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3D Presentation for Baghdad University Buildings Using Total Station Device

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Abstract

Many instruments and systems are available for engineering surveys. The total stations are capable of the measuring with a high degree of precision in a single instrument. Total stations device are used for station setting up, setting-out many points from one station.

Their major purpose of this work is to take advantage of total station for setting up building and to establish 3D representation using AutoCAD program.

The area of the study was Civil Engineering Department at Baghdad University campus AL Jadiriyah. The completion of the work is done in two stages;

1. ***The field work: In this stage, the Total Station Nikon Nivo-5C was selected for the current study. This device was measured horizontal and vertical distance, elevations, and coordinates from a single set up. This data directly stored on memory.***
2. ***The office work: In this stage, AutoCAD program is adopted for design and establish 3D representation of the building to be completely faster and easier.***

Finally, AutoCAD models provided the basic building information such as boundaries, dimensions and positions. This method is used for construction surveys, designer works and other users.

Keywords: Total station, AutoCAD, setting up, 3D, building, positions

تمثيل ثلاثي الأبعاد لبناية في جامعة بغداد / مجمع الجادريه

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الخلاصة:

هناك العديد من الأجهزة تستخدم للأعمال المساحية ومنها الآن جهاز محطة الرصد المتكاملة حيث يوفر قياسات دقيقة والعديد من الإمكانيات باستخدام جهاز واحد. وهذا الجهاز شامل للقيام بكافة الأعمال المساحية مثل رفع العديد من النقاط وتوقيعها أو تسقيطها من نقطة واحدة. الغرض الأساسي من استخدام هذا الجهاز في عملنا هو لتحقيق الفائدة من استخدامه لتمثيل البنايات بأبعادها الثلاث وتمثيلها بموديل يرجع له المستخدم . منطقة الدراسة هو قسم الهندسة المدنية جامعة بغداد في مجمع الجادرية.

يتم تنفيذ العمل على مرحلتين:

١. *العمل الحقلي*

الجهاز المستخدم Nikon Nivo5C . الجهاز يقيس المناسيب،المسافات،وإحداثيات النقاط. ميزة استخدامنا لهذا الجهاز غيره عن بقية الأجهزة لأنه يعمل بنظام Windows حيث يخزن المعلومات في الذاكرة بعد إدخالها مباشرة بصورة رقمية ولأنه يعمل بعاكس وبدون عاكس.

٢. *الحسابات المكتبية :برنامج الأوتوكاد لتمثيل البناية 3D وبشكل أسهل وأسرع. النموذج الذي نحصل علية يمكننا من اعتباره مرجع بتسجيل كافة التفاصيل. يستفاد من معلوماتنا المهندس الإنشائي والمصمم ولأي مستخدم بصورة عامة.*

1. Introduction

Traditionally, theodolites, levels and tapes are still used on site. The visible outputs have usually been via the medium of drawn topographic plans. The users had manually investigated these plans for their required purposes [1].

Many instruments and systems are now available for engineering surveys. The total stations are capable of measuring angles and distances with a high degree of precision in a single instrument and reading all measurements digitally. The angles and distances may be used to calculate the coordinates of actual positions (Northing, Easting and Elevation) of surveyed points, or the position of the instrument from known points, in absolute terms. The data may be downloaded to an external computer and application software will generate a map of the surveyed area [2].

2. Total Station Device

Total station is an electronic/optical instrument used in modern surveying. It is designed for measuring of distances, locations of any point, horizontal and vertical angles and

elevations in topographic and geodetic works. As shown in **Figuer.(1)** [3]. A total station is a theodolite and an electronic distance meter (EDM). If it is not located over the known location, then a minimum of two known locations are needed in order to be able to calculate the exact position of the total station. By using this instrument, the surveyor is able to do their job quickly [4].

