RECENT ACHIEVEMENTS IN MONUMENTS PRESERVATION APPLIED FOR PROTECTING THE BUILT ENVIRONMENT*

M. ZÁDOR

Section Monuments Preservation, Institute of History and Theory of Architecture, Technical University, Budapest, H-1521

(Received: January 19, 1984)

Aggressive agents concomitant to technical development and urbanization have a nearly analogous impact on man, on natural, and on built, artificial environment. Consequently, also problems are common, imposing coordinated measures, as seen from the practice in several countries. Concern focussed on the protection of the existing building stock is seen e.g. from the scope of the 1974 CIB Congress in Budapest, or from the Hungarian decision on building of 1978.

From the dual aspect of need and difficulty of protection, a special case is that of the most ancient building stock, in particular, buildings under Monuments Act, the most valuable ones from cultural and touristic aspects.

Let me outline principles, methods issuing from these statements, as well as recent scientific achievements of research made at the Section Monuments Preservation, Institute of History and Theory of Architecture, Technical University, Budapest, introduced (or to be) into practical utilization.

At the same time I should like to have this activity embraced within the scope of environmental engineering in this country, to have "protection of built environment" given adequate importance within sectoral and national environmental engineering activity. Namely, protection of natural, and of built environment against physical, chemical and biological aggressive agents raises often research and practical problems that are analogous even up to details. Now let me drop some words on this necessarily negative side of scientific-technical development, the accelerating destructive effect of environmental harms, and on new methods of protection thanks even to this technical development (such as diagnostic tests, surface protection methods, in particular, stone surface conservation, etc.) and on their practical applications.

* Lecture at the Scientific Session of the Faculty of Architecture, TUB, November 1981.

Influence of accelerated environmental harms on monuments preservation

Historical monuments differ from other components of built environment not only by peculiar values and preservational-reconstructional restrictions but also by their longevity permitting to trace the destruction process. Abrupt destruction of the world's outstanding stone monuments in the recent decade and a half has come to the foreground of interest, and induced interested organizations (UNESCO, ICOMOS, RILEM) to forward research work at scientific centers, in particular, on practical cleaning and conservation of stone monuments and façades. Already at the beginning it was understood (confirmed by subsequent investigations) that e.g. in this country, destruction process of monumental stone surfaces has accelerated by five to ten times in the recent fifty years.

This peculiar acceleration is directly due to atmospheric pollution, though, in a doubtless relation to the natural ageing process of Hungarian stone materials, and to the insufficiency of conventional protective means against aggressive effects of this intensity. The same acceleration process is manifest on building façades of other materials (e.g. brick, plastering), still awaiting to be investigated and prognosticated. Obviously, acceleration constrains those interested in monuments preservation to look after new materials and methods able to keep pace with the destruction rate, at the same time to respect principles of monuments reconstruction, as well as to suit technical parameters imperative to any building surface protection (e.g. less than 10% reduction of vapour diffusion).

These considerations are underlying research on monuments preservation all around the world — in part, under the guidance of the mentioned organizations — and their implementation conform to national legislations and facilities.

Scientific-technical development as a factor of meeting recent tasks of monuments preservation. Activity of the Laboratory of Monuments Preservation, Technical University, Budapest

A specificity of monuments preservation is to be interdisciplinary, involving sciences accessory to history, such as archaeology, history of arts, ethnography, as well as technical sciences, and recently — with the aggravation of aggressive effects — natural sciences, first of all, chemistry. The present age being characterized by the acceleration of scientific-technical development, this process — an important factor of destruction — had to had recourse to for developing new, efficient protective methods replacing the antecedent, insufficient ones.

Actual cooperation between marginal sciences is most hampered by the lagging interdisciplinary education, expected to make up the gap between those "speaking different languages" at least to a degree to let architects engaged in monuments preservation ask questions and understand answers. Specialist engineering education in monuments preservation at the Technical University, Budapest, delivered — among others — by representants of all the mentioned sciences, looks back to a mere five years.

