



FAXE H2OBLOCK/ PROsystem Report

KRONBORG CASTLE, WINE CELLAR

Helsingør, Denmark



HORNBÆK, 23.05.2016.

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• General information about capillary rising damp



Capillary rising damp is characteristic of old buildings, built at a time when builders were unaware of waterproof materials such as bitumen and the like, which are now used for waterproofing. Moreover, old buildings are often built without foundations, directly on the ground.

Since the basic construction materials (brick, stone, mortar, concrete...) are to a greater or lesser extent porous, through them, that is through micro capillaries existing in their structure, damp gradually moves upward from the soil.

The "culprit" for this is the surface tension of water, which occurs due to the polarization of water molecules, and its direct consequence is capillarity. Due to capillary action, water "climbs" up the wall, and while moving, creates an additional electromagnetic field in the wall, which enhances the capillary effect.

Given the structural and static characteristics of these facilities, in capillary rising damp sanitation the appropriate method must be carefully chosen. Classical methods, that is, construction (physical) methods of sanitation - "pressure injected systems" and "slot sawing", are very aggressive to the static of the building. Therefore, when it comes to old buildings, such sanitation methods are not recommended either by the civil engineering profession, or the institutions dealing with the protection of cultural and historical heritage.

PROsystem capillary rising damp elimination system using electro-osmosis has been successfully used for many years. This elimination system is extremely fast and efficient for damp walls affected by capillary damp.

It is suitable primarily for older buildings without adequate waterproofing, especially for facilities of great cultural and historical value, such as castles, manor houses, religious facilities, museums, and all other buildings regardless of their purpose, which were built prior to using waterproofing materials. The system can also be used for newer buildings with defective waterproofing or in which waterproofing was bridged due to floods, with capillary damp remaining permanently.

Clear signs of rising damp

Unpleasant smells in the space – health risk

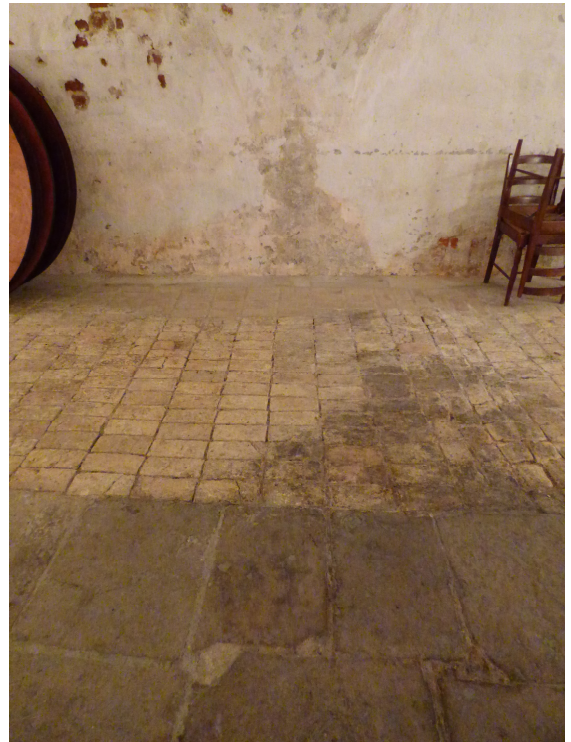
Increased atmospheric moisture

Cooler spaces

Fungus

Appearance of salts/nitrates on wall surfaces

Destruction of facade and plaster/outer walls and paint



• Uniqueness of Kronborg Castle

Kronborg is a castle and stronghold in the town of Helsingør, Denmark. Immortalized as Elsinore in William Shakespeare's play Hamlet, Kronborg is one of the most important Renaissance castles in Northern Europe and has been added to UNESCO's World Heritage Sites list.

The castle is situated on the extreme northeastern tip of the island of Zealand at the narrowest point of the Øresund, the sound between Denmark and Sweden. In this part, the sound is only 4 km wide, hence the strategic importance of maintaining a coastal fortification at this location commanding one of the few outlets of the Baltic Sea.

The castle's story dates back to a stronghold, Krogen, built by King Eric VII in the 1420s. Along with the fortress Kärnan, Helsingborg on the opposite coast of Øresund, it controlled the entranceway to the Baltic Sea. From 1574 to 1585 King Frederick II had the medieval fortress radically transformed into a magnificent Renaissance castle. The main architects were the Flemings Hans Hendrik van Paesschen and Anthonis van Obbergen, whereas the sculptural work was coordinated by Gert van Groningen. In 1629 a fire destroyed much of the castle, but King Christian IV subsequently had it rebuilt. The castle also has a church within its walls. In 1658 Kronborg was besieged and captured by the Swedes who took many of its valuable art treasures as war booty. In 1785 the castle ceased to be a royal residence and was converted into barracks for the army. The army left the castle in 1923, and after a thorough renovation it was opened to the public.