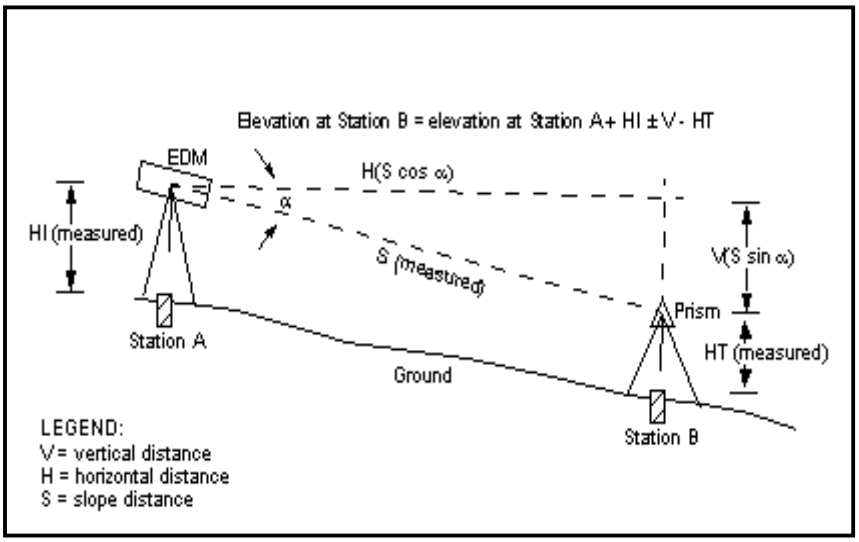

Fig .(1) Geometry of Total Station Device.

2.1 Advantages of Total Station Surveying

- Relatively quick collection of information
- Easy to perform distance and horizontal measurements with simultaneous calculation of project coordinates (Northings, Eastings, and Elevations).
- Layout of construction site quickly and efficiently.
- Digital design data from CAD programs can be uploaded to data collector.
- Daily survey information can also be quickly downloaded into CAD which eliminates data manipulation time required using conventional survey techniques [5].

2.2 Detail Survey (Locating Position)

This method will most probably be:

(a) by distance and bearing method using a total station.

(b) by GPS using kinematic methods.

Considering method (a). As shown in **Figure. (2)**, a total station would be set up over a control point whose coordinates are known as ‘a’, and back-sighted to another control point ‘b’ whose coordinates are also known. Depending on the software on board, the coordinates may be keyed into the total station. Alternatively, the bearing of the line ‘ab’, computed from

the coordinates, may be keyed in. Assuming the topographic position of a road is required, the total station would be sighted to a corner cube prism fixed to a detail pole held vertically at (P1), the edge of the road. As shown in **Figure. (2)**.This process is repeated for the remaining points defining the road edge and any other topographic data within range of the total station **[6].**

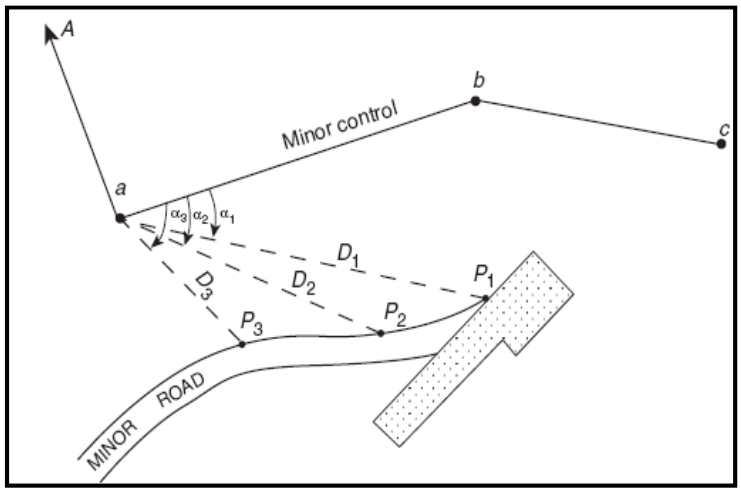

Fig .(2) Detailing by Distance and Bearing Method.