An important tool of education is the Laboratory of Monuments Preservation at TUB, engaged also in physical, petrographical, chemical and biological tests, at a difference from usual laboratory work, in conformity with the demands of lasting preservation, conservation of monuments. A peculiarity of our laboratory work — specific to monuments preservation — is to need — instead of special laboratories (physical, chemical, biological) — simultaneous application of tools and testing methods of all three. Even, since most monuments are built of stone, the Laboratory of Monuments Preservation functioning as a basic laboratory and cooperating with several laboratories had to adopt special tools and methods for petrophysical tests. The actual main activity of this Laboratory has been to investigate causes and degree of surface deterioration of historical monuments — or, in general, of old buildings — and to find new materials and methods of protection, at the latest scientific and technical standing. Most investigations concern surface water absorption and vapour diffusion. Namely, surface water is deemed to be precondition of any physical, chemical and biological degradation process, imposing to safeguard surface water repellency. At the same time — in a two-way fight against backwardness and the use of inadequate, often failure-bound new materials — water repellent, and at the same time fully aerating materials had to be found. To this aim, relying on research in this scope by Dr. Gábor Winkler and on the cooperation of the staff of the Department of Chemical Technology, TUB, a new, realistic method has been developed for vapour diffusion measurement.

A new testing method in the same scope is scanning electron microscopy yielding exact information on the destruction and the condition of pores hence aeration ability in an about 3 sq.mm part of the material. These tests involving also IR spectroscopy — made under the guidance of Dr. Éva Orcsik, Chem. Eng., laboratory leader — were internationally the first to detect causes of destruction of soft limestone constituting most of Hungarian historical monuments and building façades, and to try conserving agents for adequacy. As a practical application of this method, let me refer to the test made on the Hungarian Parliament building pointing out the destruction process to have already started on the surface of new stone material replacing the original, damaged stones.

An example of non-destructive — laboratory, or mainly in-situ — tests is the so-called glass-pipe test for measuring surface water repellency. As an

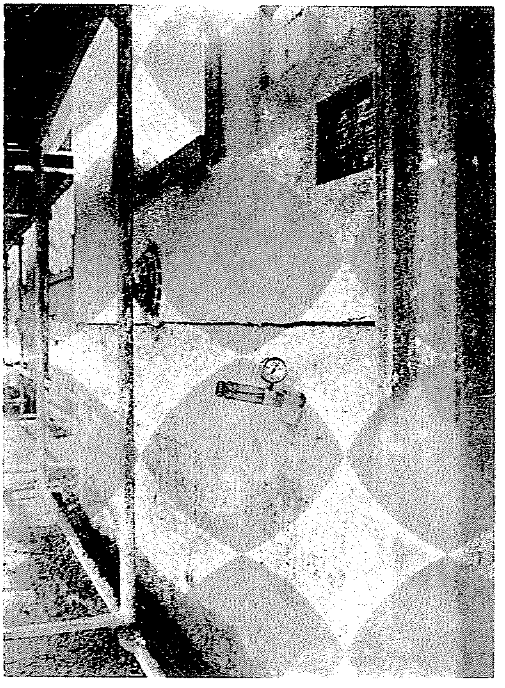

Fig. 1. Probing

intermediate step between laboratory tests and research, and applications, pilot tests would be of importance. Difficulties of their technology and organization constitute, however, the weakest link in the process of research to become productive force. Our pilot plant at the Technical University, Budapest being demolished, actually a new pilot plant is on the way of realization in common with the Municipal Building Enterprise No. 1.

It should be noticed that pilot tests or experimental applications by enterprises or, in the actual case, by the National Monuments Inspectorate made so as not to hamper the production process, encounter difficulties, obstructing, or even preventing practical implementation of a number of research results of importance for the protection of built environment. Laboratory work underlies our subject-oriented relations with Technical University departments and non-university organizations. Beside fundamental research, research in these subjects is done primarily as technical-scientific research basis of, and commissioned by, the National Monuments Inspectorate. Let me outline essential results of the research work related to the scope of this Congress.

