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Information Systems for Monuments and Historical Buildings

Systèmes d'information pour les monuments et bâtiments historiques

Informationssysteme für historische Bauten

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SUMMARY

The drawbacks of traditional approaches to information management and treatment for historical buildings are reviewed, and the opportunities and advantages offered by systematic application of modern information science tools are illustrated. The possibilities of an organized effort aimed at taking the first steps in this direction are also briefly discussed.

RÉSUMÉ

L'auteur montre les limites de l'approche traditionnelle à l'organisation et au traitement des informations pour les monuments historiques; il indique les avantages d'une application des outils modernes fournis par l'informatique et propose les premières approches concrètes dans cette direction.

ZUSAMMENFASSUNG

Die Nachteile traditioneller Vorgehensweisen bezüglich Datenverwaltung und Behandlung historischer Gebäude werden einer Revision unterzogen. Die durch eine systematische Anwendung dieser modernen Informatikmittel sich bietenden Vorteile werden beschrieben. Die Möglichkeiten gemeinsamer Bemühungen, mit dem Ziel erste Schritte in diese Richtung zu unternehmen, werden ebenfalls kurz besprochen.

1. GENERAL.

Quite too often, studies on safety and preservation of monumental buildings are subjected to serious shortcomings stemming from the lack of proper information, or from the poor quality and organization of existing documentation.
Indeed, not only are historical monuments often insufficiently documented, from an engineering or from the architectural and even geometric point of view; it also happens that previous experiences in the field, which could bring precious contribution or inspirations to the treatment of the particular problem in hand, are not known (or, again, not adequately documented) and thus go unnoticed, with serious economic and/or technical drawbacks, including repetition of efforts and errors, unnecessary loss of time, costs of un-needed expertise etc.
Yet, simply to mention a single one among the topics which could be selected for discussion, the modern tools of informatics provide the possibility of mounting a rational effort toward making all the relevant knowledge, accumulated about particular buildings, or about particular classes of problems, properly documented and recorded in object - oriented data bases.
If this goal were achieved, the door would be open to easy access by all concerned parties, and the experience gained from each single case-history would integrate those from other similar applications, with important synergistic effects. The appropriateness (or otherwise) of applying certain methodologies to certain classes of problems could be highlighted by automatic selection through proper query languages, and so on.
More generally, the possibilities offered by contemporary information Science open up a vast spectrum of choices and opportunities, as appears from the following outline.

2 - OUTLINE OF IMPORTANT POINTS FOR DISCUSSION:

2.1- (General)

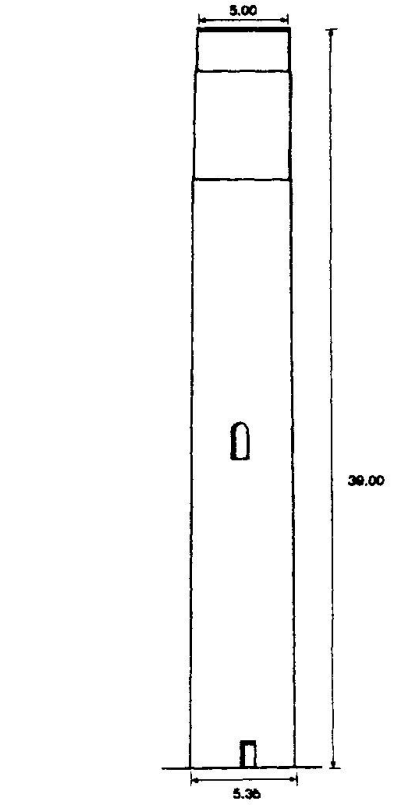
Critical attention should be devoted to detailed examinations of the depth of penetration of information technologies.
In particular one should identify and discuss the numerous drawbacks of presently used traditional procedures, such as e.g. slowness, difficulty of information retrieval, obstacles to diffusion and cross-reference of information, etc.
From this recognition of insufficiency of traditional approaches, one should then more clearly appraise the necessity of using the large possibilities of informatics for easy access to relevant data sets.

