Terrestrial laser scanner for the deformations monitoring and buildings damage

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Recovery from disaster

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Introduction

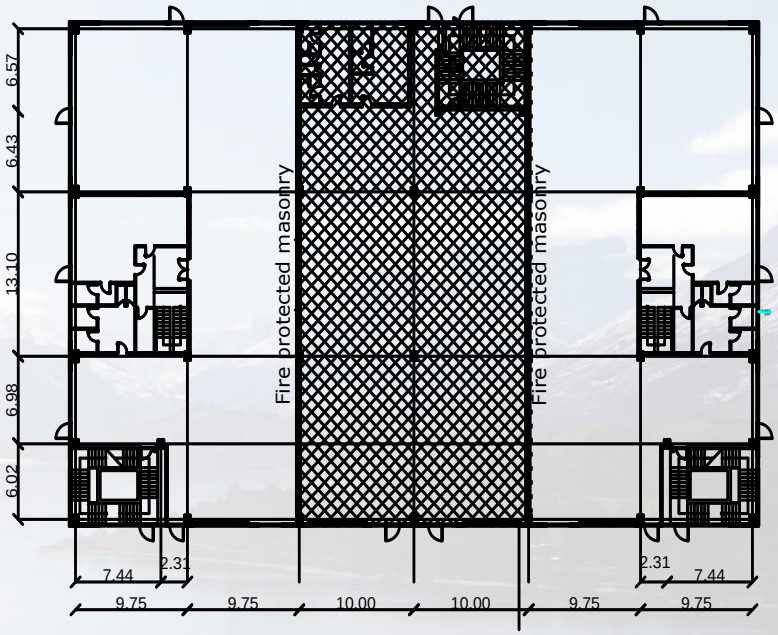
The work presents the use of the terrestrial laser scanner to study and to assess damaged buildings.

As known, terrestrial laser scanner provides a contactless 3D model of an object or building. The knowledge of a 3D model of a building give the opportunity to study the deformations and quantify the damages with high accuracy.

Introduction

The monitoring and measuring of the compromised building play an important role in the engineering field, because allow to make decisions about the possibility to restore or eventually destroy it.

Case study: Burned industrial building



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Recovery

from disaster

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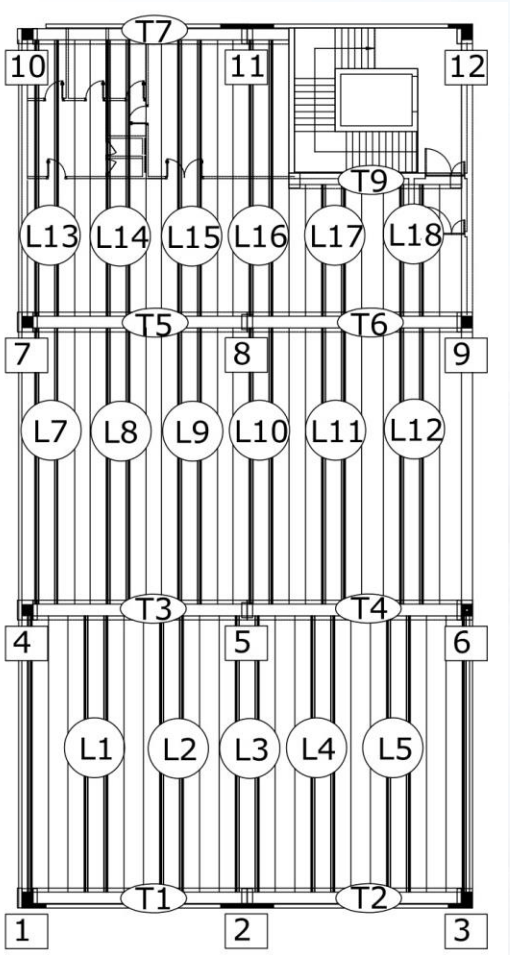
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Equipment