Fig. 2. Laboratory measurement of vapour diffusion

Diagnostic tests on causes and degree of environmental harms

Supposing the actual condition of our historical towns and monuments as being acquainted with, surface damages rather problematic from cultural policy, touristic, and economical aspects are needless to be discussed in detail. Recurrence of corrosion phenomena soon after reconstruction does not contribute to the fame of our trade. An investigation into its causes showed but a minor percentage to be ascribable to construction deficiencies, most having arisen regularly, in spite of a strict adherence to design specifications and technological instructions. Thus, the problem is supposed to be rooted in pre-design tests or in their absence.

Obviously, no helpful therapy can be established without a correct diagnosis. The actual practice of macroscopy would be inadequate even for experienced, old skilled workers, actually growing increasingly rare. The demand for up-to-date means and test methods also depends on this recognition and on the increase of requirements. This induced the Surveying and Soil Testing Enterprise to adopt our building diagnostic method developed for universal building reconstructions, and our Institute to elaborate the diagnostic test method previous to monument reconstructions for Target Program Commission No. 11 at the Ministry of Building and Urban Development.

Diagnostic tests make use of non-destructive, possibly in-situ methods but also special laboratory tests are of importance. It seems us, scientific documentation — obligatory before monument reconstructions — should be integrated with building diagnostic documentation, defining — based on the mentioned testing methods — materials and structures of the given building, their e.g. corrosion damages, as well as enviromental: soil and atmosphere features, in particular, chemical and biological pollutions. Reconstruction designers are hoped to soon realize that lasting and economical façade surfacings or preservation of the former from aggressive agents depend on the knowledge of environmental harms, on the correct "dimensioning". Exact data are available on both soil conditions and atmospheric pollution; simply the needed information has to be gathered.

Technical possibilities of in-situ diagnostic tests have much improved in recent years with the advent of new instrument types such as recent ultrasonic instruments, Thermovision, etc., providing fast, exact information. Our study also reviews the needed instruments, and suggests to install and operate a testing car. No essential change can be expected in this problematic else than through the development of approach; creation of material means being the lesser problem.

Up-to-date means of monuments' surface protection

Diagnostic tests usually point out two fundamental aggressive effects. One is soil moisture, to be considered as a Hungarian endemic, now efficiently resisted by our patented chemical wall dampprofing agent named "Silicophob-Anhydro" utilized by 52 enterprises, not to be discussed further. The other is precipitation on building surfaces, primarily destructive because of the yearly mean of 40 to 50 freezing-thawing cycles, at the same time a fundamental cause of chemical and biological damages.

Our research on up-to-date methods of surface protection had first to clear theoretical problems. Subsequent research had three trends:

— invisible, aerating, water repellent surfacings, essentially new means to conserve ruin walls and stone surfaces not in need of strengthening;

— special aerating, water repellent, substance-colourable plasterings, of rather limited use in monuments preservation because of the requirement to preserve the original plastering, but they have been successfully used for e.g. wall socles (see wall socle of the medieval Köröshegy church). Because of its imported admixture, its furthering depends on finding adequate Hungarian substances (tests are promising in this respect);

— the third surface protection possibility is to use special paints similar to traditional lime paints both by texture and by vapour diffusion, but more durable than these because of water repellency.

After fundamental research and target program studies, pilot tests have been made in all three scopes, followed by practical applications. Latest research work has been done in cooperation with the Department of Inorganic Chemistry, TUB, leading to new, still more efficient protective coatings (Szilorlakk 1000, Szilorlakk 1401).

Surface protection by invisible protective coatings is exemplified by the 1973 treatment of stone pylons of the Chain Bridge and of the Tunnel entrance, manifesting a strong difference between their stone surfaces and those of the neighbouring stone buildings, not only for soundness of the former but also for their permanent colour due to self-cleaning effect.

