

## Zenith Line

# Unconventional Use of an Automatic Total Station

**Joel van Cranenbroeck**, Director of Technology

New Business Division, Leica Geosystems AG, Switzerland

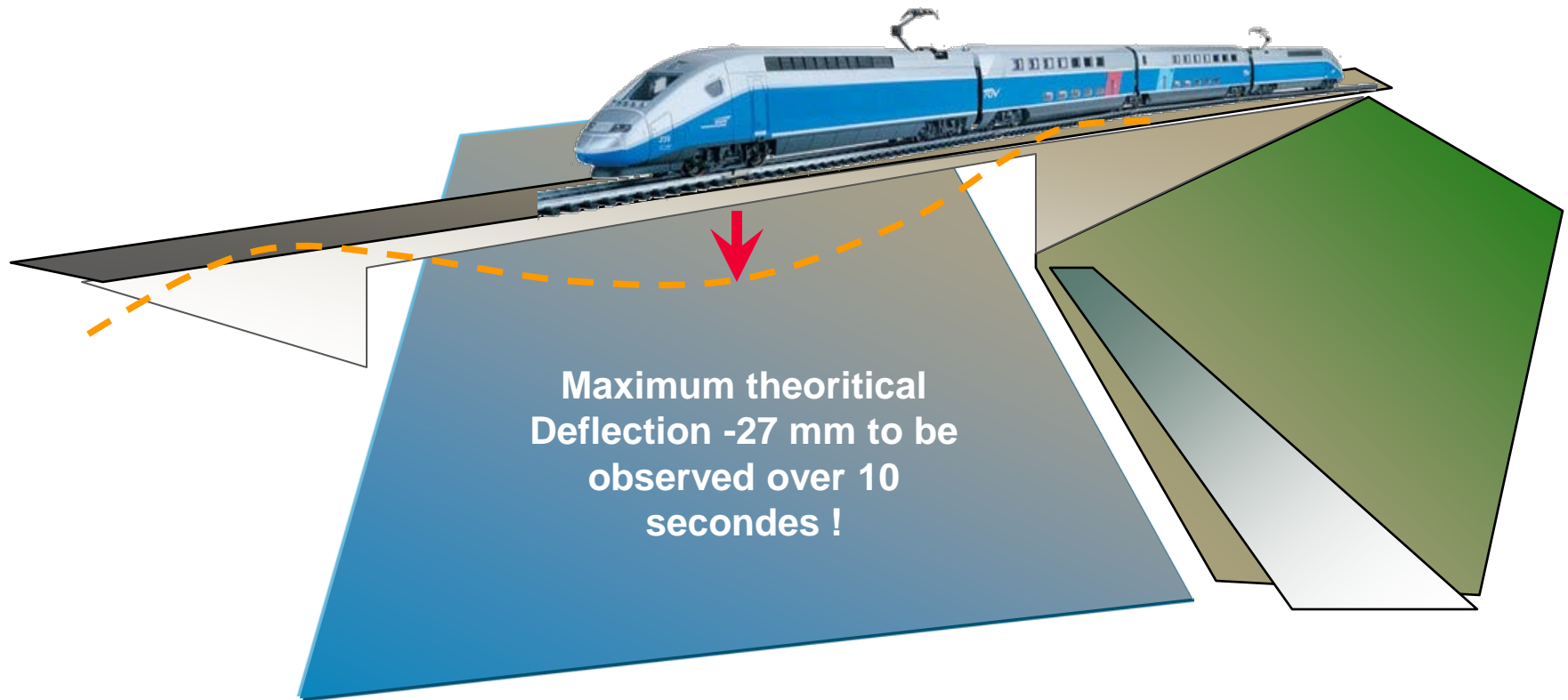
**Soang Hun OH**, Competence Manager Extreme Engineering

IMoSS AG, Dubai UAE

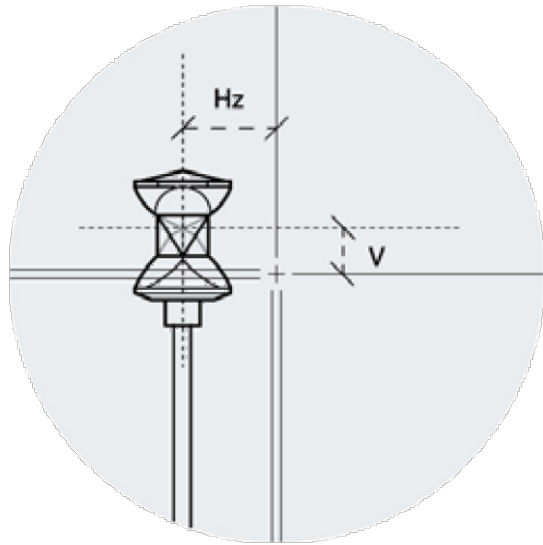
- when it has to be **right**

**Leica**  
Geosystems

# Case study : Bridge kinematic loading tests with TGV (High Speed Train) at 260 km/hour ( NOV 1995)



# Automatic Target Recognition (ATR)



Automatic Target Recognition (ATR) is the sensor that identifies the prism and measures its position on an image sensor to determine its exact angular location.

The ATR is available on the robotic total stations to allow automated measurements, precise measurements without manual aiming, one-man surveying, etc.

