OPEN ACCESS
International
Journal
Of Modern Engineering Research (IJMER)

# The Evolution of Traditional Urban Survey using Applicable Surveying Techniques

Ahmed E. Ragheb[1], Mohamed A. El-Fayoumi[2]
[1]Assistant Professor, Public works Department, Faculty of Engineering, Ain Shams University
[2] Assistant Professor, Urban Planning and Design Department, Faculty of Engineering, Ain Shams University

***ABSTRACT**: This research deals with how to facilitate and manage surveying methods to accomplish modernized and cost effective urban survey with best achievable accuracy. This is done by replacing traditional surveying methods with modern methods from both theoretical and practical point of view. At first, a theoretical assessment process on a tradition urban planning project in Saudi Arabia is performed by replacing traditional urban planning techniques previously used with more applicable surveying techniques as total stations regarding different matters such as applicability, cost and accuracy. After approving the main idea of this modernization process, a practical urban planning case study is performed using total station, geodetic GPS receivers and GPS navigators, on a private settlement block consisting of 6 buildings in a crowded neighborhood of Cairo city. The applied surveying techniques showed high efficiency regarding cost and effort, while saving observation time reaching to 60%. Accordingly, the adopted practical application proved to be beneficial for all desired aspects, as well as being promising for more extensive study areas in future.*
***Keywords:** GPS, Surveying techniques, Urban Survey*

## I. INTRODUCTION

Various purposes of urban planning are of vital importance nowadays, basically [1] property documentation of formal and informal settlements, legalization and taxation are just few applications. However, initial stages of these applications in the form of urban survey have to be performed in a safe and economical manner along with social and environmental experience of the area under consideration to achieve adequate and high performance [2]. Undoubtedly, there is a strengthened relationship between urban survey procedures and surveying field, as the need for accurate and comprehensive urban survey parallel with efficient cost and time is a problematic phenomenon of traditional, primitive and detailed urban survey, hindering accuracy and inclusion of data [3]. Accordingly, urban field is firm depending on that of surveying to start its existing situation studies phase, followed by analysis and the upgrade process or even any other missions that must initially refer surveying, in order to know what will be used to upgrade or develop. See Fig.1.

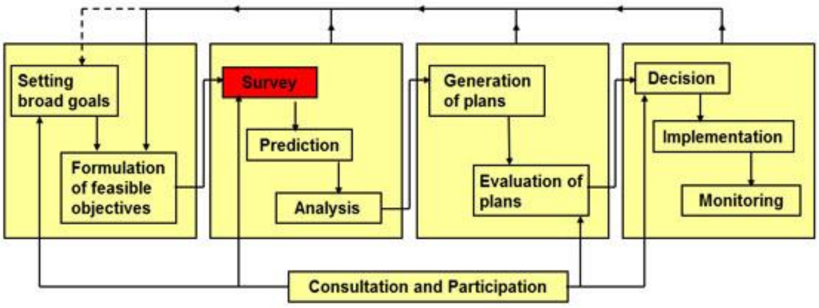



Fig. 1 Characteristic features of different stages in the physical planning process [4]

## II. METHODOLOGY

The basic idea starts with illustrating both urban and surveying fields to pinpoint the main problematic issue that is the different urban surveying types and techniques and their reflections on traditional and modern surveying methods. Here by, the research penetrates deeply into its two main axes, the first is the theoretical part on a previously surveyed project using linear measurements and the simulation of other applicable surveying technique in the form of total station. Secondly, the practical part, with a comparative study through different traditional and more advanced surveying methods, in order to reach out and deduce how to facilitate and manage surveying methods to accomplish modernized and cost effective urban survey with best achievable accuracy.

