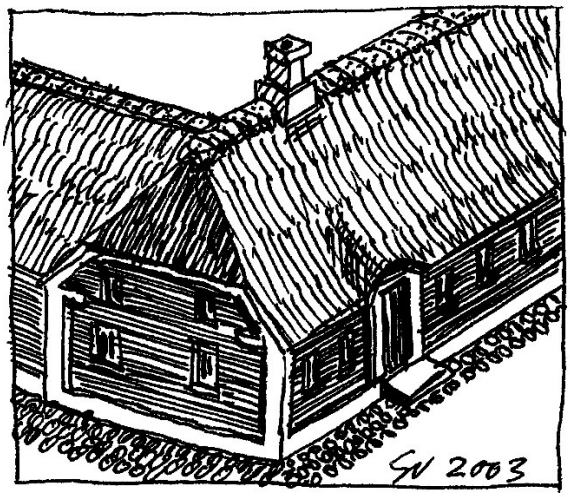
Preventive Maintenance
(Forebyggende Vedligeholdelse)

By Søren Vadstrup
Associate Professor at the Royal Danish Academy
School og Architecture
Master Program for Cultural Heritage, Restauration and Transformation
Center for Bæredygtig Bygningskultur
Resilient Heritage Conservation - *A cross-disciplinary group of researchers at the Royal Danish Academy*



Preventive maintenance of a brick building with a thatched roof

- *Any visible cracks in the facades must be registered and closed with porous materials.*
- *Keep especially the mortar joints intact in masonry*
- *Facade overhangs must be tight and without cracks*
- *Especially under the windows*
- *The plinths' surface treatment must be kapillaropen, e.g. lime colour or wooden tar colour*
- *The round-stone covering around the house must have a slightly leaning surface, away from the house.*

Background

Protection, conservation and enhancement of the Danish architectural heritage, as original, authentic and unspoiled as possible, but also adjusted and suited to modern living standards, is a vital element of the Danish identity and quality of life - as well as an important element in the economy.

But these two demands, the demand for an original and authentic substance in the architectural heritage and the wish for modern living standards in the houses and cities, catch us on the horns of a big dilemma. In the process of restoration and modernizing, the original materials and authentic qualities of the house are often diminished or spoiled. In practice, you throw out the baby with the bath water.

Lots of examples show us however, that it *is* possible to keep both the original substance in old houses and obtain modern demands, such as technical equipment, insolation standards and so on. But it is regretfully not the way, most buildings and towns are treated today.

As it is now, the protection, conservation and enhancement of the Danish architectural heritage costs several milliards of money every year. If we are using these milliards to reduce and depreciate the authenticity of the architectural heritage, we are losing both our heritage, our identity and money. Therefore, if we instead more consciously could use the money and efforts to keep up and enhance the original substance of the architectural heritage, we would get a positive effect on the protection of the heritage, as well as the employment, the environment and sustainability and consequently for the citizens too.

Modern materials and methods

We are used to think, that the use of new and "modern" building materials, methods, products and tools always is the best way of solving the problems of maintenance and upkeep of old buildings. But lots of examples shows, that these products do not always work well together with the old materials and constructions, and they are not always as sustainable in production, use, deterioration and disposal and furthermore often spoil the authenticity of the old house.

In Denmark, the old buildings often lose their original architectural qualities and authenticity, because:

1. The house owners do too many and too expensive alterations to these quite humble houses.
2. The house owners and their houses are test cloth for untested new materials and new constructions
3. The house owners and their craftsmen often add too hard, tight or stiff materials to the old weaken constructions and materials, which often causes trouble.
4. The house owners and their craftsmen do not examine and do not trust the qualities and properties of the often only slightly deteriorated original materials.
5. The house owners know too little about the special building traditions and building materials of old buildings

By 'old buildings' we mean buildings build before app. 1960-1970. By that time a lot og new and modern building materials was introduced and also the building constructions and the crafts techniques were changed quite much.

