# New Technologies for Safeguarding Cultural Heritage

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## 1. BASARABI RUPESTRIAN ENSEMBLE DEPARTMENT OF CONSTANTA

DESIGNER AND EXECUTION STONE CONSERVATION: DORIN DANILA

CONSERVATION TEAM: Eng. MIRCEA CONSTANTINESCU, REST. FRANCISC DOZSA, Phy. CAMPEANU GHEORGHE, Chem. IOAN ISTUDOR

MAIN ACTIVITIES:

- structural restoration of entire concrete basement.
- stopping capillary action of basement.
- engraved decorative surface consolidation.

This high materials technology was implement with the help of KRYTON INTERNATIONAL – CANADA.

Examples of places where was used Krystol T1 and T2 treatment and KIM for concrete waterproofing, cracks repairing and reinforced steel protection.

The main reason for this research are the followings:

1. concrete protection against chloride and sulphates action self-healing of cracks by crystal growing in the pores, voids and capillary

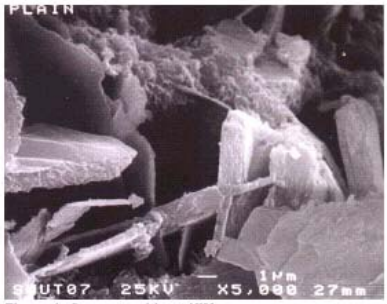


Figure 1: Concrete without KIM

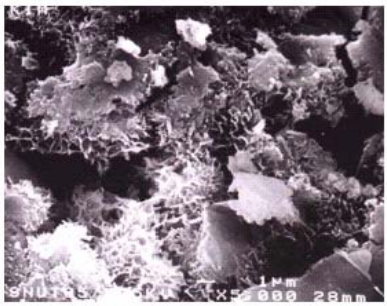


Figure 2: Concrete with KIM

In particulary case of this restoration ,this technology help us to stop the continuos degradation of the stucture and stops the humidity to destroy the structure.

Research of a treatment against salt crystallization with barium hidroxide is developed in this moment.

To stop the capillary action we used different polyxyloxanes olygomere and water based water repelents products,

## 2. NEW TECHNOLOGY FOR STONE CLEANING – LASER CLEANING

This technology is used in conservation of artefacts, sculpture, architectural details for the removal of black encrustations from the natural stone.

It was undestood then that laser radiation would lead to a major advancement in conservation techniques, as a tool that could selectively remove layers of soiling without causing harm to the historic surface beneath.

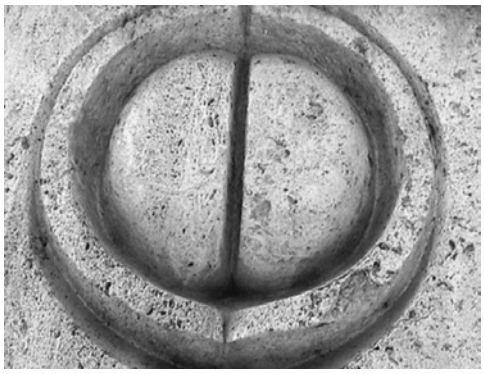
Since then the technology has been developed and refined resulting in a highly efficient, sensitive, noninvasive conservation tool.

The laser cleanig process is effective and extremely selective, leaving a high quality, sensitive finish without any loss of substrate material or increase in surface area through roughening. Even decayed and friable objects can be sensitively cleaned using a laser.

Another advantage of the laser cleaning system is that very little waste produced. It can be very easily collected and disposed of using a simple extraction system.

This technology will be studied during the process of conservation – restoration of the C. Brancusi masterpieces in Targu – Jiu Romania: The Gate of Kiss and The table of sillance.

The firm Lynton Lasers by UK will be involved in colaboration with romanian restorer. The execution works are solved by TLS company and restorer Dorin Danila.



LYNTON
*Lasers*

### 3. Limits of modern technologies used in historic objects

The modern thecnologies are not always the best solution. Their limits should be set by the artistical sense of the restorator or the talent of the restoration worker.

