Institut Agronomique et Vétérinaire Hassan II

School of Geomatic Sciences & Surveying Engineering

Bienvenue Welcome

CONTRIBUTION OF GPS IN SURVEYING QUARRIES

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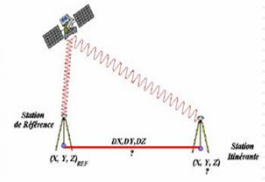
OUTLINE

- INTRODUCTION
- OBJECTIVE
- EXPERIMENTAL STUDY
- RESULTS AND DISCUSSION
- CONCLUSION

INTRODUCTION

- GPS and total station play an important role in collecting surveying data
- GPS system offers a three-dimensional positioning in a global reference frame, at any time, regardless of the meteorological conditions and over the globe



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INTRODUCTION

- Quarries involve an important industrial activity
- Provide important materials for building and public works
- Contribute to economic development and land planning as well as they are a great source of income

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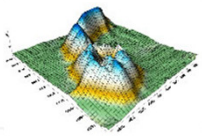
INTRODUCTION



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OBJECTIVE

- Experiment the use of GPS in surveying quarries in order to
- Determine the volumes of rubble using two surveying methods
- Test GPS contribution in improving the quality and performance
- Compare the results in terms of volumes determinations / The total station

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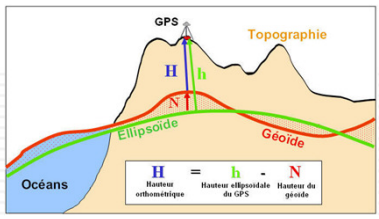
GPS AND LEVELLING

- Orthometric heights: **H = h - N**
- Small areas, flat terrain

$$\Delta N = \Delta h - \Delta H$$

- If we consider $\Delta N \approx 0$
- Therefore : $\Delta h \approx \Delta H$
- Orthometric heights:

$$H_{pt} = H_{ref} + \Delta h_{ref\text{-}pt}$$



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EXPERIMENTAL STUDY

The study sites

- Sites are two quarries of marble (or limestone) located in the northern region of Morocco
- These careers are open, and were operated over several years.

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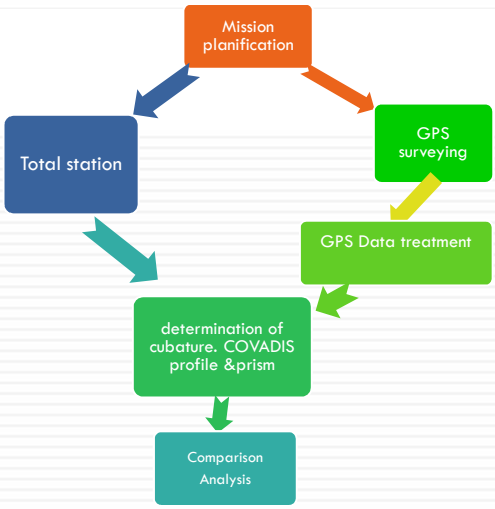
EXPERIMENTAL STUDY



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EXPERIMENTAL STUDY

Survey using total station

- The monitoring every six months.
- For each career, several new points were determined in order to fully cover the career by known points in three dimensions
- Point determination: traverse (several stations)
- Nb of people: 5

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EXPERIMENTAL STUDY

GPS Survey

Characteristics of GPS receiver reference point :

- Highest point of the route
- Stable: there is no mining in its closure
- Free of obstacles to assure good reception of GPS signal
- Far from site's installations

GPS observations :

- Number of satellites> = 4
- PDOP <7
- Stop and go mode for mobile receiver
- Reinitialization time is 20 minutes (signal interruption).
- Observation time: 15 seconds

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RESULTS AND DISCUSSION

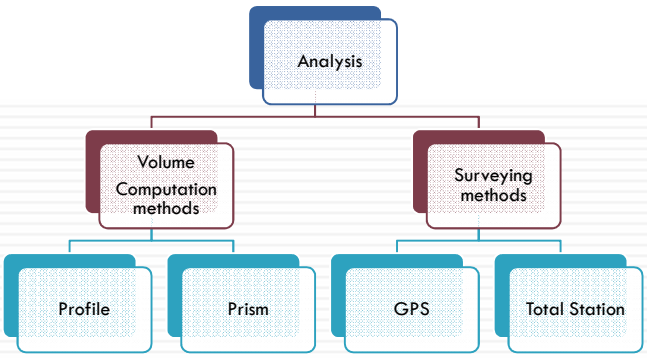

FIG MARRAKEC 2011 MAI 2011

RESULTS AND DISCUSSION

Comparison methods of calculating cubature (prism & profile)

First career:

By total station:

- The differences between cubatures obtained for various levels by the two methods vary between 1 m^3 and 188 m^3.

Using GPS

- The differences between cubatures obtained for various levels by both methods vary from 2 m^3 to 12 m^3.
- After analysis, we can see that the results of cubature for each kind of survey, using the two methods are very closer.
- Ccl: the methods of calculating cubature by profiles or by prism lead to similar results.

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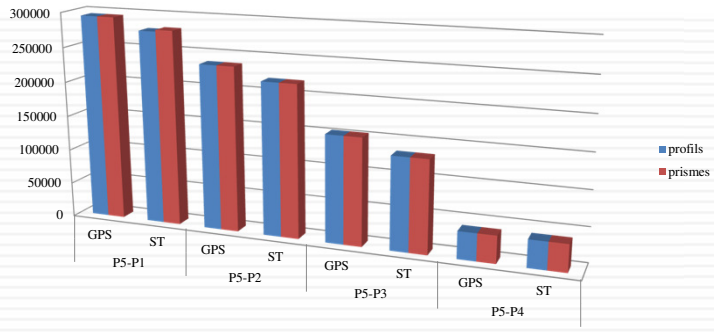
RESULTS AND DISCUSSION

Cubatures using two methods (m^3)
First career



RESULTS AND DISCUSSION

Comparison between results of two survey methods (GPS vs total station)

First Career : the differences between level P5, the current state of the this career and the precedent surveys (levels P4, P3 , P2 and P1).