## III. URBAN SURVEY

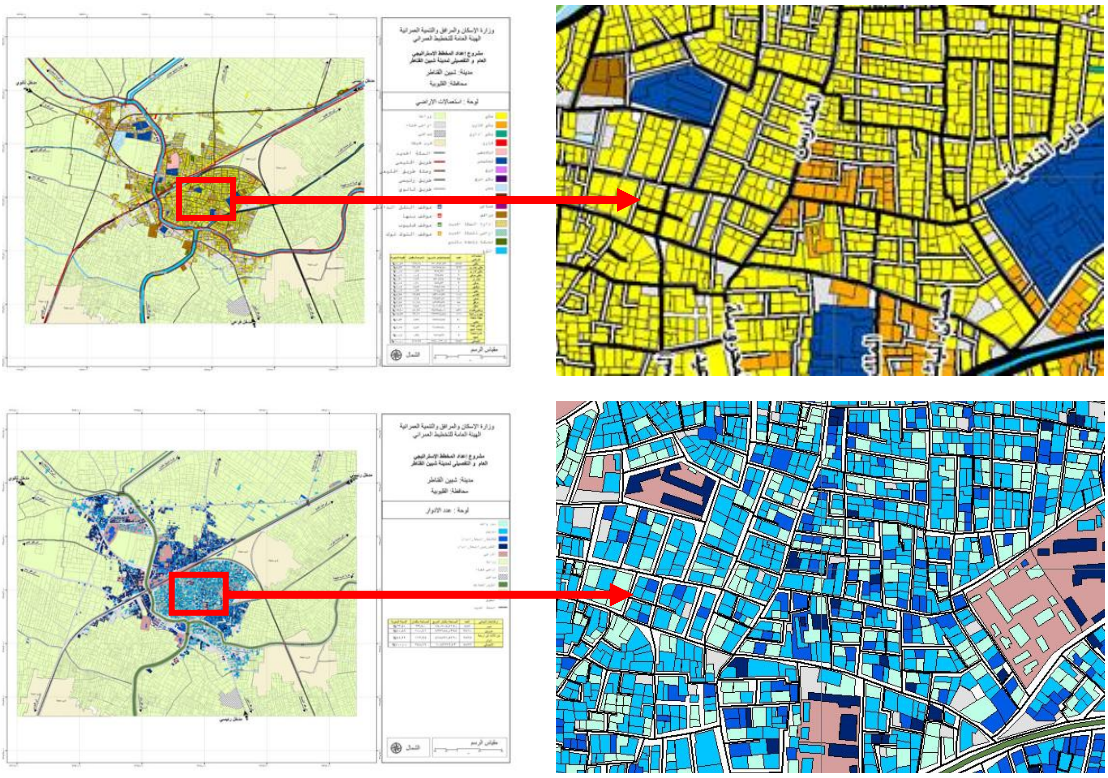
Urban planning is the discipline of land use planning which explores several aspects of the built and social environments of municipalities and communities. Other professions deal in more detail with a smaller scale of development, namely architecture, landscape architecture and urban design. Regional planning deals with a still larger scale. In terms of its objectives, planning is the elaboration of a set of related programs designed to achieve certain goal, while the planning process itself is the set of interventions and other actions undertaken during the elaboration of a plan. On the other hand, in terms of future control, it is the ability to control the future by current acts [4].

### 3.1 Urban Survey Definition

The urban survey concerns with the existing situation studies for an urban fabric context, which is a preparatory phase for analysis studies for the location to start further upgrading phases. This mentioned preparatory phase is very important as the accuracy of the related studies after that depends totally on the accuracy of this initial step. Accordingly, it is clearly essential to study and compare between different types and methods of urban survey, as to be able to reach the most accurate and progressive method to be used as a starting step in the right way of this long phases work.

### 3.2 Urban Survey Types

Here we need to define and study different variable types and methods, then subsequently, give fairly comparative analysis to illustrate the most effective, accurate, short timing and cheapest method. Consequently, several methods can be used to obtain the same main results with some differences in quality, details, accuracy, data covering and many fields' usages. The first type is the ordinary method by using the satellite images maps then start to update it by visual observations and non-accurate measurements of lengths and dimensions, then merging these drawn information by filled applications for all observed data to obtain finally the named fundamental maps, using geographic information system (GIS). This can be summarized clearly in five basic drawing sheets namely; land-uses, building uses, buildings heights, building conditions and building construction. An example of some of those sheets is given in Fig. 2.



