Monitoring and continuous maintenance of monuments and historic buildings

1. The traditional and modern structural system of the buildings
2. Use of the historic technologies
3. Existing maintenance systems
4. Development of maintenance systems
5. The work of maintenance systems
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The traditional and modern structural system of the buildings

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The modern structural system

- Water insulation (under and above the structure)
- Painted (not coating) + Vapour barrier + secondary cover
- Laminated concrete slabs
- Reinforced concrete slabs
- Cement plasters (not breathing)
- Relative thin silicate walls + thermal insulation
- Several high tech electrical and building installation works
- Reinforced concrete slabs
- Pitched roof covering + PE layer (primer + secondary cover)

The motion of vapour and moisture in the buildings

Traditional vs Modern
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**The structural system of the buildings**

- heat insulation with the mass of material
- insulation with coating
- the system lets moisture (vapor) in the structures, and helps to leave
- to be restored with traditional materials (+ technics)
- modern

**Historic technologies**

- technologies of historic trades, that not anymore used among modern construction activities.
- e.g.:
  - pargetting
  - traditional plasters
  - smithcraft
  - stone masonry
  - traditional carpentry

It is a time consuming decoration - appearing as applied art.

We use advanced techniques instead.
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The use of historic technologies

maintenance and restoring

Maintenance:
Preservation of the proper state of buildings with continuous monitoring and failure corrections.

Restoration:
Construction process aiming the proper state of the building, after it has been more or less lost.
The importance of the maintenance systems

DEF:

- a service system for the regular control and continuous maintenance of the buildings
- performed by non-governmental, non-profit organizations
- voluntary to be joined
- specialized trade personnel is employed

Organizations

Monumentenwacht Nederlanderen, Netherlands
- the first maintenance service
- founded in 1973 as a private initiative
- territorial organizations and a national umbrella organization
- partially supported by the state
- being a member of maintenance service is a necessary condition of the national grants for restoration work

Monumentenwacht Vlaanderen, Belgium
- founded in 1991
- follows the Dutch model
- today nearly 10,000 buildings are investigated

Maintain our Heritage + Bath Preservation Trust, United Kingdom
- operating since 1999
- a federative organization of local maintaining services
- a pilot project in 2002-2003
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#### Organizations

**BAUDID, Germany**
- Federative organization of different monument services

**Bygningbewarings, Denmark**
- The total costs of the organization are paid from the fees of the owners exclusively

**MAMEG, Hungary**
- Since 2006
- Independent foundation
- The Dutch Monumentenwacht was the model
- Centres in 14 regions - representatives in many countries

**Historic Scotland, United Kingdom**
- Governmental organization
- Provide information and professional help to the owners for continuous maintenance

**NIKU, Norway**
- Non-governmental foundation
- Researches on monuments
- Helps to maintain and restore the buildings properly

**Porta Speciosa, Hungary**
- Since 1995
- Non-profit organization
- Federation of professional maintenance specialists
- Focusing on the problematics of the monitoring
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What is the benefit of the maintenance service?

- continuous maintenance
- occasionally performed restoration
- savings

Value vs. time

How can the optimal operation be ensured?

- adequate approach of the owners
- development of a maintenance / conservation system
- support of the state (legal; financial)
- support of the professionals
- standards, guidelines
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How were organizations established?

- development of the system of the services
  - non-profit (e.g. foundation) / profit oriented company
  - by location / by function
- the characteristics of the federative / umbrella organization
  - governmental / non-governmental

What are the main challenges?

- there is no received standardized system
- there are too few standards, guidelines, regulations
- limited financial sources of the owners
- lack of specialists and experts (technician, engineers, skilled worker)
The possible solutions

- Establishing umbrella organizations, ensure cooperation of the existing initiatives, development of guidelines or standards
- Training more skilled workers and technicians (governmental responsibility)
- Governmental support system
- Informing and supporting the owners

The work of maintenance systems

1. Diagnostics for monitoring historic buildings
2. Indicators -> actions / treatment
The possible procedures

Three different levels of diagnostics:
- **Local monitoring** (e.g. by caretakers/owners) (site-based diagnostics)
- **Start-up diagnostics** (structure- and impact-based diagnostics)
- **Continuous maintenance monitoring** diagnostic (structure- and impact-based diagnostics)

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**Maintenance protocol for owners and caretakers**

<table>
<thead>
<tr>
<th>Daily work</th>
<th>After storm, windstorm, earthquake</th>
</tr>
</thead>
<tbody>
<tr>
<td>handling of doors and windows (opening, closing windows before rain or in case of wind, etc.)</td>
<td>controlling the rainwater goods, the roof coverings, the soundness of the doors and windows (in case of storm, windstorm)</td>
</tr>
<tr>
<td>removal of the fallen leaves (at accessible places), take care of vegetation around the building</td>
<td>controlling soundness of load bearing structures, facades (in case of major storm, earthquake)</td>
</tr>
<tr>
<td>cleaning the windowills, the terraces, and the sidewalks around the building</td>
<td>controlling the soundness of superstructures on roof (antenna, cable-pylon, chimney) (in case of storm, windstorm, earthquake)</td>
</tr>
<tr>
<td>removal/handling of snow and ice (avoiding salt if possible)</td>
<td>removal of debris, bough, etc. from roof, slits, balconies, terraces (in case of storm, windstorm)</td>
</tr>
<tr>
<td>controlling, cleaning and treating the claddings, coverings and the furniture</td>
<td>controlling the installations (heating, water supply, etc.)</td>
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<td>controlling the lamps, changing light bulbs in time</td>
</tr>
</tbody>
</table>

