SURVEYING IN EMBBANKMENT DAMS, TASK, CHALLENGES AND SOLUTIONS

ALI MOHAMMADI

***Abstract*—** EMBBANKMENT DAMS are considered to be one of the biggest construction projects that a set of engineers and other human forces and machines work in construction, and the most important part of this set is the SURVEYING part. Contractors try to use professional surveyors and Use the equipment in this part because the speed of project progress and the quality of its implementation are directly related to this section.

EMBBANKMENT dams include a series of tunnels, roads, concrete and metal structures, and embankments, and during the construction of each, a surveyor must be present in order to control it according to the map and provide all the required information and coordinates To control the calculation of the surface and volume, collect together with the supervising engineer. Small dams can require at least 3 surveyor teams, and in large dams, it can increase to more than 30 teams, such as the GOTVAND dam in Iran, so planning for the activities of these teams can be complicated. We intend to get to know the experience of the surveying engineer who has been in charge of surveyor teams in 4 EMBBANKMENT dams, his tasks, challenges and solutions, so that the surveyors can familiarize themselves with what is ahead of them before entering such projects and Employers can help the progress of the project by knowing more about the details in this collection.

***Keywords*—**DATATRANSFER, DTM CUTFILL, SECTION, 3DMAP, Pixel.

I. INTRODUCTION

LET'S take a look at Fig.1, Fig.2 and Fig.3. We are going to review the surveying in this project which was under construction in 2007.

If you plan to work professionally as a surveying engineer, dam construction is the best place for your activity because you can use all your abilities in such projects. You must have the ability to work in tunnel excavation and embankment. As the head of surveyors, you must be able to lead all surveyor teams and master the required software and surveying instructions.

Fig.1 shows excavation in KHODA AFARIN dam

Fig.2 shows excavation and Embankment of the dam

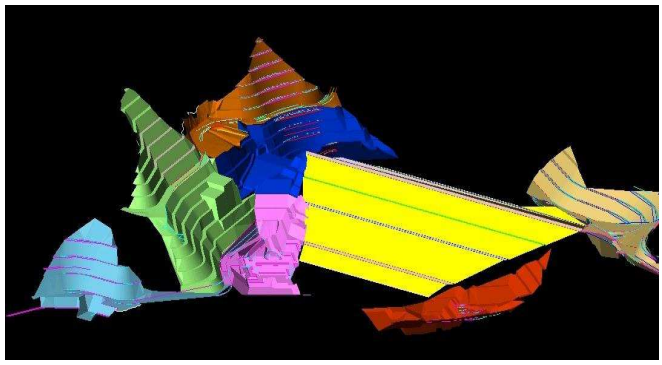

Fig.3 The map is designed in 3D

Description of the head of the surveyors

1- Examining and receiving the necessary plans to control the execution operations from the supervision and technical office

2- Controlling land surveyors and providing job descriptions.

3- Request the required equipment.

4- Control the devices used and report the calibration of the devices to the supervision.

5- Receiving and reviewing the surveyor's daily report in the workshop.

6- Receiving the data of TOTAL STATION in the form of a file and signed for documentation.

7- Documentation.

8- Providing the approved map to surveyors.

9- Benchmark survey creating.

10- Designing the required programs in computers and engineering calculators.

11- Designing access roads and required excavations.

12-Estimating the performance of excavation or embankment operations performed at the end of the month based on documentation

13- Preparation of documents needed by sub-contractors and evaluation of their performance.

14- Estimating the volumes of the designed plans according to the client's request.

15- Visiting work fronts to control execution and design operations.

16- Participation in workshop meetings.

Fig.4 the Engineering calculator

In order to control the map, surveyors need to program in an engineering calculator. By entering information into the program, they can perform their own calculations to control the map of excavations, embankments, and sloping surfaces. Usually, the head surveyor programs these programs for the surveyors and explains how to use it.

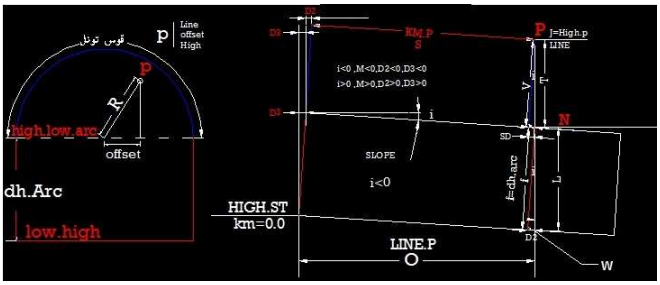

Fig.5 Tunnel requirements calculations

In this project, the surveyor controlled the tunnel in Fig. 6 by using the geometric drawing of the tunnel in Fig. 5 and using the calculator in Fig.6.