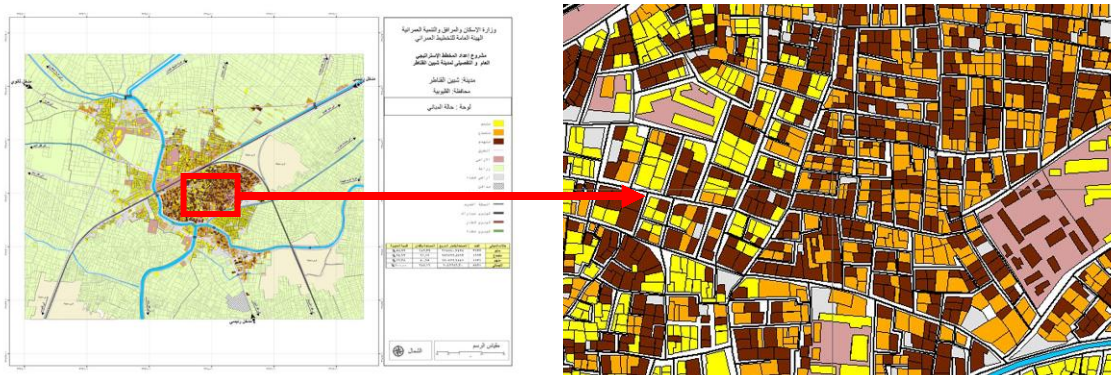


Fig. 2 Example for land-uses, buildings heights and conditions sheets [6]

The second type is detailing, which uses first sketches to draw, approximate the building outlines, this sometimes can be aided by total stations to give more accurate drawing for its outlines of the ground floor plan and the land edges. After that the survey engineers starts to measure the internal dimensions for the roof and its components and any missing dimensions not given by the total station, and then all observed data and obtained information are filled in applications. The overall product are cad drawings sheet for the collective map of the buildings, and every building is drawn in a different sheet as follows: land sheet, ground floor sheet, typical floor sheet, roof sheet, apartment sheet and any additional drawings sheet (such as shops,….etc), as given earlier in Fig. 2. Note that, this second type is used by both the urban field and that of surveying.

### 3.3 Urban Survey Results

Accordingly, as illustrated in the previous section, urban survey results are, in the first type; colored drawing sheets with areas and information which are not detailed and accurate enough and do not give full needed data, while in the second type, almost full detailed information are extracted, but takes longer time, more effort, expensive procedures, great number of manpower and variable work steps that gives accumulative errors.

## IV. SURVEYING FIELD

As much known to many people in the engineering field, the surveying process is the base and start point for almost all projects. That is to say, prior, during or even after design, construction or field work, surveying measurements will be taken, whether for fixation of control reference points, setting out of previously determined points onsite or production of maps and quality control. Few examples of such applications include; water pipelines layout, establishment of residential complexes, excavation works, deformation monitoring…..etc. This can be done by different instruments and techniques varying in technology, price and application.

### 4.1 Traditional Surveying Methods

Previously, surveying application in urban survey projects included mainly the use of regular tapes distance measurements and optical theodolites for angular measurements. Different kind of tapes varying in length and material were used in measuring the boundaries and details of buildings and complexes. However, this technique –although its simplicity and cheap price of the used tool- has many disadvantages, starting with various errors accompanied with the tape, such as sagging especially in long distances, difference of nominal length and temperature effect….etc. Optical theodolites were quite handy and popular in angular and direction measurements in order to maintain building corners especially non right angle corners, but similar to the use of tapes, at the end large amount of data are required to be taken, displayed and then saved and copied, in addition to all this, the whole field operation being time consuming and executed using extensive manpower.

### 4.2 Modern Surveying Methods

Recently, many modern surveying instruments are used in various projects and applications, mainly total stations and GPS equipment. Total stations combine both distance measuring device (EDM) along with angular measuring equipment (Theodolite) together with processor and memory, in order to observe, calculate and save direct boundaries corners and features in their local or global coordinate (Easting, Northing, Height) format. GPS receivers wither geodetic precise ones or less accurate navigators, observe continuously rotating satellite signals from sky, and again determine the global coordinates of surveyed points relative to the Global datum. The wide use of the aforementioned instruments comes from their efficiency, or in other words easiness of data sampling, storage and display. This will of course lead to reduction in manpower needed as well as required field and even office work time. However, these advantages will surely be accompanied with slight disadvantages, which should be compared versus their benefit of usage.