Faro 3D Laser Focus

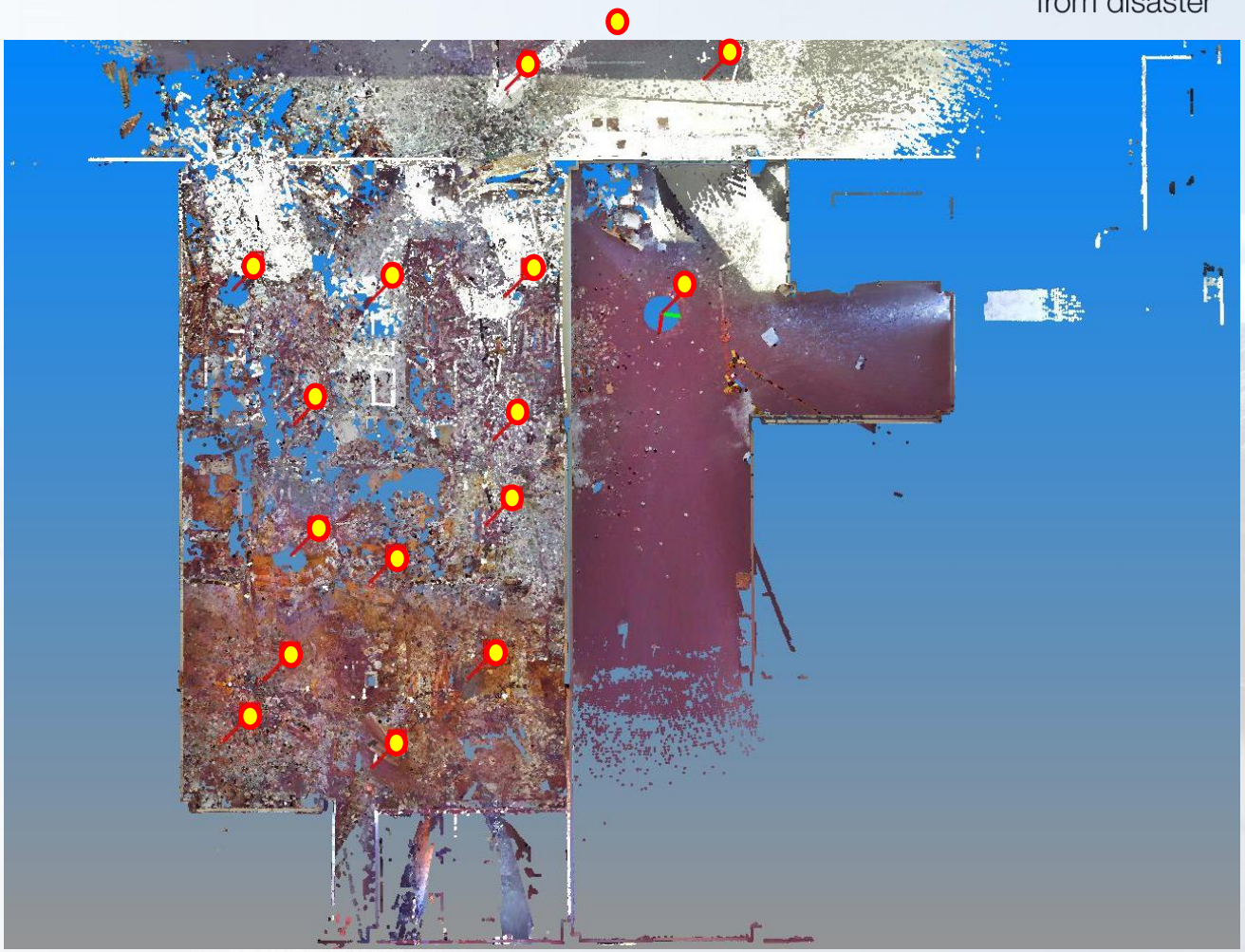
Range 0.6 m – 120 m
Linear distance error of ±2mm (10m and 25m)
vertical visual field of 305° and a horizontal one of 360°
vertical and horizontal resolution is 0.009°
scanning speed of 976.000 points/sec