Fig.6 Tunnel requirements calculations

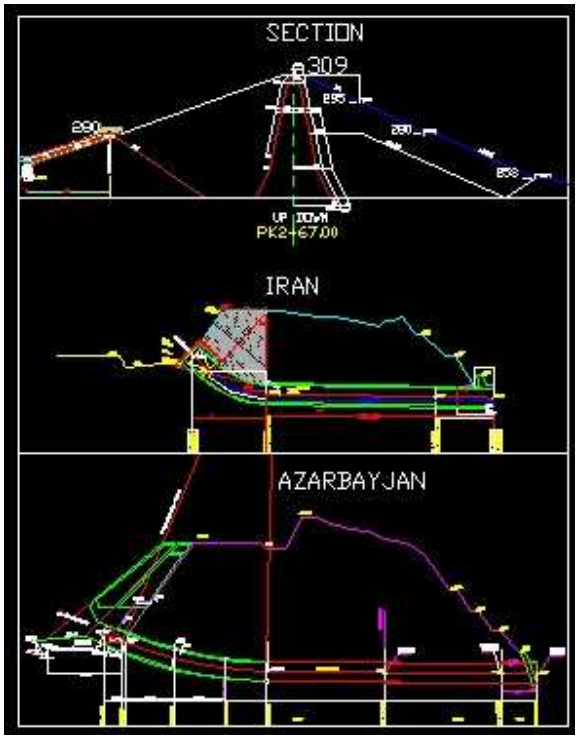

Fig.7 The water supply tunnel of the power plant and the embankment section of the dam

Controlling the tunnels you see in Figure 7 is considered a challenge for surveyors because the calculations of the tunnel section must be done perpendicular to the axis. Also, to draw it, the surveyor started programming in Excel. The TOTAL STATIONS used in this project were simple in which the surveyors used two programs, Reference Line and Arc. In Fig. 8, you can see a sample menu of TOTAL STATION programs. You can see in Fig.8.

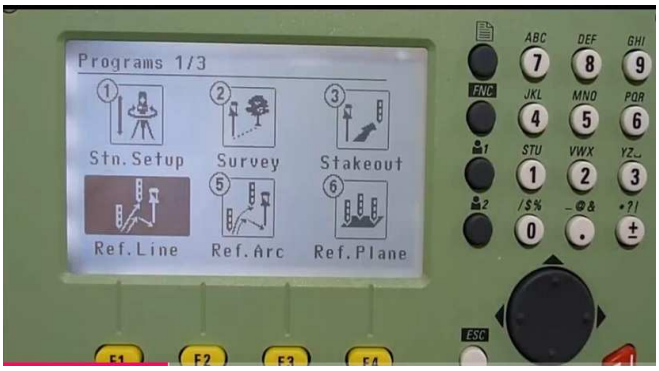

Fig.8 shows DTM Programs menu of TOTAL STATION

Fig.9 shows Tunnel in AZARBAIJAN

Fig.10 shows Tunnel in IRAN

The tunnels in Figure 9 and 10 are challenging tunnels that were controlled by designing the program in the calculator and using arc and reference line data in TOTAL STATION program.

Fig.11 shows Benchmark survey creating

Creating a benchmark at high altitudes is used for free stationing.

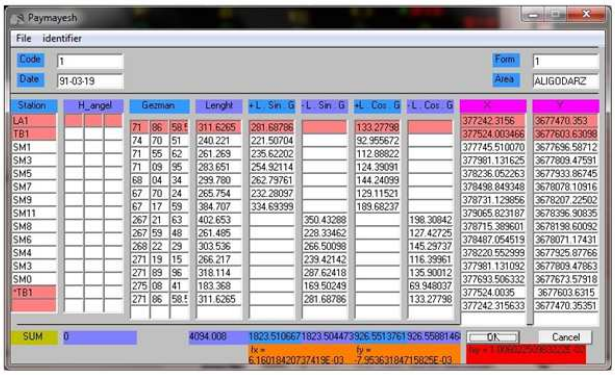

Fig.12 shows Traverse calculation

Traverse is another task of surveyor superintendent that must be done in tunnels and dam areas. There are various programs to do it. Calculating the traverse table is one of the calculation methods designed by the surveyor in this project with Visual Basic. You can see sample of traverse in Fig.12.