2.2- (Detailed discussion of areas where informatics could provide signal advantages):

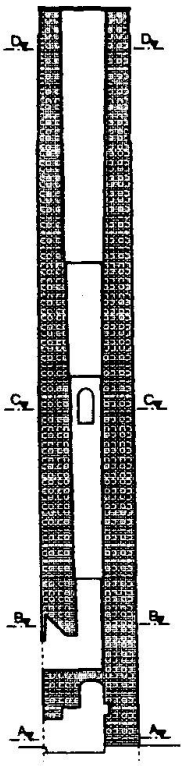
2.2.1 On-line monitoring and "safety control" of monuments. It should be noticed that these systems, given significant installation and operating costs, are in fact conceivable only for important structures; what to do for lesser ones?;

2.2.2 Numerical models for:

- assessment of safety under normal and exceptional loads;
- measurement interpretation; identification;
- diagnostic of damage, trend analysis;



VIEW FROM NORTH



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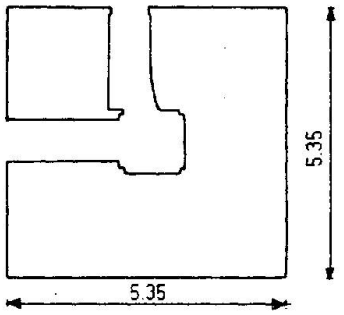

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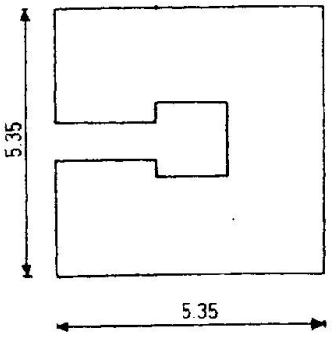

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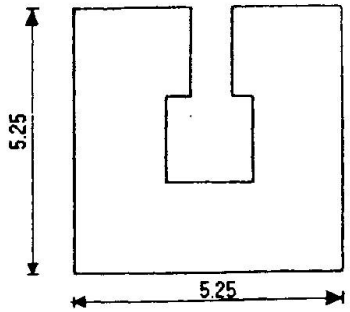

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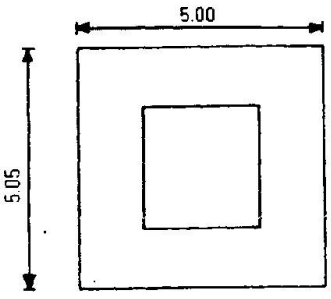

D - D CROSS SECTION

Fig. 1 - Traditional documentation for a masonry tower.

- forecasting and hindcasting of intervention effectiveness; objective comparison of different intervention alternatives;

2.2.3 Data-bases containing and updating all relevant information about individual monuments, e.g.:
- present geometric definition;
- history: modifications, additions, repairs, construction methods and materials, exceptional events, etc;
- mechanical properties: densities, Young moduli, Poisson's ratios, damping factors for above-ground structural materials; geotechnical and geomechanical properties for foundation materials;
- structural static and dynamic in-situ measurements, if any;
- numerical models and structural analysis, if any;
- diagnostic and safety assessment, if any;
- proposals for future interventions (if any);
- norms and regulations, where applicable;
- codes of practice;
- references to published and unpublished works, to experts, etc.

In this framework, items to be discussed are:
- possible structure of data bases;
- possibilities of national or international funding; operating costs, etc).

2.2.4 "Expert system" technologies to help in diagnosing structural troubles and in formulating investigation or intervention planning.

2.2.5 Formative activities, teaching, transmission of experiences.

2.2.6 Other ideas (initiatives at the national and international level; reduced-scale implementations to serve as a working example, funded by international or national cultural foundations or by large information-business corporations.....)

2.2.7 Multimedial techniques: possibilities for use in the documentation of historical monuments, where alphanumerical, graphical, photographical etc. documents are necessary and where archiving, cataloguing and access functions are presently not satisfactory.

2.3 (Conclusions) On the basis of recognized needs and opportunities (see above), as well as of past experience, one should be in condition to ascertain whether times are ripe for an intense, organized effort at bringing the full potentialities of information sciences to the help of monument preservation. In the alternative, one should discuss and identify what seminal initiatives could be taken to foster a rapid development.
It is highly probable that, in addition to institutional channels, technical and conservationist organizations should be contacted and sensitized to provide either partial funding or at least mass-media wide publicity and support.

3. (CONCLUDING REMARKS).