GEXCEL
GEOMATICS & EXCELLENCE

JRC Reconstructor Software v. 3.1.0

22 scanning with resolution **6 mm/10 m**

- 18 indoor
- 3 indoor at the first floor (to verify the ceiling)
- 3 outdoor



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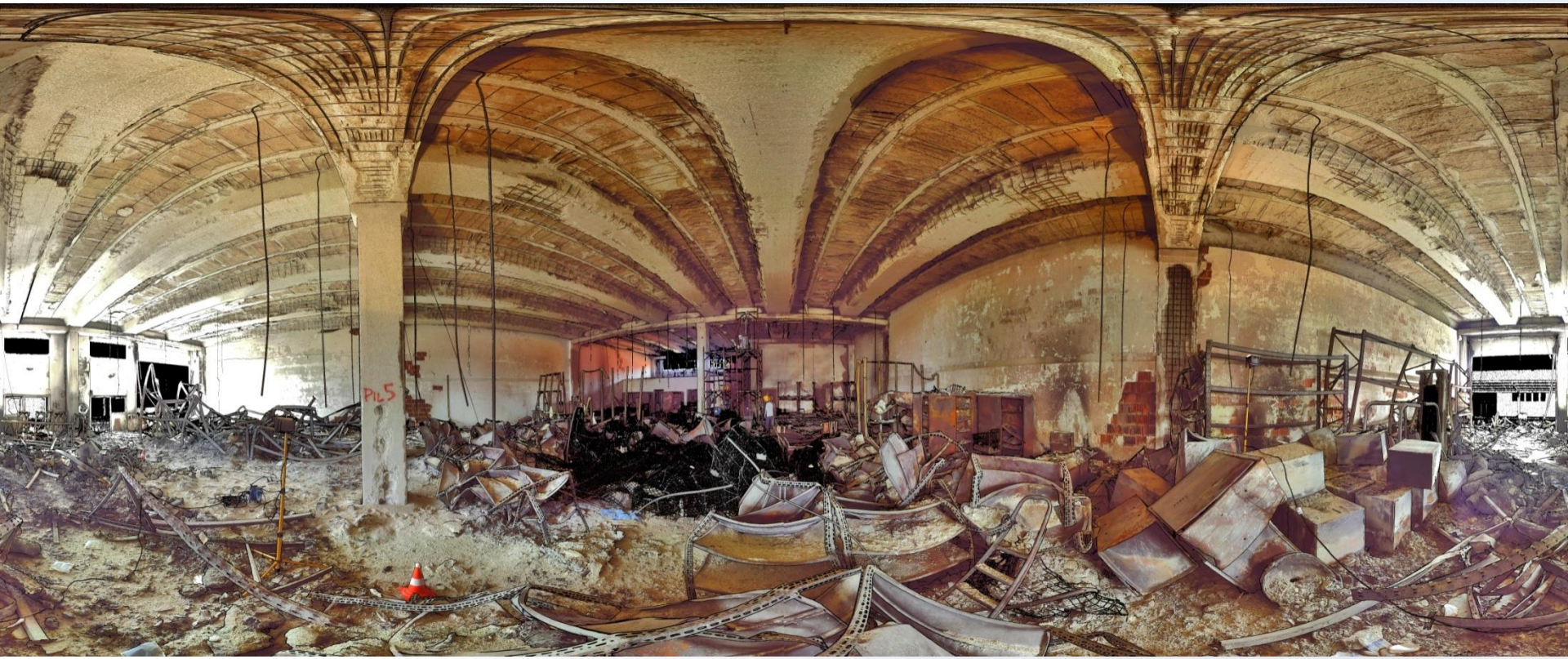
from disaster



