New Materials for Safeguarding Cultural Heritage

Report about the State of the Art in Austria

Johannes Weber,

Institut of Conservation and Restoration – Technology, University of Applied Arts Vienna, Salzgries 14/1, A – 1013 Vienna, Austria

1. Introduction

The contribution will be focussed on stone and architectural surface, and it will try to give a short but comprehensive view of the practice of conservation in Austria at present. It is based, as a matter of fact, on the author's experiences to which singular events or procedures may have elapsed.

2. Natural stones

As to natural stone in building and sculpture, the geological situation of Austria brings about the predominance of specific lithotypes in the different Austrian regions:

2.1 Soft porous limestone

In the North-East of Austria, i.e. in the area of the capital Vienna, more or less soft limestones – calcarenites from the Tertiary – have been extensively used from the Roman times onwards, through the medieval times till the 19th or 20th cent., when these stones faced a last period of exploitation during the unique boom in Vienna's building activity in the late 19th cent. In our days all but 1 quarries have closed down, and it can be quite a difficult task to find appropriate stones for the substitution of original ones.

The most porous of these limestones reach 40 % porosity and are of poor resistance to outdoors weathering agents in a polluted atmosphere; calcite being the major constituent of these stones, they readily form gypsum as a product of corrosion, which leads to the well-known phenomena of black crusts or sugaring due to loss of cohesion, respectively. Frost resistance, on the other hand, is generally good unless in cases when detritic minerals such as clays are abundant.

Cleaning and consolidation of the porous limestones in their advanced state of weathering seemed an irresolvable problem, first because wet cleaning methods – which in general work well for black crusts on limestones – had the risk of too high moisture input into the weakened stone beneath, second because no satisfactory consolidant seemed to exist for this type of stone: Methyl and ethyl silicates, originally designed for weathered silicate sandstones, were met with great caution in the case of calcarenites in Austria. This fact may have contributed to the long-years practice of stone-by-stone substitution on large buildings like the Vienna Cathedral.

The situation has much improved during the past few years, since laser has started to offer good possibilities of efficient and careful cleaning without use of water. Its use for porous limestones at difficult conditions – various old treatments, remnants of colour to preserve, etc. – was experienced during the conservation of the late-Romanesque main portal of the Cathedral St. Stefan at Vienna. Since then, the number of firms and restorers owning laser cleaning is still low but increasing, and there are apparatus to hire, so that some of the competition specify laser as the only cleaning method accepted.

Careful dry cleaning of the surface of a stone, on the other hand, makes it easier to consolidate the stone after cleaning. The most frequently applied consolidants for the Austrian calcarenites are ethyl-silicate based. A larger variety of products with different properties has emerged from this family of products; though in general there are rather good experiences, the use of specifically tailored silicates on porous limestones (and lime plasters) would deserve a series of lab and on-site tests and evaluations.

Methods of consolidation based on lime, which regularly resurface in the discussion about the conservation of plasters and renderings, are not taken into consideration for limestones of any type.

2.2 Compact limestone

In contrast to the soft porous limestones, a number of compact types of limestone frequently called “marbles” have been used throughout the centuries. While in some of the alpine areas of Austria such stones predominate amongst the building stones, their use in Vienna was normally restricted to epitaphs and single monuments. The two most important lithotypes of this group of stones are the Adnet Stone, a red limestone resembling e.g. the Italian Rosso di Verona, and the Untersberg Stone, a pale compact limestone. In general, weathering of these limestones proceeds along distinct inhomogeneities and not at grain boundaries between the single components. Thus, consolidants are required which have not only good properties of penetration into narrow veins, but are also able to bridge cracks. Especially the Adnet Stone has been used not only in Austria but also in many places of neighboring Bavaria, and its specific problems of conservation due to the selective weathering of clayey veins and layers, have been discussed and published in the 1980-ies (“Adneter Rotmarmor”, Arbeitsheft 25 des Bayerischen Landesamtes fuer Denkmalpflege, 1984). At that time, solutions of acrylics seemed to be the only appropriate consolidant for Adnet Stone, and the same held for Untersberg Stone, where as early as in 1982 the laboratory of the Austrian Federal Office for the Care of Monuments, on the base of laboratory tests and following the Italian experiences at San Petronio, Bologna, for the first time in Austria decided for Paraloid B-72 in the conservation of Vienna’s Baroque Plague Column. Long-term exposure since then seems to reveal acceptable results, but a more detailed monitoring would be desirable.

Since that times acrylics have remained to be the products of choice to consolidate compact limestones in Austria; in recent times, however, the combined application of acrylic solutions with e.g. alkyl-alkoxy-silicate consolidants is a favoured alternative, and the use of modified silicates capable to bridge even larger gaps in the pore structure of a stone is a matter of discussion.

2.3 Marble

As to the deterioration and conservation of marbles, Austria shares this problem with most of the other European countries. Thus, the 11th Workshop of the project EUROCARE-EUROMARBLE in the year 2000 was organised by Austria.

Recently, the conservation of white marble has been a topic of major importance in Vienna. Though marbles, which occur in quite a number of places in Austria, were of local use from the Roman times till in our days, most of the white marbles used for Vienna’s sculpture, monuments and buildings of the 18th to the early 20th centuries were coming from Carrara, Laas and Sterzing; all three occurrences are situated in today’s Italy, and they produce white marbles of Statuario quality, however at significant different average grain sizes.

