iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VI **Month of publication:** June 2021

DOI: https://doi.org/10.22214/ijraset.2021.35235

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

To Study the Effective Utilization of Total Station, GPS, Laser Scanning Equipment

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Abstract: ***In a budget of Fy2020 Indian Construction sector adapted special place in it , There is rapid growth and implementation of new technology in infrastructure has been seen. Restrained development in sector of survey and analysis which is backbone of civil engineering is also observed. Use of highly precise and more rapid electronic instrument in field of surveying has shown upper hand over the conventional technologies. Following research deals with the implementation and user interference of newly adapted tools correlative to the old one. Till to date the cloth or metal tapes, surveying chains were used to measure rectilinear or linear intervals while 30' or 20' theodolite is used to carry out horizontal as well as vertical angular measurements. While most of levelling task of cutting or filling or gradient drawing were made with help of dumpy level and staff. But prime trouble of working on such traditional tools are very time-consuming, laborious and have chance of instrument or human error due to defective calibration. So for Precise and accurate work modern equipment are preferred e.g Total station, GPS, electronic compass. Thus following research deals with study of such few modern tools.***

Keywords: Conventional Tools, Modern technology, total station, theodolite , accuracy, precise measurement, Global Positioning System

I. INTRODUCTION

Due to weather change or visibility due to poor air quality satellite navigation is get difficult in urban areas and due to the high rise buildings the quality of signal also get weak sometimes thus leading to error in accuracy of the position of the point thus the technological development in the GPS system is certainly the need of the todays world. Due to lack of research and development most of these instrument were imported. Also special type of skilled operator is needed to handle such instrument. The following research deals with the studying and analysis of such instrument and inlisting the key factors for selecting the appropriate instrument among the chosen , Case study of a local site in Pune has been considered too as infrastructural development has been seen in Pune region for last few decades.

A. Background

The following research has been made over three key instruments , A total station, GPS and TLS (terrestrial laser scanner) they are being studied on the basis of there Accuracy , precision and least counts and there limitations. Surveying has offered great assist in growth and development of infra-structural revolution it's the core of civil engineering for century. There are basically two types of surveying geodetic and geometric surveying in geodetic surveying the curvature of earth is considered and vice versa. Dumpy levels, level tubes and compass these types of traditional tools are now being replaced by the newly developed and advance Auto-level, Total Station and electronic distance measuring devices with GPS devices assisting it for more precise and hurdle free work. In past all these techniques are being used singularly which could be time consuming process but in recent times all these system or instrument of surveying used in combination to get precise and error-free Measurements taken on field thus saving time , cost and laborious tasks .Results from such tool varies the accuracy desired. For example marine navigating need extremely precise and accuracy in surveying such as hydrology and marine engineering combined with surveying location of tides and ocean base depth as small error in calculation can change the navigating path hugely. Overall we can say that the combination of various surveying technology are necessities of todays world for precise and accurate work establishment for making overall work cost-effective and efficient as much as possible. Well here accuracy is defined as the maximum possible efficiency obtained from the instrument. While precision is the recurring value that comes to closest as possible to the previous one and consecutive values. Exactness of tolls like gps and total station depends on the measuring accuracy of the tool and measurements obtained with least errors for example the global positioning system have the problem of Signal strength, Hardware setups, weather , Array continuity ,lag in transmission and receiving units can cause the extreme differences in the output signals. Similarly the coordinate errors, local attraction , visibility issues , Continuity of grids are the some problems related to the total station workouts.

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In geodetic surveying the earths curvature is taken in the consideration so there is limitation of the ranging distance as the straight horizontal distance get limited by the curvature of the earth. While the signal strength , sighting angle , and laser scanning of receiver of the laser distance measuring devices affects its accuracy i.e if the angle measured at 90 degree gives more accurate result than the angle measured at oblique angle. And the results from device in thousands of points as a output are difficult to intercept .Thus overall each system has its limitations and the pros for different scenario.

