Vulnerability of Cultural Heritage to Hazards and Prevention Measures

Defects and Damage on Historical Buildings Caused by Neglecting and Improper Management

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Missing tile, clogged gutter, not renewed painting of window, frames, etc. are very simple defects which, when are not treated in time and properly, can cause a serious damage to the historical structure. Not only a clogged gutter itself, but also surrounded plaster, masonry, and doors below can be affected by leaked rainwater. When the maintenance i.e. debugging of these simple defects is neglected, after a certain period of time, large-scale restoration is needed. Such restorations, although are carried out on very high quality, always mean loss of original substance of the historical building.

1. Vulnerable parts on historic building

1.1 Roof

1.1.1 Roofstructure

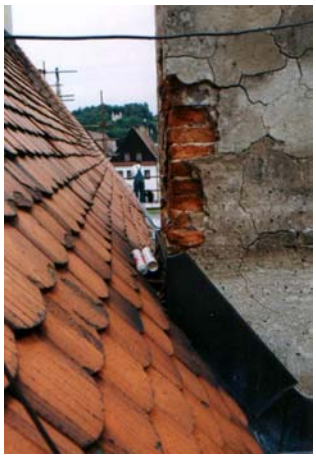
In roof timbers, the principal defects in original timber may be large dead knots leading to partial failure of the member, longitudinal fissures due to shrinkage and radial cracks, only visible at the ends, which together with the fissures may weaken a member and vane due to faulty conversion or decay sapwood. Fungus and insect attack is very serious problem especially for joints, as well as chemically aggressive excrements of beards and animals living in underroof spaces. These excrements cause slow chemical changes in the wood and weaken the members. Roofstructure (trust) is very vulnerable to any water penetration. There are some places, where water is usually penetrate in. Around the chimneys, roofwindows, gable wall, etc. Wooden members in this places can be very easily affected by rot or fungi, because of high humidity and temperature, very usual in that spaces. Specially dangerous is insect attack. Usually it is caused by incorrect preparation of wooden material, which is built-in without bark removal. In the space between wood and bark are very often located grubs of longhorn beetle and Anobidae sp.

1.1.2 Roofcover

Plays most important role in protection of the building, since it is its function. Roofing material is continuously exposed to the climatic conditions. Most damage occurred in spring when snow is melting and in autumn, when heavy rains are combined with strong winds bringing fallen leafs and other debris. In addition biological roofing materials (wood, thatch, etc) can be attacked by insects, moss, fungi, etc. usually on southern site of the roof, where is favourable temperature for pests. For analysing of weak points of roofcover is very important to know quality and lifespan of roofing material. In generally there are places, which are tend to be damaged.

Not only the quality of roofing material is important, but regular maintenance as well. Also simle defects will cause serious damage - House No. 39 on The Town Hall square – Bardejov

Most vulnerable places are where vertical construction penetrates roofcover. Only a little defect on the details around chimneys, gable walls, electricity poles, dormers, etc. , if not treated properly, can cause large damage to whole building. The load by strong wind is higher on ridges and on the borders of the roof, then on other parts of the roof and wind can blow away tiles from that parts. Hail, in fact, usually caused only a very little damage, when braking few tiles, or roofwindow. On another hand damage will occurs when broken tile is not replaced immediately.



When places where vertical construction penetrates roof cover are not maintained regularly, serious damage can occured. - House No.38 on The Town Hall square – Bardejov

1.1.3 Chimneys

Beside gutters, the most vulnerable points for rain penetration in most buildings are chimneys, which until now, were not build with water-proof trays, thus allowing water to penetrate down the stack. If there is not sufficient lap cover between roofing materials, the details can allow capillary attraction or penetration trough porous materials. Rain penetration will cause rotting of roof timbers at abutments, as these are rarely properly flashed and damp-proofed in historical buildings. The top of the chimney is very vulnerable and when the stability of this part is not ensured by regular maintenance, by proper technical solution, or by other means, falling bricks can damage roofcover and plaster can help to block the rainwater disposal system.

Bricks falling from the top of chimney are dangerous for roofcover. - House No. 38 on The Town Hall square – Bardejov

Another danger caused by improperly maintained chimney is fire. Inspection of fire-proof of the chimneys is regulated by special regulations, is obligatory and is provided on regular bases by specially trained sweeps.