A long debated issue about restoration is wether this field is only science or also a part of art.

The new technologies can solve restoration problems:

- Faster
- More accurately
- With smaller costs than handcraft

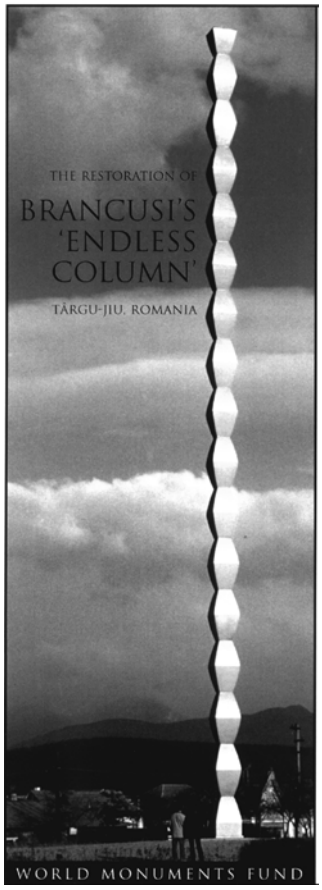
The new technolgies cannot totally replace the old technologies, for several reasons:

- They are sometimes too “perfect”, their accuracy can lead to industrial “perfection” and can destroy the original artistic touch

- They might create secondary effects that are not known yet
- They cannot entirely solve the problems imposed by the restoration of an object with patrimonial value

From this point of view, the new technologies should be used in combination with the old ones, on a case to case basis, in order to really benefit the restoration process and to preserve the original materials.

The role of the new technologies needs to support and complete the old ones, none should replace the other, but the best results are obtained when they are used complementary.


## 4. ENDLESS COLUMN RESTORATION - Social, economical and environmental implications of the use of old technologies

The use of old technologies in restoration is reflected in the generally very high costs of the works.

Old techniques require a lot of handcraft and time for the application.

Still, it is these techniques that keep the highest degree of authenticity of the restoration and respect the principle of the minimal intervention.

In Romania, because of the past political conditions and their economical implications, the old techniques of construction and restoration have been preferred, as far as a tradition has been created over this regarding the rural architecture.

Today, due to the effects of the free market economy, the interest for handcrafted work has diminished, especially due to the raising costs of the workforce. Therefore, it is absolutely necessary to create Patrimony Fine Arts and Crafts studies and further on, professions, as we can see in th EU countries.

***A few examples:***

The hand-made tecnique of brick making is still existing in ROMANIA, and it is kept alive for economical reasons (in some parts of the country, human workforce is much cheaper than aquiring technology)

LIME IS ALSO STILL HAND-MADE IN SEVERAL PLACES AND ITS QUALITY IS VERY GOOD.

Orthodox churches (the religious majority in Romania) are today still being entirely decorated with frescos, done by the original tehcnique, and their number is bigger every day.

Concerning the environment, the old technologies do not impose major problems. They maintain the balance of nature and the result of their use is not harmful in any way for the environment. The big disadvantage tough, is that they require a great deal of handcraft and specialized personnel.

***Example:***

For the cleaning of the facades of the Architecture Institute, we used the old technique of applying sepiolite and ammonia bicarbonate compresses, using a big amount of handcraft work.

After covering joints and missing parts with lime mortary, modern protection technologies have been applied: hydrofugant 224 (polixiloxanic –oligomer)

## 5. Standards, testing and assesments after interventions

One of the problematic issues in Romania is the application of the constructions laws and standards.

These laws stipulate that it is not allowed to work with technologies and materials that do not have the state technical agreement

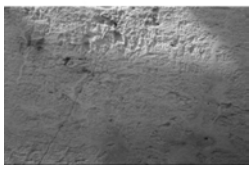
On the other hand, the technologies that are used in restoration are most of the time non-conventional, and have as a basis particular experiences and cases (such as a certain combination of lime with other substances or materials, a certain original colour mixture, etc, that cannot be attested at every restoration, exactly because of their particular character on the case to case basis)

In this situation, stipulating special ammendments in the law, regarding resatoration is an important need at the moment.

