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Rural and urban sites in seismic areas

by

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Abstract

Special inventory and mapping of historical sites by aerial photogrammetry has to be followed by the surveying of the monuments by terrestrial close range photogrammetry. Equipments, organization of field and office work, the problems of the choice of reference plans, the use of continuous plotting of the actual shape and the possibility to eliminate physio-psychological errors of perception are mentioned.

0.0 Special inventory of sites in seismic areas

Historic monuments research groups and conservation institutions need the exact and exhaustive inventory of structures and their environment.

0.1 The main topics of such an inventory can be devided in four aspects:

0.11 history of art and architecture

0.12 urban and regional planning

0.13 technology (i.e. structural problems, geology, seismology)

0.14 organization (i.e. alarm, evacuation, emergency interventions)

0.2 The information is recorded as formal (written) or unformal (photographs, magnetic tapes, etc...) documents.

1.0 Photogrammetry and inventory

1.1 Photogrammetry produces unformal documents

1.2 Cultural property has to be identified and compiled in such an inventory. Such inventories reach from simple and more exact to scientific inventories covering the results of multidisciplinary research.

1.21 Inventories exist as files, microfilms or computer readable documents with special retrieval methods.

1.22 The different inventories should be published.

1.23 Inventorized assets should be identified and localized in situ. Photogrammetry has proved to be extremely effective for this purpose:

1.231 - maps of the area (drawn up mostly by air photogrammetry)
  - for planning purposes
  - as basis for geological, seismological research, as road or rail maps, etc...

1.232 - city maps with different scales

1.233 - detailed survey of special monuments

1.234 - bloc elevations of facades

2.o Photogrammetric interventions after the earthquake

2.1 Metric photos prove the apparent shape of the monu- and the actual shape with all the deviations and deformations caused by time or catastrophes. New photograms should be taken after an earthquake in order to actualize the existing survey and to be able to compare it by plotting to existing metric photos of the same object.

2.2 Difficulties for the taking of metric photos after an earthquake:

2.21 Air photogrammetry

2.211 No problems arise for air photogrammetry.

2.212 The only need will be to accomodate the flying height to the different focal lenghts.

2.22 Terrestrial and especially close range photogramme- try used in case of catastrophes.

2.221 Terrestrial, compared to air photogrammetry, although more difficult, has to be used as necessary comple- ment to aerial surveys.

2.222 It is often difficult to place the camera at the most favorable point or to approach it to the da- maged building.

2.222.1 Impassable routes or ruins of collapsed structures are only a few of the additional difficulties.

2.222.2 Three, better, four operators should form an inter- vention team.

2.23 Recent interventions of terrestrial photogrammetry after serious shocks (especially in Middle America and Northern Italy) allowed us to gain useful ex- perience for quick surveying in emergency cases.

2.231 The weight of the photogrammetric equipment is another difficulty which has to be mentioned. Each kilogram is another serious handicap.

2.232 Stereocameras would therefore be the best instrument to be used in emergency cases in order to enable the

operators to move easier between ruins and to shorten their dangerous work.

2.232.1 Double or more positions of single cameras with different negative sizes and focal lenghts become necessary in such exceptional cases.

2.232.2 The possible distance, however, between the camera and the object, as well as the height of the object, will certainly not be too important.

2.232.3 Orientation times of the cameras have to be shortened as fas as possible under dangerous conditions.

2.232.4 The best equipment for the overwhelming majority of the most important tasks consists in: double cameras (stereocameras) with 12o cm base lenght or more, negative size 19 x 12 cm or 4 x 5 inch, horizontal and vertical base positions, focal lenght under loo mm (the best seems to be around 6o mm), the possibility for tilted photos.

2.233 Reference planes

The choice of the reference plane on the spot of a delapidated or demolished object is also very difficult under exceptional conditions: rubbish may cover the bases of buildings, walls may be deformed, parts of buildings may have collapsed.

2.233.1 My opinion is that the choice of the reference plane in a plotting room far from the building concerned is much more complicated and even not correct, although technically possible (with an analytical plotter).

2.233.2 We have to find the original reference plane and this is only possible on the spot in front of the monument. The reference plane for the survey must be the same as the one used for the construction, for each modification and for the use of the building itself.