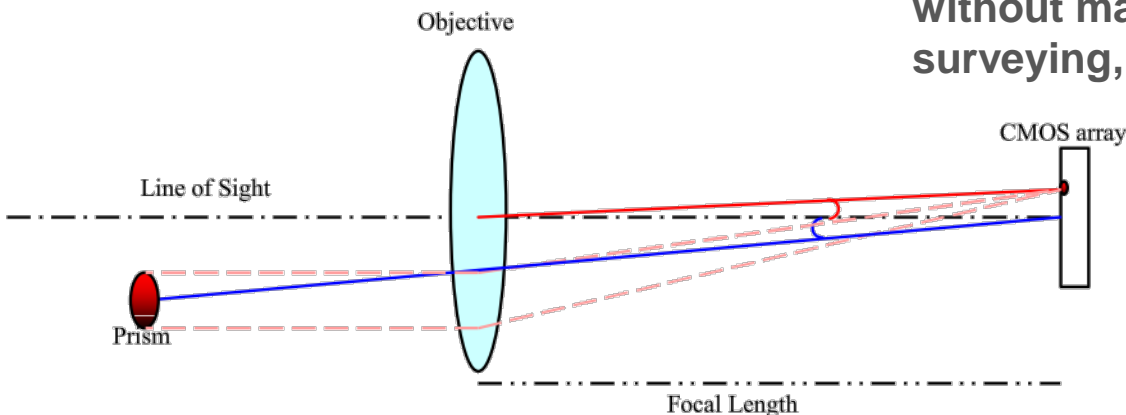
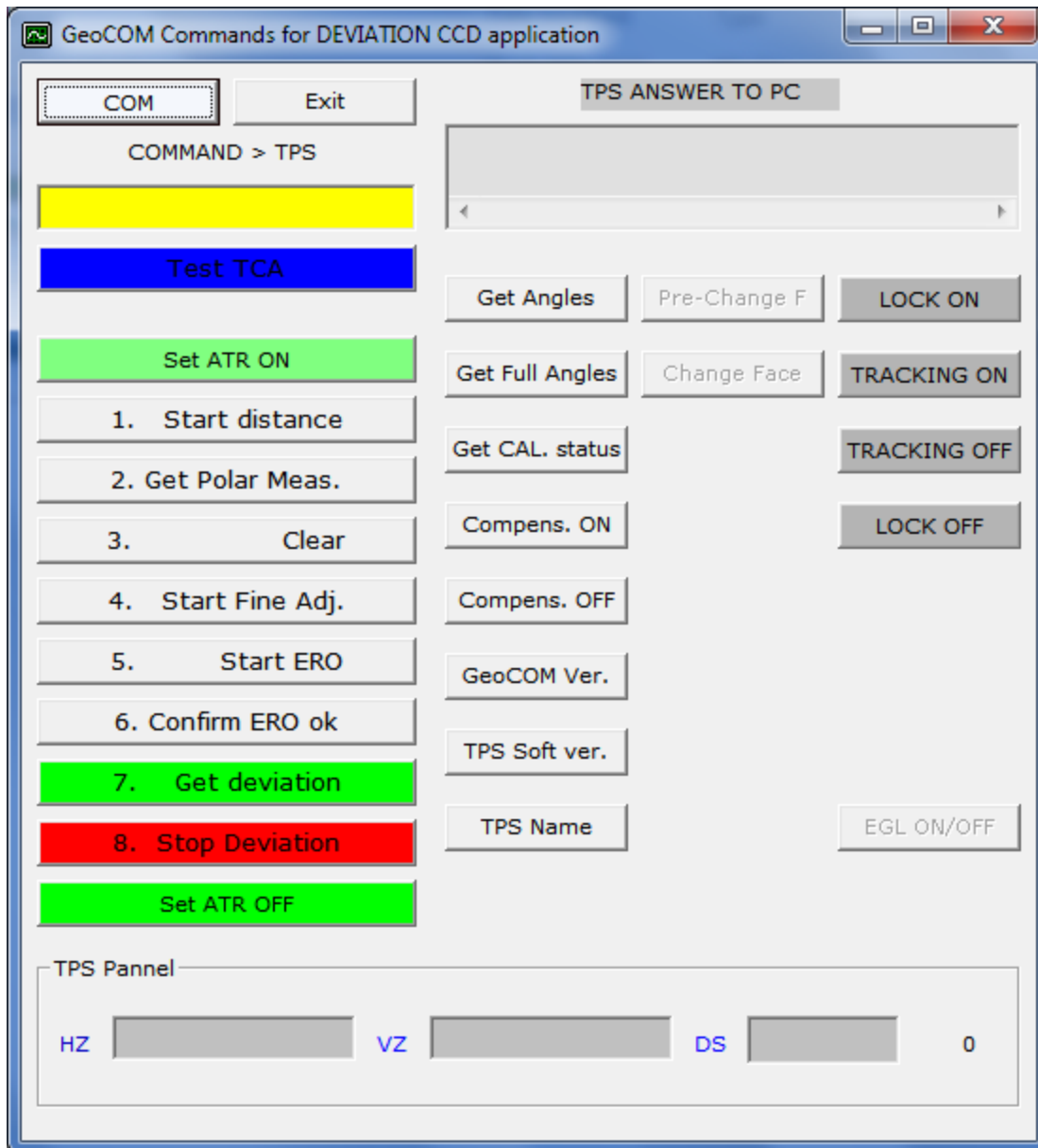


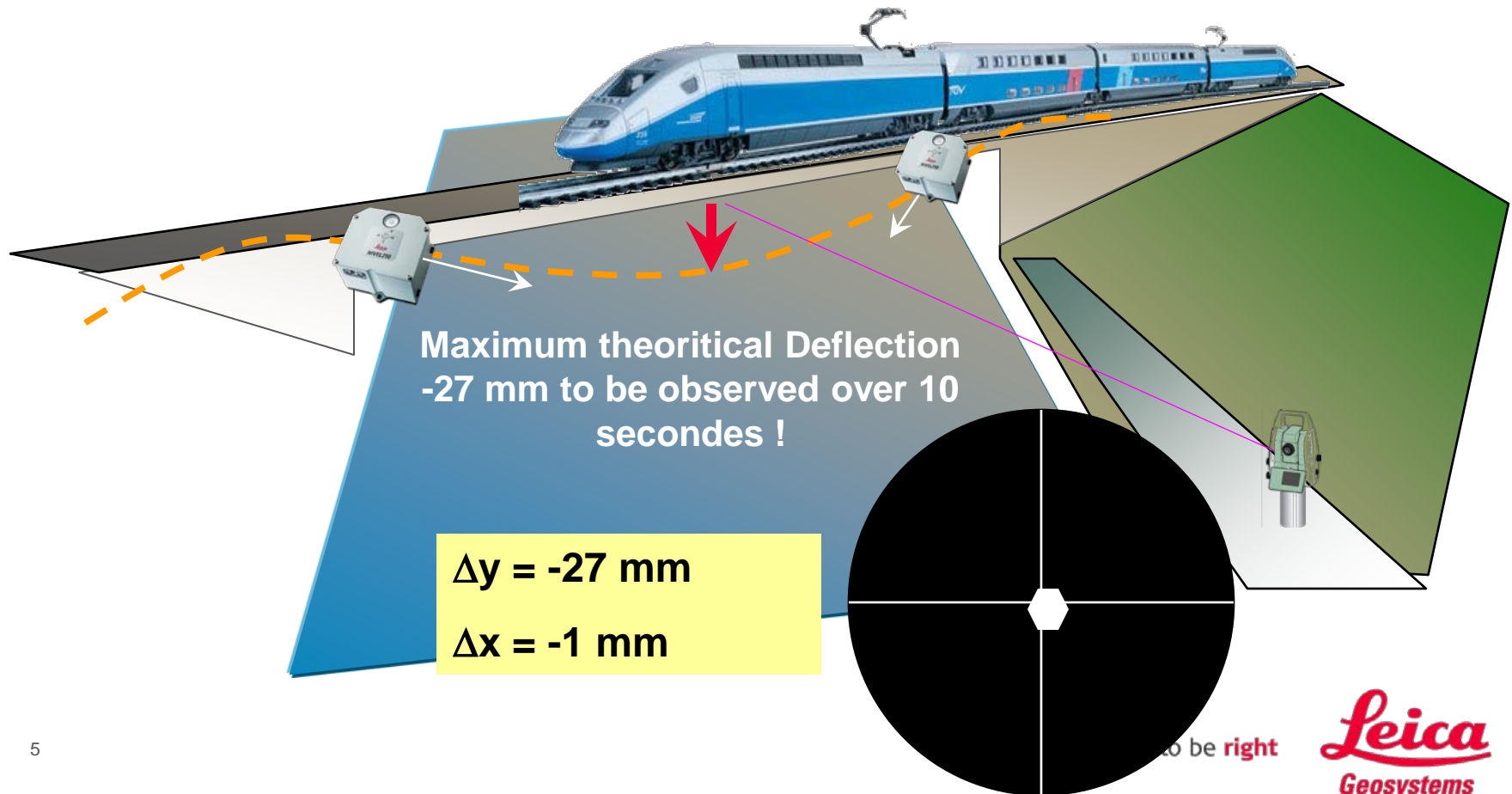
Figure 4: Simplified image geometry



The concept is to track the deviation of the prism without engaging the motor drives retro-actions.

The telescope stays steady, the up/down and right/left deviation of the infra-red beam reflected by the prisms and receives by the CMOS area into the telescope is delivering fast and high accurate  $\Delta Hz$  et  $\Delta V$  that multiply by an initial distance measurement can produce a  $\Delta X$  and  $\Delta Y$  along the line of sight.