Another aspect is the necessity of having a monitoring of the technologies and materials that have been succesfull in the previous restorations, as well as with the ones that have had a negative effect on the previous restoration works.

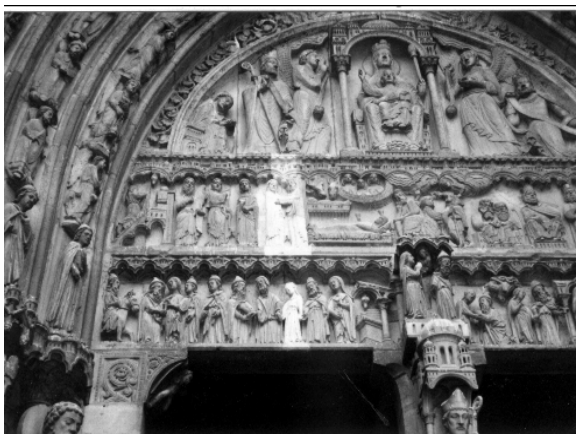
PROBE EXECUTATE DE FIRMA VISA SABLAJ SIMPLU

SE OBSERVA GRADUL INALT DE COROZIUNE PRODUS IN ZONELE DE SLABA CONSISTENTA A PIETREI PRECUM SI VENATURA USOR MASCATA DE PRAFUL ALB AL NISIPULUI



- Sablaje tehnichnologies

+ Laser technology



## 6. NEW TECHNOLOHY FOR OLD MONUMENTS

restoration works for modules of ENDLESS COLUMN, work of art of CONSTANTIN BRANCUSI sculptor.

The project is based on preservation concept of artistic and historical potential of the monument and based on scientific restoration principles.

The adopted methodology will put into practice the purpose of restoration.

The purpose of restoration is to preserve by interventions, that related to the monument necessities, must comply with and preserve its integrity and its conceptual and morphological authenticity.

Intervention means are methods or industrial proceedings, that answer to the necessities of the monument restoration, with some restrictions and some conditions, dictated by complying with the ethical principles of restoration.

By No. 96 M notice from 8 February 2000, National Commission of Historical Monuments establishes that the proceedings from Technical Survey must comply with the following necessities of monument restoration:

- investigation of the basic material by non-destructive control proceedings;
- defects removal by remedy proceedings of the material defects, material of which are made the modules;
- giving back the initial aspect by recovering proceedings of covering with metal on the outer surface of the module bodies;
- ensuring of preservation for the characteristics acquired by restoration act, for a long period of time, by proceedings of making an efficient pellicle protection for the inner and the outer surfaces for the modules.

The outer layers of covering modules are deteriorated, largely, from technical point of view, because of the corrosion phenomena and from artistic point of view, they don't keep the original characteristics (the author's artistic intention).

The state of pig iron bodies (parts) for the modules has been partially determined by non-destructive control with ultra-sounds, the situation being presented in the primary draft.

The module is the essential compounding element of the monument, by its succession, form and dimensions, the author has achieved the desired artistic effect.

The visible part of Column is composed by 18 elements, 15 entire (modules) and 2 halves (half modules) and a detached cover, complying with the succession of ½+15+1/2 modules, plus the cover that close the outer half module, from base to the top.

The module is an empty body that, at the outer, has the form of two trunks of square pyramid, settled on a parallelepiped prism with a square base, with a little convex faces and joint.

The modules, half modules and the cover has been made of type FC 200 pig iron (gray pig iron with layer graphite with perlite structure with phosphorus euthectic), by casting in a form with core.

The outer surface of the modules body has been covered with a Zn layer, deposit by thermal spraying, over this being deposit a decorative layer of brass, by the same method.

The modules has been superposed one over the other, without fixing between them, on a steel pillar that is embedded in a concrete foundation.

Positioning for the laying of the modules, face- to- face, has been done with steel purlins, different as thickness, fixed between the inner side of the body wall and the outer side of the central pillar.