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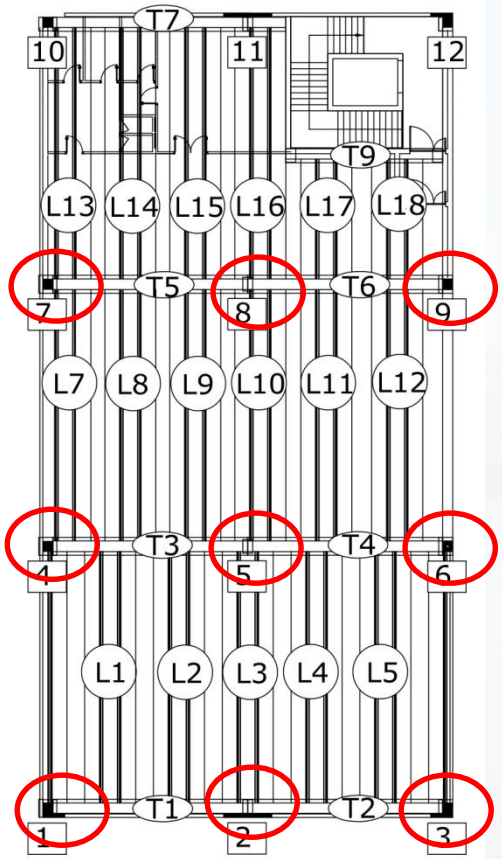
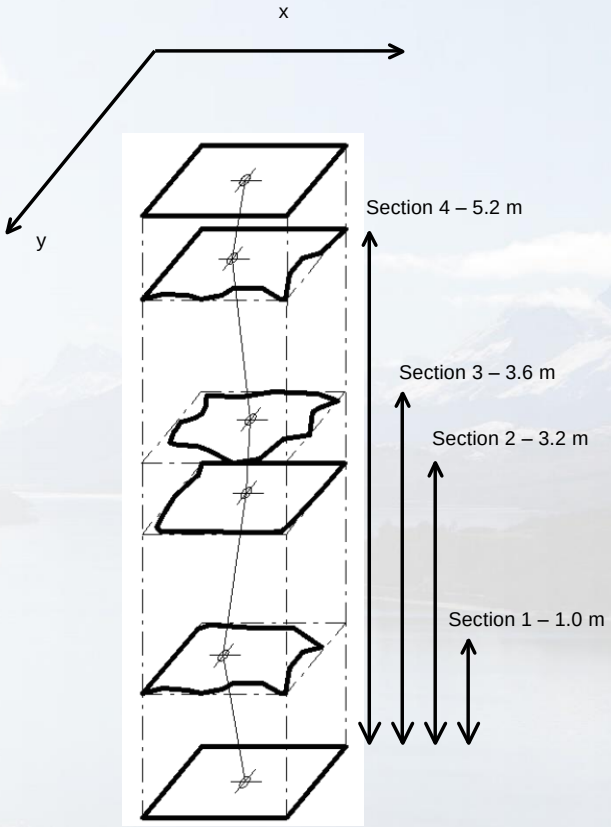
Coloumns