In older houses with brick foundatione, it is very important that the plinth plaster and the surface treatment are not too dense, but instead are as capillary open as possible. Here the plinth is both plastered with a hard cement plaster and tarred with a very dense asphalt tar. This causes the rising ground moisture to run even higher into the brickwork - here right up to the windows - and moistens the brickwork so that both beams, floors and windows rot. Instead of the ground moisture seeping out through the plinth itself, where it does no harm.

Research:

Identification of the particular characteristics of the traditional building culture in Denmark and its local and regional materials and constructions.

1 Draw up a set of guide-lines for the correct materials and methods for restoration and maintenance.
2 Training programmes for house owners and craftsmen in correct restoration and maintenance.
3 Information programmes which improve public awareness of the for the correct materials and methods for restoration and maintenance of old buildings
4 Continuing production of traditional building materials and systems for recycling of useable traditional building materials.

A so-called 'seaweed-farm' on the island of Læsø
The very special roofing material is eel grass, which has proven to have a very long lifetime and durability of over 300 years. But for the last 50 years, the eelgrass around Læsø has had a disease that has made the threads very short. Through a great effort from many sides, a system has now been established where the eel grass is harvested in the waters south of Zealand, from where it is sailed in ships to Læsø. Therefore, you can once again build both new tang roofs on Læsø again, and repair the old ones.

Traditional building materials
There is about 40 construction materials used in the historic Danish building culture, which we calls for the traditional building materials, since they represent very long experiences and traditions. Therefore, we know these materials in better or worse, their technical and sustainability advantages and disadvantages through hundreds of years. The same cannot be said about many modern building materials, which in many cases we have only a few years' experience and which have even often come with new and improved products constantly. Therefore, traditional materials in many areas have completely different technical characteristics than new ones.

The traditional materials advantages:
1. They have very long experience
2. They are relatively weak, which means that they make little harm on old buildings surfaces
3. They are maintainable
4. They have a long maintenance margin
5. They can be repaired

We can observe that many of the traditional building materials can survive relatively long time without maintenance, but when this happens, it emits number clear warning signals that tell about beginning of internal decomposition.

The most important advantage of any conventional building material is probably that thy are immediate and relatively easy and simple to repair, if it is necessary. It means, that the building materials in the building constructions, can have a very long life.

How long does a powerful red lime color like this last before it needs to be retreated? Most people would say one year. But this building, Ewaldsgade 5 in Copenhagen, built in 1853 by N.S. Nebelong, and listed in 1978, I myself was involved in the lime washing of in 1987. And here 36 years later, the building has not been lime washed since. It is not 'unlimited durability' yet, but it helps a lot when the work is done according to new research.