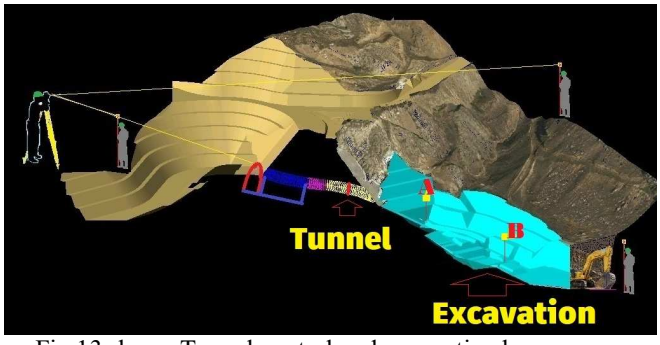

Fig.13 shows Tunnel control and excavation by surveyor

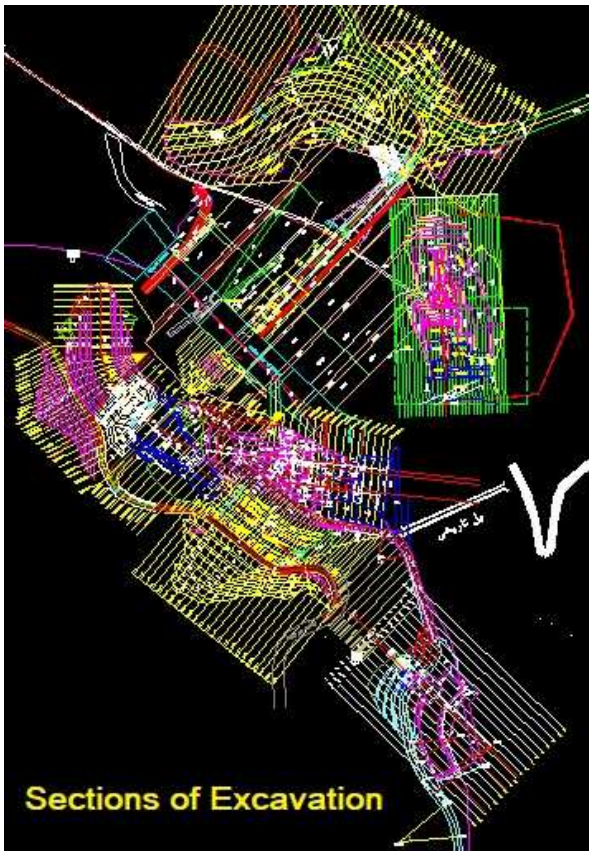

Fig.14 Shows sections that used for calculations of excavation volumes

In this project, in order to calculate the volumes of excavation, cross-sections were defined and using the area of the cross-section and the distance from each other, the volume table was calculated.

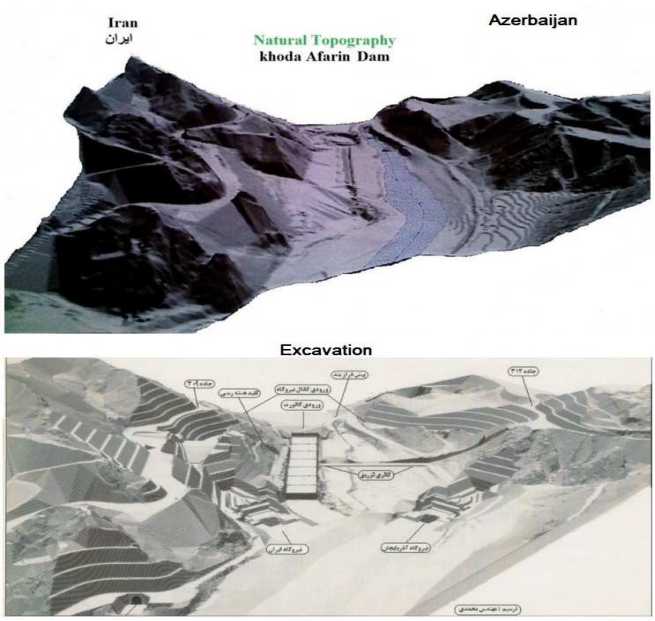

Fig.15 Shows 3d natural and excavation area

Fig.16 shows advanced TOTAL STATION whit DTM stakeout program

In expensive and advanced cameras, you can install programs that can be used in excavation and embankment calculations, such as the DTM stakeout program in Fig.16, which can perform calculations in relation 3DFACE of the project map. It can also be used to control the tunnel by purchasing the tunnel program license in Fig.17.