2.3 Mapping and Setting Out

The purpose of this stag is to locate the boundaries of the works in their correct position on the ground surface and to define the major elements. In order to do this, two control points must be established on or near the site. Total Stations offer many advantages for almost all types of surveying. They are used for topographic, Hydrographic, cadastral, project and construction surveys **[٤].**

2.4 Base Lines

A baseline is a line running between two points of a known position. Baselines can be simply two specified points joined; they can run between two buildings, they can mark the boundary with an existing building/development or they can mark the center line for a new road **[6].**

A baseline is suitable for small sites where referencing back to the baseline for all the works is possible. In the example, point A of building X is set out by taping dimensions 1 and 2 from the baseline and point B is set out by taping dimensions

3 and 4. As shown in **Figure.(3)**. The dimension A B is then checked against that required. The remainder of the building can be set out from the base line **[6].**

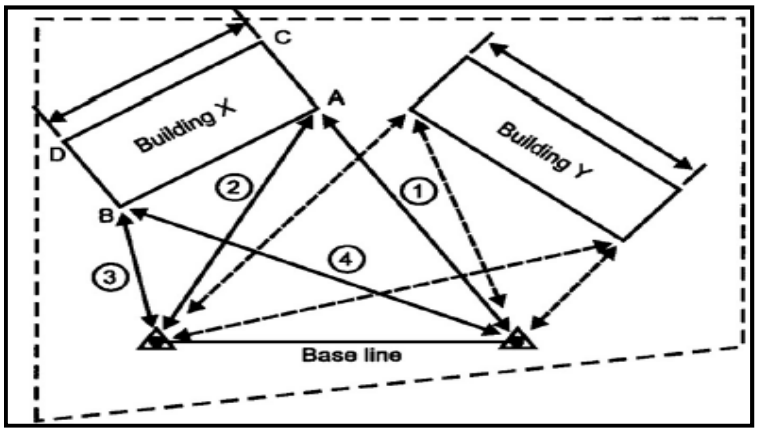

Fig. (3) Baseline with Buildings.

3. Experimental Work

The main task of this study is to introduce the total station technique and AutoCAD software for representation 3D buildings. The area of the study was Civil Engineering Department at Baghdad University campus AL-Jadiriyah. As shown in **Figure.(4).**

Fig .(4) Satellite Image of the Study Area (Google), 2014.

3.1 The Field Work

Survey data collected quickly, accurately and efficiently in the field using Total Station. The Total Station Nikon Nivo-5C was selected for the current study [٧].

Horizontal and vertical distance components, elevations, and coordinates were computed and displayed the results on a digital screen. Because the coordinates of the occupied station

and a back sight station were inputting to the system, the coordinates of the sighted point are immediately obtained.

The work flow process for collection the positioning of the buildings is made up of four steps:

(a) Recording Survey station (GCPs of two points near building that setting up).

(c) Data Collection (surveying setting up)

(d) Measuring the height of building.

(e) Presentation 3D model using AutoCAD Software 2012.

3.1.1 Recording Survey Station

Survey stations were represented with the Ground Control Points with known coordinates (X,Y,Z) obtained from maps of the Baghdad University with respect to the geodetic system. Then, locations of the two GCPs of the base line were recorded. As shown in **Figure.(5)**. The coordinates of GCPs are illustrated in **Table (1).**

Fig .(5) Locations of the Two GCPs in This Work.

Table .(1) The Ground Control Points Coordinates.

GCP I.D.	Northing (m)	Easting (m)	Elevation (m)
11	3681701.343	441858.940	36.255
12	3681109.611	441702.700	36.185

3.1.2 Data Collection (Surveying Setting Up)

The principle of the surveying set up method using total station is represented that given the coordinate of the instrument position (survey stations) and a back sight station, the coordinates of any other point can be computed. The angles and distances were used to calculate the coordinates of actual positions (Northing, Easting and Elevation) of surveyed points.