1.1.4 Rainwater disposal

Properly working rainwater disposal system is essential for safeguarding of historical building. Also small defects on gutters and downpipes can cause a serious problems, they must be maintained regularly. Dysfunction of disposal system is evident during heavy rains. Wall staining, rust marks and internal moist patches usually point to defects. Raising of moisture can cause attack by fungi and deterioration of wooden parts of the structure, falling off plaster and painting layers, defects on ceilings etc. Rainwater disposal system can be damaged or blocked at the beginning of spring by melting snow mixed with remains of trees from autumn. Wet, heavy snow can easily move not properly fixed gutter, what leads to problems with water flow. Autumn remains are not visible from the ground and at the beginning are dangerous only during heavy rains. Later, when the system is not cleaned remains of leafs, branches, etc. become a basis for growing moss, and leads to rust of metal parts connected to that places and to total block of the system in certain point. If rainwater is not removed from the roof immediately, can easily penetrate through other damaged point, or simply flow down the facade. Problems can be caused by improper design of the details, not correct realisation, or even by using low quality materials.

More than 20 years missing downpipe is continously damaging walls, foundations and ground soil. - House on The Trinity square – Banska Stiavnica

Water penetrating from broken rainwater drains, which do not dispose water at least 3-4 meters from foundations, usually cause moisture penetration into basement and crypts. Serious damage to historical structure can occurred when foundations and ground below are

affected by water. Bearing capacity of wet ground is usually lower than bearing capacity of dry ground, because of dissolving and flowing out some elements of the soil by water. In addition, the depth of foundation if certain kind of historical buildings /(folk architecture) is lower then depth of frozen soil in winter (in Slovakia it is about 80-100 cm). In this case the expansion of wet masonry and ground, can cause structural defects of outer wall of the building.

Driving rain will often penetrate doors and windows and cause rot to sills and the base of frames, especially if painting has been neglected.

1.2 Walls

1.2.1 Excess moisture

Moisture penetrating by capillary from the ground into masonry transports dissolved salts. By evaporating of water salts crystallise and destroys plaster and painting layers, later also masonry can be affected. This problems usually occurred in basement, not exceptionally on first floor as well and were caused by elimination of natural evaporation of water from the ground trough the floor. Damp-proofed floor layers in interior, and asphalt or concrete sidewalks touched to the facade do not allow natural water evaporation. Stopped ventilation in basement (by closing ventilation windows), or in the space below wooden floor cause rising of humidity, which creates ideal conditions for fungi and mould. Very often is the rising of the moisture in outer walls caused by leaking of drainage close to the foundation.

1.2.2 Masonry walls

Cracks in masonry walls are usually indicating movement of whole structure. The tendency for movement should be deducted from the tapering and angle of any cracks, many signify nothing more then thermal movement and the slow wearing out of the structure. But cracks may be very significant and can indicate a likely failure. It is important to record and study every significant crack, if its only in plaster layer, or goes trough the stone or brick wall. If any of cracks are considered as serious, arrangement of gauge or micrometer reading across three points can provide regular recording. After analyzing this data proper measures should be undertaken.

Cracks on the wall occurred during construction works on neighbouring house. Although they are not moving any more, they must be maintained, not to cause more damage. - Jewish synagogue on Klastorska street – Bardejov

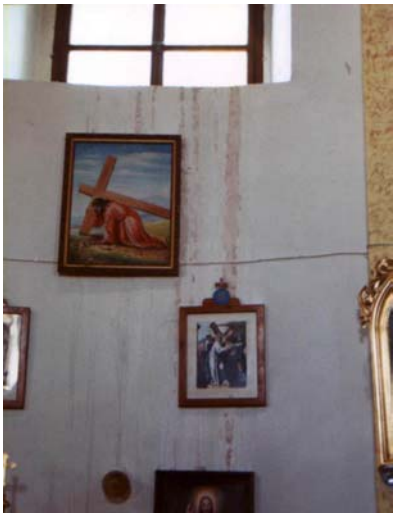
In the cases, when the foundations are on soil less than 1 meter deep, some deformation of the wall can be caused by soil shrinkage cracks. Adjacent trees and shrubs or wall creeping plants may case settlement by extracting water from the clay in summer. Moisture in walls is as serious as in foundation masonry.