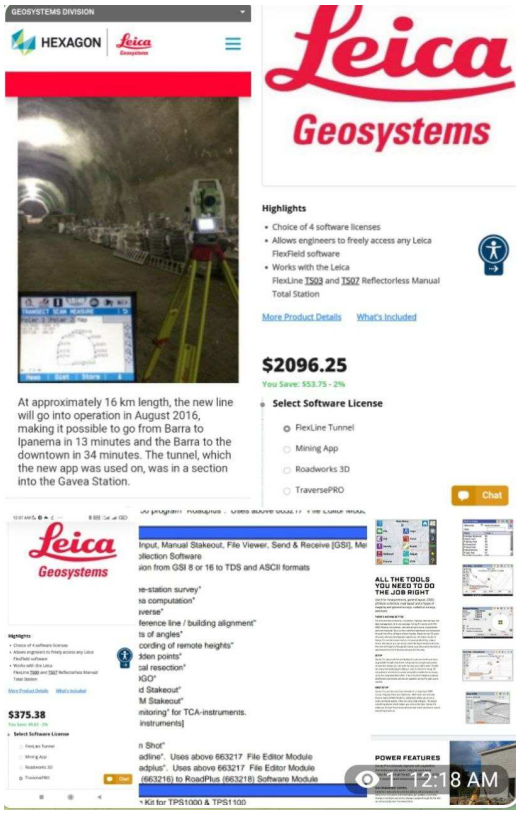

Fig.16 shows advanced TOTAL STATION whit tunnel program

But these TOTAL STATIONS are expensive in addition to the mentioned programs and cost companies more than 20 thousand dollars, so in countries like Iran, companies prefer to use cheap TOTAL STATIONS of 2000 dollars and the number of teams The surveyor should use more surveyors in the project. . Also, expensive TOTAL STATIONS are more complicated than simpler cameras, and surveyors prefer to use simpler and cheaper TOTAL STATIONS.

With the advent of mobile phones, it became possible for surveyor engineers to design the programs they designed on calculators and computers in mobile phones. Apps can provide surveyors with more features and their use is much easier. It is one of the complex TOTAL STATIONS, and they will not need to buy expensive TOTAL STATION. You can see Fig.17 that surveyor in KHODA AFARIN dam designed he converted programs from calculator and Excel to app [1].

Fig.17 shows apps that use to dams

Fig.18 shows section app used to tunnel

In this app Fig.18, you can enter the ID tunnel in straight path or circular arc, in the plan and longitudinal section, the coordinate of points relative to the section are calculated and drawn on the app [4].

Also you can draw the sections in DXF format.

If you have DATATRANSFER app in your mobile phone you can transfer data to SECTION app through cable. In Fig 19 you can see DATATRANSFER app, with this app you don't need TOTAL STATION with USB port [1], [2], [7].