As a conclusion to the following considerations, it is suggested that possible guidelines and proposals be discussed among specialists (with knowledge, if possible, both of engineering and informatic aspects), with a view to formulate in due time

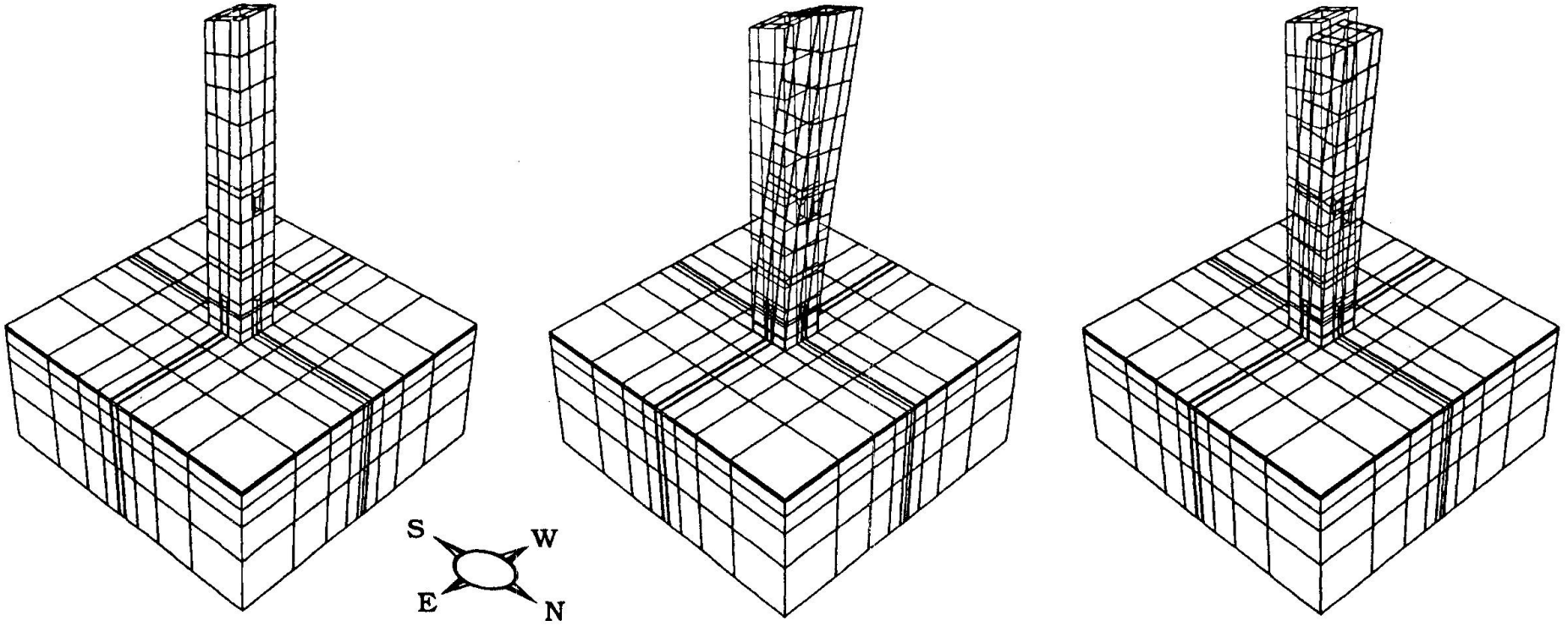

Fig. 2 - Examples of graphical rendering for a FE mathematical model of the tower of Fig. 1: Discretized geometry and first two vibration modal shapes.