Now speaking about disadvantages, price of used instruments here in is one good example, as total stations are minimum three time expensive than regular digital theodolites, while geodetic GPS receivers being at least 7 times more. However, regular navigators are cheap in price; quarter the price of digital theodolites, but they sure will propose degraded accuracy. Concerning GPS receivers, various errors will affect GPS positioning, either from satellites, atmosphere or receivers. However, most of these errors can be modeled and thus reduced by adopting several techniques such as differencing between two receivers, i.e. relative positioning, some errors will still evolve in the solution, especially the inevitable multipath error, caused by receiving signals from more than one path.

## V. THEORETICAL ASSESSMENT PROCESS

After presentation of the different techniques to be adopted in the current research, the theoretical applied part in this research will be introduced, regarding the case study area, and surveying of the building complex using both traditional and modern instruments.

### 5.1 Case Description

The area under study consists of 9 buildings as a part of building complex in Madinah, KSA, which was already under investigation in a previous urban survey project. Three of these buildings are only one floor buildings and the others are multi-story buildings consisting of three to four floors. Fig. 3 shows a layout of these buildings along with surrounding streets [7].


Fig. 3 Madinah map, KSA showing Google maps hierarchy for case site [8]

### 5.2 Traditional Surveying Methods Application

Dimensions of all buildings in this case are surveyed using a tape and two persons. The required time intervals to survey each building are indicated in Table 1. Note that, all common points repeated among floors in each building have to be observed each time in order to find its relation and dimensions with respect to every point per each floor, which is considered a disadvantage when compared to surveying of such buildings using more advanced instruments.

### 5.3 Modern Surveying Methods Application

The application of reflectorless total station here is a theoretical application, meaning that it was not applied during the actual project. Herein, the time required for the surveying of buildings using a total station is investigated, which is shown as well in Table 1. Note that the application of GPS was not undertaken in the theoretical case because it was not applied during the actual project, basically due the variety of its usage according to the surrounding environment, mainly because the usage of GPS and its success will depend on the blockage of satellite signals, loss of lock and multipath. This will be highly variable near to buildings especially while surveying of buildings dimension from the outside. However, the usage of GPS will be taken into consideration in the practical applied case later on.

Also not here that, surveying of buildings using a total station in this case is done only using one surveyor only due to the unneccessity of another surveyor to hold the reflector, as the use of reflectorless total station is very beneficial here in and could be thought to be a must. This is backed by the fact that the cost of reflectorless total station is reasonable nowadays and very applicable here in by targeting buildings' points directly given that buildings are within few hundred meters from the instrument, which is the case here and originally during any urban survey project. Of course, the usage of only one surveyor during the whole process will definitely vastly decrease the overall cost of the urban survey work.

### 5.4 Theoretical case Results and Conclusions

After studies from different point of views such as shape, accessibility….etc, some important conclusions can be extracted, noting that some factors regarding the building such as building dimensions, current status, material….etc. is outside the scope of the current research as it will not affect the undertaken factors, such as time and cost among the comparison between techniques and thus can be considered non effective here. In addition, some of the shops within the buildings were identified without dimensions, due to accessibility, which could be solved easily using total station, as will be shown later.

From previous experience, the time required for one linear measurement is taken to be 15 seconds, and another 15 seconds for manipulation between one measurement and the other, while regarding total station measurements, the time for setting the instrument over any point for a regular surveyor with moderate experience is 3 minutes, taking 15 seconds for observing each point and targeting from one point to the other. A very powerful remark in the use of total station, is that when the building dimensions changes from the base to repeated floors, and since buildings usually are not entered from the inside and measured from the outside borders, in some cases mostly the dimensions of the buildings are obtained in an approximate way using the projection of a staff and mentioning the distance between such projection and the actual dimension of the base, or approximated from the previous or latter floor. This will surely affect the accuracy of these measurements. On the other hand, this can be simply resolved using reflector less total station.

In addition, a very important remark, is that number of setups of the total station instrument can be minimized (which considered the most time consuming step) if the dimensions of several buildings can be obtained from common setups of the instrument especially for adjacent buildings. This is very clear in the time saved, as shown in Table 1. From the shown table, it can be seen that the concept of common setups among different buildings has excluded seven required setups through the whole project saving around 62.5 minutes of the whole process, that is around 44 % of the total required time when using linear measurements. This of course will surely be highly multiplied for bigger projects having multiple of buildings' complexes. Based on the results obtained here from the theoretical case study, the efficiency of the applicable total station technique was well illustrated, in the form of time saving, less effort and manpower needed and of course leading to better accuracy. This was a main catalyst to apply such technique along with GPS positioning in the practical case study.