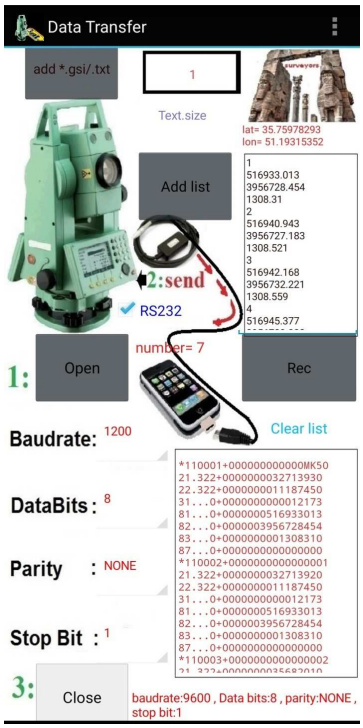

Fig.19 shows DATATRANSFER app

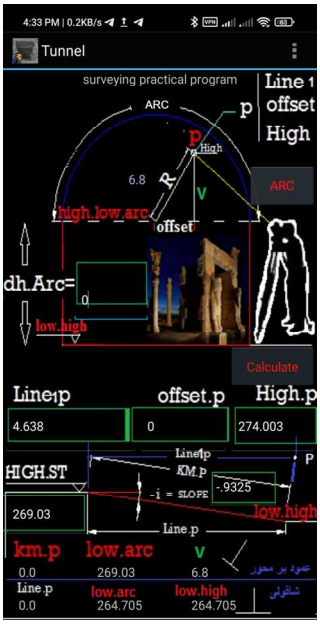

Fig.20 shows TUNNEL app

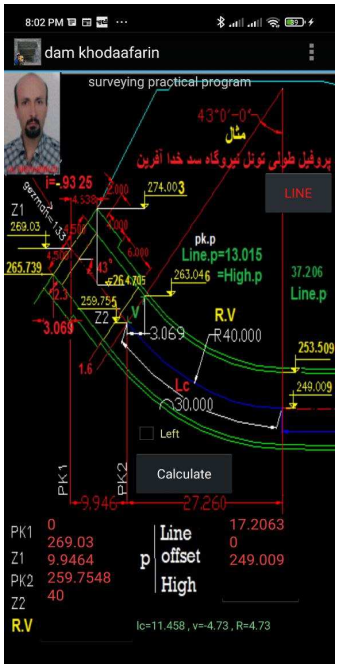

Fig.21 shows TUNNEL app

Also, you don't need DTM stakeout program in the TOTAL STATION, you can use DTM CUTFILL to control excavations and tunnel section. You must enter surface file in DXF format into the app. You can see this app in Fig.22 [5], [6].

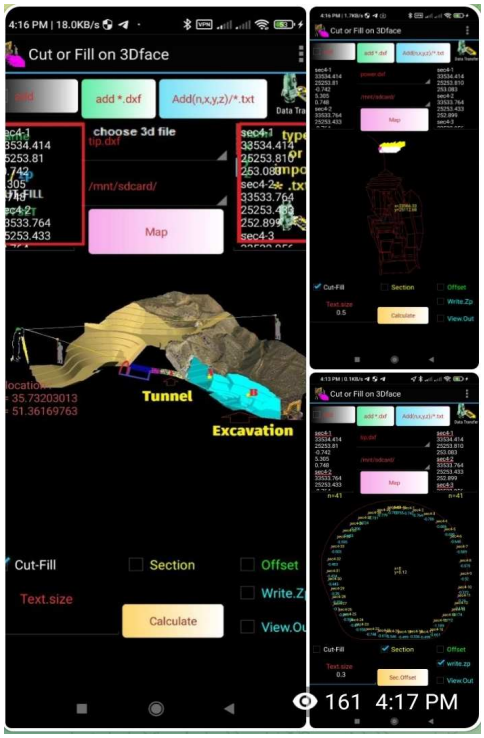

Fig.22 shows DTM CUT FILL app

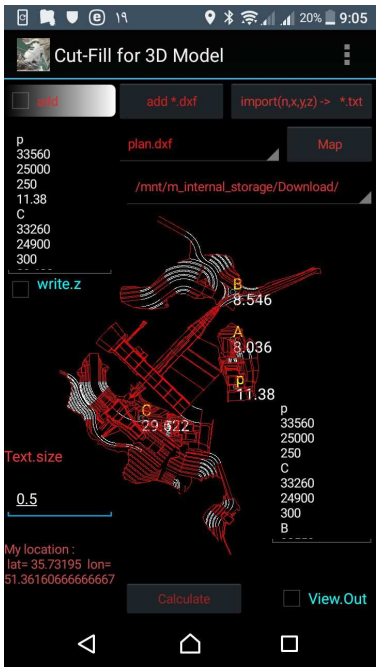

Fig.23 shows calculation and drawing map in DTM CUT FILL app

You can make 3Dface, Section and draw, build topography and calculate volume when transferring coordinates to a mobile phone. In Fig.24 3DMAP app did that.

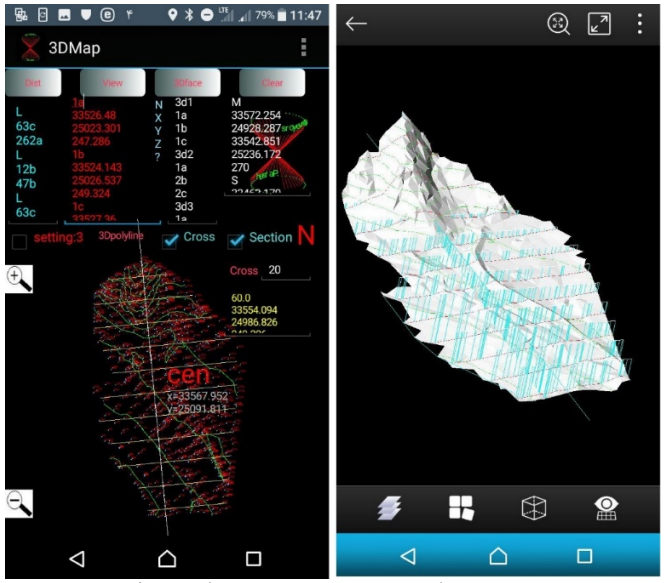

Fig.24 shows 3DMAP app and 3D MAP

You can use sections to calculate the volumes of excavation and embankment. In Fig.25 you can see sections that this app made in DXF format in your mobile phon. Also, the program is able to calculate the volume of the material depot or tank. You can see an example of these calculations in Fig. 26 [1].