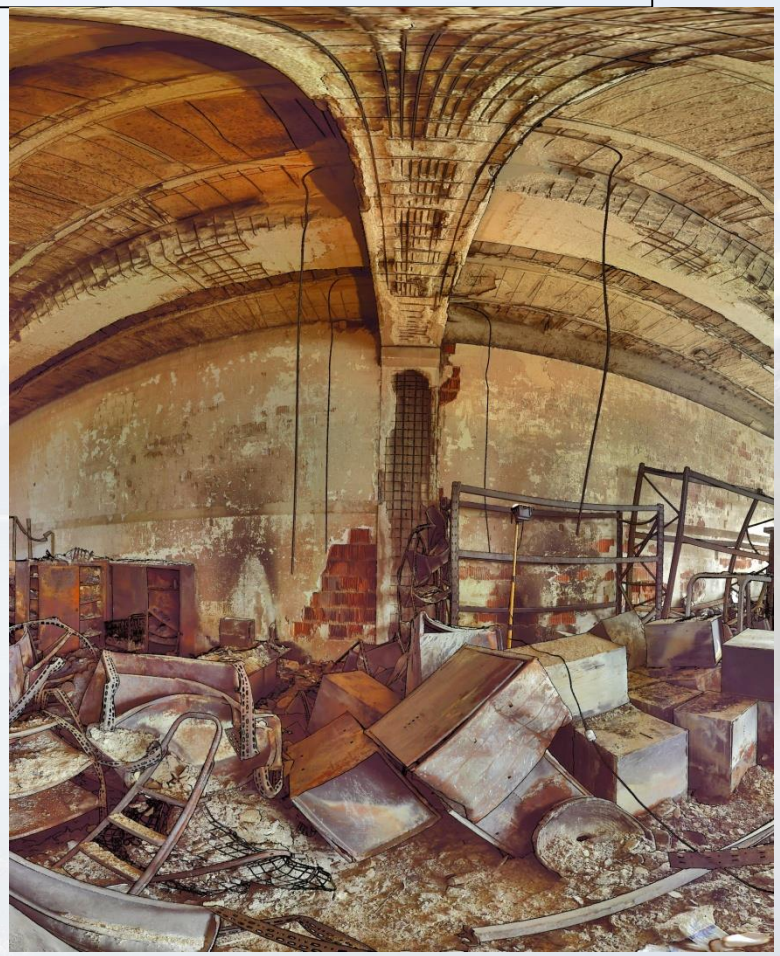


Structural elements scheme

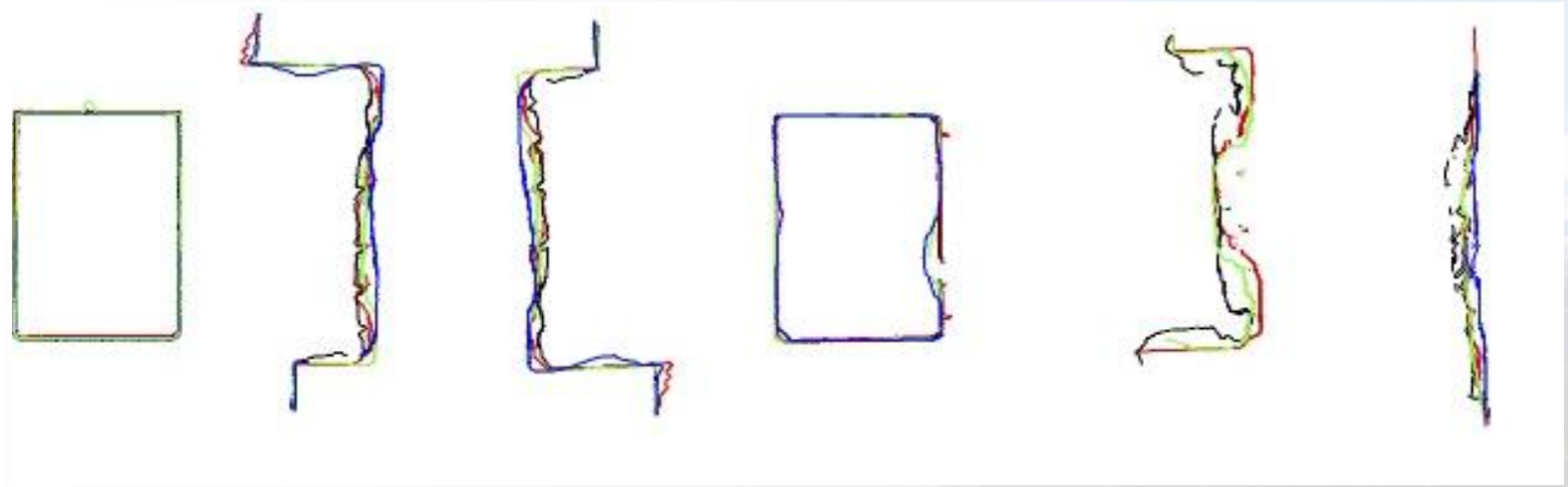


Scheme of the column cross-section center of gravity detection

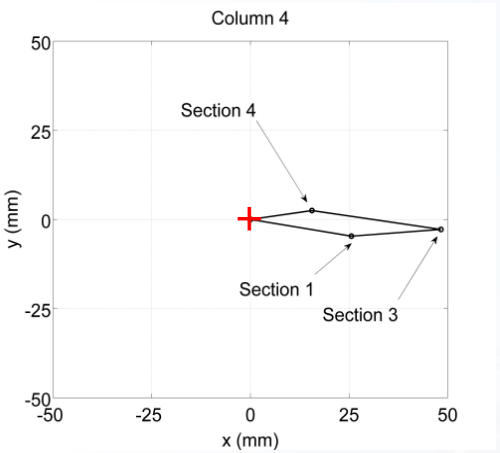
Coloumns



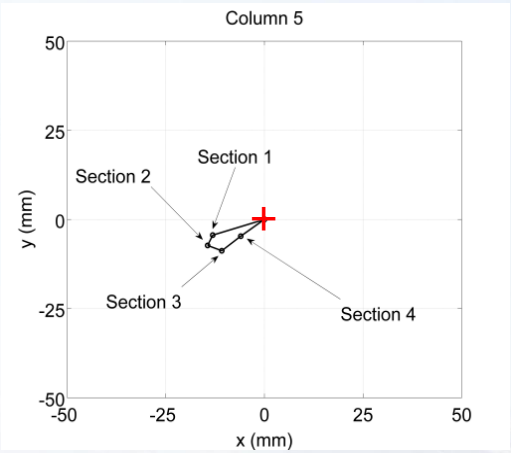
Column 8 Column 7 Column 6 Column 5 Column 4 Column 9