# Case study : Bridge kinematic loading tests with TGV (High Speed Train) at 260 km/hour (1995)



26 NOVEMBER 1999

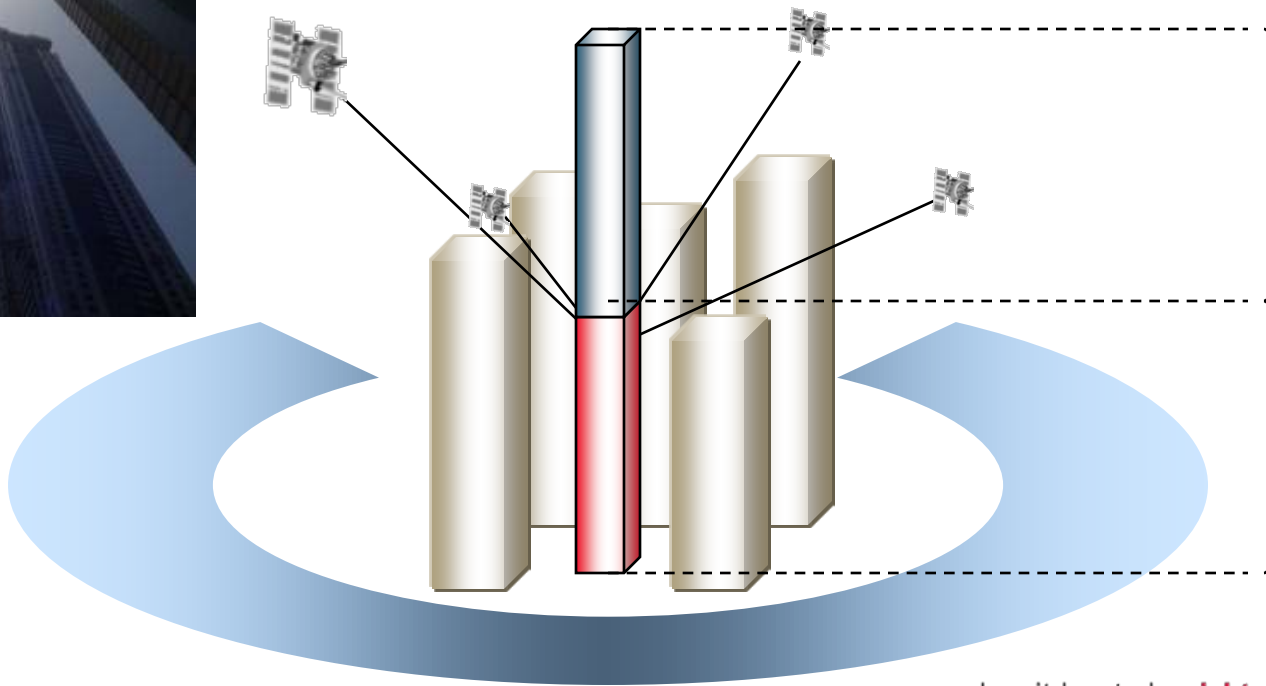


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# When GNSS is not possible to use ?



*GNSS Satellites are rising from East to West and cumulating to the South while never rising from the North*



**Blue level**  
Satellite's geometry and availability **good ...**

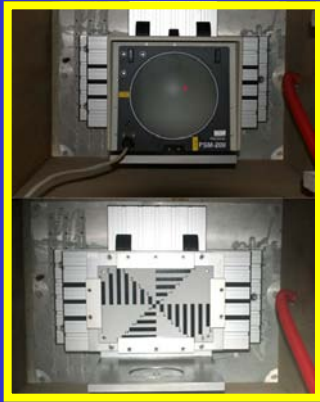
**Red level**  
Satellite's geometry and availability **poor ...**

- when it has to be **right**

# Vertical Laser Plummet ...

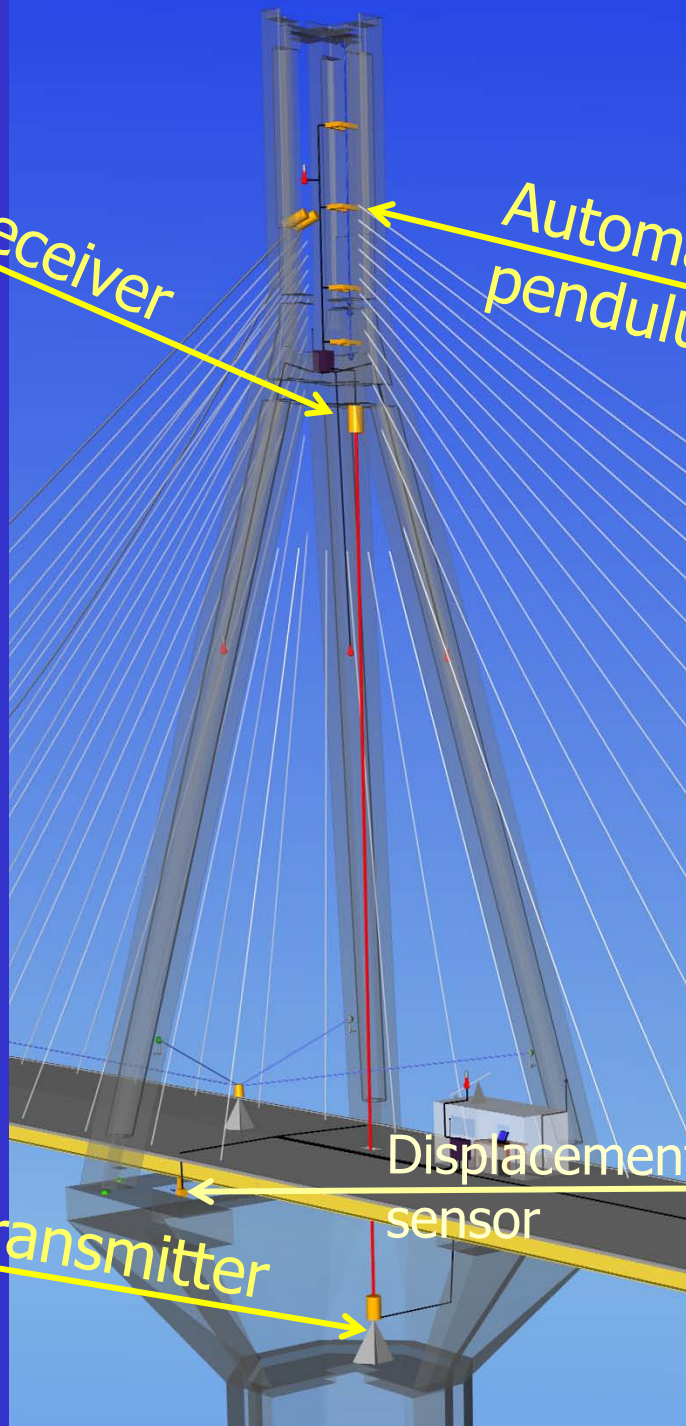
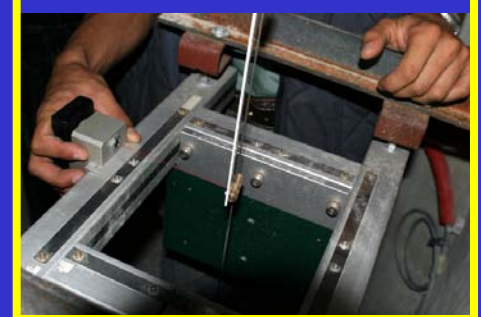