• Drying up the wine cellar of Kronborg

First meeting in Kronborg Castle took place on the 14th of September 2014 with the following staff present:

- Uffe Kjerulf, the architect of Kronborg
- Per Faxe, the director of Faxe H2OBlock

After the survey and examination of the object it was determined that the percentage of rising damp in the Castle construction is extremely high, what creates a big problem for the building and for visitors and people who work there. The smell of damp is actually the smell of stale water in the walls that evaporates from the walls, spreading bacteria and fungi thus saturating the space and causing increased atmospheric humidity.

The situation with rising damp in the wine cellar was alarming: representatives of Faxe H2OBlock measured humidity using a capacitive measuring device and took pictures. All proved a high level of relative humidity as well as wetness of the construction.

As the true and lasting sanitation can be achieved only by drying the walls with H2OBlock/ PROsystem - system, which guarantees that existing moisture will be dried out and capillary effect will be stopped, it was decided to install PROsystem device right away.

First of all it was settled to dry out the wine Cellar. The wine cellar is in the central part of the old Kronborg. The task is special because it is a case of 4 meters thick walls located directly at the moat. One of the stones in the floor can be lifted so it can be seen how high the groundwater and the water in the moat stands.

On the 9th of October 2014 a H2Oblock with action radius of 27m. was installed centrally in the wine cellar. So it covered the entire wine cellar.

In order to compare changes in humidity level in the wine cellar and in the area, which is out of H2Oblock 27 action range, the Beer Cellar was chosen for additional measurements.

34 zones were determined for measurements in the wine cellar. Within each zone measurements were taken at the following heights from the floor level: 25, 50, 100, 150 and 200cm. A total of 170 measurement points.

And in the beer cellar 19 zones were determined. Within each zone measurements were taken at the following heights from the floor level: 25, 50, 100, 150 and 200cm. A total of 95 measurement points.

Only measurepoint 5 and different windows in wine cellar is exactly marked points.

Please see the plans for Wine and Beer Cellars with measurement points in the 1st and 3rd Annexes.

• **Comperative analisys 09.10.2014.-20.05.2016.**

PROsystem device was installed on the 9th of October 2014 in the Wine Cellar.

First results of dehidration were noticed already after 24 hours: unpleasant smell became much weaker, "salt beard" appeared on the walls, damaged materials (paint and plaster) began to flake and fall off.

As a result of the dehydration process, materials changed colour (become brighter) and became smoother to the touch.

Damp rises up the walls, carrying dissolved salts and nitrates. When the damp evaporates and dries up, the salts crystallise, and given that crystallisation stress is one of the highest in nature, the resulting pressure causes significant damages.

Frost in the winter and vapour in the summer rotate in the structure, causing the constant slow destruction of the structure, i.e. the disintegration of the wall. This means that the structure itself weakens in its functional sense. The worst damage usually occurs in the wall zone up to which damp rose, that is, where it stopped rising.

During the dehydration process, the surface parts of the walls are the first to dry up. Thus, the damaged materials (paint and plaster) increasingly flake and fall off. It is (together with salts appearing in the surface of walls) one of the indicators of the changes that occur due to building dehydration.



During the trial period (09.10.2014.-20.05.2016) measurements were taken 4 times:

09.10.2014

10.10.2014

27.11.2015

20.05.2016

Please see a Table with measurements in the 3rdAnnex.

As it is seen there was a drop of 12% in the humidity level between 09.10.2014 and 10.10.2014. And in the beer cellar there was no decrease in humidity percentage.

Measurements on the 27.11.2015 showed no changes and it was discovered that groundig was pulled out, what interfered dehydration process. The problem with grounding was solved in the middle of 2015.

Last measurements were taken on the 20.05. 2016. The results showed nearly 19% decrease of humidity level in the wine cellar if compared to the start measurements. And damp situation in the beer cellar is unchanged.

The measurements for point no. 5 with the precise markings showed the same trend as other measurements.



09.10.2014.

10.10.2014.



20.05.2016.



09.10.2014.



20.05.2016.

• Conclusion:

After installation of PROsystem / H2Oblock, the following results were observed: wine cellar walls became dry, unpleasant smell disappeared. The duration of the complete drying of the walls depends on the thickness of walls, building materials, soil permeability, temperature and other conditions such as visual and sensitivity

The result of the drying process is during the period rated visual, tactile and olfactoryly. Evaluation based on these senses clearly shows that there has been a significant drying.

Thus we come to the conclusion that PROsystem / H2Oblock effectively eliminates capillary moisture, so it is recommended to have PROsystem devices installed in all the Castle spaces. This will help to dry up walls and floors and to prevent capillary effect in future.

During trial period it was recorded nearly 19% decrease of humidity level in the wine cellar what can be considered a great success. It should be noted that due to the fact that salt is current conductor; the results of measurements could be interfered in the way that the measuring device could show higher humidity percentage.

Therefore the average decrease in relative humidity is to be regarded as minimum 19% what makes H2Oblock extremely efficient in capillary rising damp elimination.