Earthmoving / Grade Control Options

There are three major categories of systems available to the earthmoving contractor.

1) Laser-Based Display Systems

These are generally easy-to-use modular systems that are flexible and configurable to the machine and site needs. Used for machine guidance, these laser-based systems are found in a range of construction and earthmoving applications and machines including dozers, backhoes, scrapers, skid steers, and excavators.

The systems are elegantly simple to use and understand. Some contractors start out with a digital linear laser receiver that is mounted on the front of the machine atop a heavy-duty mast. Perched at a height above the operator's compartment, a number of the receivers provide 360-degree operation. The receiver is used as a stand-alone battery-powered display system for guidance. With the laser receiver, the operator has additional valuable information needed to perform grade work faster and more accurately.

2) Laser-Based Grade Control Systems

Add proportional valve controls to the machine's hydraulics and a user interface and voilá the laser-based display system is upgraded to automatic. If these changes are combined with an electric mast option, the laser receiver can be raised or lowered from within the operator's cab, saving the operator time and effort. The signals from the laser receiver are used to control a proportional hydraulic valve for blade correction, allowing operators to grade faster and more accurately. This type of system is better suited to contractors involved in larger site preparation, such as residential and commercial site development.

Laser-based grade control systems have numerous benefits for the construction contractor, including: reduced stakeout requirements, improved material yields and faster job cycles, thus cutting cost and eliminating communication errors, rework and idle machine time.

3) 3D Grade Control

Probably the most revolutionary change in construction earthmoving has come about with the introduction of 3D grade control. The 3D system measures the X, Y and Z coordinates of the machine blade and compares that data to the preloaded digital terrain model. The design elevation and cross-slope for the current position are then calculated for the current position, and the system automatically moves the blade to the correct cut or fills position elevation and slope via the machine's hydraulics. Grade and slope information along with the blade's position is shown on the cab display. The GPS grade control systems can be precise to 30 millimeters and can enable operators to perform bulk earthmoving in a stake-less environment, using either automatic or manual blade control. When combined with an advanced tracking sensor, the grading accuracy can narrow to plus or minus 5 millimeters, which provides precise finished grade work.
Briefly then, there are two major categories of 3D grade control systems:

**GPS Grade Control** — This system puts design surfaces, grades and alignments inside the cab and enables operators to perform bulk earthworks and mass excavation in a stake-less environment. The GPS (Global Positioning System) approach takes advantage of a network of satellites encircling our planet. GPS antennas are mounted on both sides of the machine's blade. The GPS receiver on the machine computes the exact position of the GPS antennas many times per second.

**Advanced Tracking Sensor (ATS) Robotic Total Stations** - For precise finished grade work, the ATS robotic total station automatically tracks a target which is mounted on the blade of the machine. The ATS continuously measures the target's position and transmits the data to the in-cab computer, which then determines the desired elevation and slope for that position. A beneficial feature of the ATS instrument is that it has "search intelligence," which means that if the sight line between the machine and its target is interrupted the ATS quickly relocates the target automatically.

Both 3D systems provide the equipment operator with all the details of the automatic grade control system right at their fingertips. An on-board computer determines the exact position of each blade tip. It compares these positions to the design elevation and computes the cut or fill to grade. This information is displayed on both the screen in plan view, cross-section view, or text and a light-bar display. The light-bar display, used for manual operation, guides the operator up/down for grade and right/left of a defined alignment. In automatic operation, the cut/fill data is used to drive the valves for automatic blade control.

**A Number of Advantages**

Earthmoving is a requirement of practically every construction job. Advanced technology is taking design data from the office and putting it right into the machine cab, allowing operators to grade complex designs, such as vertical curves, transitions, super-elevated curves, and complex site designs - all without stakes, string-lines or paper layouts. Because the data are there in the field, the site foreman or operator can quickly set the new grade or pad elevation right in the operator's compartment, without waiting for grade stakes to be set or repositioned. Additionally, the precision afforded by these technologies can provide material savings, better job estimates, reduced rework, and when necessary, extend the work day into the night.

With the construction market becoming more demanding and competitive than ever before, contractors are increasingly turning to sophisticated machine control systems for significant process and productivity advantages, reduced costs and greater efficiency.