3.1.3 Measuring the Height of Buildings

The process of finding the height of objects without actually going to the top of the object is known as Remote Elevation Measuring (REM). As shown in **Figure. (6).**This feature measures the elevation of a point where a prism cannot be placed directly.

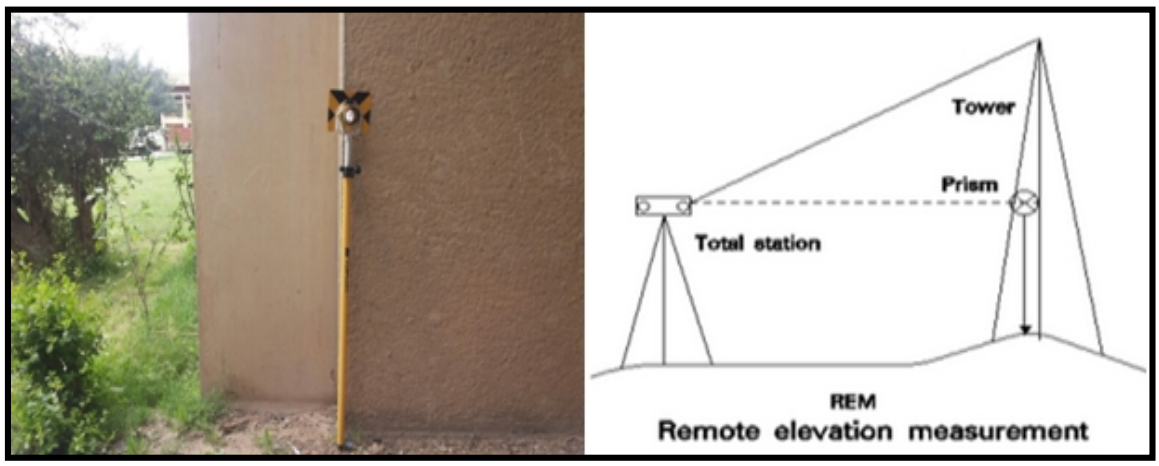

Fig .(6) Measuring Heights with Total Stations.

3.2 AutoCAD Interface

AutoCAD is a very powerful application for drawing; it contains all the tools that needing. AutoCAD using to plot a list of coordinates (X,Y, and Z) that collecting on the field with a total station [^].

3.2.1 Import Data

Microsoft Excel has become a standard for importing tabular data. It offers several formats and ways to read/import information. X,Y,Z Coordinate were directly putting in AutoCAD without having to do it one by one.

Table (2) Lists positions the corners of the building of civil engineering department. The local coordinates system as measured using total station device Nikon Nivo-5C. Results as agree with [1].

Table .(2) Positions of The Points.

G	F	E	D	C	B
	No.	**Northing (m)**	**Easting (m)**	**Elevation (m)**	**Building Height (m)**
	1	441668.786643	3681220.124713	36.936354	
	2	441668.127620	3681226.399681	36.926811	
	3	441666.813427	3681237.589642	36.940314	
	4	441680.610646	3681263.350496	36.926707	
	5	441679.784375	3681272.674341	36.945772	
	6	441662.876491	3681280.346231	36.707903	
	7	441680.011381	3681300.008322	37.034473	
	8	441648.396175	3681302.344292	36.713986	
	9	441650.602186	3681279.045390	36.735115	
	10	441614.582237	3681275.337053	36.697539	
	11	441594.482837	3681297.593399	36.653147	
	12	441589.373437	3681351.417734	36.607353	7.6
	13	441620.253406	3681215.558396	36.579831	
	14	441689.703670	3681300.844621	36.882775	
	15	441691.437152	3681282.771181	36.884775	
	16	441715.355158	3681284.992829	36.845314	
	17	441717.651791	3681284.454807	36.835250	
	18	441715.469121	3681284.727630	36.838111	
	19	441716.336382	3681276.224664	36.847435	
	20	441729.094599	3681267.933118	36.780157	
	21	441728.247455	3681276.973067	36.800199	
	22	441727.092971	3681285.427219	36.812762	
	21	441728.247455	3681276.973067	36.800199	
	22	441727.092971	3681285.427219	36.812762	
	23	441668.616611	3681219.925433	36.886354	
	24	441662.456431	3681280.046217	36.697903	