B. Problem Statement

Survey is determining the position of Point relative to each other while calculating angular measurement in three dimensional view with help of various tools and equipment. In the following research the three such tools or technology are studied in depth as we know the global positioning system can find the position of any point on earth easily but when it comes to urban areas due to lack of visibility due to air pollution or the high rise buildings locating such points become hectic and errors get involved thus affecting the 3D output data while in case of laser scanner we get data in terms of points which is huge in number thus handling such complicated data output is difficult and labours thus to overcome these difficulties it is very important to minimise the data quantity output and hence minimising the data output maximize the accuracy of measurement. In case of Total station it can locate single point coordinate with optimum accuracy, the system locates the position with respect to zinuth or datum line which is basically a reference line but if the survey is geodetic then sighting distance, Weather, local attraction and calibration of the device affects the result. Thus studying these flaws our investigation will carryout contrast between all three techniques in term of time requirement, output and accuracy of result.

C. Objective of the research

The prime objectives of our research is to evaluate and contrast between available technique i.e. Total Station, global Positioning system and lesser scanner and then determining the pros and cons of the devices. Key feature of objectives are as follow.

1) To Evaluate the accuracy of guidance network which provides reference output RTK & TLS
2) To determine the accuracy of global positioning system and compare it
3) Cost and time expenditure for all three system
4) To Contrast between all three techniques on the basis results obtained
5) To give scope of future based on conclusion made on observation

II. OVERVIEW OF SURVEYING METHOD .

A. Laser Scanning

The Laser scanning is the method of printing the surface printing directly on basis of scanning made with optimum efficiency. Even though the laser technology is three decade old system there hasn't been significant amount of development in the technology until mid 90's. In laser technology the surface points with different shape and sized terrain is imprinted in the form of binary data as an input and then its converted to the 3d image display or 2d drawings it basically the technology of surface mapping the major benefit of such technology is , it can process the numerous amount of data in single instant with high precision thus reducing overall time requirement. In laser scanning number of pictures are taken on different angles such as perpendicular or oblique angles thus helps in determining the depth of the surface. Hence all the scanned pictures are integrated to form a singular 3D image e.g. the Leica HDS0250 Scanner is used for scanning the image of the different angles with optimum vision capacity of 40 degree by 40 degree. It has great accuracy of 4mm for single point scanning while have 6mm accuracy of angled multiple point scanning. It can pan image upto the 360x195 size. It has tilt mounted mirror image to capture Images at any desired angles with tilt mount imbedded. Thus HDS0250 has high accuracy and precision for fixed scanning as well as elevated field covering when the tripod cant be integrated with the device. Thus making an ideal device to maximise angle of capture and scanning capacity. The device can be categorised on the basis of time requirement to scan, rate of data structuring and panning of lenses, viewing capacity based on the number of points captured and there accuracy.

B. Total Station

Total stations are electronic optical distance measuring devices that use the terrain and man-made features used to survey the terrain (they are also sometimes used by other interest groups such as archaeologists, engineers, and others). Total stations have been developed from theodolites (accurate instruments for measuring horizontal angles and It can still be thought of as an electronic theodolite integrated by a distance meter with a distance of one meter capable of calculating slopes and distances from a particular point of view and measuring different mapping and local locations. Following figure shows the total station.

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Fig. 1 Total station

In our research Lieca Model of total station is observed which is shown it the above figure, To give a little idea of how well positioned accuracy is maintained with angular accuracy at this level, a rule of thumb is that the arc has a 1 cm error at a distance of 1 second 2000 meters, so the total angular error of 1 second when measuring a point at a distance of 2 km from the instrument. The station of the station will be 1 cm. A 10 second distance of the arc instrument will achieve the same accuracy at a distance of 200 meters. In total station the measurement of two distinct point can be determined correlative to each other as long as the line of sight is clear for any obstacles the maximum ranging distance for TS is 2km and angular measurement for the two distinct point can be also find out by use of three coordinate system ie x,y,and z relative to the reference point whose elevation is known from the datum. Due to development in science and technology newly developed total station can be used autonomously reducing chances of error, for accurate and precise surveying following key elements are to be taken into account are following

1) The whole device system should be properly levelled and the centre should aligned correctly
2) Device should be maintained and calibrated periodically for optimum accuracy
3) To eliminate the error precise readings should be noted in recheck procedures.
4) For some calculations to eliminate error due to local attraction average angular should be measured upto 3 decimal for accurate results

In Leica model the instrument is setup with automatic target intercepting system as in many electronic distance measurement devices (EDM) they are equipped with laser and prism system when such system are used in road project or infrastructure with reflective or shiny surface finishing it tends to reflect the incoming rays from EDM , Thus in given system ATD helps to precise measurement of angles and distances automatically.

