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**CIVIL ENGINEERING**

**1. Benefits of GPS over other forms of equipment for measuring**

GPS stands for global positioning system, and it uses signals from satellites to pinpoint a location on the Earth’s surface. In addition to transmitting information about location, GPS can provide data about velocity and time synchronization for various forms of travel. GPS uses at least 24 separate satellites in a system that consists of six Earth-centred orbital planes, each having four satellites. It is used for determining a position (location), moving from one place to another (navigation), monitoring the movement of a person or object (tracking), creating a map of an area (mapping) and making precise time measurements (timing).

The benefits of GPS are;

* It offers a higher level of accuracy than conventional surveying methods
* Calculations are made very quickly and with a high degree of accuracy
* GPS technology is not bound by constraints such as visibility between stations
* Land surveyors can carry GPS components easily for fast, accurate data collection
* Some GPS systems can communicate wireless for real-time data delivery (time saving)
* GPS surveying can save significantly on labor costs
* Compared with the conventional method, GPS-RTK can be used to improve the efficiency of the building grid and can greatly reduce the labour intensity of the workers. A reference station has more than one mobile station, the mobile station does not require a reference station command, a single person can operate independently.
* Its graphic strength is high, can effectively improve the point reaching speed. Mesh optimization is more convenient.

**2. TYPES OF ERRORS ASSOCIATED WITH ABSOLUTE GPS POSITIONING MODE**

* **Satellite clock**: GPS position calculations, as discussed above, depend on measuring signal transmission time from satellite to receiver; this, in turn, depends on knowing the time on both ends. NAVSTAR satellites use atomic clocks, which are very accurate but can drift up to a millisecond (enough to make an accuracy difference). These errors are minimized by calculating clock corrections (at monitoring stations) and transmitting the corrections along with the GPS signal to appropriately outfitted GPS receivers.
* **Upper atmosphere (ionosphere)**: As GPS signals pass through the upper atmosphere (the ionosphere 50-1000km above the surface), signals are delayed and deflected. The ionosphere density varies; thus, signals are delayed more in some places than others. The delay also depends on how close the satellite is to being overhead (where distance that the signal travels through the ionosphere is least). By modeling ionosphere characteristics, GPS monitoring stations can calculate and transmit corrections to the satellites, which in turn pass these corrections along to receivers. Only about three-quarters of the bias can be removed, however, leaving the ionosphere as the second largest contributor to the GPS error budget.
* **Receiver clock**: GPS receivers are equipped with quartz crystal clocks that are less stable than the atomic clocks used in NAVSTAR satellites. Receiver clock error can be eliminated, however, by comparing times of arrival of signals from two satellites (whose transmission times are known exactly).
* **Satellite orbit**: GPS receivers calculate coordinates relative to the known locations of satellites in space, a complex task that involves knowing the shapes of satellite orbits as well as their velocities, neither of which is constant. The GPS Control Segment monitors satellite locations at all times, calculates orbit eccentricities, and compiles these deviations in documents called ephemerides. An ephemeris is compiled for each satellite and broadcast with the satellite signal. GPS receivers that are able to process ephemerides can compensate for some orbital errors.
* **Lower atmosphere**: The three lower layers of atmosphere (troposphere, tropopause, and stratosphere) extend from the Earth’s surface to an altitude of about 50 km. The lower atmosphere delays GPS signals, adding slightly to the calculated distances between satellites and receivers. Signals from satellites close to the horizon are delayed the most, since they pass through the most atmosphere.
* **Multipath**: Ideally, GPS signals travel from satellites through the atmosphere directly to GPS receivers. In reality, GPS receivers must discriminate between signals received directly from satellites and other signals that have been reflected from surrounding objects, such as buildings, trees, and even the ground. Antennas are designed to minimize interference from signals reflected from below, but signals reflected from above are more difficult to eliminate. One technique for minimizing multipath errors is to track only those satellites that are at least 15° above the horizon, a threshold called the "mask angle."
* **Selective Availability:** Selective availability (SA) was the intentional error introduced by DoD to make sure that no hostile forces used the accuracy of GPS against the US or its allies. On May 1st, 2000, the White House announced a decision to discontinue the intentional degradation of the GPS signals to the public. Civilian users of GPS will be able to pinpoint locations up to ten times more accurately.