From the aspects of monuments preservation, national economy, or aesthetics of the protection of built environment, it is hardly conceivable why e.g. many thousand sq.m of stone surfaces have been cleaned (by rather obsolete methods) in Budapest, to be left untreated to resume in a few years their previous, unaesthetic appearance, surface deposits still accelerating destruction. In this field a fundamental change may be expected from our cooperation with the Stone Carving and Sculpturing Enterprise of the Ministry of Building and Urban Development, already demonstrating economical, cultural policy and monuments preservational usefulness of research work done at this University on e.g. cleaning and conservation of the Parliament building.

Although our research work and international activity are focussed on the lasting protection of stone surfaces, actual research on the painting of monuments is stressed by the overall exterior reconstruction of the Buda Castle District. Here environmental engineering is closely related to aesthetic and cultural education. Failures, surface damages (also a touristic drawback) by and by reduce to the traditional lime paints (inducing, by their rapid destruction, to look after alternative materials), inasmuch as the recent techniques

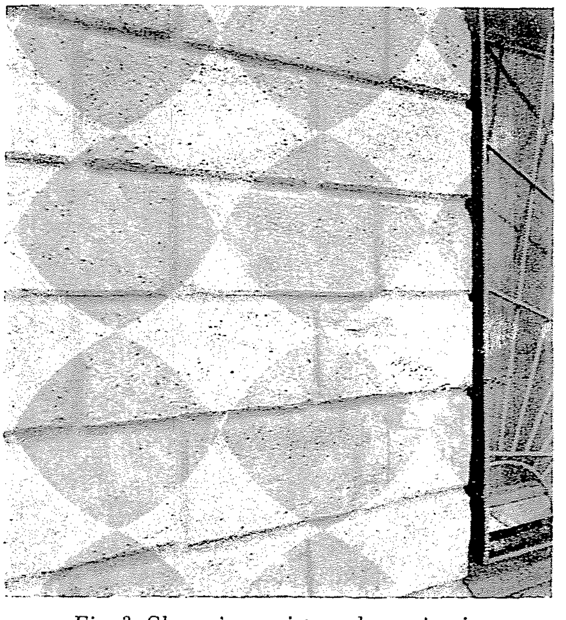

Fig. 3. Glass-pipe moisture determination

do not lead to more durable, and otherwise satisfactory, materials. In this field, silicon paints — not yet used in this country — seem to be of interest.

These recent methods, research works and realizations in cooperation with the National Monuments Inspectorate and Target Program Commission No. 11 of the Ministry of Building and Urban Development have been outlined to raise the interest to applications for protecting the built environment.

Our perspectivic fundamental research should be centered on diagnostic methods and on stone surface protection with strengthening. Joining international research in this scope, good achievements are expected on Hungarian soft limestones, in spite of increasing chemical pollution and unfavourable climatic conditions in this country.

Beside monuments preservation aspects in this scope, let me point to planned reconstruction of thoroughfares, town centres, of utmost significance for the townscape, making research institutes, designing architects and building enterprises concerned with protection of the built environment likely to face enormous problems in the decades to come. To solve them at the required scientific niveau, taking requirements of the national economy into consideration, several restricting factors have to be eliminated. Let me briefly outline them, and suggest comprehensive tasks likely of interest for this Congress.