3.2.2 Surface Model

To represent surface model, Clicking on the Drafting and Annotation options. As shown in **Figure. (7).**

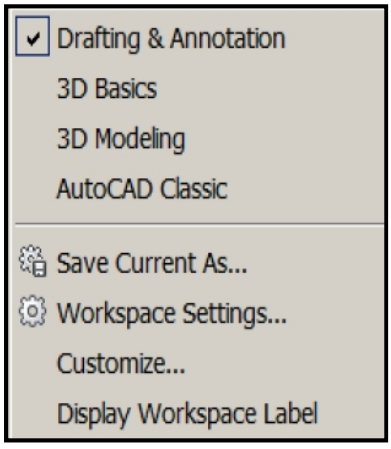

Fig .(7) workspace option

3.2.3 3D Presentation of Model

The 2D model functionality is equally useful for 3D model. Each of the three Coordinates (X, Y, Z) includes the ability to select objects in 3D space. Using Z-direction (building height), it enables program to 3D model creation in the space. AutoCAD workspaces are sets of menus, toolbars and other windows that are organized the work in a custom drawing environment [9].

Finally, the 3D representation of the buildings in this work was drawn. **Figure.(8)** Presents 3D model interface of this work depend on **Figure.(9)** which presents 2D model interface of this work.

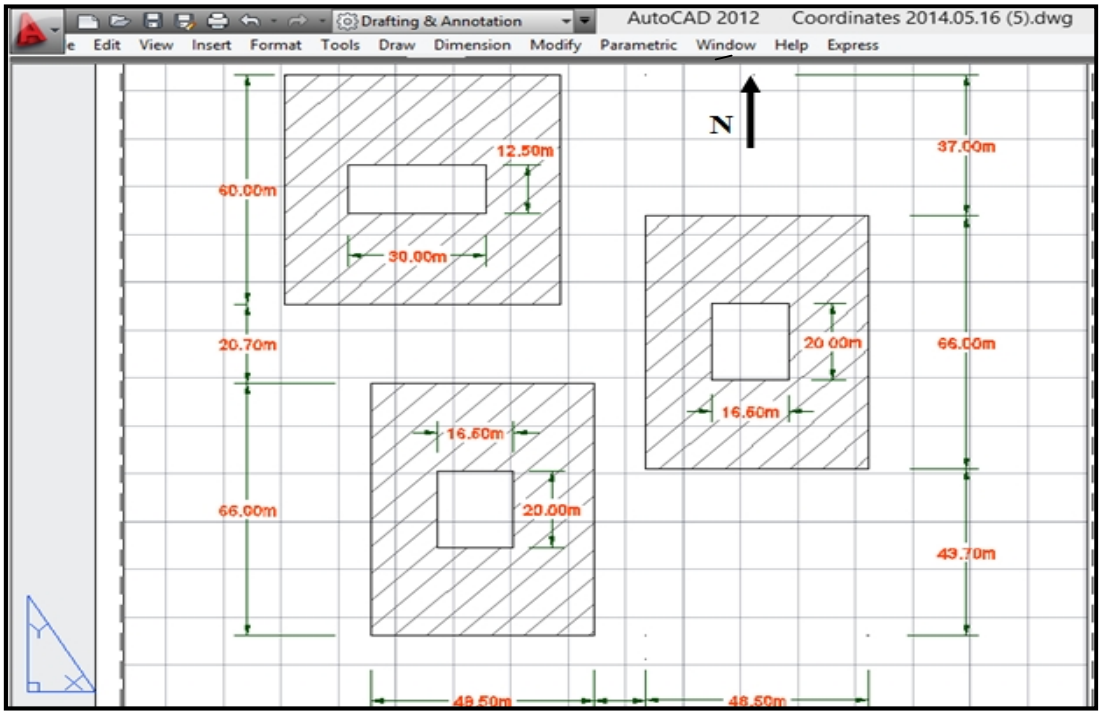

Fig .(8) 2D Model Interface of The work.