2.234 Control point measuring by topographic methods and instruments.

2.234.1 It is very difficult to define control points on damaged buildings.

2.234.2 The best method would be to mark the control point with chalk on the monument and to simplify the control point measuring as far as possible in order to reduce the time of this operation under dangerous conditions.

2.234.3 Marking the building for control points may have another very important consequence: marked buildings are not destroyed by caterpillars.

2.234.4 Aftershocks following heavy earthquakes endanger considerably the operators working for the surveying. Thus working hours should be as short as possible. Operators should also wear protection helmets and a permanent contact with the security guard (by walkie-talkie) is necessary.

3.o The importance of photogrammetric surveying prior to the catastrophe.

3.1 Normal conditions should be used for complete and exact surveying with sufficient control points in rural or urban sites in seismic zones.

3.2 Such preventive surveying is of great value for the surveying under exceptional conditions when some principles may not be completely fulfilled.

4.o The use of metric photographs.

Interpretation, especially stereoscopic interpretation accompanied by some additional measurements (for comparison) offers quick information.

5.o Photogrammetry avoids errors of perception

5.1 Due to the fact that the laws of human visual perception are largely influenced by the individual experience of the building expert, he may perceive

the shape he expects instead of the unfamiliar shape the demolished building realy presents after the earthquake.

5.11 First security and reinforcement measures based on such incorrect perception may prove ineffective and the building collapses during the next aftershock.

5.12 The same reinforcement based on impartial photogrammetric surveys may save the building for further restoration.

5.2 Legal instruments based on photoplans must determine the conservation of the aspect of a site:

5.21 The skyline, the dimension of new structures, which should be set up in the place of completely destroyed buildings among historic houses in historic centers.

5.22 Such photoplans could help local authorities to decide on reanimation or reconstruction measures, discourage building speculation and prevent new buildings from destroying the aspect of a historic site.

5.3 Conservation of remaining elements of a historic building.

5.31 Increasing use by architects and civil engineers of universal plotters offers reliable documents for research and definitive conservation.

5.32 This second approach to the information of the shape is absolutely needed. The international instruments of governmental and non governmental organisations need more and more the continuous plotting of the actual shape.

5.4 Anastylosis

5.41 Anastylosis is possible under the condition that 7o-loo% of the original material of a collapsed building can be used for the reconstruction.

5.42 Before moving the stones, anastylosis has to begin with the survey of the ruins. Each element has to be surveyed and plotted separately.

5.43 The next step would be to compare the plotted elements with the surveys taken before the catastrophe.

6.o The plotting equipment

6.1 Catastrophes also destroy or damage non movable photogrammetric equipment.

6.2 Metric photos must therefore be adapted to each plotter available in the seismic area.

6.21 This is one of the reasons why we try to increase the volume of our universal equipment.

6.22 On the other hand it would be wrong to further only the analytical equipment without using all existing analogical plotters still available after an earthquake.

6.3 A small portable plotter, not dependent on electricity, with reduced accuracy, for coninuous drawing of elevations and horizontal as well as vertical sections would be extremely useful for first interventions. Unfortunately such an equipment is still not on the market.

6.31 Its accuracy should be ± 5 cm (eventually ± lo cm, but ± 5 cm would be better);

6.32 distances between camera and object should be about lo - 15 m (eventually 2o m);

6.33 deformations between lo and 5o cm or more are frequent;

6.34 planes of buildings often are very simple;

6.35 salient or reentering parts of facades with differences between 1 m and 3 m;

6.36 the overlapping of the photographs can be 100%.

7.0 Conclusion

7.1 In seismic areas inventories of non movable historic assets in urban or rural sites have to be completed by aerial and terrestrial photogrammetric surveying prior to and after seismic events.

7.2 The use of terrestrial close range photogrammetry is difficult after catastrophes.

7.3 Urgent interventions must be quick in order to reduce the time the operators are exposed to danger. Different types of equipments have proved to be extremely useful for this purpose.

7.4 Interpretation of photographs, a first plotting for urgent measures (eventually with reduced accuracy) followed by an exact, continuous plotting of the deformed structures, compared to the plotting of the same structures prior to the event may save many damaged buildings and offer the best information for the planning, restoring and the reconstruction of historic urban or rural sites as well as for their reanimation and reintegration in the regional planning.