Cubature using GPS & Total station			
	GPS (m³)	Total ST (m³)	mixed (m³)
P5-P1	294038	280055	297924
P5-P2	236197	218748	234552
P5-P3	153532	132788	142368
P5-P4	39289	39387	41416

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RESULTS AND DISCUSSION

Comparison between results of two survey methods (GPS vs total station)

Analysis : First Career

- Results of cubature from the two surveys are different.
- The result obtained by GPS survey is greater compared to that obtained by total station.
- Results of cubature between levels P4 and P5 are closer to each other
- The difference between the results of cubature using GPS and total station is close to 2 ‰.

Results of cubature obtained by GPS and mixed survey are close to each other. The difference does not exceed 5% of the total cubatur e.

After these remarks we can say that the GPS survey compared to the total station , represents better the first career.

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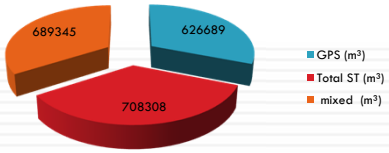
RESULTS AND DISCUSSION

Comparison between results of two survey methods (GPS vs total station)

Second Career

- Differences represented here are between levels P1 and P5.



The analysis shows that:

- There is 12% difference between cubature obtained using GPS survey and that obtained using total station survey.
- GPS data are insufficient compared to that of total station, so it is not adequate to represent this career.
- we can conclude that the total station survey, compared to GPS survey, represents better this second career.

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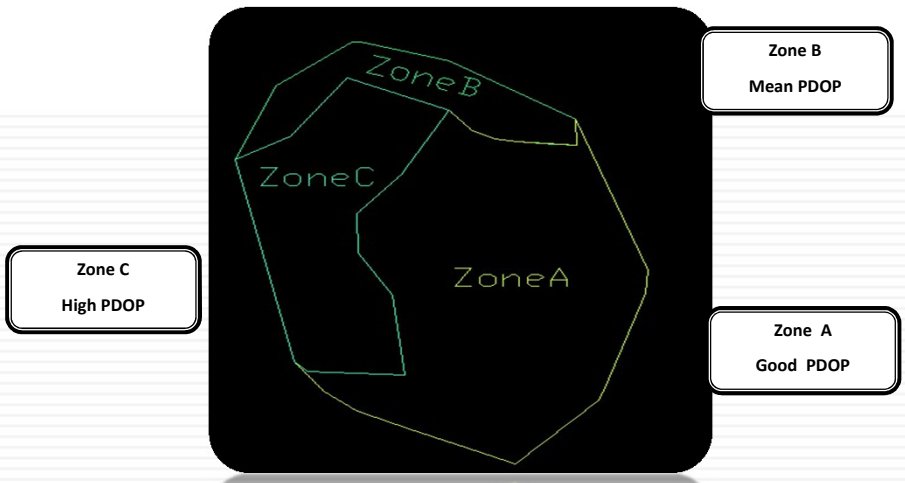
RESULTS AND DISCUSSION

Comparison between results of two survey methods (GPS vs total station)

- The major problems encountered during the survey of this career by GPS, were caused by satellite geometry.
- There was a very large area of the career not surveyed because of the depth of certain of its zones.
- Consequently, the PDOP was increasing rapidly. For that purpose we need to know the density of surveyed points in each case.



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RESULTS AND DISCUSSION

Analysis of density of points

- The accuracy of a Digital Elevation Model (DEM) depends on the density of measures adapted to the variation of the terrain.
- In a rough terrain, we need a survey that describes better its characteristics.
- The density of points over 400 m, is :

	GPS	Total ST
First career	2.41	1.07
Second career	1.80	2.02

FIG MARRAKEC 2011 MAI 2011

RESULTS AND DISCUSSION

Density of points

	GPS	Total ST
First career	2.41	1.07
Second career	1.80	2.02

- Therefore, the density of points in the first case is better with GPS survey
- while it is better using Total station in the second career.
- We can therefore explain that the differences in results of cubature between the total station and GPS are due to the density of the surveyed points.
- When density is good the cubature defines well the terrain.

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CONCLUSION

Total station and GPS to survey two different quarries. Considering the obtained results we can draw the following conclusions:

✓ The profiles and prism methods of calculating cubature lead to similar results.

The use of GPS to survey a career has certain advantages:

✓ In a clear and less rugged career, the use of GPS to survey will save a significant amount of time.

✓ The rate of survey is limited by the speed of displacement of the mobile receiver.

✓ Using a single fixed reference station for multiple mobile receivers reduces costs and time.

✓ The GPS represents the advantage that the intervisibility is not necessary to make survey.

✓ The GPS also minimizes the number of people needed during survey operations.

CONCLUSION

GPS limits/problems

- ✓ The multipath and the interruption of signals for deep careers.

The use of a total station to survey a career presents certain disadvantages:

- ✓ we need several stations to cover a very large area of a career.
- ✓ The use of total station is handicapped by problems of intervisibility which influences on time and cost operations.
- ✓The total station survey is time consuming.
- ✓The density of surveyed points is the most critical factor
- ✓ Complementarities between the total station and GPS will certainly give best and complete density of the terrain, therefore good cubature results.

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THANK YOU FOR YOUR ATTENTION