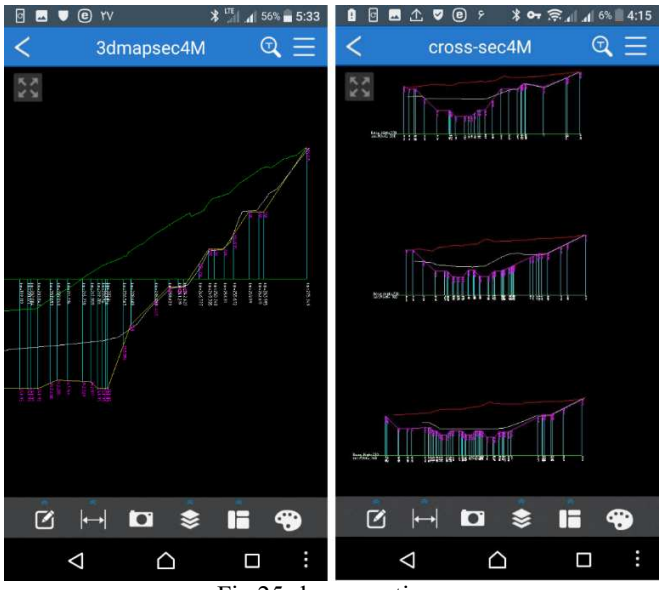

Fig.25 shows sections

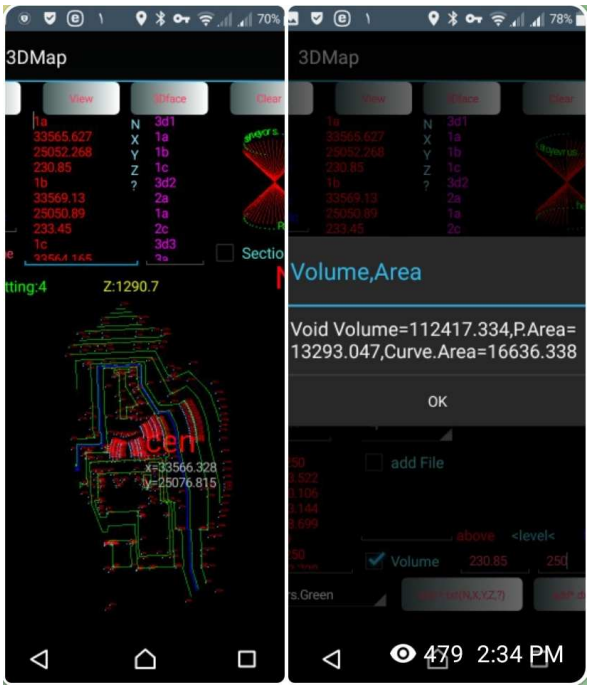

Fig.25 shows calculation void volume

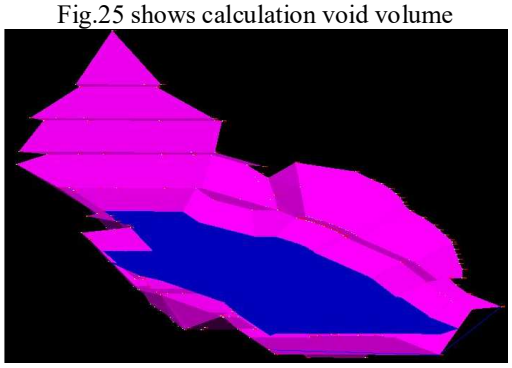

Fig.26 shows void volume

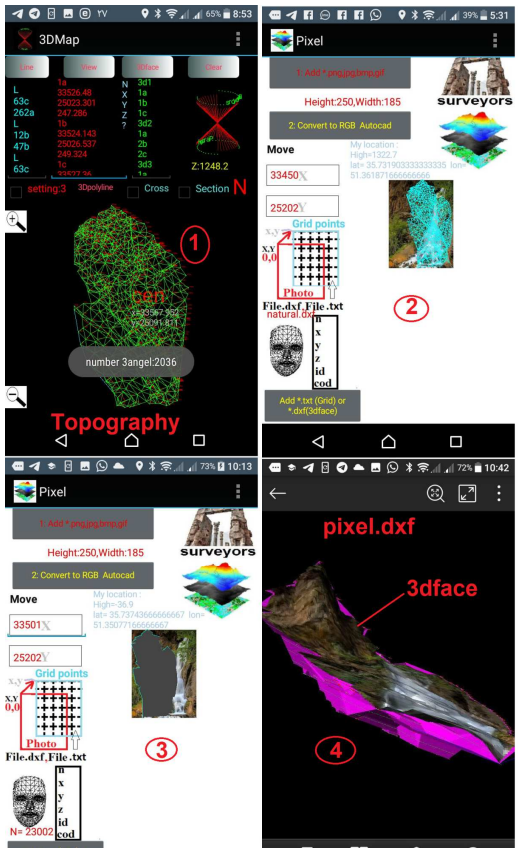

Fig.27 shows "**Pixel app**" that converts raster to vector

With pixel app you can import 3Dface and line objects if file is DXF format and put that on picture then create grid points and join picture on 3Dmodel then export picture with DXF format[1].