1.3 Interior

1.3.1 Windows and doors

Rot is often found at the bottom of frames and in wooden sills and then may spread into the wall lining or fame. A sagging arch or lintel indicates trouble – either structural settlement or local defects such as dry rot in concealed timbers. Defective putties at paintwork are common faults, which can lead to more serious trouble.

Condensation from windows can also be a serious cause of trouble. Windows and doors are always exposed to the climatic condition so the regular renewal of painting can not be abandoned.



Water condensation on the window glass sheet causes damage to painting, plaster, and to window frames as well. - Greek-catholic church of Virgin Mary in Chmelova

1.3.2 Floors and staircases

Floors and staircases may be the elements most likely to collapse and care should be taken if there is any doubt. Collapse or damage is generally due to fungus and insects attack in the ends of beams. Beams can be weaken by walls moving out, thus loosening their end bearing, or by the floor's strutting and wedging woring loose.

Mould on the wooden ceiling inndicates high humidity above the ceiling. - Building on Town Hall square 3A, Bardejov

Damage is often caused by single-minded electricians and plumbers cutting joists at their weakness points to insert cable and pipes. The wearing of all floors in historical buildings is a problem too.

Staircases of historical buildings are either of wood or in masonry. The joints at the newel posts and the stiffness of these members are important as well as the strength and stability of balustrades and firmness of handrails.

1.3.3 Internal finishes

Most of the defects likely to be found, unless accounted for by structural actions, are due to poor workmanship; shrinkage cracks, plaster detached from lath (dangerous in ceilings) and the separation of plaster coats are examples. The cause of all such defects should be analysed.

Mosaics and wall paintings of all types need special consideration, since they are vulnerable to condensation and penetrating water capillary action. Care must be taken to note canvas linings and wallpapers, which may have historic and artistic value. Ornate plaster ceilings are very heavy, so special attention must be paid to the fixing of their armatures. Cornices also present similar problems, particularly if their framing is of wood and liable to decay.

1.4 Mechanical and electrical services

Mechanical and electrical services are dangerous when installed or used improperly, or when lifetime of the materials used is over. Usually only licensed companies or craftsmen can realise this parts. According our legislation, this services, especially electricity must be examine and controlled regularly by the authority. On another hand defects are very dangerous, if they occurred they can cause fire. Internal water supply system is very often a source of damage not only in historical buildings. Leakage of water destroys not only paintwork or layers of plaster, but sometimes can cause cracks in the walls or volutes by overloading of the structure (when, for example, continuously penetrating masonry of the volutes).

1.5 Drainage

The danger points for broken drains are point of entry to sawage system and at point of entry to a building, if settlement has occurred, and under a lightly constructed drive over which heavy loads may passed. Damaged ventilation of the top of the drain can cause condensation of aggressive steams from the sewage. Leaking septic or savage tank is dangerous because waste water usually contains more aggressive dissolved salts than rain water.

Problems mentioned above can by caused by wrong management, neglecting of maintenance, improper design of the details, not correct realization, or even by using low quality materials.

Very simple activity – cleaning certain points on drainage system - can avoid many problems. - House in Town reserve Litomerice

2. Improper maintenance

Majority of the defects mentioned above can be avoided, when the building is maintained on regular basis. Unfortunately in Slovakia we do not have legal tools to motivate the owners to do this. In addition there is no specialised organisation to inspect the building and to formulate the advises for efficient maintenance regularly, since the main task of the Institute of Monuments is research, documentation and methodology of the listed

monuments which are going to be restored, or are under restoration. Of course, many of the owners are taking care of their property. But very often happens, that the maintenance is provided in improper way. In usual situation, when the owner has a limited budged for maintenance, it is essential to repair most dangerous and serious defects of the building. For example repairing of chimney, which is falling apart, deteriorated roofcover, or cleaning drainage system is usually more important, then repairing of plaster of the main facade.

Repairing of the plaster of main facade was finished without repairing of deteriorated top of the chimney. House No. 38, Tawn Hall square, Bardejov before and after repairing of main façade.