Current projects comprising the conservation of marble are e.g. monuments and fountains in the gardens of the Schoenbrunn Imperial Palace, further a large number of statues at the attic of the Parliament building, and finally the numerous marble slabs covering the Otto-Wagner Church “Steinhof”, to name just a few. In all three cases it must be stated that we deal with remarkable states of marble decay – sculptures are sugaring at their surface and strongly lack cohesion in their interior, slabs are deformed to high extents due to

the action of sun causing thermal dilatation, and frequently there is uncertainty whether or not a given marble object can be saved at all through its conservation.

Ultrasound transmission measurements as a well-established tool for the evaluation of the state of decay of white marble have been employed as a standard in all of the three above cases; sometimes they served as a control method for the efficacy of treatments. The group of researchers led by A. Rohatsch at the Vienna University of Technology has been performing large series of on-site ultrasound measurements coupled with the assessment of mechanical strength and some petrophysical laboratory parameters of decayed marbles; this enabled to establish a correlation between transmission velocity and mechanical parameters for this type of stone.

Acrylics in solution, e.g. Paraloid B-72, are since years the standard consolidants used for crystalline marble in Austria. Recent measurements by A. Rohatsch (still unpublished) point to the fact that such treatments could even aggravate some of the key mechanical properties of decayed marble. Nevertheless, acrylics continue to be used for marble consolidation in Austria, because empirically the seem to work quite well, and because no other product has proven more adequate till now. Only recently, combined treatments as mentioned for compact limestones are tested.

Apart from the product used, it is since long recognised that one of the key issues in marble consolidation is the need of deep penetration of the consolidant into the narrow pores of this stone to reach the core of e.g. a sculpture; in many cases such cores are known to be more heavily weathered than the surface layers. Therefore, and based on some recent experiences abroad and later on in the stone conservation laboratory of the Federal Office, an in-situ “vacuum”- or low-pressure application of consolidants was requested for the latest competitions of Vienna marble statues conservation (Parliament building). In course of those works, the technical problems connected to vacuum treatments of sculptures and reliefs in-situ have been overcome in an impressing way; thus, the achieved pressure gradients were capable of transporting the consolidant solution along the whole length of the sculpture, but control measurements by ultrasound showed still quite small and unpredictable increases of the mechanical strength by such treatment. It has still to be checked to what depth the solution would penetrate when applied in the described way, and where the consolidant would finally precipitate.

2.4 Sandstone

Passing over to quartz-rich silicate sandstones, which are just of local importance in Austria though some of the finest works of medieval architecture are composed of such stones (e.g. the Bone House in Tulln or the Church of Schoengrabern), there are long-term experiences of alkyl silicate and silicon treatments on such stones. They point to the fact that such products can generally produce good results for decayed sandstones, but that much attention must be drawn to an optimum way of application. Problems in finding the appropriate consolidant appear when there is too high a clay content in such sandstones, or when there are specific patterns of decay, e.g. the formation of scales detaching from the stone. However, the past years have seen developments of modified silicate-based products (e.g. pre-condensed or so-called elastified silicates, respectively) which proved to be of use not only for sandstone conservation, but also for granites or, on the other hand, plasters and murals.

3. Plaster and renders

The increasing awareness of the importance to preserve the historic surface of our built heritage has led to enhanced discussions on how to clean, consolidate, restore and present the architectural surfaces. During the past decade, cleaning has achieved novel possibilities thanks to rotational blast and finally to laser techniques. While the former is since years defining the standard in most of the façade restoration programs in Austria, the latter, i.e. laser cleaning, is still limited to exceptional cases. A research project of the EU-Raphael scheme has recently proved on a scientific basis that a combined procedure of blast and

laser cleaning techniques can be the best solution when the surface is composed of different materials which differ in their sensitivity to mechanical stresses.

As to the consolidation of historic plasters and renders, the range of products and techniques is especially wide. On one hand there are the ready-to-use products for grouting and injection, most of them developed and produced in Germany or Italy. By their chemical nature they are either lime-based (dispersed lime hydrate), or based on cements or other hydraulic binders, either silica sols or ethyl silicates, or on the contrary based on synthetic resins. For a practitioner it is almost impossible to base his decisions for one or the other group of products on safe criteria, even if the number of excellent scientific papers dealing with the products' properties is increasingly high. That is why, especially in the field of plaster consolidation by injection, the empirical approach is the predominant way to select. In November 2001, a seminar was organised by the federal Office for the Care of Monuments (BDA), especially designed to inform the Austrian restorers and conservators about the potentials and limits of each group of products. It was not surprising to note that most of the invited speakers came from Germany, where research and development in this area are significantly more advanced than in Austria.

The "structural consolidation" of the grain fabric of plasters and renders is again a field of application for those consolidants which are normally used for natural stones. However, it has to be mentioned that the use of lime in its different forms – lime water, lime milk, lime putty – to consolidate heavily decayed plaster layers is facing a certain revival thanks to the activities of the Department of Architectural Conservation of the BDA. This department, located in the former Carthusian convent of Mauernbach, has been following interesting alternative ways not only by the exclusive use of lime for the conservation of some of their renders, but also in the esthetically "incomplete" presentation of some of their façades after restoration, due to the fact that finishing paints or similar were not applied and original renders appear side by side to fillings and repairs.

When dealing with renovation and restoration of 19th cent. buildings, one is frequently encountering a mortar material known as Roman cement. This material is not produced any more, despite its obviously high durability and its good working properties. Repairs and new elements have to be performed with modern cements which, however, do not match colour and structure of the Roman cements. This lack of an appropriate mortar binder has led to Austria's engagement in a RTD project granted by the EU-Commission within its 5th Framework Programme. This project is designed to lead to a revival of Roman cement production in Europe.

4. Bibliography

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