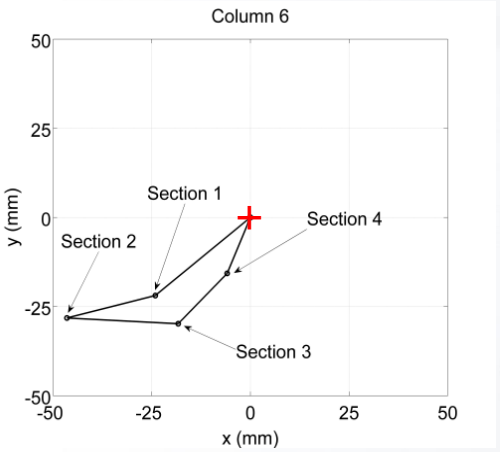
Section1 - 1.0 m Section 2 - 3.2m Section 3 - 3.6m Section 4 - 5.2m


Column 4
Section 4
Section 1
Section 3
y (mm)
x (mm)
50
25
0
-25
-50

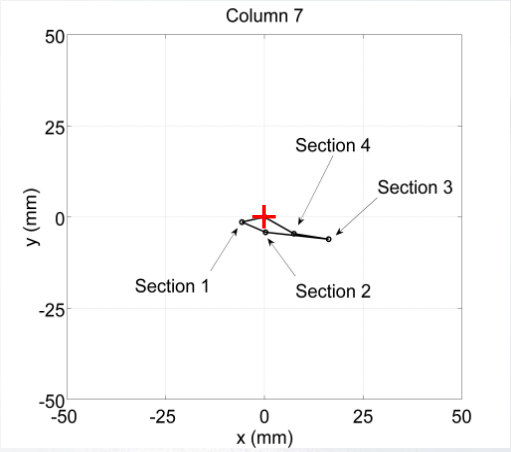
(a)


Column 5
Section 1
Section 2
Section 3
Section 4
y (mm)
x (mm)
50
25
0
-25
-50

(b)


Column 6
Section 1
Section 2
Section 4
Section 3
y (mm)
x (mm)
50
25
0
-25
-50

(c)


Column 7
Section 4
Section 3
Section 1
Section 2
y (mm)
x (mm)
50
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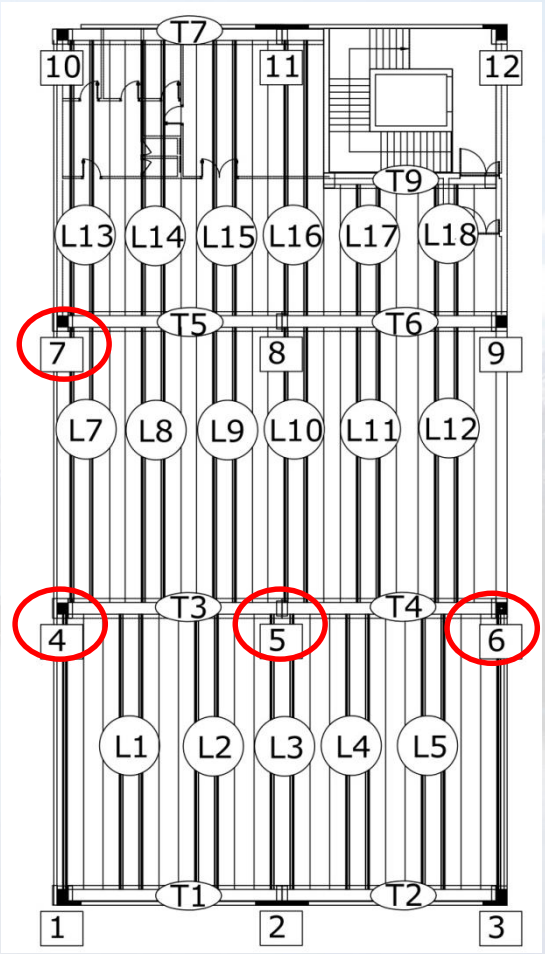
0
-25
-50