When the defects are not treated in right way, without any serious analyse, using wrong materials, techniques, etc. the danger can even increase. Although it is known, that the cement plaster has very high resistance against diffusion of vapour, it is still used as a solution against excess of moisture into masonry. Same problem is using concrete damp floors in the basement. Sometimes it is enough to use simple logic.

Although there were some maintenance activity done, they are not sufficient since they were related to consequence not to cause of the damage. - Garden house of the castle at Liblice

3. Regular technical inspection

The methodology of all conservation depends upon making an inspection and report at regular intervals on all items of cultural property, recording visible defects factually, in order to diagnose the causes of decay and propose an effective cure that involves only the minimum intervention.

What is required is a coordinated strategy involving the owner and users of the building, the maintenance stuff and the daily cleaners, all of whom can, by constant vigilance, provide an early-warning system.

Inspectors beside preparing reports can provide „first aid“ repairs - Team of Monumentenwacht Netherlands inspects Palffy‘s manor house in Svaty Jur.

Inspections are the basis of future action, so it is important that they should be thorough and accurate. The purpose of the initial report is to record and evaluate the significance and condition of the historic building. Most importantly, the report can be used as a basis of the maintenance plan, so it is a essential part of the strategy of preventive maintenance which is the highest form of conservation.

A full report may be worked up by stages, as follows:

- Initial report based upon visual inspection, listing all defects, and describing and
- studying the building.
- A maintenance plan. Approximate itemised estimates or immediate urgent and
- necessary repairs and other desirable works.
- Historical research and analysis supported by photographic records.
- Recording of the initial state of the building; soil mechanics, humidity studies and
- opening up suspect parts.
- Further studies. Structural analysis.
- Final estimates and proposal with specifications and full report for submission for
- governmental grant covering all above factors, as they modify each other.

3.1 Economical efficiency

In generally prevention is better than cure. And cheaper. Although In Slovakia there was no economical calculation done, it seams to be obvious, that to maintain the building on regular bases is cheaper, than to restore it in longer period of time. In addition, the budget for preservation of cultural monuments in Slovakia is decreasing constantly. By inclusion of the policy of maintenance into national policy for preservation of cultural monuments and into legislation, the decreased budget can be used more efficiently. This topic can be a subject of research since it can be a very strong argument for state authority to enhance maintenance and to introduce national maintenance policy. Of course reducing of costs for keeping the property in good condition is right motivation for the owner as well.

3.2 Conservation policy-legislation

Venecian charter on preservation and restoration of Monuments and Sites approoved in the year 1964 clearly define importance of regular maintenace:

Section 4.

“For preservation of monuments is regular maintenance essential.”

This important recommendation was indtroduced into our national legislationas well. Recently valid legislation in the field of preservation of cultural monuments in Slovak Republic - Act No. 50/1970 of SNR (Slovak National Council) and related executive regulation No. 237/2000 issued by The Ministry of Environment – Building Act (section No. 86) and Act No. 27/1987 of SNR – on state preservation of monuments (section No. 9) – includes maintenance into preservation of the build environment. On another hand there was not elaborated and introduced nation’s policy for implementing efficient system of regular preventive maintenance of historical buildings.

In the year 1973 was in the Netherlands founded an organisation “Monumentenwacht” with the goal to implement the idea of regular preventive maintenance through cyclical technical inspection and “first aid” repairs of the historical buildings. Today Monumentenwacht Netherlands yearly inspect 25% of all listed buildings in The Netherlands. They initiated the changes in governmental policy of subsidising of protection and restoration of monuments. From subsidising of large restoration projects towards supporting regular preventive maintenance. Later on, the approach of Monumentenwacht Netherlads becomes a model for similar activities in different European countries (In Flanders Monumentenwacht Vlaanderen, in Germany Denkmalservice, in Denmark Raadvads Bygningssyn and the idea is developing in other countries of the Europe).

4. Conclusion

Many defects and damage on historical buildings are caused by neglecting, or by improper maintenance. Since the owner of that buildings are usually not specialists in the field of monument’s preservation, there is need for defining a preventive maintenance policy as well as for an independent, highly skilled specialist, who can provide the owner with the information on technical state, threats, causes of damage and with advises for efficient maintenance. Technical inspections and preventive maintenance of historical buildings must be provided on regular bases.

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