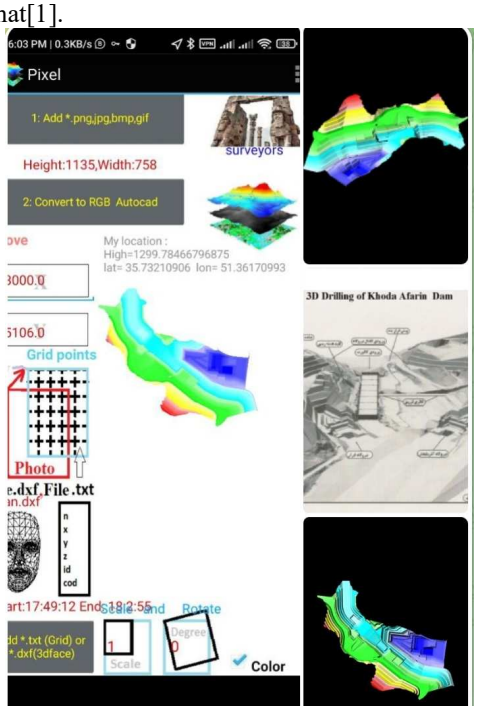

Fig.27 shows levels with different color

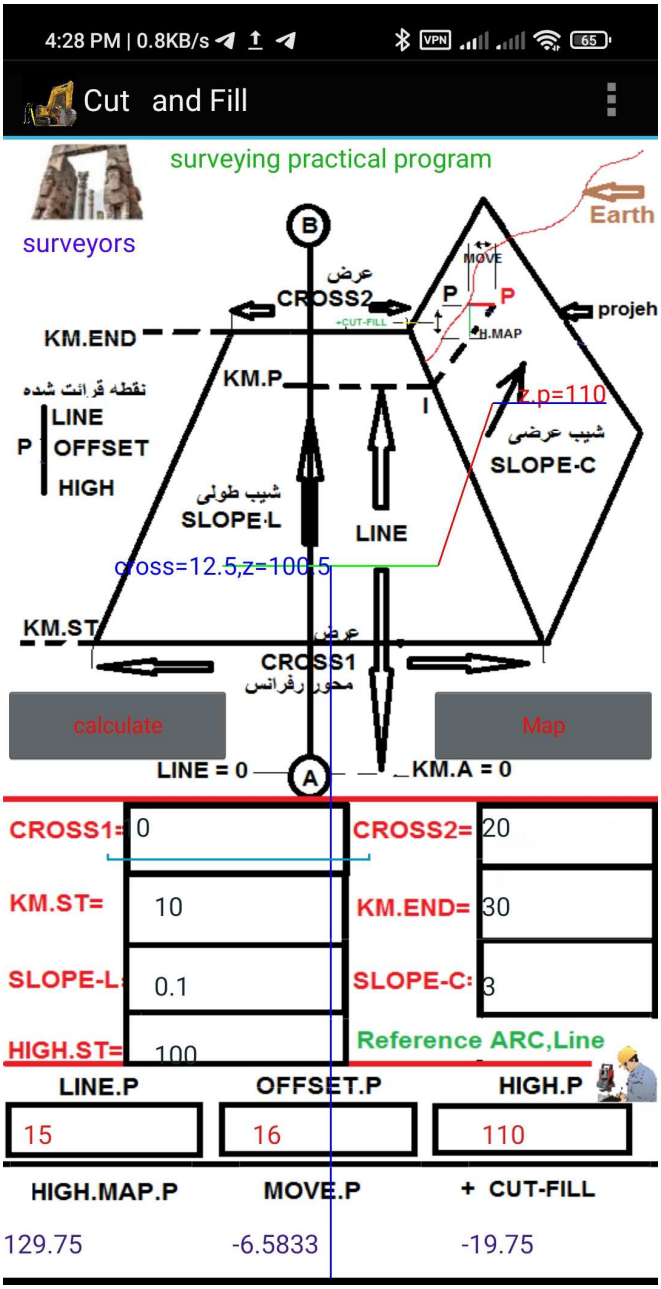

Fig.28 shows CUTFILL app

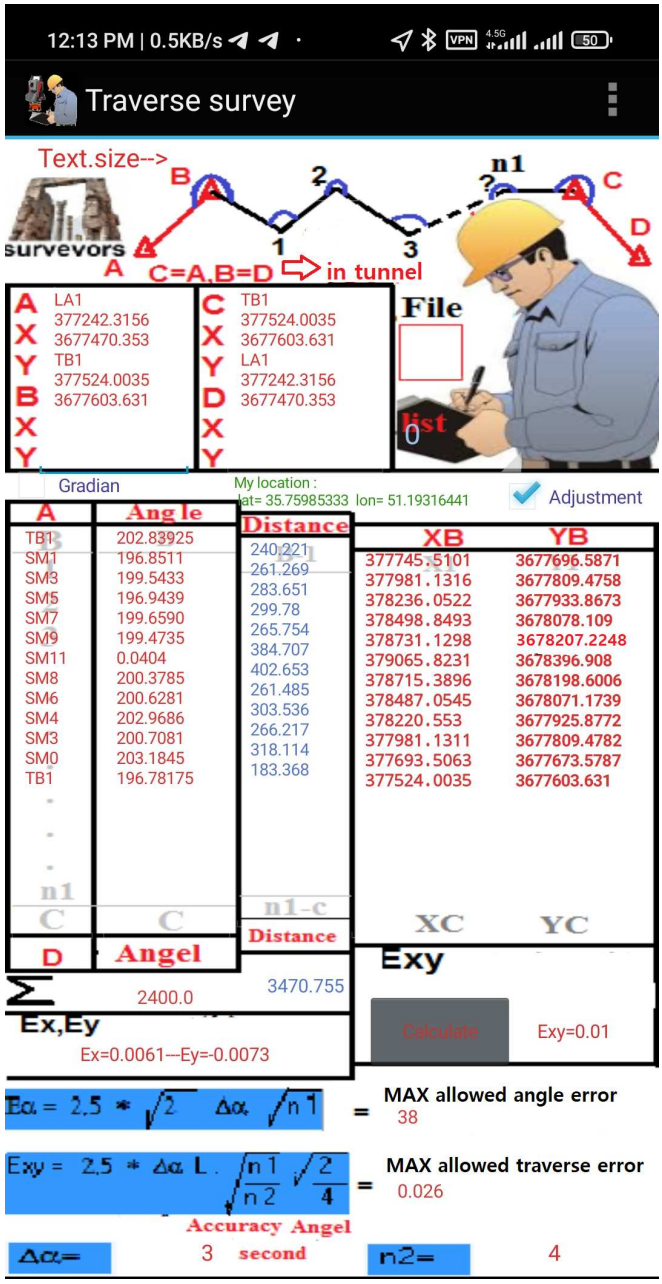

Fig.29 shows Traverse app

The CUTFILL app in Fig.28 use to control excavations and embankments and for seeing calculations and drawings on the app [1].

Surveying apps are helpful for surveyors but create challenges for TOTAL STATION sellers because surveyors will not need to buy expensive TOTAL STATION with expensive license program so surveyor has to design by himself without support from the company. Surveyors can also perform traverse calculations on mobile phones. In Fig.29 you can see sample traverse that you saw in Fig.12 [8].

REFERENCES

[1] https://t.me/naghshebardaraneparseh
[2] https://play.google.com/store/apps/details?id=usb.parseh
[3] https://play.google.com/store/apps/details?id=tunnel.parseh
[4] https://play.google.com/store/apps/details?id=section.parseh
[5] https://play.google.com/store/apps/details?id=cutfill3dfile.parseh
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[8] https://play.google.com/store/apps/details?id=traverse.parseh