Receiver

Automated pendulums



Displacement wire sensor

Transmitter





# **PENTOMINIUM Plot No. 392-567 Marsa Dubai**

## **Proposal for Monitoring & Control Survey Services**

- when it has to be **right**

**Leica**  
Geosystems

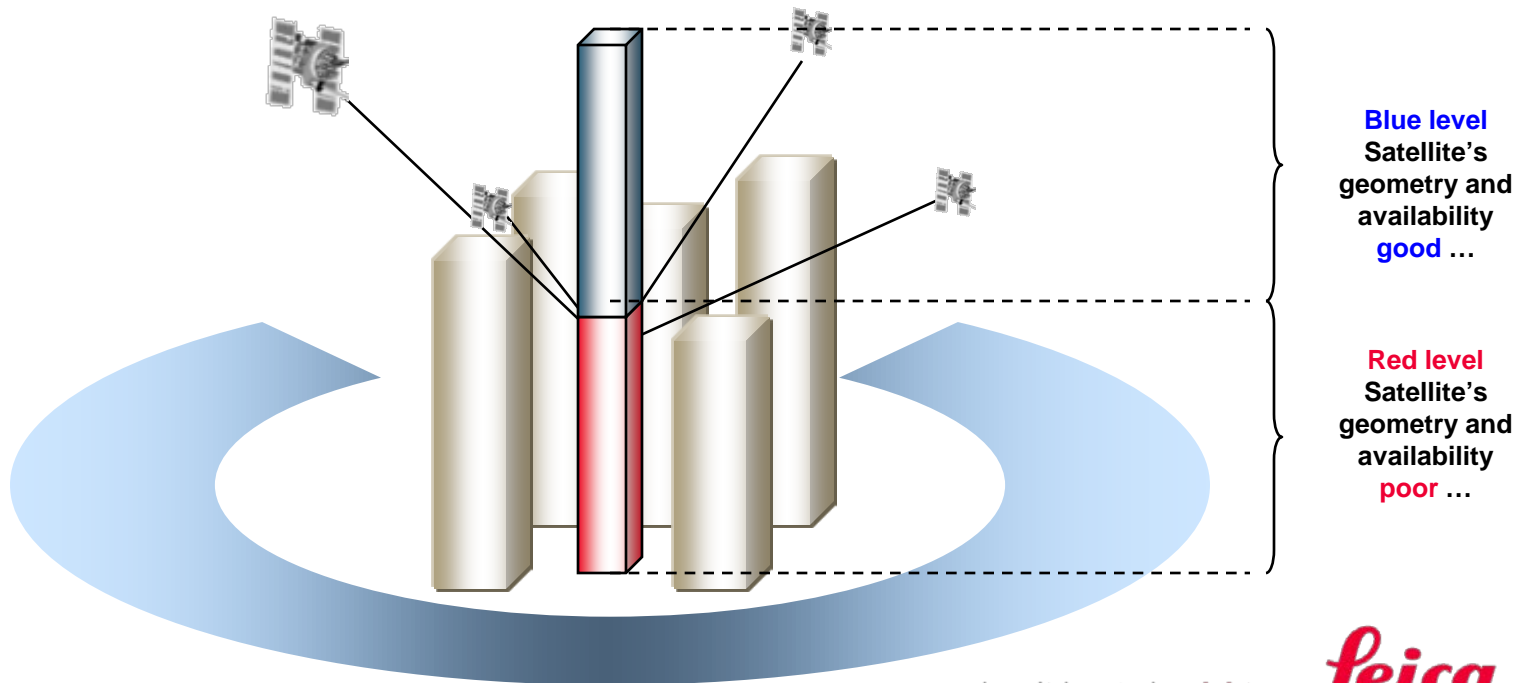
# PENTOMINIUM Plot No. 392-567 Marsa Dubai

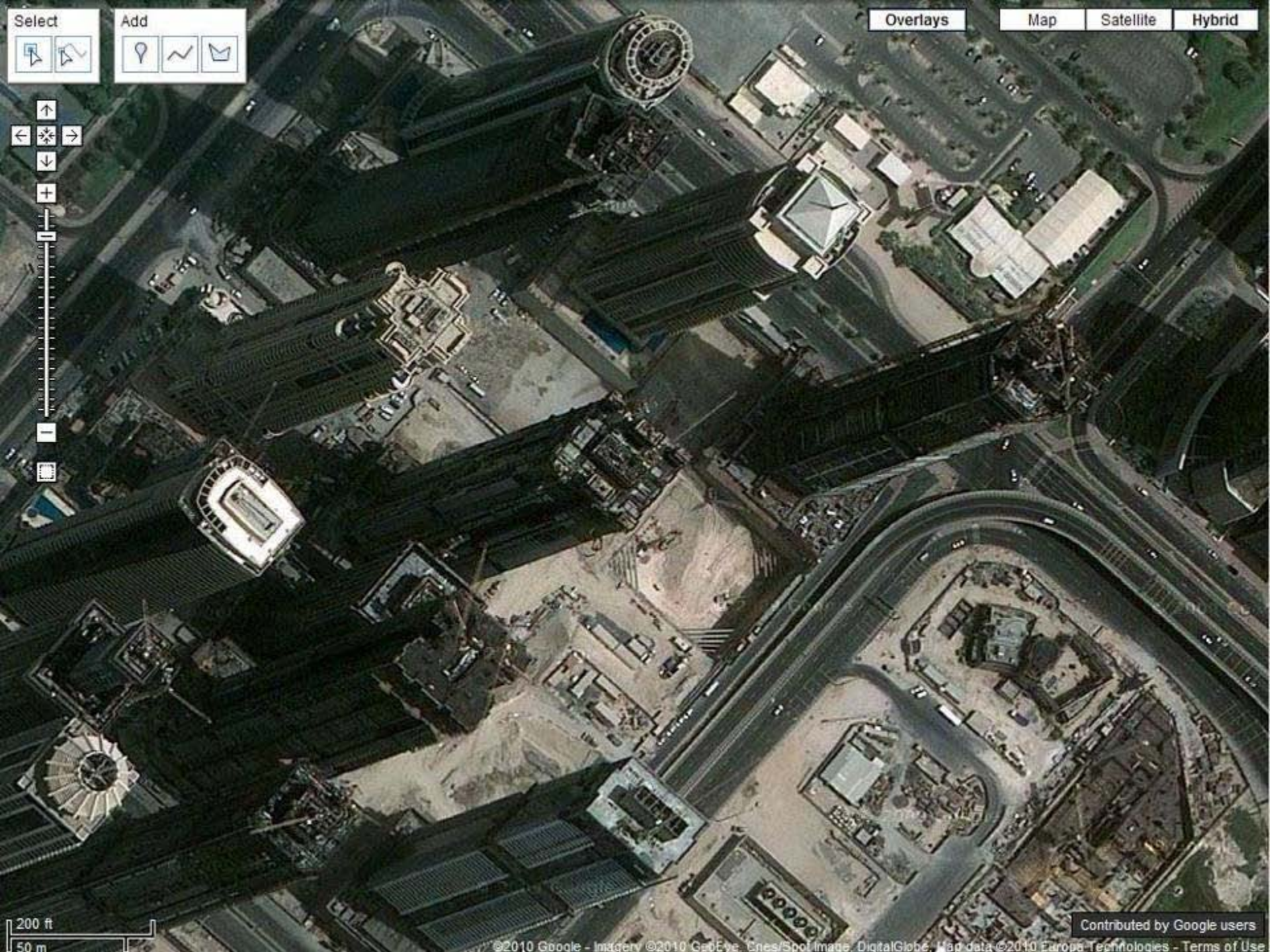
## 2 systems / 2 levels proposal (CWCS & SDSM)

The environment of the new tower is at least for the first 300 meters unfavourable (obstruction and reflection) to make full use of GNSS (GPS and GLONASS) technology due the signal's obstructions.