In above model of total station operator don't have to worry about the correct alignment of prismatic bisector and receiver as the whole task is done automatically by tool itself , thus saving time and labours task.

C. Global Positioning System

Fig2.GPS reicever

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The above figure 2 shows the GPS receiver which tends to receive the final output signal from transmission device in the form of electromagnetic ultraviolette waves which are directly transmitted by satellite roating around earth upto precision of few mm. But such the wave have to travel through stratosphere of earth which is occupied with different gases thus wave could refracted or there integrity gets affected by the atmosphere causing error in exact location of desired point. To overcome such flaws the reference line between two point with receiver on each point relative to each other is measured on same set of satellite so that atmospheric effect on transmitted waves is get eliminated. Distance between these two points decides the accuracy of location with identical set of receiver. Accuracy also may get affected by path of satellite, solar waves, number satellite interacted, wavelength of signal and ambiguities.

III.COMPARISONS

A. Total Station and Global Position System

Even though both system show great performance in surveying each system has there flaws, But traversing by total station can be obstructed by the obstacle between two inter-visible points which GPS can manage anyway despite of any obstacle. Generally in survey of large mass station point are often at large distances thus limiting the capacity of Total station over GPS. Thus GPS make work Less-Hideous and timely without interrupting survey line of work. The following table shows the contrast between GPS and TS

TABLE I

Total Station	GPS
3D coordinates indirectly acquisitioned	3D points are directly Acquistioned.
horizontal as well as vertical precision are good.	horizontal precision is good as compared to vertical precision.
Type of prism, angle and distance affects the accuracy of device	Precision depends on number of satellite, path of satellite, atmosphere and wavelength.
More accurate	Less precise
independent of Satellite	Dependents on Satellite for accuracy
Needed inter-visibility between the instrument and the prism.	Not needed.
Only surveyed in Day light	Can be surveyed in Day or night time

From the table it is clearly understand that without inter-visibility Total station cant be used while GPS is the key for surveying on any terrain with any obstacle while GPS can be utilised in bad weather or more precise location is necessary.

B. Total Station and Laser Scanner

Laser scanner is device used to locate the position numerous point in the form of binary data , in surveying these points define the location of point on surface in 3D format while the total station is single point coordinate system of surveying, following table shows the differences between the both systems.

Table II

Laser scanner	Total station
Multiple point measurement	Single point measurement
Can be surveyed in Day or night time	Only surveyed in Day light.
Vertical precision is good as compared to horizontal precision.	Better precision in both directions
Precision depends on length and angle to be measured	Type of prism, angle and distance affects the accuracy
Heavier due to setup	Light weight thus Easy for transportation

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IV. RESULTS

From the current research in the end it will lead to deep understanding the pro and cons of each of distinct system of surveying (Total station, Laser system and GPS) helps in understanding there advantages and disadvantages thus assisting one the exact need of device according to location and precision needed. Following observations are made from our study

A. Total station of specifically studied of model Lueica needs periodic maintenance so that tool could be calibrated to start accurate work as if device is not calibrated then it cause bubble tube to make error in level of instrument and damaging the accuracy of device.
B. It is necessary to calibrate the mentioned tools before start of surveying for optimum precision
C. The type of work which requires error free and precise leveling or surveying work so that output from such work can be used as the reference , we suggest use of TS rather than GPS.
D. Establishing a grid of reference line singularly is hideous and time consuming task and it will cause errors in tracing and surveying thus we suggest to carryout work in group so that distributed work have optimum accuracy.

V. CONCLUSION

All the studied equipment have there different advantages for different types of work based on working capacity, accuracy, efficiency and workability we differentiated the all three tools i.e Total station, GPS and Lesser scanner. Contrast between global positioning system and Total station is made based on RTK Guidance network while contrast between Total station and Lesser Scanner is made based on L-Type building based in Stockholm in Sweden. From study and research made on these tools we can conclude the following points

A. With the help of total station fourteen points of control were marked over the ground co-relative to each other with very high accuracy upto 3 decimals which can act as reference line
B. The outcomes from laser scanning done over the same grid of network are compared against result obtained from the Total station of Lueica brand.
C. Finally the comparison between total station and fascade by surveying the L-shaped building in Sweden has made to find out the co-ordinates of location based on that the results were compared based on time expenses, and rate of accuracy and the method is recurred for five times for achieving maximum accuracy. The output from the contrast are then established upto 3rd decimal to achieve précised comparative result for both horizontal and vertical points. On the same control points we get standard deviation of 8mm in horizontal and 1.5mm in perpendicular direction is observed.The result are differentiated by very minute value while for RMS its 9mm in linear direction and 22mm in perpendicular direction