## VI. PRACTICAL URBAN SURVEY CASE STUDY

### 6.1 Case Description

Following the conclusions obtained from the theoretical case study, it was essential to justify the results through an actual practical case applying traditional and more advanced surveying instruments. The chosen practical study area consists of six adjacent buildings as a part of a building complex in Nasr City area, Cairo, Egypt. These buildings had variable heights, different floors and accessibility around them, as two of these buildings are about 11 floor buildings and the others are intermediate height buildings consisting of five floors, as shown in Table 2. Fig. 4 and Fig. 5 show a layout of these buildings along with surrounding streets. These variable factors were the main reason behind the choice of this study area.

Table 1 Comparison on the usage of traditional and modern surveying techniques for the urban survey of the practical applied case (Ground: G, Repeated: R)

| Building | Floors | Tape | | Total Station (TS) | | | | | Time difference between TS and Tape (sec) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Measurements | Time required (sec) | Points | No. of setups | Setup Location | Time required (Setup & Observation) (sec) | Effective Required Time | | |
| 2610401 | G | 9 | 270 | 6 | 1 | Roof | 270 | 270 | 0 | One common setup on roof for the three buildings |
| 2610403 | G | 11 | 330 | 7 | 1 | Roof | 285 | 105 | 225 | |
| 267439 | G | 11 | 330 | 7 | 1 | Roof | 285 | 105 | 225 | |
| 268402 | G | 11 | 330 | 7 | 2 | G | 465 | 285 | 45 | Setup A for 2 buildings |
| | R | 23 | 690 | 11 | | G | 165 | 165 | 525 | |
| | Roof | 8 | 240 | 4 | 1 | Roof | 240 | 240 | 0 | --- |
| 268404 | G | 6 | 180 | 5 | 2 | G | 435 | 75 | 105 | No new setup required |
| | R | 9 | 270 | 5 | | G | 75 | 75 | 195 | |
| | Roof | 5 | 150 | 3 | 1 | Roof | 225 | 225 | -75 | --- |
| 267440 | G | 17 | 510 | 10 | 2 | G | 510 | 330 | 180 | Setup B for 4 buildings |
| | 1 | 15 | 450 | 5 | | G | 75 | 75 | 375 | |
| | R | 25 | 750 | 14 | | G | 210 | 210 | 540 | |
| | Roof | 17 | 510 | 10 | 2 | Roof | 510 | 510 | 0 | --- |
| 269402 | G | 11 | 330 | 7 | 2 | G | 465 | 285 | 45 | Setup C for 3 buildings |
| | R | 13 | 390 | 5 | | G | 75 | 75 | 315 | |
| | Roof | 23 | 690 | 10 | 2 | Roof | 510 | 510 | 180 | --- |
| 267441 | G | 7 | 210 | 5 | 2 | G | 435 | 255 | -45 | Setup D for 3 buildings |
| | R | 14 | 420 | 7 | | G | 105 | 105 | 315 | |
| | Roof | 16 | 480 | 8 | 2 | Roof | 480 | 480 | 0 | --- |
| 269404 | G | 5 | 150 | 4 | 2 | G | 420 | 240 | -90 | Setup E for 2 buildings |
| | R | 31 | 930 | 16 | | G | 240 | 240 | 690 | |
| | Roof | 7 | 210 | 2 | 1 | Roof | 210 | 210 | 0 | --- |


Fig. 4 Cairo map, Egypt showing practical case site [9]


Fig. 5 General layout of practical case site [9]