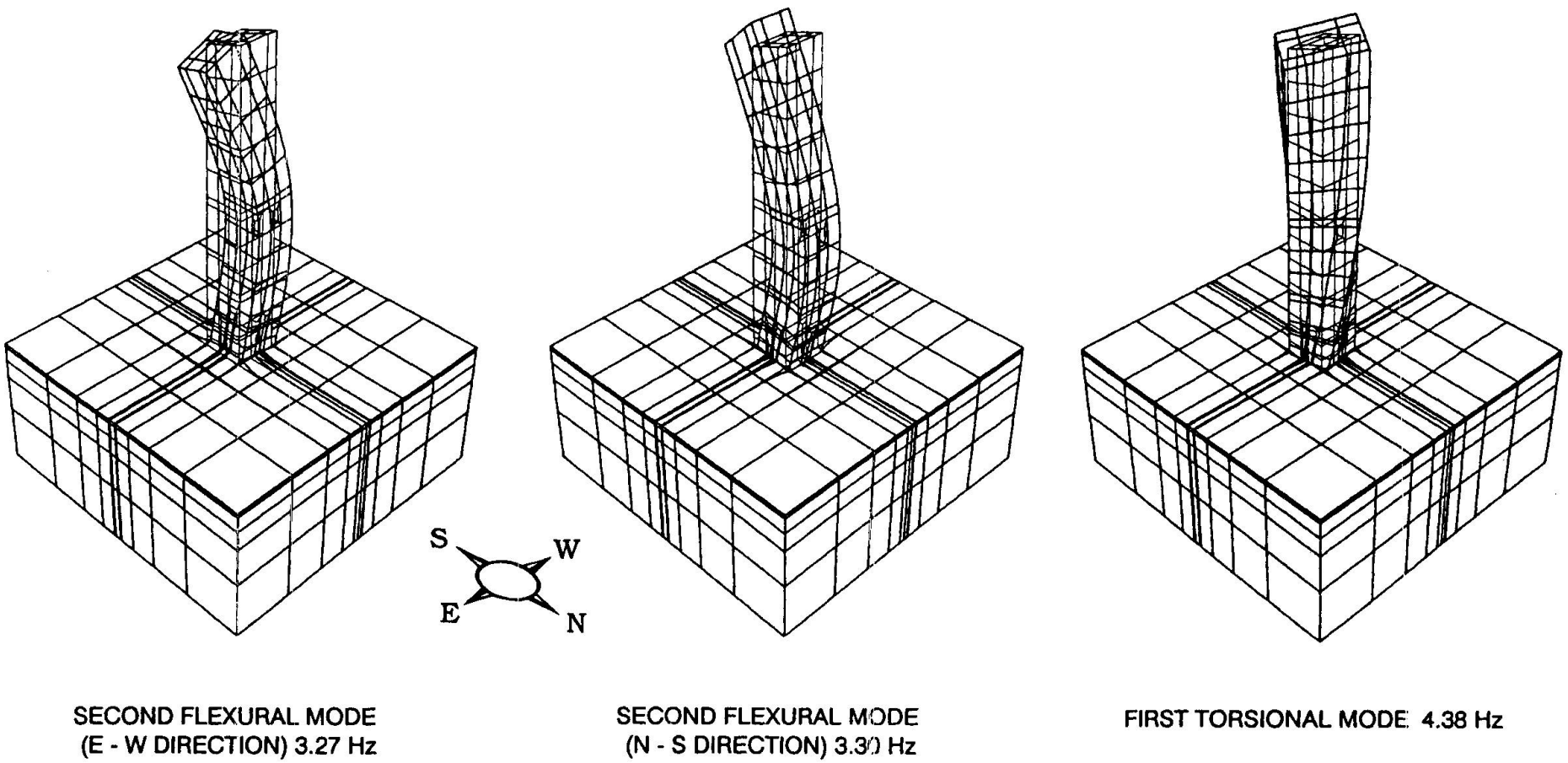

Fig. 3 - Examples of graphical rendering for a FE mathematical model of the tower of Fig. 1:
Third, fourth and fifth vibration modal shapes of the tower of Fig. 1.