VI. ACKNOWLEDGMENT

I would like to thank you my guide and other regarding faculty for remarkable guidance

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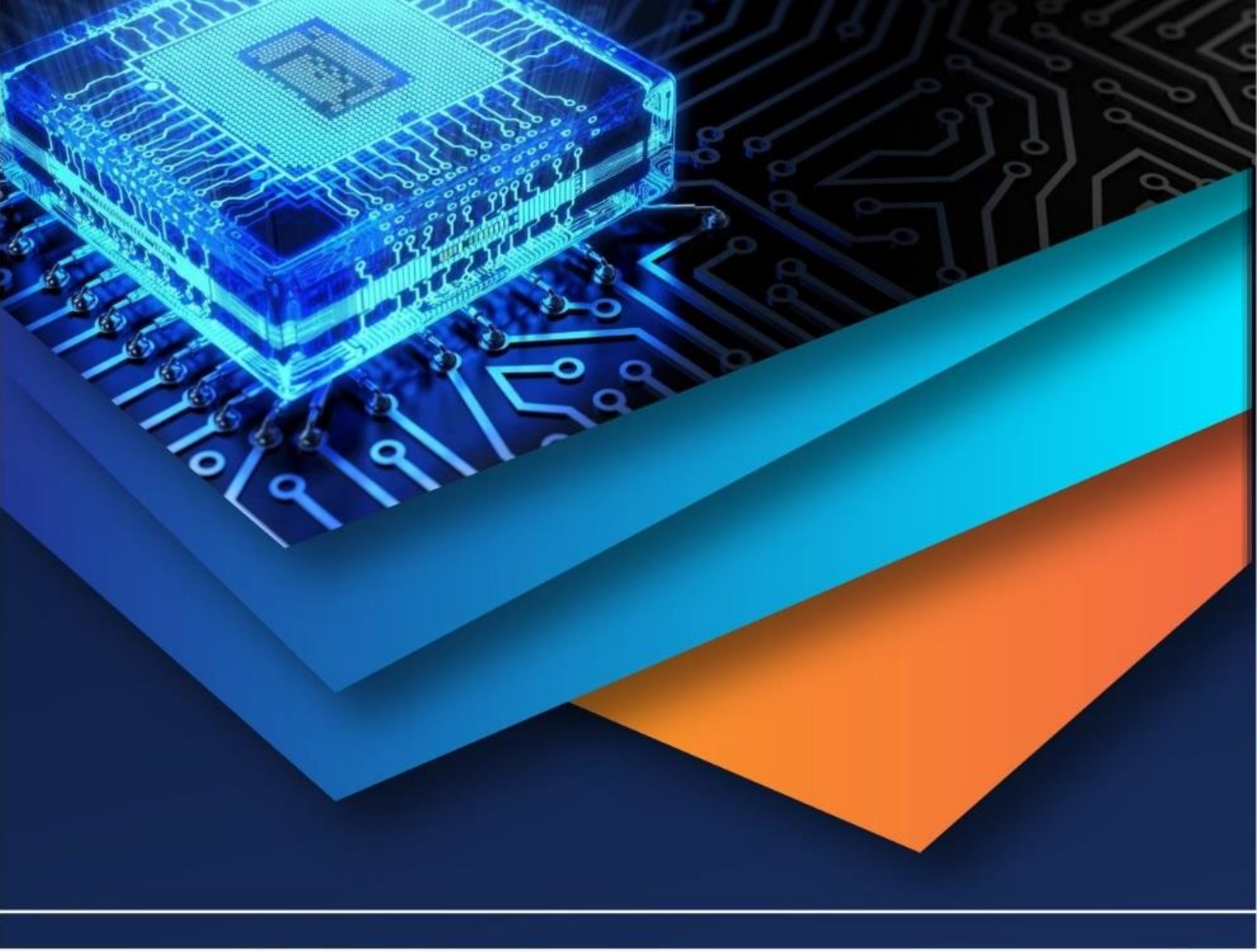

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