*In case of need call for the monitoring service!*
### Types of diagnostics used for the service system

<table>
<thead>
<tr>
<th>Type</th>
<th>Visual</th>
<th>Instrumental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site-based</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Structure-based</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Impact-based</td>
<td>X</td>
<td>X</td>
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</table>

### Site-based diagnostics

The state of the building is recorded by the segments of it, e.g.:

- facade segments
- rooms

In most of the cases:

- monitoring is performed by the caretaker
- simple state recording

mainly visual diagnostics
Structure-based diagnostics

The state of the building is recorded by each structural part e.g.

- foundation
- wall structure
- slabs
- roof structure
- claddings
- etc.

Typical at the specialist (e.g. static) investigation:

- before restoration
- at case of sale
- after disaster

Visual and instrumental diagnostics

Impact-based diagnostics

Recording the state of the building by the impact on the building

- restoration proposal
- investigation of the impact
- cancelling the impact
- consideration of the problem
- revealing the problems
- investigation the adjoining structures

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Typical impacts / groups of impacts

- rain
  - wind-driven rain
  - failure of the rainwater goods
  - failure of the roof
- humidity
  - leak
  - vapor
- biological impacts
  - plants around the building
  - biological pests, insects, insects
- movement of the building
  - sinking
  - vibration
- air
  - wind (erosion)
  - air pollution (corrosion)
- material incompatibility
- alteration of the climatic conditions
- new function (vapor, lack of ventilation)
- construction failures

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Material Structure Testing methods

- wood carpenter structures
- railings sampling, fungiology
- wooden floors, doors, windows
- wooden wall coverings, furniture
- composition analyses
- plaster sampling, mineralogical analyses
- glass window glazing (simple, stained glass)
- sampling

Non-destructive testing
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**Indicators**

**DEF:**
- The indicator helps us to evaluate a procedure.
- *Where are we standing?*
- *Which direction we have to follow?*
- *How far are we from the aimed goals?*

Proper indicators indicate the problems in proper time, and help to recognize the duties to be done.

**Indicators**

Which case do we need intervention for?
Which case have to be a contractor involved in the restoration works?
Which case have to be specialists involved in?
### Indicators

1. **When do we need intervention?**

   If the failure of a structure jeopardize the soundness of the other structures.

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<table>
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<tr>
<th>Structure</th>
<th>State indicator</th>
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<tr>
<td>Pitched roof covering</td>
<td>Missing, dislodged, broken elements</td>
</tr>
<tr>
<td>Carpenter structure</td>
<td>Discoloration, flashings, corrosion spots, ...</td>
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<tr>
<td>Surroundings of the building</td>
<td>Pavement cracks, plants, vegetation in the direct surrounding of the building</td>
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### Indicators

2. When have to be a contractor involved in the restoration works?

If the volume of the work is too large or the technical preparedness of the monitoring personnel is not enough for the on-site repair.

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<tr>
<th>Indicator</th>
<th>Description</th>
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<tr>
<td>Structure State indicator</td>
<td>Pitched roof covering remarkable amount of damaged elements, carpenter structure damaged, structural element, flashings remarkable amount of corrosion.</td>
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<tr>
<td>Pitching flat roof</td>
<td>Eaves material decay, Flat roof surface flooding, flashings remarkable amount of corrosion, holes, etc.</td>
</tr>
<tr>
<td>Walls</td>
<td>Plaster ... ceramic, eternit pipes leakage</td>
</tr>
<tr>
<td>Surroundings</td>
<td>Pavements sinking, dislodgement, plants structural damage caused by plants</td>
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**Indicators**

3. When have to be specialists involved in?

- If the state of the structure can not be detected by visual diagnostics (e.g. instrumental diagnostics)  
- If the monitoring personnel are not competent in the needed special fields of knowledge (e.g. statics, fungiology)

The application of specialist experts have to be done before the restoration works starts!

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<th>Needed specsialist</th>
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<td>Structure State indicator</td>
<td>Carpenter structure distortion, dislodgement, damage statics damage by fungi or insects fungiology, insectology Flat roof... Surroundings plants Structural damage coased by plants statics, gardening soil talajcsuszamlás, beszakadás soil mechanics</td>
</tr>
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**Treatments:**
1. Diagnostics of the state
2. Decision about if treatment is needed
3. Analyses (getting information on the building and on the technologies)
4. Decision about the treatment (material and technology)

**Influencing factors (choosing technology and material):**
1. Protection of the building (legal)
2. The original structure (material, technology)
3. The use of the building (function)
4. The aim of the restoration
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Thank you for your attention!

References