(d)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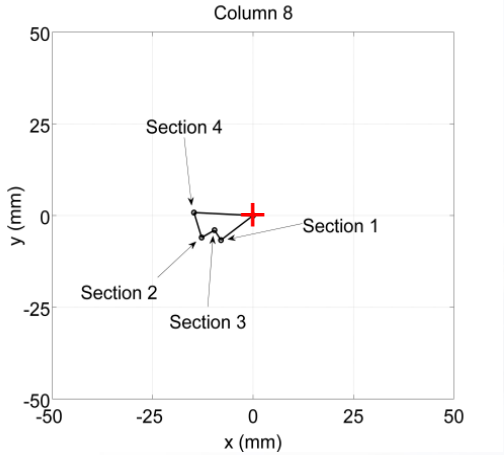
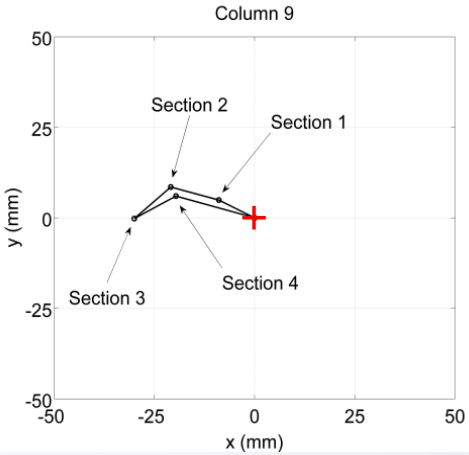
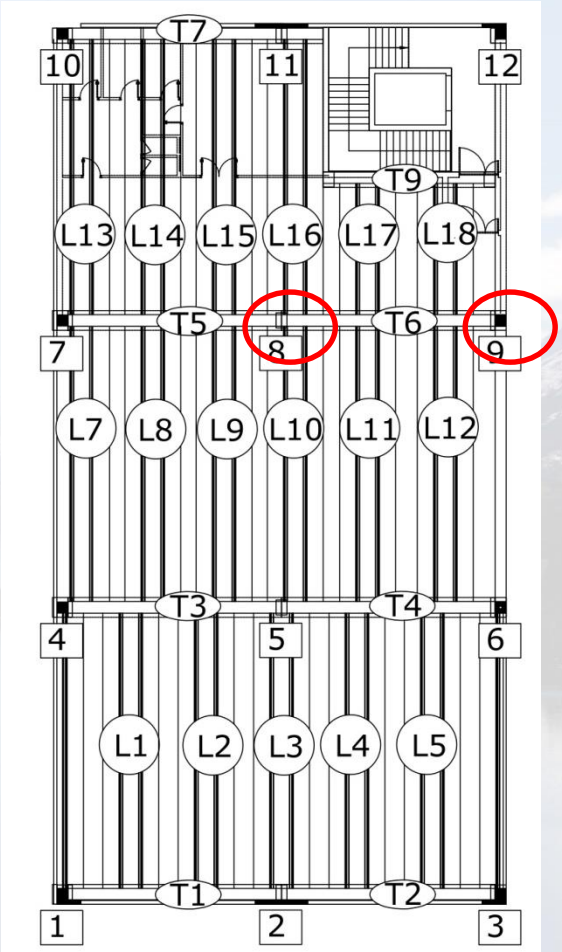

Column 8
Section 4
Section 1
Section 2
Section 3
y (mm)
x (mm)
50
25
0
-25
-50

(e)


