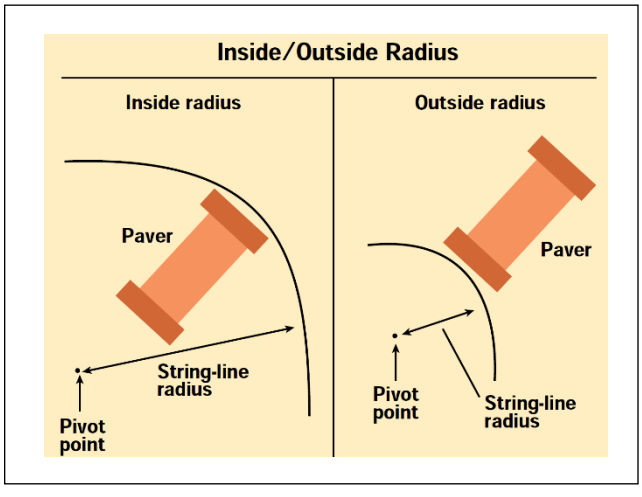

Figure 4. *The string-line radius equals the concrete radius plus the offset for an in-side radius and the concrete radius mi-nus the offset for an outside radius. When the stringline is be-tween the paver and the pivot point, it's an outside radius. When the paver is between the stringline and pivot point, it's an inside radius.*

Figure 5. *When using a fiberglass rod as a guideline for radius work, increase stake spacings. But make sure the transition between the rod and stringline is properly set.*

place. For a secure hold, make sure the notch faces the stringline.

Adjust alignment. Using a level, plumb up from the reference mark on the top of the grade hub (usually a nail) and adjust the stringline in or out as needed (Figure 3). Do this by sliding the line rod in or out of the InstaJust clamp.

Adjust elevation. The correct string-line elevation equals the desired height (offset) between the stringline and the finished concrete minus the depth of cut or plus the depth of fill. The concrete is below the top of the grade hub for a cut and is above the top of the grade hub for a fill.

For example, if a stringline offset of 2 feet is desired and the grade stake requires a fill of 0.50 feet, the correct stringline elevation from the grade hub would be 2.5 feet. If the grade stake requires a cut of 0.25 feet, the stringline would be located 1.75 feet above the grade hub.

Make final adjustments. After setting the stringline for plumb and elevation, check it by sight to locate any deviations. Also, if stakes are used between grade hubs, sight the stakes for proper alignment and elevation. Adjust the stringline as necessary.

Setting stringline for a radius

Set stringline radius dimensions. The distance from the pivot point (center of the radius) to the finished concrete is called the concrete radius (Figure 4). The distance from the pivot point to the stringline is called the stringline radius. The length of the stringline radius de- pends on whether it's an inside or out- side radius. When the stringline is be- tween the paver and the pivot point, it's an outside radius. When the paver is be- tween the stringline and pivot point, it's an inside radius.

The stringline radius equals the concrete radius plus the offset (desired distance between the stringline and finished concrete) for an inside radius and the concrete radius minus the offset for an outside radius. For example, if a string- line offset of 4 feet is desired and the concrete radius is 25 feet, the correct stringline radius dimension would be 29 feet for an inside radius and 21 feet for an outside radius.

Determine stake spacing. To set stringline for a radius, place the stakes closer together than for straight sections. To determine stake spacing, divide the radius by 10. If the radius is 25 feet, place the stakes every 2.5 feet.

Install a fiberglass rod guideline. Using 3/8-inch-diameter fiberglass rod as a guideline results in a smoother radius and allows the use of fewer stakes (Figure 5). Stake spacings can be as great as 6 feet. However, a special holder bracket must be used that slides over and connects to the line rod to hold the fiberglass rod.

To transition from stringline to radius-rod, drive a stake and line rod assembly about 4 feet before the start of the radius. This transition stake is used to change paver controls from sensing the stringline to sensing the radius-rod. Drive an anchor stake about 1 foot behind the main stringline. Place the stringline in the rod notch, adjust the line for alignment and elevation, then tie the stringline to the anchor stake. Attach the stringline to the anchor stake at a slightly higher elevation than the main stringline. The radius-rod will extend from the starting transition stake, around the radius, to the ending transition stake at the finish end of the radius. At each transition stake, where tube and stringline meet, use tape to secure the tube to the top of the string-line. Adjust radius-rod elevation and alignment, using the same procedure as for adjusting stringline. The bottom edge of the radius rod

Figure 6. *Fiberglass Radius-rod will require fewer stakes and increase radius precision.*

should be at the same elevation as the stringline. (Figure 6)

Hints to improve radius tolerances

When setting the guideline to grade, the grade elevations at the start, end, center, and quarter points of the radius should ,be known. Once the guideline is set at these locations, the remainder of the line can be sighted in. If grade elevations are only known at the start and end of the radius, use a transit to set the center and quarter points. Using the grade elevations at all these points will produce the best-looking concrete product.

After setting the guideline, take the paver for a dry run around the guideline to determine if the finished concrete radius is correctly positioned. When

pouring around a radius, the concrete will normally move toward the pivot point of the radius. It may be necessary to adjust the line slightly, in or out.

Don't Expect Perfection

According to some slipform paver manufacturers, a certain amount of concrete loss under the side of the form is unavoidable in tight-radius work because there are so many variables that must be controlled. So be realistic about the results and expect that some hand finishing of the curb will be required after the paver passes.

After gaining greater experience with tight radius slipforming, you will be able to save time and minimize handwork. Glen Miller, paver operator for Bowman Contractors, says, "We have to do a little hand-work (after machine placement) of a 2½-foot radius, but it's better than setting it by hand." Bowman's crew can finish the job in less than 5 minutes when using a machine, compared to about 20 minutes when hand forming.

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CurbDog Equipment

Stringline Position Worksheet

Distance:

A: Hub to BOC _____

B: BOC to stringline stake _____

C: Height of TOC (from hub) _____

D: Height of stringline from TOC _____

E: Percent grade _____