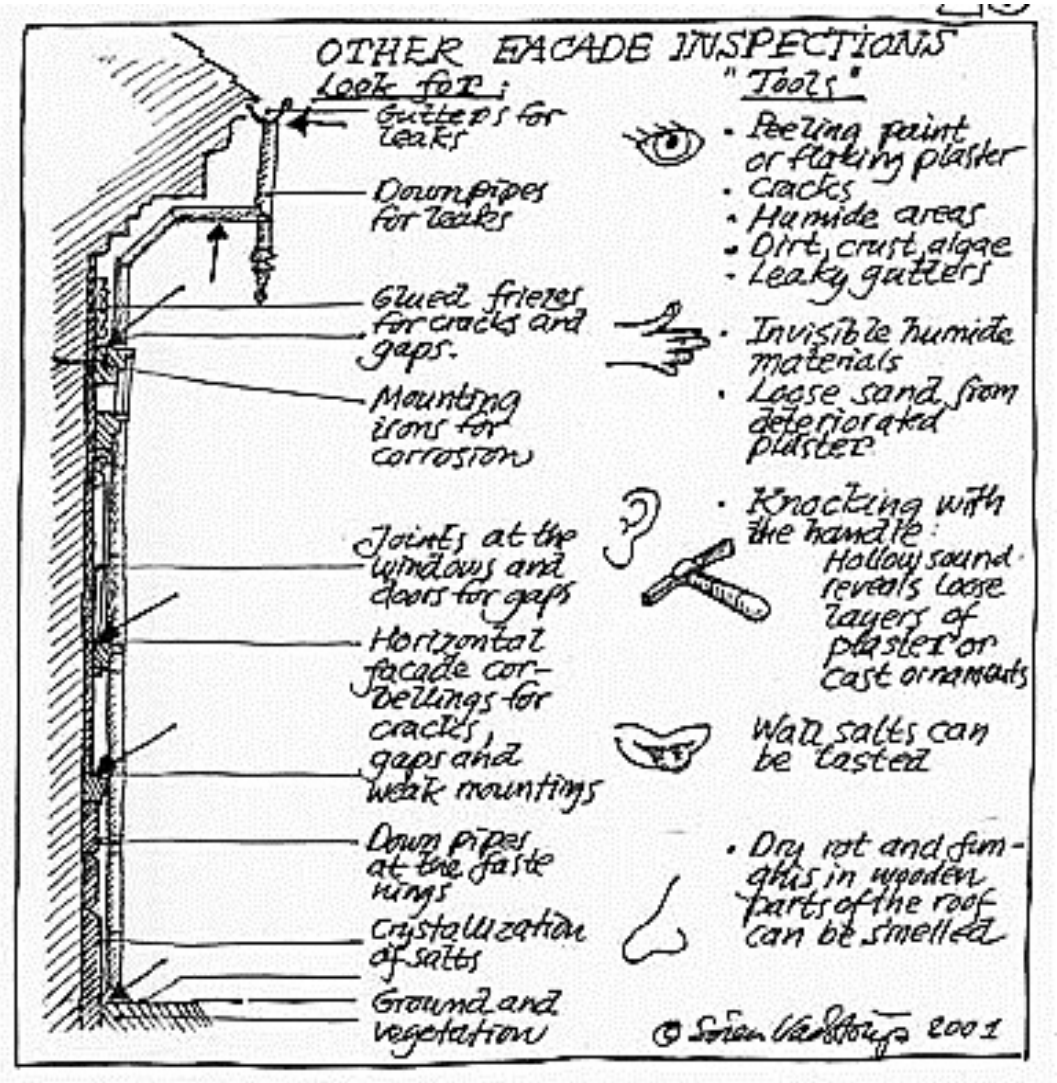
As documented on the thousands of Danish historic buildings, including windows that have kept hundreds of years, and which, if treated correctly, can last 100-200 years more. One of the oldest building materials is brick. It has been a major material in Denmark since monks and craftsmen brought the knowledge of burning clay to the century country in the 11 Century. Clay and lime for the bricks and mortar can been found in most parts of the country.

The traditional building materials disadvantages:
Long experience has of course also revealed a number of disadvantages of traditional building materials:
1. They are difficult to work with and make great demands for craftsmanship and skill.
2. They are differing and lack rules and standards. They often have no documented test results.
3. They are harassing with a number of natural enemies that can cause sudden deterioration.
4. They do not look like modern materials.
5. There may occur health and safety problems.

It is a feature of many natural biological materials that they naturally contain many problematic substances such as turpentine from resins, in order to protect themselves in the nature. Other traditional materials such as slaked lime and lime mortar, is strongly alkaline, which can be unpleasant or dangerous to skin and eyes when working with materials. The 100 years of experience with these things in this country has taught the craftsmen to work with these materials without compromising health. Sop many of these problems and bad experience with the traditional building materials happens due to lack of craftsmanship and knowledge.

The traditional materials also often have very special demands for specific humidity, temperature, UVlightning, base treatment, surface treatment, etc. for an optimal result could be accomplished. Another problem may be that there is changed in the production of the materials, and thus on the properties as a result of a modern industrial method of production, standardization, desire for greater uniformity.

Therefore, we must as far as possible go back to the original production and treatment methods to obtain a technically satisfactory product.