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PHOTOGRAMMETR. AUSWERTUNG
BESTAND NACH ERDBEBEN 5/76

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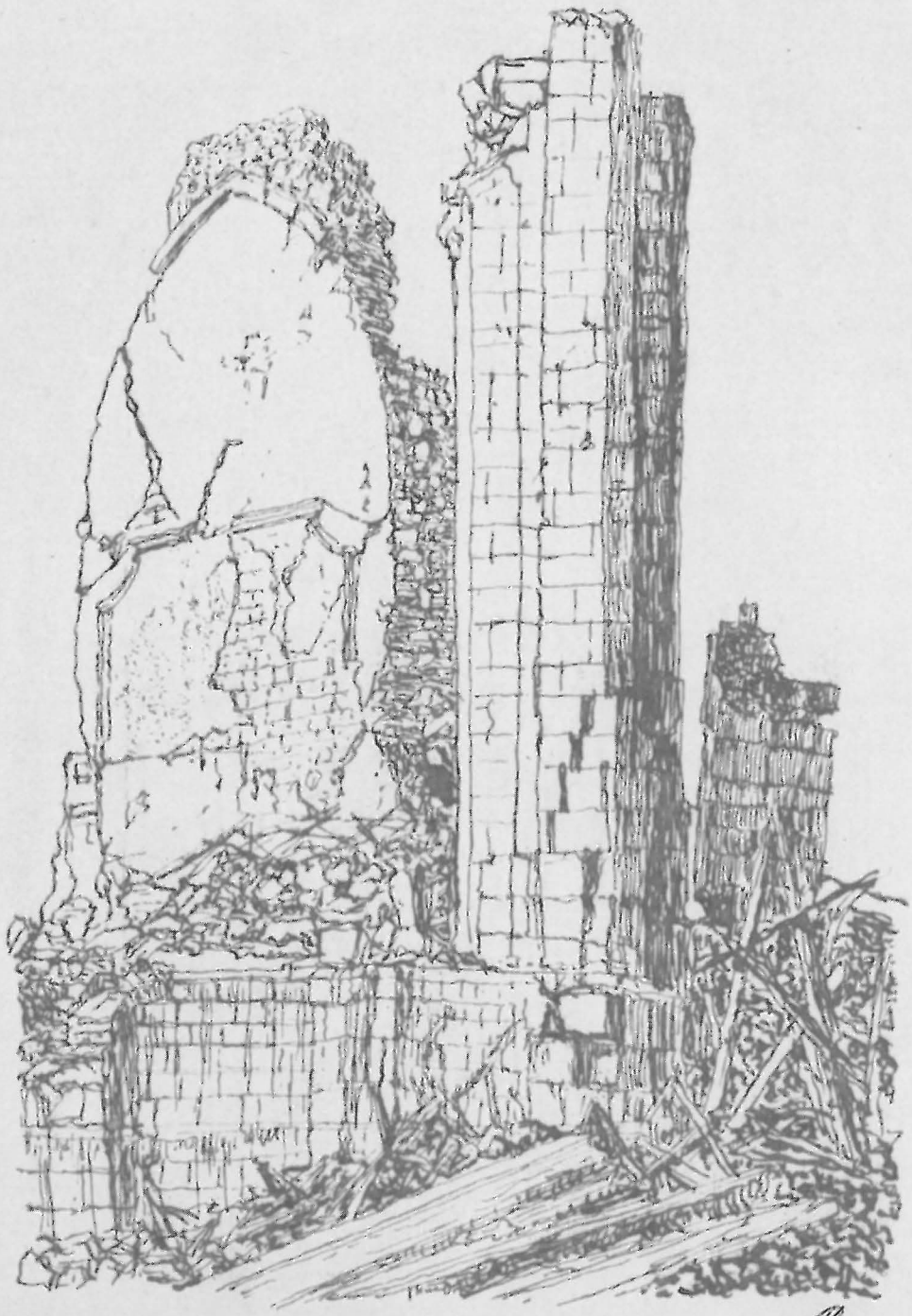

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