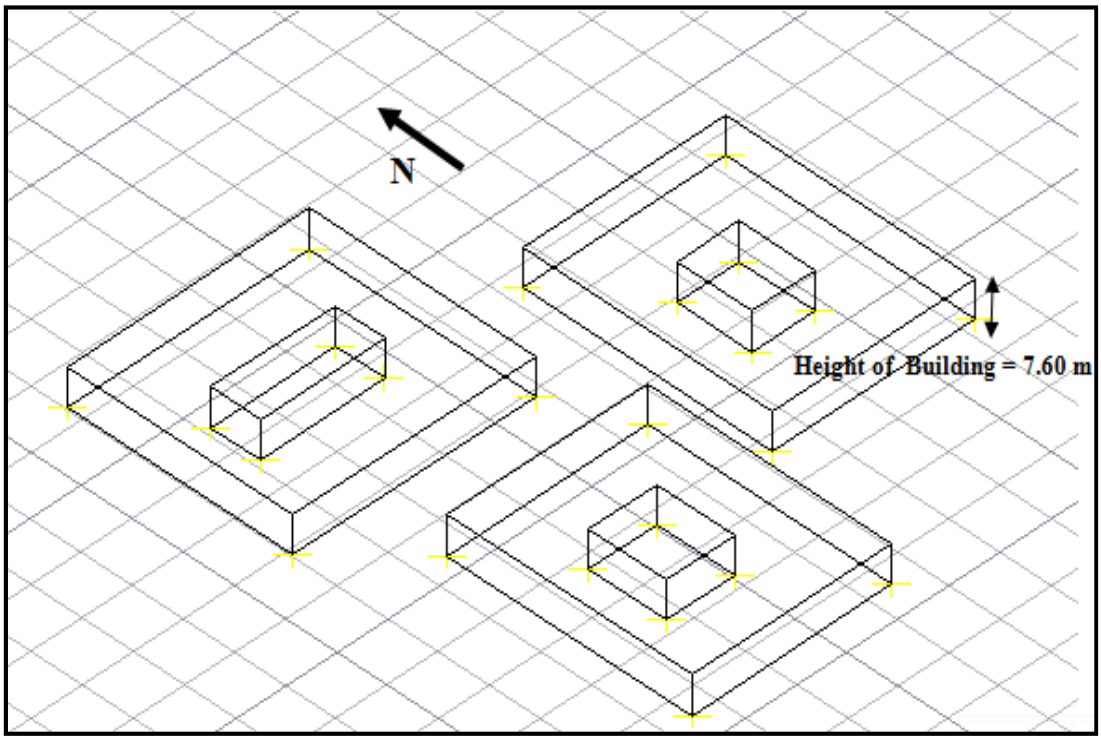

Fig .(9) 3D Model Interface of The work.

3.3 Conclusions

From the results obtained in this work the following conclusions have been made:-

We are proposing a study for establishing construction plans by using the new technology: Total Station Device and CAD drawing environment. This new investigation allows us to enhance the manner of working. The obtained results are very satisfying and we are absolutely sure that surveyors will alter the conventional procedures and they will take advantage of the new tool.

3.4 Recommendations

Based on the discussion and field work of this work, the following recommendations are made:

This study also carries out the rapid using total station instrument and GPS technologies.

Some total stations also have a GNSS interface which combines the advantages of these two technologies (GNSS – line of sight not required between measured points; Total Station – high precision measurement especially in the vertical axis compared with GNSS). Resulting can be produced using GIS software, Auto Cad Civil 3D 2013.

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