### 6.2 Surveying using Traditional methods

Herein, as a common linear surveying procedure, two tapes are going to be used for the planimetric surveying of the six buildings whether from the ground, the roof or any floor. From a practical point of view, several photos and sketches were taken for proper visualization and reliability of all surveyed buildings. Note that some measurements were taken on the roof as well, for the case where the plan of the building differs on the ground from that corresponding plan on the roof. This is a familiar case nowadays, especially with modern architecture design. Accordingly, the first part of Table 2 shows a detailed vision of the total linear measurements taken for each floor and building, along with the time taken for each process. This extensive time taken for the surveying process is accompanied with hard working paid labor, however on the contrary the whole process is executed using cheap surveying tools, such as the tape, along with moderate payments for regular not necessary skilled trained labor. Note that, in this case here, each floor should be entered in order get all relevant information for such floor, which is considered a major disadvantage of such technique regarding time, effort and privacy of such floor especially if it is occupied by civilian users. However, in such a case were details of any floor cannot be obtained directly, it is referenced with an approximation from the previous or latter floor, as mentioned earlier, which is always considered a disadvantage of this technique regarding accuracy and time.

### 6.3 Surveying using Modern Methods

A mixture of modern commonly used surveying instruments are utilized here, namely one total station, two geodetic receivers and one GPS navigator. The Trimble reflectorless total station is used for surveying of the outer perimeter of buildings from the ground. GPS receivers or navigators will be mainly used on the roof of the buildings, but not on the ground or of course inside the buildings due to the lack of clear sky and thus blockage of signals or loss of lock on satellites. The remaining part of Table 2 shows the whole procedure for the total station technique. Note that, surveying with the total station was done differently to what was performed in the practical theoretical case. Each building was surveyed relative to some control points for all its floors. Accordingly, the setup time is being considered only for the ground floor, in which any of these setups can be used then freely for all floors. In other words, in each setup, different points are observed for all sighted floors of nearby buildings.

The surveying of buildings was then performed first using two geodetic GPS receivers, where one base station is fixed on one of the previously known control points and the other rover kinematic receiver mounts on different points on the roof, and then using a GPS navigator, taking an observation time of 15 seconds on each point. However this was performed only on the roof of the buildings only, due to satellite blockage at the bottom of building or at any of its floors. This of course will lead to different analysis due the change of dimensions from the ground floor and repeated floors and roof as well, but will surely be beneficial where roof is similar to ground as well as similar multi-stories. Surveying using both GPS techniques will appear similar regarding number of surveyed points but will differ in the accuracy of the position of points, leading to higher accuracy in the case of using geodetic receivers. The whole process using GPS receivers and navigator is shown in Table 3.

### 6.4 Practical case Results and Conclusions

The comparison here between those three sets of measurement technique, is considered relative to the amount of data i.e. observed measurements, consumed time and manpower needed. However, another parameter here can be added regarding the format of data output from those latter three techniques, when compared to the output data using traditional surveying methods. This can be effective while considering the additive calculations required in order to output building coordinates to be exported to AutoCAD.

As well as, based on the results obtained from both the theoretical and practical cases, several comparisons can be extracted regarding several factors, mainly: accuracy, time and cost. Starting with accuracy, the total station and geodetic receivers possessed the best accuracy when compared to tapes and GPS navigators, as the used of tapes will degrade the accuracy due to the vast negative effect of human errors during measurements. The use of GPS navigators will implement point positioning technique which is full of errors affecting highly the accuracy of surveyed points. Now speaking about time management for each technique, and having a quick glance at Tables 1, 2 and 3, the use of modern surveying instruments especially the total station technique reduced the required time by 683 minutes, that is with 60%, due to the reduction of manpower and mainly the required time to survey each point. This proves that although the total station and GPS techniques seem to be more expensive due to the more advancement of the instrument used, but when compared to the manpower used and time required, as previously mentioned, the cost of the whole process is significantly reduced.

Table 2 Detailed report on the usage of total station technique for the urban survey of the practical case (Common Point: CP)

