

NATIONAL TECHNICAL UNIVERSITY OF ATHENS  
SCHOOL OF RURAL AND SURVEYING ENGINEERING  
DEPARTMENT OF TOPOGRAPHY  
LABORATORY OF GENERAL GEODESY

**GEOMETRIC DOCUMENTATION OF STRUCTURES AFTER AN EARTHQUAKE**

TEE  
TECHNICAL CHAMBER OF GREECE

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ΑΤΜ  
Επιστάθμιση, Εκπαίδευση, Διακρίσεις  
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**GEOMETRIC DOCUMENTATION**  
(buildings, industries, monuments, bridges)

**3 – D Registration of shape, size and place at a given time**

Geodetic methods → Modern digital total station  
→ Credibility

**Methods (depends on:)**

- The final required accuracy of the documentation.
- The choice of the proper instrumentation.
- The design of the measurements.
- Measurement of detail points by the same accuracy.
- The calculation method
- The digital procedure of the measurements and the design of the structure's elements
- The procedure of the statistical control of the results.

**DRAWINGS**

- General plan
- Horizontal sections
- Vertical (cross or longitudinal) sections and facades

ACCURACY → Demand of the study (user)  
→ Scale

{ - Size  
 - Accuracy  
 - Cost

| Scale | Accuracy ( $\sigma_x, \sigma_y, \sigma_z$ ) (mm) |
|-------|--|
| 1:100 | ±25  |
| 1:50  | ±13  |
| 1:25  | ±6   |
| 1:20  | ±5   |

**PROCEDURE**


3 – dimensional Network

- Coordinates X, Y and Z.
- The errors in the coordinates value.
- The absolute error ellipses for each point
- The relative error ellipses for all the pairs of points.

The detail points of the structure may be surveyed by using mainly the following two methods:

→ The polar coordinates method  
→ The intersection method

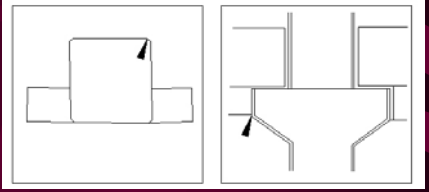
**CASE STUDY**



- ✓ Prefabricated industrial building
- ✓ Had suffered serious damages during the 1999 earthquake in Athens
- ✓ 80m in length, 20m in width and 10m in height

**CASE STUDY**

- Instruments (Reflectorless Dior 3002 + T1610)
- Method (Polar coordinates)
- Detail measurements



## CASE STUDY

*Produced plans in 1 : 100 scale*

- **Two** plans of horizontal sections.
- **Three** vertical longitudinal sections - fa ← ades
- **Eleven** vertical cross-sections - fa ← ades.

## CASE STUDY

The vertical cross section H - H'.

| SECTION | CM                    |                       |                       |                       |                       |                       |
|---------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|         | Left pillar           |                       | Central pillar        |                       | Right pillar          |                       |
|         | 1 <sup>st</sup> level | 2 <sup>nd</sup> level | 1 <sup>st</sup> level | 2 <sup>nd</sup> level | 1 <sup>st</sup> level | 2 <sup>nd</sup> level |
| D - D   | 11                    | 5                     | 0                     | 0                     | 5                     | 2.5                   |
| E - E   | 17                    | 8                     | 5                     | 2                     | 19                    | 9.5                   |
| Z - Z   | 11                    | 5                     | 0                     | 0                     | 52                    | 25                    |
| H - H   | 5                     | 3                     | 4                     | 2                     | 19                    | 9                     |
| U - U   | 0                     | 0                     | 0                     | 0                     | 14                    | 6.5                   |
| I - I   | 7.5                   | 3.5                   | 2                     | 1                     | 14                    | 7                     |
| K - K   | 18.5                  | 9                     | 2                     | 1                     | 14.5                  | 5                     |
| L - L   | 10                    | 5                     | 2                     | 1                     | 18                    | 8                     |
| M - M   | 10                    | 5                     | 2                     | 1                     | 0                     | 0                     |
| N - N   | 0                     | 0                     | 16                    | 7                     | 0                     | 0                     |
| O - O   | 0                     | 0                     | 5                     | 2.5                   | 2.5                   | 1.2                   |

*By using the Geodetic documentation method can these values of the deviation from the vertical for each pillar, be determined in such a hazardous nature.*

## CONCLUSIONS

- ☑ The geodetic method by using the digital total stations without reflectors proved to be efficient for the reliable documentation of a structure. The produced plans, provided full and accurate geometric information for all the elements that composed every detail of the structure
- ☑ The main characteristics of the geodetic method as applied in this project are:
  - The convenience and speed of the measurements.
  - The accuracy within a few millimeters was achieved in the positioning for even the inaccessible points of the structure.
- ☑ This accurately and trust – worthy documentation produced by Surveying engineers offers an enormous assistance to other Geoscientists and Structural engineers in order for the right decision to be reached concerning the failure of any given structure.

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Thank you for your attention

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