ENHANCING THE SPEED AND QUALITY OF PIPELINE CONSTRUCTION

GNSS Rapidly Gains Ground

GNSS, short for Global Navigation Satellite System, is rapidly gaining ground as a tool in many different areas of work. Dutch contractor A.Hak is one of the companies at the forefront in terms of incorporating this technology's many applications into its everyday operations. A prime example of a project in which A.Hak has embraced GNSS is the construction of the North-South Route, a major gas pipeline that will run from the province of Groningen in the north to the province of Limburg in the south of The Netherlands. It is a project that involves a lot of precision digging.

One of the specialities of internationally operating Dutch contractor A.Hak is laying pipelines, both above and below ground, for the transportation of oil, water and gas. The latter is the case with the North-South Route, a 48-inch gas pipeline to run the length of the country. A.Hak is carrying out the work for N.V. Nederlandse Gasunie, the Dutch gas company, whose mission is to transform The Netherlands into Europe's gas hub par excellence. The use of GNSS in combination with sophisticated technical drawings makes construction more cost-effective and less prone to delay while at the same time enhancing quality levels.

The principle

With the aid of a GNSS system, a combination of GPS (American), Galileo (European) and GLONASS (Russian) systems, one can determine any location on Earth in world coordinates. When using GNSS for pipe construction work, a piece of machinery - an excavator, for instance - will be specially equipped with GNSS devices such as a so-called roverbox (receiver), antennas, sensors and a touchscreen computer. The system is similar to an ordinary car navigation system, although GNSS is far more precise thanks to the availability of correction signals from a base station. In a car system, the GPS coordinates are combined with the data of a street map to be able to tell the driver which route to take. The GNSS system adds another layer: technical drawings of the working situation. These drawings can be uploaded to the roverbox using a USB stick or an internet connection, and can then be combined with the local coordinate system. The operator can select any line or plane on his touchscreen for executing the construction operations. This allows him to display multiple views of the area: from an overview of the total working area to an extreme close-up of a specific point.

Drawings and crane files

Technical drawings for the pipeline under construction are generated using CAD software. This is done on the basis of a digital terrain model (DTM), preferably covering the entire construction site. AutoCAD Civil3D enables designers to design a pipe system both in ‘plan view' and in ‘profile view'. Changes in one view automatically lead to the other view being altered as well. This software makes it possible to convert drawings to suitable files for the excavator with minimal intervention of GNSS supplier-specific software.

The preparatory phase of a project entails the collection of as much information about the environment as possible, which is then incorporated into a 2.5D drawing. This drawing includes 2.5D visuals of the planned pipeline, the work site lay-out, and the exact positions of temporary auxiliary structures, such as caissons, bridges and groundwater pumping systems, prefabricated sections and existing cables and pipes that need to be crossed.

Trenches and wells

At present, A.Hak uses GNSS mainly for digging trenches and for wells that are being dug while working from the surface. Because of the precision of the GNSS equipment, the amount of earth that has to be moved during digging can be minimised. But GNSS-equipped excavators can be used for other purposes too. The bucket of the excavator, which holds a sensor, can be used for recording position measurements: the operator places the bucket at a point of interest and records the coordinate, which is then saved to the roverbox. These coordinates can subsequently be extracted from the roverbox using an internet connection or a USB device.

Other applications

The information from measurements of the terrain taken before excavating can be very helpful when restoring the terrain to its original condition after the work has been completed. Conventional markers such as pylons and lines can easily get moved during the work process, and re-establishing their correct positions can be difficult and time-consuming, so knowing the exact positions of existing cables and pipes repeatedly proves to be particularly useful. Since the integration of GNSS technology into the excavators, losses incurred through damage to cables and pipelines have been significantly reduced.

Other uses of GNSS technology include fencing off the working area, constructing temporary car lanes and bridges, setting up pipe support systems, placing the initial pipe in the right direction and at the correct height, constructing horizontal drainage, and monitoring the strand placement versus the centre line during the above-ground strand welding operations - all without requiring the assistance of a land surveyor, designer and/or implementation manager.

Advantages

In most of the applications mentioned above, GNSS proves to be a time-saving system. In a world where time is money, both contractor and owner obviously benefit from any technique that shortens the overall timeframe. In addition, when working with the correct technical drawings and GNSS-equipped material, the bulk of the work can be done by operators without any assistance from the owner, foreman, implementation manager or land surveyor. Finally, due to the precision of GNSS, the quality of the pipe-laying process is dramatically enhanced; the radius of curvatures and bends, for instance, can be dug exactly as shown in the drawing. If required by the implementation manager or customer, the contractor can report whether the trench has been dug correctly within 30 minutes of its planned route. The actual trench can be compared to the designed trench before the cable or pipe is lowered into it. Any unforeseen circumstances can be reported back to the land surveyor, designer and/or constructor immediately, enabling adjustments to be made quickly and efficiently.

The future

All in all, a GNSS-equipped machine combined with a carefully prepared work plan - as a 2.5D drawing or better - is the same as having continual access to a private land surveyor, work planner and digger. GNSS is not only efficient, but also greatly improves safety and quality levels and the speed of execution.

In the near future, we will see increasing numbers of machines equipped with GNSS devices. Such devices will have been built-in from the start and will work fully integrated with the other processes. A.Hak expects these developments to change the nature of a land surveyor's and foreman's roles. Instead of being present at a single work site or within a single team continuously, their main tasks will consist of controlling, monitoring and managing systems and digital data. By using internet connections to and from the roverboxes in combination with webcams, land surveyors and foremen will be able to work on several projects in different locations at the same time - from behind their own desks.

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