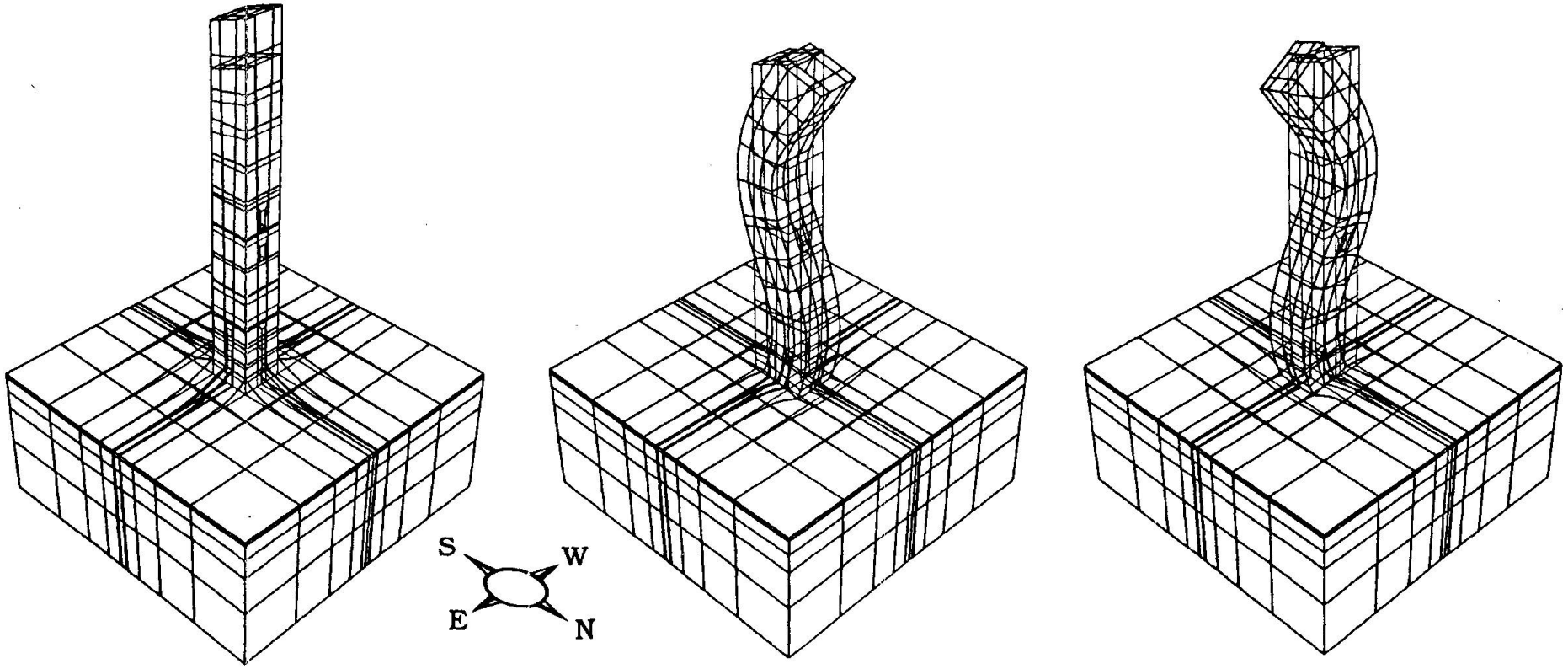

Fig. 4 - Examples of graphical rendering for a FE mathematical model of the tower of Fig. 1:
Sixth, seventh and eighth modal shapes of the tower of Fig. 1.

realistic proposals aimed at taking the first steps along the above-described road.
As a first suggestion, it could be envisioned to restrict initially the attention to a particular class of structures sufficiently homogeneous with each other, so as to reduce the size and difficulty of the task.
An example in point could be the cataloguing and documentation of "tall towers", of which there are numerous examples not only in Europe, but practically in all the countries of ancient civilisation.
Such a cataloguing and documentation could e.g. cover the following aspects (see also preceding point 2):

- history (age, interventions, important events: earthquakes etc);
- geometric definition of the structure;
- characterization of construction materials (type, degree of conservation, mechanical properties);
- characterization of foundations from a geotechnical or a geomechanical point of view (as above);
- dynamic characterization (eigenfrequencies, eigenshapes, damping factors);
- results of surveys and/or monitoring;
- structural problems;
- engineering studies so far;
- proposals for future interventions, etc. (including economic and environmental evaluations).

An effort of this kind could also help to detect important classes of common problems, to grade the structures according to their relative degree of safety, to establish priorities for interventions.
It could, last but not least, be a precious source for estimating residual life or deciding emergency measures in case of exceptional events.
The data base should of course be updated and maintained regularly so as to provide a realistic picture of the current situation, as well as to allow the users to detect time - trends of interest.
Such an endeavour could only be funded through public Authorities and on a national basis, but it would be wise to start at once with sufficiently co-ordinated criteria, so as to make possible fast, efficient exchange of information or even, at a later stage, the creation of a truly international Data Base.
If this first effort could be a successful one, it could then be extended to cover other classes of structures.
In this way the considerable difficulties that one can envisage in association with a broad program-such as, without doubt, is the one above described - could be subdivided in time and met with in a gradual manner.
It is deemed that a pragmatic approach, more or less along the lines already mentioned, could be the one with the greatest chances of success; it is also probable that the present time is the right one to start making proposals and, possibly, initiating demonstrative - if partial - projects in this field.