Leica Geosystems therefore suggests to consider also **2 levels** depending of the availability of GNSS signals

*GNSS Satellites are rising from East to West and culminating to the South while never rising from the North*





Overlays

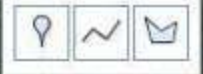
Map

Satellite

Hybrid

Select

Add



Contributed by Google users

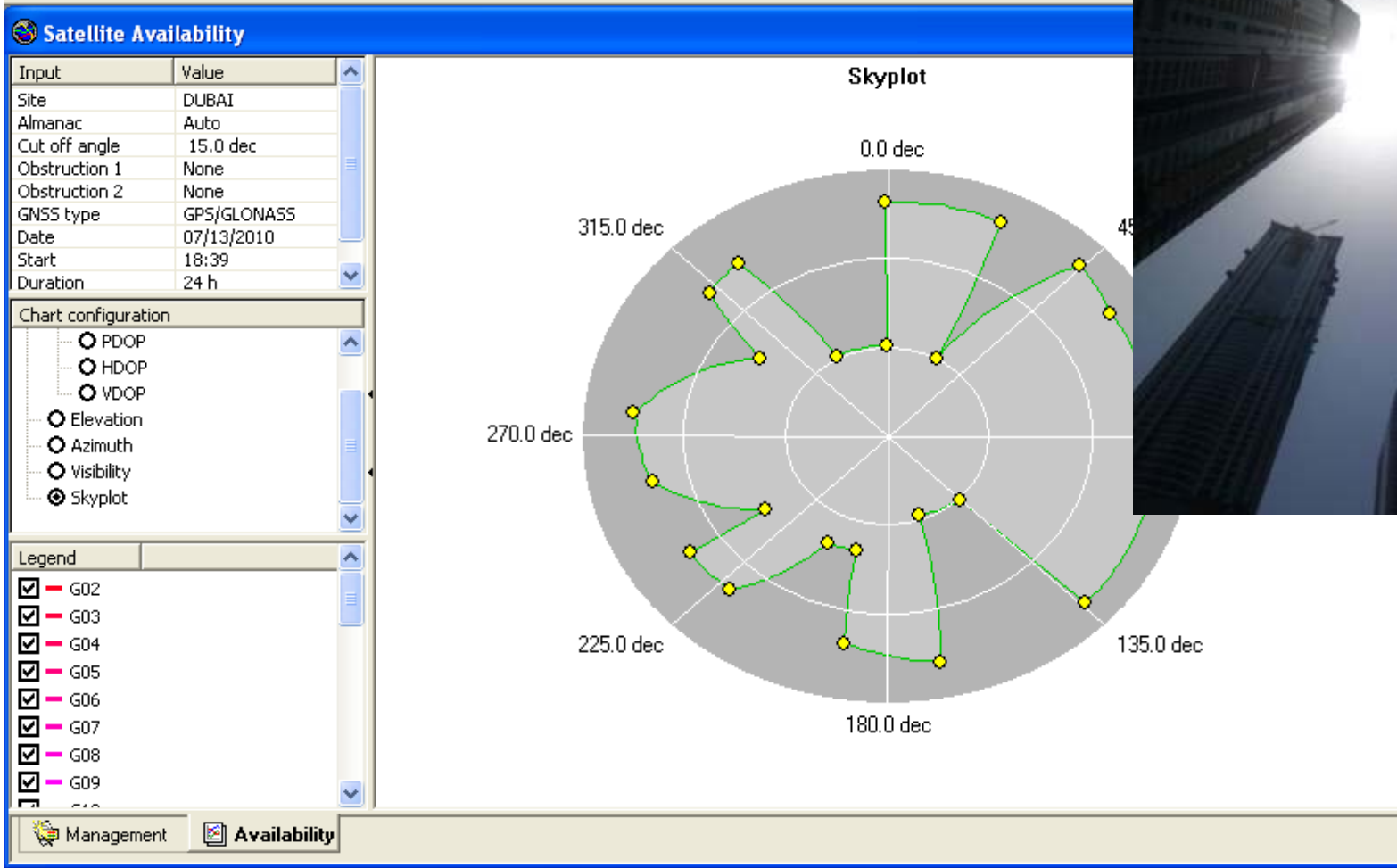
# GNSS Mission Planning

## How to cope with such environment ?

The new Pentominium tower is already surrounded by several **high buildings** where the **average height is about 300 meters** which means that below that height GNSS signals can easily be blocked.



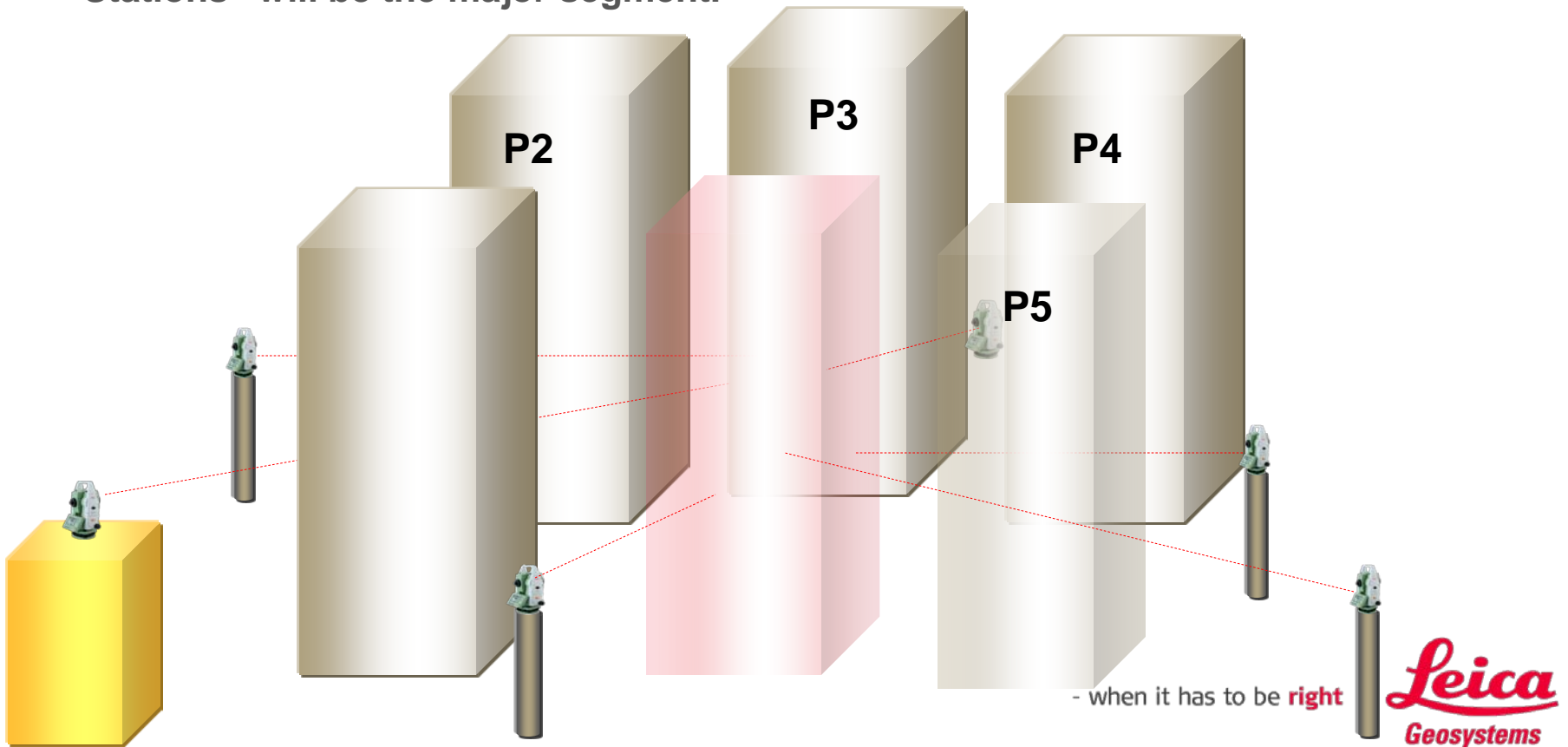
# GNSS Mission Planning



# PENTOMINIUM Plot No. 392-567 Marsa Dubai

## SDSM - RED Level ( $h < 300m$ )

The RED level characteristic is that having no good geometry (GDOP) from GNSS and most probably also multiple reflection (multi-path's) the “networked Total Stations” will be the major segment.