| Building | Floors | Tape: Measurements | Tape: Time required (sec) | TS: Points | TS: No. of setups | TS: Setup Location | TS: Time required (Setup & Observation) (sec) | TS: Effective Required Time | Time difference between TS and Tape (sec) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| B1 | G | 18 | 540 | 8 | 3 | G | 320 | 320 | 220 | |
| | 1 | 29 | 870 | 24 | | | 360 | 360 | 510 | |
| | 2 | 51 | 1530 | 35 | | | 525 | 525 | 1005 | |
| | 3 | 52 | 1560 | 39 | | | 585 | 585 | 975 | Similar to 8th Floor |
| | 4 | 54 | 1620 | 39 | | | 585 | 585 | 1035 | |
| | 5 | 54 | 1620 | 39 | | | 585 | 585 | 1035 | |
| | 6 | 54 | 1620 | 44 | | | 660 | 660 | 960 | |
| | 7 | 54 | 1620 | 43 | | | 645 | 645 | 975 | |
| | 8 | - | - | - | | | - | - | - | |
| | 9 | 54 | 1620 | 47 | | | 705 | 705 | 915 | |
| | 10 | 54 | 1620 | 42 | | | 630 | 630 | 990 | |
| | 11 | 54 | 1620 | 38 | | | 570 | 570 | 1050 | |
| | Roof | 44 | 1320 | 36 | 2 | Roof | 900 | 900 | 420 | |
| B6 | G | 22 | 660 | 16 | 4 | G | 960 | 960 | -300 | |
| | 1 | 68 | 2040 | 44 | | | 660 | 660 | 1380 | |
| | 2 | 99 | 2970 | 70 | | | 1050 | 1050 | 1920 | Similar to 3rd Floor |
| | 3 | - | - | - | | | - | - | - | |
| | 4 | 52 | 1560 | 37 | | | 555 | 555 | 1005 | |
| | 5 | 99 | 2970 | 71 | | | 1065 | 1065 | 1905 | |
| | 6 | 123 | 3690 | 83 | | | 1245 | 1245 | 2445 | |
| | 7 | 62 | 1860 | 39 | | | 585 | 585 | 1275 | |
| | 8 | 71 | 2130 | 45 | | | 675 | 675 | 1455 | |
| | 9 | 62 | 1860 | 40 | | | 600 | 600 | 1260 | |
| | 10 | 71 | 2130 | 45 | | | 675 | 675 | 1455 | |
| | 11 | 62 | 1860 | 38 | | | 570 | 570 | 1290 | |
| | Roof | 83 | 2490 | 50 | 2 | Roof | 1110 | 1110 | 1380 | |

| Building | Floors | Tape | | Total Station (TS) | | | | | Time difference between TS and Tape (sec) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Measurements | Time required (sec) | Points | No. of setups | Setup Location | Time required (Setup & Observation) (sec) | Effective Required Time | | |
| B2 | G | 10 | 300 | 4 | 4 | G | 780 | 240 | 60 | 3 common CP with B1 (1st and 3rd floor are similar) |
| | 1 | 44 | 1320 | 24 | | | 360 | 360 | 960 | |
| | 2 | 67 | 2010 | 40 | | | 600 | 600 | 1410 | |
| | 3 | - | - | - | | | - | - | - | |
| | 4 | 60 | 1800 | 38 | | | 570 | 570 | 1230 | Similar to 5th Floor |
| | 5 | - | - | - | | | - | - | - | |
| | Roof | 36 | 1080 | 24 | 2 | Roof | 720 | 540 | 540 | 1 CP from B6 |
| B3 | G | 10 | 300 | 4 | 3 | G | 600 | 420 | -120 | 1 common CP with B2 |
| | 1 | 47 | 1410 | 29 | | | 435 | 435 | 975 | |
| | 2 | 70 | 2100 | 47 | | | 705 | 705 | 1395 | |
| | 3 | 63 | 1890 | 37 | | | 555 | 555 | 1335 | |
| | 4 | 63 | 1890 | 37 | | | 555 | 555 | 1335 | |
| | 5 | 63 | 1890 | 43 | | | 645 | 645 | 1245 | |
| | Roof | 65 | 1950 | 23 | 2 | Roof | 705 | 345 | 1605 | 2 CP from B1 and B6 |
| B4 | Ground | 10 | 300 | 4 | 3 | G | 600 | 240 | 60 | 2 common CP with B3 |
| | 1 | 16 | 480 | 8 | | | 120 | 120 | 360 | |
| | 2 | 22 | 660 | 12 | | | 180 | 180 | 480 | Similar to 3rd, 4th and 5th Floor |
| | 3 | - | - | - | | | - | - | - | |
| | 4 | - | - | - | | | - | - | - | |
| | 5 | - | - | - | | | - | - | - | |
| | Roof | 46 | 1380 | 25 | 2 | Roof | 735 | 375 | 1005 | 2 CP from B1 and B6 |
| B5 | G | 10 | 300 | 4 | 2 | G | 420 | 420 | -120 | 2 common CP with B6 |
| | 1 | 16 | 480 | 12 | | | 180 | 180 | 300 | Similar to 2nd, 3rd and 4th Floor |
| | 2 | - | - | - | | | - | - | - | |
| | 3 | - | - | - | | | - | - | - | |
| | 4 | - | - | - | | | - | - | - | |
| | 5 | 22 | 660 | 12 | | | 180 | 180 | 480 | |
| | Roof | 44 | 1320 | 25 | 2 | Roof | 735 | 555 | 765 | 1 CP from B1 |