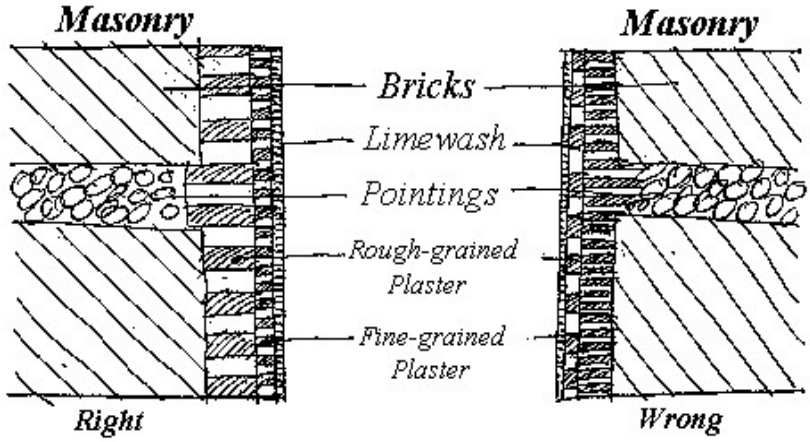
You can use your five 'senses', the sense of sight, the sense of touch, the sense of smell, the sense of hearing and the sense of taste, to a great extent when you have to examine older buildings for moisture, loose plaster, salts or rot and fungus.

The physical balance in old buildings

In most of older buildings, which were built in the traditional Danish building traditions, you can observe some interesting characteristics, which naturally prevents the deterioration and damage from water and its acolytes: moisture, salt, ice and acids, which together constitute the vast part of the degrading factors. All these preventive elements manifest itself in a natural physical balance of the building which we should be very careful not to change. These are for instance:

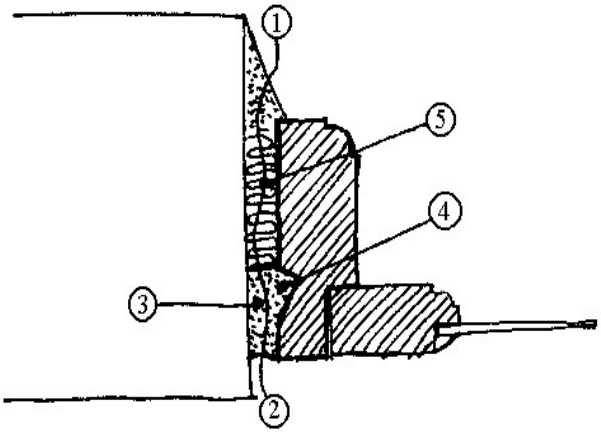
1. *Water resistant constructions.*
   This is primarily to keep water and moisture away from the building's structural parts. First of all through a dense and sloping roof with a good large overhang preferably with effective guttering and downpipes. Secondly by preventing water gathering in protrusions or cracks in the façade through the consistent use of kapillar open and weak ventilated technology.

2. *Quality improvement of the materials through craft process.*
   In the traditional architectural technology, materials are not just materials. Wood, masonry, plaster, iron, and paint quality can be improved and optimized for the specific use by various pre-treatments and through workmanship. As the water in masonry is always moving from large pores to small, it is very important that the façade plaster always built up of two layers of mortar increasing fineness of grain outwards. Thereby for the first rejects the plaster most of the water and the second pulls it automatically any water out of masonry. If this construction will be turned, which happens occasionally, plaster absorbs water into masonry.



An example of the very sensitive physical balance in the traditional building constructions, is the micro construction of plaster on masonry, which due to the capillarity of the water, must have increasingly finer pores from the inside and out. This was in former times well-known by the experienced craftsmen. They knew also that if the wall furthermore is finished by the very fine grained lime wash, this capillarity system worked even more better. But if this clever and natural micro construction of lime plaster and lime wash, was changed, for instance by adding a tight layer of plastic paint, the natural balance will disappear and damages break out.

3. *Triple protective of critical places.*
   Three especially critical areas in traditionally built houses are the different materials clashes in façade construction, for example between wood and masonry, and the rising soil moisture in the masonry. At these places, the traditional Danish building traditions as part of the natural physical balance operate with three double secure solutions that complement each other if one of the solutions would fail.