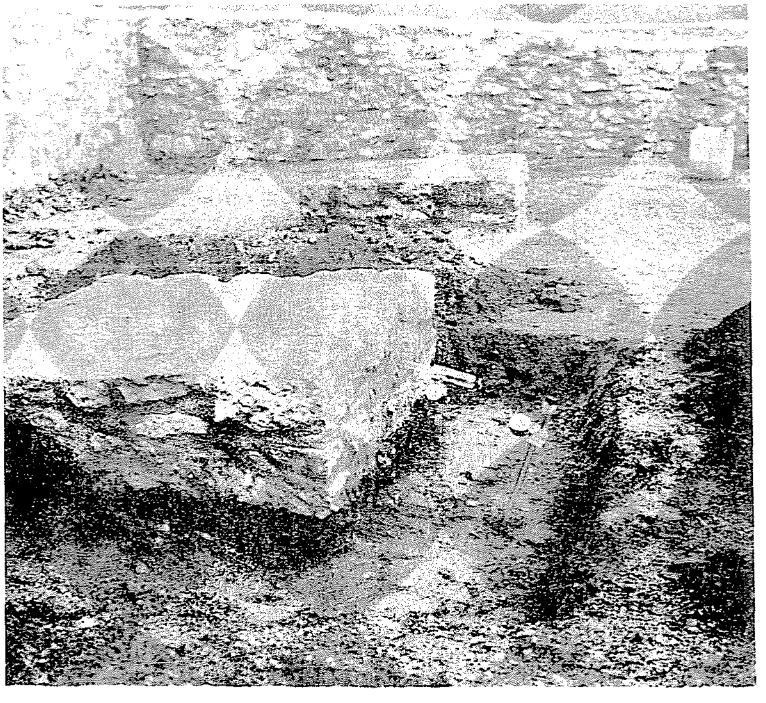

Fig. 4. Silicophob-Anhydro treatment

No significant progress is likely to be achieved in the protection of built environment and the related problems of monuments preservation without integrating this activity with that of the advanced sphere of environmental engineering. The fact that these two activities belong to ranges of two different authorities in this country — National Office of Environment and Nature Preservation. and Ministry of Building and Urban Development — does not exclude common, or at least, coordinated research and practical measures against harmful effects on man and on natural or built environment. For instance, maps indicating atmospheric pollution, in particular, sulfur dioxide contents, clearly show the rate of protection needed for building façade durability. Protection beyond required is a loss to national economy, and so is its opposite: inadequancy of protection for lasting soundness. On the other hand, aggressive biological agents affect man just as built environment — although this latter protracted.

Top-level coordination has to forward overall and subject-wise coordination between self-contained work at research stations. Information flood in scientific life imposes subject-oriented information gathering and distribution between interested research stations, as a means of cooperation between marginal sciences.

Clearly, problems of the protection of built environment, in particular, of monuments preservation, are interdisciplinary in character, impossible to be solved else than in teamwork between representants of different sciences, provided there is a common language to speak.

Since in the case of historical monuments, and in general, of ancient buildings, the need for recent methods is proportional to the age of the building, that is, the older the building, the more advanced methods are needed to upkeep it, the more up-to-date scientific and technical achievements have to be applied for its protection. An efficient therapy being dependent on correct diagnosis, let me submit the suggestion to organizations interested in maintenance and preservation of monuments to develop a systematic method of high technical niveau, taking research under way at the Building Research Institute, and our previous study on building diagnostics in this scope, into consideration. Its generalization would require to equip all-round diagnostic cars.

Last but not least, let me insist on the imperative of educating specialists for the discussed field. The quoted new problems have to be reckoned with both in curricula of architectural education at universities or high schools, and in post-graduate education of specialists, keeping in mind the education in marginal sciences, bringing up specialists outside the frames of the actual education system but of utmost significance for the national economy. I should like to suggest investigation of the problematic of environmental engineering and protection of the built environment from educational aspects by leaders of competent authorities, in common with representants of the Ministry of Education and of the Technical University, Budapest.

Raising these few problems of this extremely wide and complex problem was meant as a modest contribution to forward efficiency and regularity of work on the upkeep and maintenance of our existing building stock, among them of the most valuable ones: historical monuments.

Summary

Environmental engineering, protection of built environment and monuments preservation are in strict relation, imposing cooperation between competent organizations, authorities, and research stations. Scientific and technical development accelerates the destruction process but at the same time offers new facilities of protection, such as diagnostic methods and/or protective coatings. Interdisciplinarity of the problem requires to educate specialists acquainted with marginal sciences.

Prof. Dr. Mihály ZÁDOR, Head of Section
H-1521 Budapest