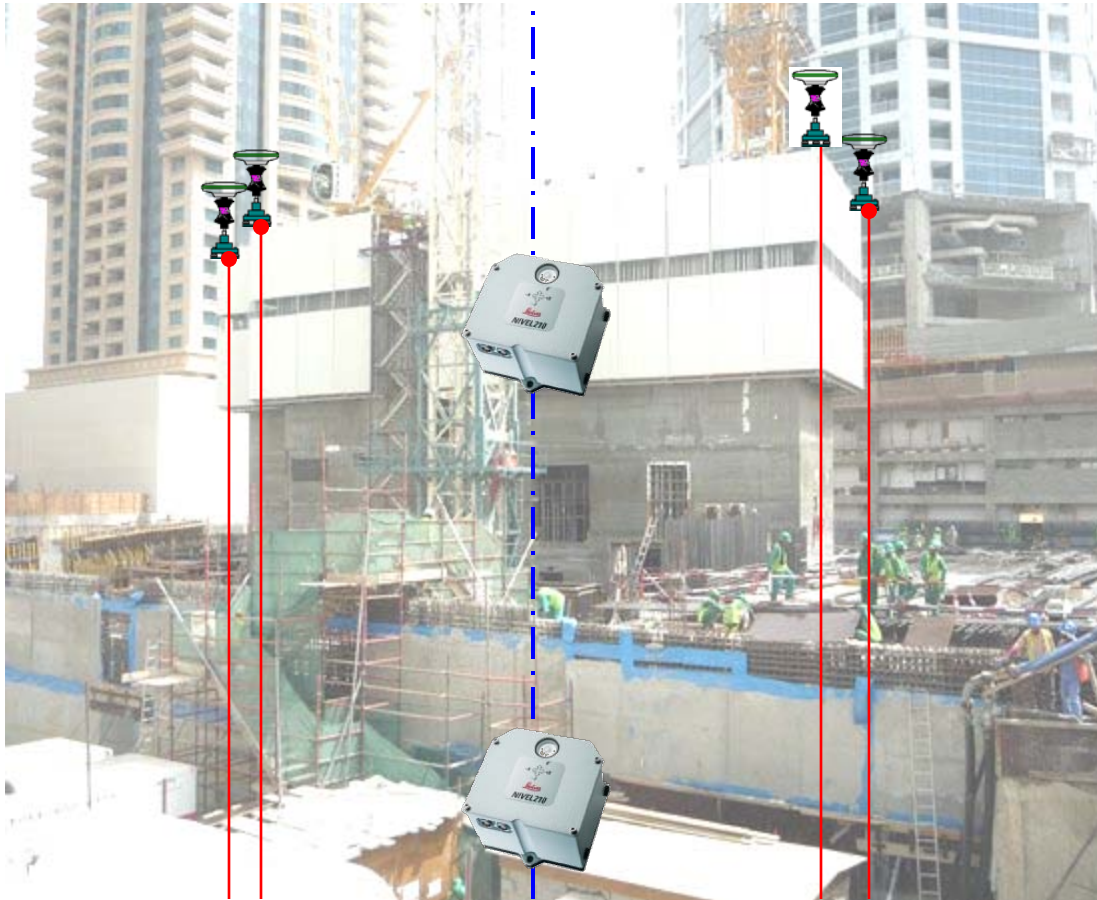




# Examples of Total Stations located in city centres



# PENTOMINIUM Plot No. 392-567 Marsa Dubai Core Wall Control Survey System - RED Level

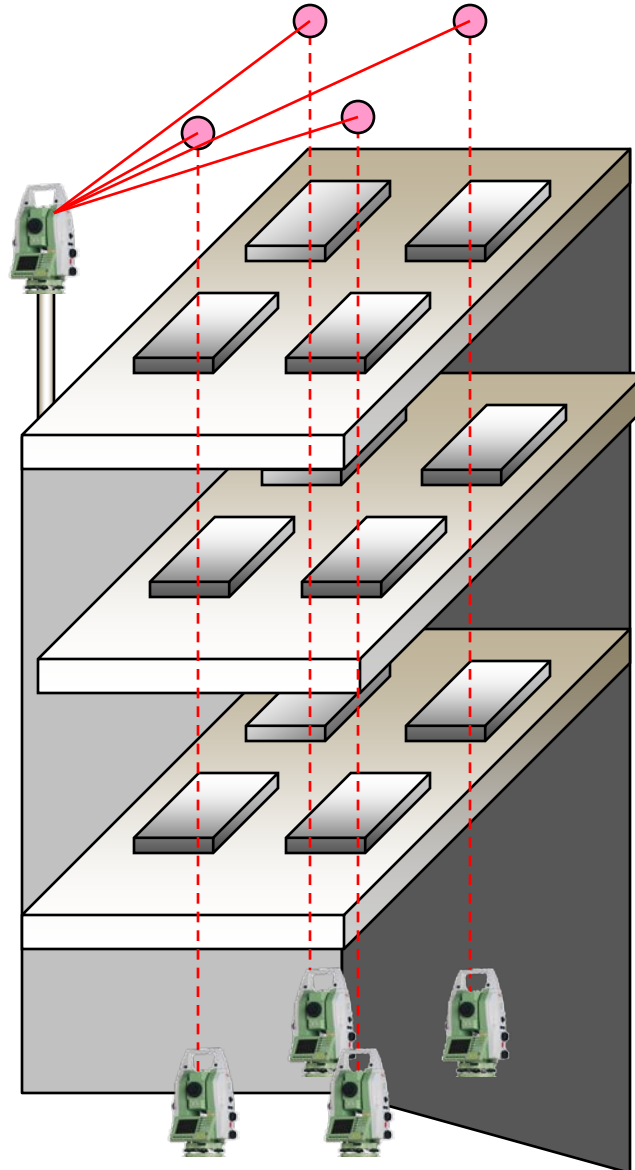


“Vertical guideline” sensors ( Zenith Line onboard application ) will be installed from the ground level to periodically checked the system.

The precise inclinometers collocated with the GNSS Antenna’s and the 360° reflectors will provide the tilts information.