The modules ahs an average weigh of 880 Kg. for each, the superior module has 440 Kg, the inferior half module has about 580 Kg.

The link between the modules and the central pillar is made by steel purlins that allows the transmission of horizontal forces provoked by the wind or by earthquakes.

After the original project, the total mass of the modules, estimated at 14,226 daN, in the absence of the horizontal forces, doesn't load the central pillar, the purlins transmitted only horizontal forces, not vertical forces.

Technological process estimated for the modules restoration comprise the following categories of works, in chronological order, that are different stages of an compelled flow for each of them: Investigation by non-destructive control, Remedy of defects Inner primary protection, Covering with metal of outer surface ,Finishing of covering with brass , Sealing of covering with brass , Final inner pellicle protection, Supplementary pellicle protection.

**Cleaning of examined surfaces** has as purpose, preparation of the module surfaces, for the examination by non-destructive control.

Operation consists in removal of material agglomerations (sand, paint and corrosion products) from the inner surface of the module, that accumulated by washing with filtration water and removal of covering with metal existing layers, removal of corrosion adherent existing products, from the outer surface of the module walls.

Operation is executed for the inner surface and for the outer surface, by manual cleaning procedure with a jet of water fine particles, at high pressure (Water jetting). Procedure is applied according to SSPC+SP 12/NACE No.5 standards regulations (Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultra-high Water jetting Prior to Recoating).

**Investigation by non –destructive control** has as a purpose localization, characterization and classification in the pathological draft of discontinuities opened to the surface for the basic material of the modules body (cracks, clefts, superpositions, empty spaces from casting, porosities).

**Ultrasounds examination** has as a purpose finding the structural defects and surface defects, that affects resistance and integrity of the modules body or can affect the quality of covering with metal. **Examination by penetrating liquids** has as purpose finding the discontinuities opened at surface for the basic material of the modules body. Work is executed by control procedure by penetrating liquids, with a color contrast

**Remedy of defects** has as purpose elimination of structural and surface defects, that affects resistance and integrity of the modules body or can affect the quality of covering with metal.

Remedy operation of the structural and surface defects is made by welding or by covering with metal, depending on settled typology and technology.

**Finishing of remedied surfaces** has as a purpose bringing at the level of the module surface for over-rising resulted at remedy. Operation is executed by careful grinding with angular grinding machine with flexible disk and /or electrical with band grinding machine.

**Covering with metal of the outer surface** has as a purpose:

1. execution of protection covering with Zn of the outer surfaces of the modules body made by pig iron.
2. Execution of decorative covering of the outer surfaces with brass of the modules body made by pig iron.

Operation consists in deposit of Zn layer on pig iron and deposit of brass layer over Zn layer.

Operation is executed by covering with metal procedure in electric-arc, in a system with a robot arm with 6 freedom degree, integrated completely, that comprises the following works:


*Table 1 CHARACTERISTICS OF COVERING WITH ZN*

| Thickness | Deviation thickness [%] | Equiva-lent density [%] | Porosity Pores/ sqdm | Adherence [MPa] | Hardness [Rh] | Oxides contain [%] | Texture aspect |
|---|---|---|---|---|---|---|---|
| Max. 200 | +/- 10 | 95 | - | Min. 6 | 30 | 0.5-3 | 10-13 |

The operation's purpose is covering of the depth (rebord) and the outer surface of the walls of pig iron modules over Zn layer, with a brass layer, with the following characteristics:

*Table 2 CHARACTERISTICS OF COVERING WITH BRASS*

| Thickness | Deviation thickness [%] | Equiva-lent density [%] | Porosity Pores/sqdm | Adherence [MPa] | Hardness [Rh] | Oxides contain [%] | Texture aspect |
|---|---|---|---|---|---|---|---|
| 600 | +/- 10 | 95 | null | - | | 0.5-3* | 15-23 |


Outer final pellicle protection has as purpose supplementary pellicle protection of the covering with brass. Utilized material will be a product of HV LAOUER HEMPEL type applied in superposed layers, with a final minimum thickness of 50-70 m of dried material.