Table 3 Detailed report on the usage of GPS surveying techniques for the urban survey of the practical case

| Building | No. of points | Geodetic Receivers | | GPS Navigator | Time difference (sec) | Remarks |
|---|---|---|---|---|---|---|
| | | Setup time of Base station (sec) | Time of surveyed points (sec) | Time of surveyed points (sec) | | |
| B1 | 36 | 1800 | 540 | 540 | 1800 | Setup time required for initialization on the reference point |
| B2 | 24 | - | 360 | 360 | - | |
| B3 | 23 | - | 345 | 345 | - | |
| B4 | 25 | - | 375 | 375 | - | |
| B5 | 25 | - | 375 | 375 | - | |
| B6 | 50 | - | 750 | 750 | - | |

It is worthwhile mentioning here that, although surveying using GPS is always hindered on the ground and repeated floors of all buildings, it can be merged efficiently with total station. This can be performed by surveying each building with both the total station and GPS techniques, by using the first on the ground and repeated floors, while using the latter on the roof. This will surely produce the most effective combined technique regarding applicability, cost and time.

## VII. RESULTS AND RECOMMENDATIONS

The use of modern surveying equipment in the form of total stations and GPS receivers/ navigators, improved not only the accuracy of the surveying task, but as well as the efficiency of the survey due to the vast improvement in the form of reduction in number of manpower required to perform the same task in the traditional method using tapes, in addition to time saving in performing the survey and planning process. This of course can be easily proved by the large amount of data required to survey buildings' relations and dimensions using tapes. However, this large amount of data is reduced quite considerably using modern surveying by dealing with coordinates obtained from any of the aforementioned instruments, as well as the ability to control the amount of data that are essentially needed in urban planning purposes.

In addition, modern surveying is not only appreciated than traditional methods in this context only, but since the amount of data is known and easily formatted, and can be recognized easily, given the fact of proper reconnaissance of the site prior to surveying, field planning is considered advantageous in this case, since total number of instruments, manpower per day, number of days can all be set in advance before start of the survey, which offers a very powerful tool for modern surveying, as several factors and focal issues can be resolved accurately, not forgetting the pre-estimation of the surveying process cost in advance.

## REFERENCES

[1] R. Wickramasuriya, L. Chisholm, M. Puotinen, N. Gill, and P. Klepeis, An automated land subdivision tool for urban and regional planning: Concepts, implementation and testing, Environmental Modeling and software, 26(12), 2011, 1675-1684.

[2] C. Freeman, Development of a simple method for site survey and assessment in urban areas, Landscape and Urban Planning, 44, 1999, 1-11.

[3] A. Burger, A. Grimm-pitzinger, and E. Thaler, A combination of modern and classic methods of surveying historical buildings – The church st. valentine in the South Tyrol, XXI International CIPA Symposium, Athens, Greece, 2007.

[4] P. Wathern, Environmental impact assessment: Theory and Practice, ISBN 0-203-40997-3, 1988, Master e-book ISBN.

[5] G. Smith, Impact Assessment and Sustainable Resource Management, London: Longman, 1993, 77-78.

[6] General Organization for Physical Planning (GOPP): Strategic planning for Shebin el Kanater city / Kaliobia governorate / Egypt, Urban survey phase, 2006.

[7] Urban survey and surveying project for the central area in Madinah, Kingdom of Saudi Arabia KSA, Dar El Salam office, Planning Organization in Madinah, KSA, 2011.

[8] Google Earth maps 2011.

[9] Google Earth maps 2013.