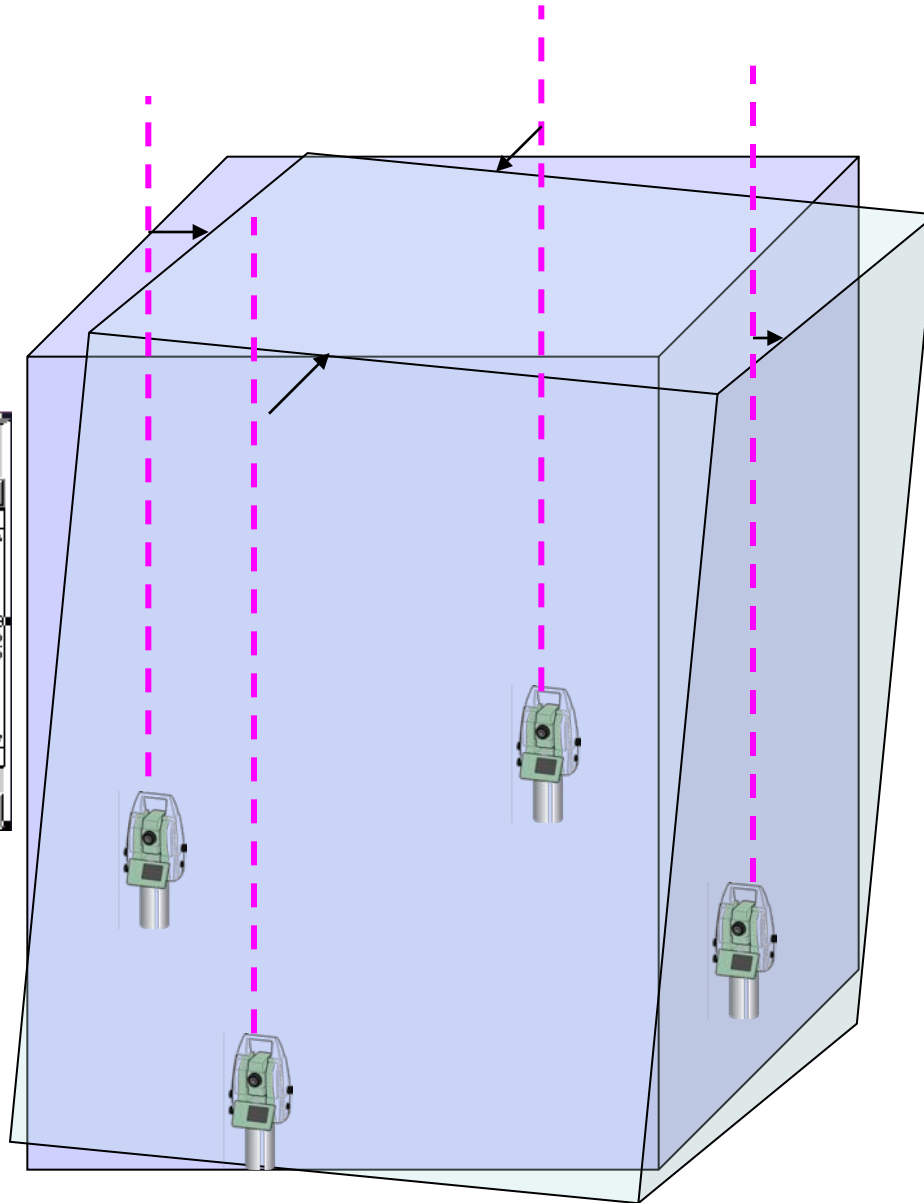
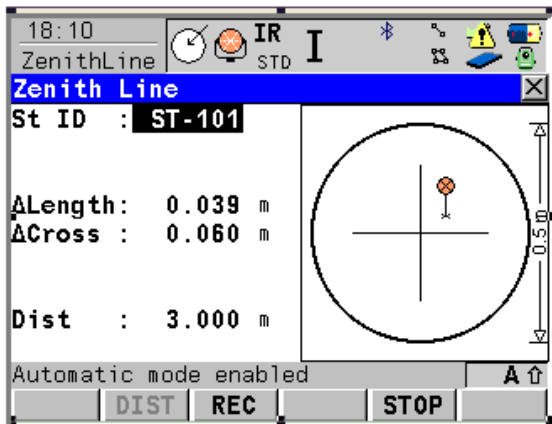
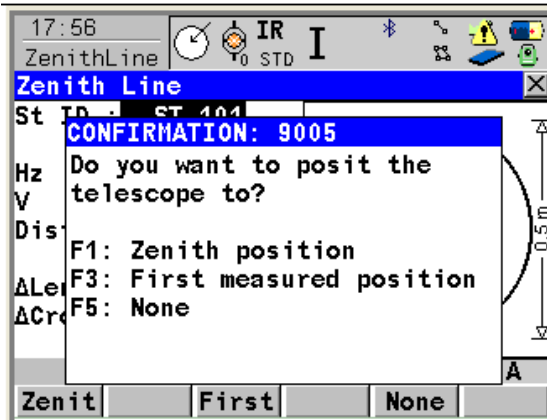
The Leica NIVEL200 will be progressively installed as well along the core wall main axis and networked to provide the complete profile of the structure.

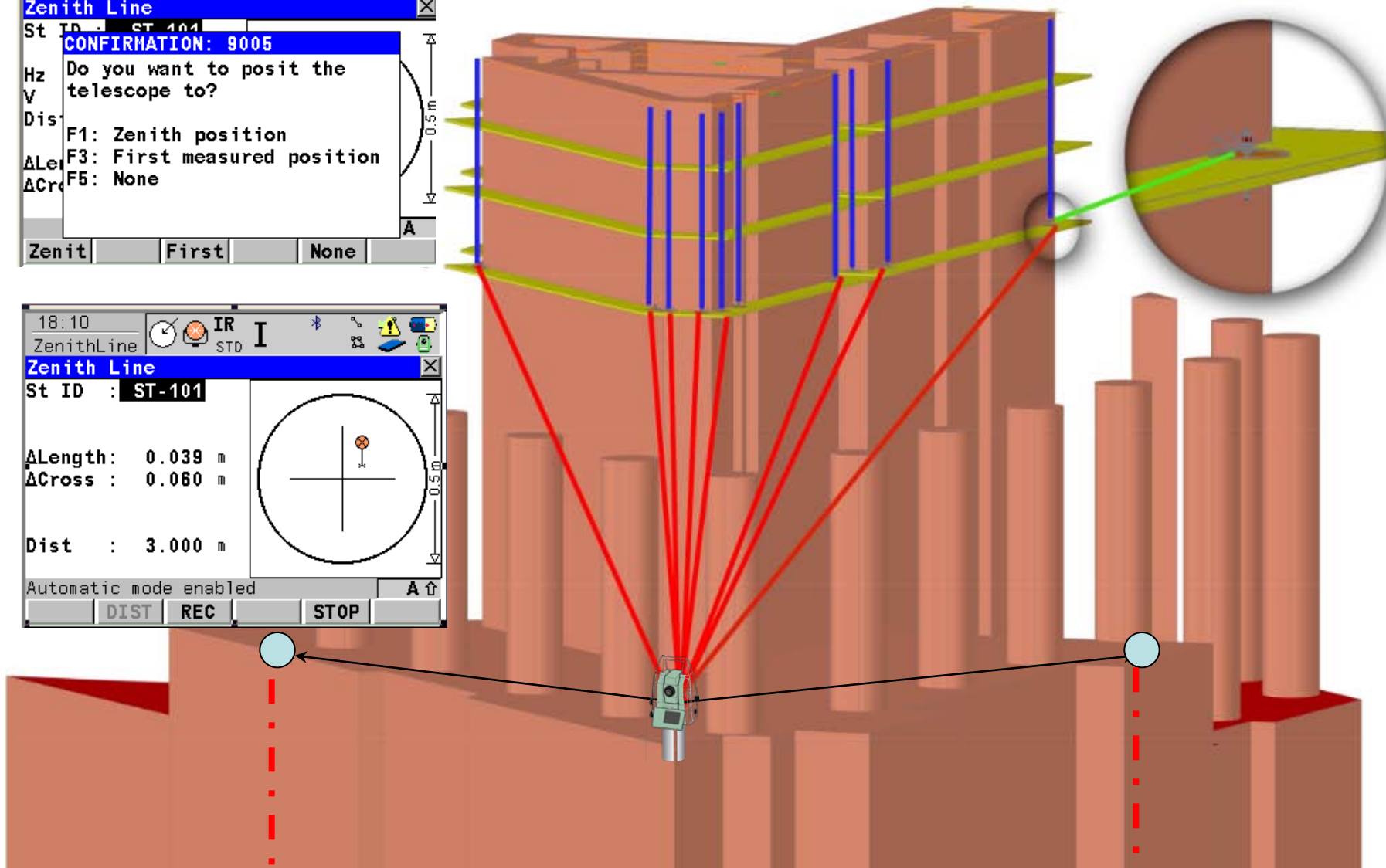
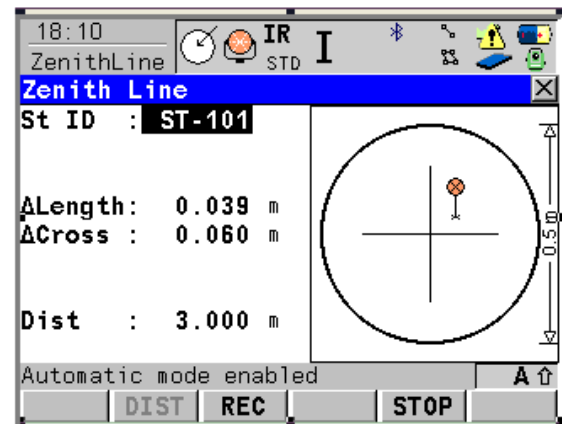
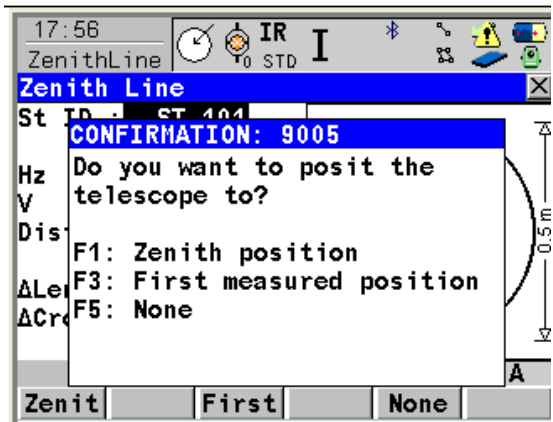
# From ground level up to the height ...