Column 9
Section 2
Section 1
Section 3
Section 4
y (mm)
x (mm)
50
25
0
-25
-50

(f)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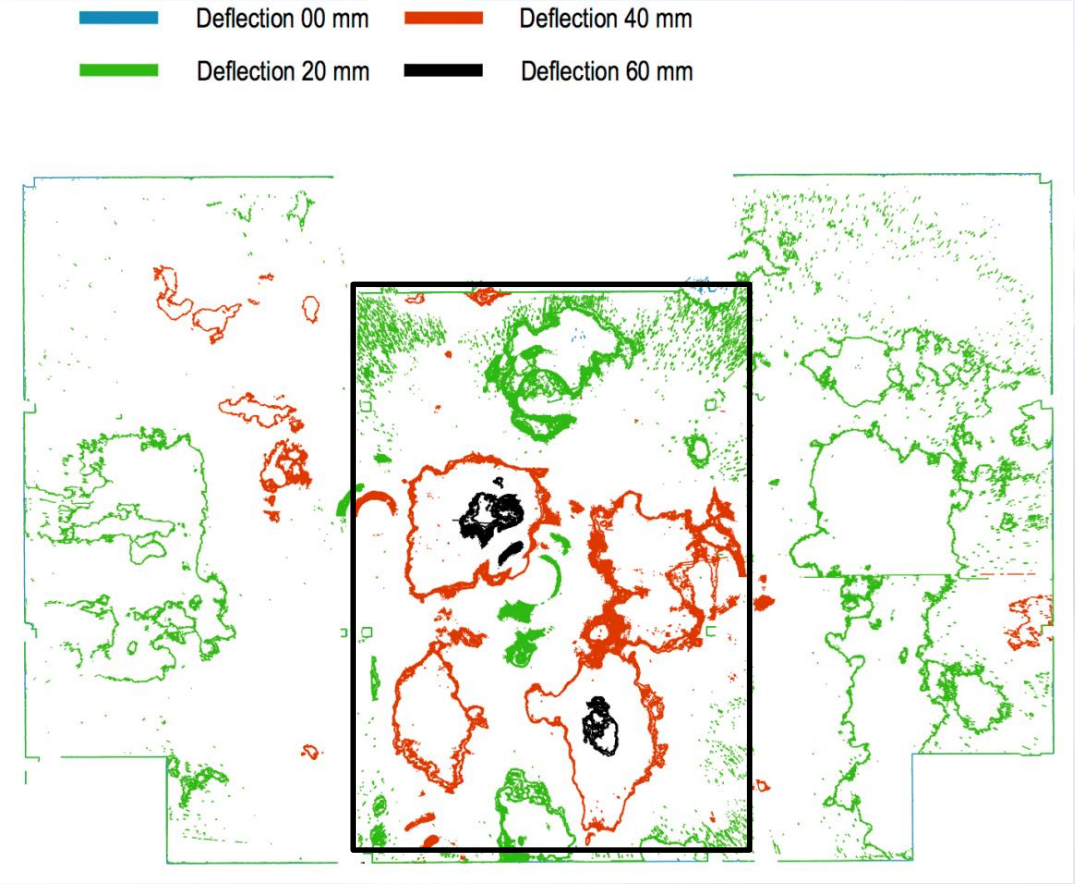
Beams

Beam	*L* (m)	*v* (mm)	*y* (m)	*δ* (mm)	r_v (mm)	*α*(deg)
L1	12.28	80.70	6.52	14.80	72.84	0.07
L2	12.29	22.10	12.14	24.70	-2.30	0.12
L3	12.25	36.20	12.15	38.20	-1.69	0.18
L4	12.23	91.20	8.17	25.40	74.23	0.12
L5	12.26	39.90	7.65	23.60	25.17	0.11
L7	12.21	-23.40	6.97	1.60	-24.31	0.01
L8	12.26	-12.30	9.10	-7.00	-7.10	-0.03
L9	12.25	-14.90	10.32	-10.50	-6.05	-0.05
L10	12.22	-30.90	10.20	-22.00	-12.54	-0.10
L11	12.30	-19.20	3.67	-15.10	-14.69	-0.07
L12	12.24	-23.50	5.80	-7.20	-20.09	-0.03
L13	11.85	-25.20	6.65	-2.60	-23.74	-0.01
L14	11.92	-19.10	6.34	-1.00	-18.57	0.00
L15	11.89	-12.20	5.47	1.60	-12.94	0.01
L16	12.25	-31.00	8.57	-10.60	-23.58	-0.05
L17	5.57	-11.90	0.97	4.80	-12.74	0.05
L18	5.67	-9.10	4.17	-27.00	10.76	-0.27
La	12.23	-36.70	7.97	-13.80	-27.71	-0.06
Lb	12.25	-32.10	9.30	-15.90	-20.03	-0.07
T1	9.20	63.10	8.79	60.10	5.68	0.37
T2	9.33	-28.60	6.22	-0.20	-28.47	0.00
T3	9.35	32.60	8.83	32.60	1.81	0.20
T4	9.35	-11.90	3.65	-17.70	-4.99	-0.11
T5	9.35	31.00	3.75	32.10	18.13	0.20
T6	9.35	-26.00	4.83	-30.30	-10.35	-0.19
T7	9.33	12.00	1.41	15.70	9.63	0.10
T9	6.84	29.80	6.76	30.00	0.15	0.25

Ceiling


Deflection 00 mm
Deflection 40 mm
Deflection 20 mm
Deflection 60 mm

Restoration

After the restoration

Conclusion

The TSL for the structures monitoring is a valid technique because it's not destructive and it provides the geometry of a building or structure even if this is inaccessible.

The possibility of having accurate 3D models allows the study of deformations in an accuracy way. This gives the opportunity to evaluate the interventions needed in order to restore a structure to its original state respected the costs and the work times involved.

Drawback: the complex data processing; the difficulty in extracting plans and sections from the 3D model in an automatic way and without the intervention of an operator.

THANK FOR YOUR ATTENTION