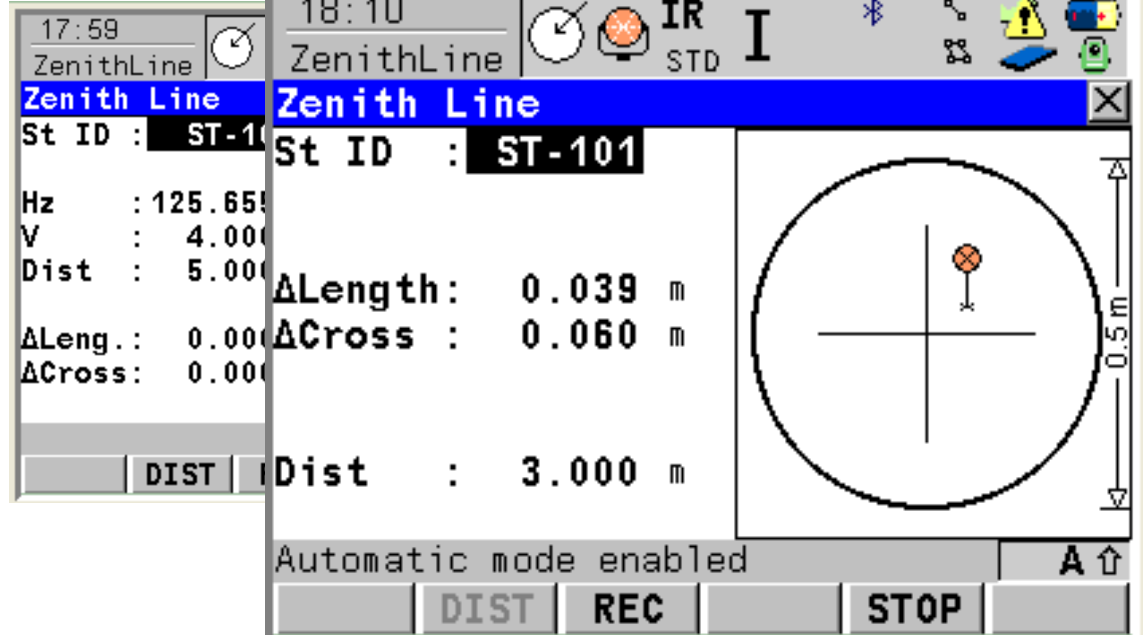
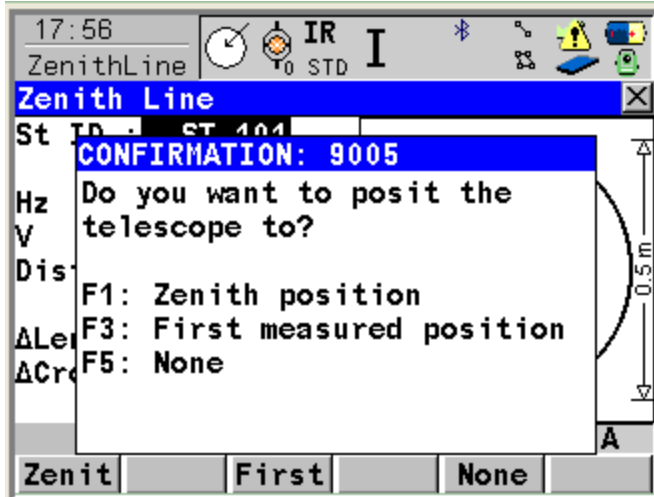
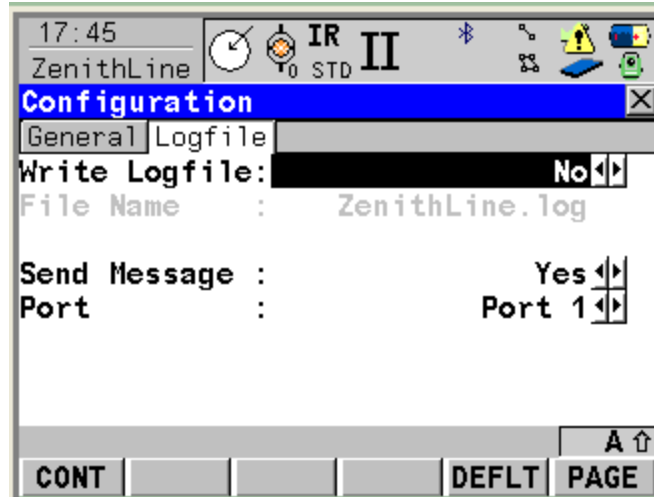
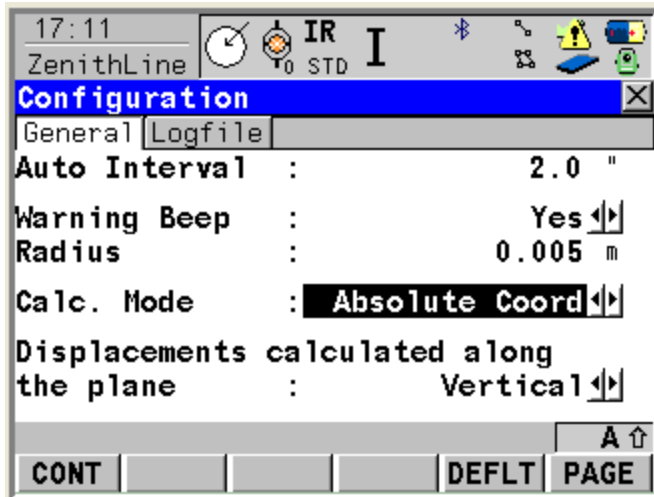


# Brisbane - Australia









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Word order	Description	Data type	Units
1	Station ID	string	
2	$\Delta X$	double	meters
3	$\Delta Y$	double	meters
4	$\Delta Z$	double	meters
5	Horizontal Angle first measurement	double	gons
6	Vertical Angle first measurement	double	gons
7	Slope Distance first measurement	double	meters
8	Horizontal Angle current measurement	double	gons
9	Vertical Angle current measurement	double	gons
10	Horizontal Angle corrected	double	gons
11	Vertical Angle corrected	double	gons
12	Horizontal angle correction	double	gons
13	Vertical angle correction	double	gons
14	Compensator inclination length	double	gons
15	Compensator inclination cross	double	gons
16	Calculation Mode	String	Absolute/Relative
17	Plane	String	Horizontal/Vertical/Perpendicular
18	Measurement date	date	Day/month/year
19	Measurement time	time	24 hours



# Conclusion

- A Leica TPS with ATR feature and a reflector, can be used as advanced « zenith laser plummet » with much more key features :
  - Measure precise vertical distance ( height )
  - Automatic operation with logging feature and streaming through serial port of the TPS
- The more we know what's inside our instruments, the more we can derive new and innovative way to answer problems with a solution ...
- The initial concept and validation on several cases have been imagine by a Leica exclusive agent in Belgium.
- Leica Geosystems has adopted at the start an open format attitude that encourages users to develop their own applications.