1 The construction is completely kapillar open through the fine pores in the mortar.
2 The construction is low ventilated.
3 The mortar joint is reinforced with cattle hair in order not to fall out.
4 The mortar joints are locked through a V- incision in the jamb.
5 The joint is tightened with flax fibres impregnated with wood tar, which avoid fungus.

The very critical joint between the masonry and window frame is an example of 5 double secured constructions against moisture damages even with the use of something advanced as a custodian impregnation

Changes in the physical balance

As previously mentioned, one can often observe that the older buildings and facades that are constructed and maintained using traditional materials, are in a kind of physical balance in relation to different impacts from water, moisture and relative movement between the materials. Much damage to facades due to people in different ways upset or disturbs the natural balance.

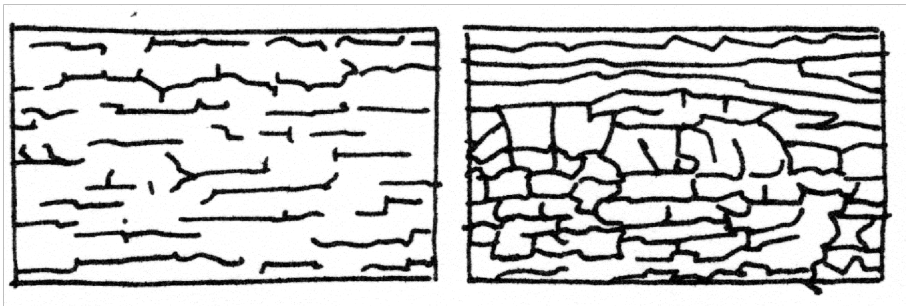
A typical example is the insulation of older masonry. It is wisely to save energy and money on heating by putting mineral wool into the cavity in the wall. But insulation means that inevitably lowers the surface temperature in winter several degrees in the outer layer of brickwork. Sometimes things go well, but other times it starts outer wall of the façade or façade plaster to rattle as a consequences of frost peeling. The old materials simply do not have strength for the new low temperatures and maybe it is better to spend more money on repairing the masonry and plaster.

Other examples of total changes in the physical balance can be painting of a vapor tight plastic paint, as well as thin plastering of brick facades with cement mortar, and finally, asphalting masonry plinths with dense asphalt tar. Even something as diminutive as changing out lime mortar joints around the windows to a rubber sealant, can upset buildings' physical balance.

Finally, something as harmless as cleaning of dirt from the façade also can influence on the physical balance. It can namely happen that the surface torn up so that absorbs more water, dirt and salts, as well as wood or steel parts inside the façade structure becomes moistened. Also, harmfull chemicals being left from the cleaning process in the surface, can lead to weathering, discoloration or salts.

Maintenance signals.
As a further protection of the construction, the traditional materials emit themselves a number of obvious warning signals when they need maintenance. And when it happens it should be noted some time before something goes wrong: cracks on timber windows, linseed oil paint fade or cracks, plaster gets flaw, chalk wear out, wooden surfaces become grey or black and steel parts gets rusted.

When these *red warning lights* turn on, it's time for ordinary maintenance or repairs, depending how late you can act. General maintenance includes: peeling and painting, sanding and painting of steel parts and so on. All this relatively simple and cheap processes. The problem is, unfortunately, that many are not familiar sufficiently good with the traditional materials, misunderstand these signals and believe that materials should be replaced. For example, solid and valuable old windows, because point itself shows, that must be maintained.



Typical 'snakeskin cracking' of linseed oil paint after approx. 4-5 years. This, the 'fingerprint' of the linseed oil paint, does not mean that the paint layer must be removed and repainted. The linseed oil paint is still firmly attached and may only need to just have a coat of boiled linseed oil to regenerate the paint and wood, and not repainting at all.

Preventive maintenance

Preventive maintenance is a strategic and target-oriented action on building materials and -elements in order to slow down the deterioration rate. Instead of waiting for the deterioration to come, you make, often quite small, preventive or consolidating works.

Preventive maintenance consists of 5 elements:

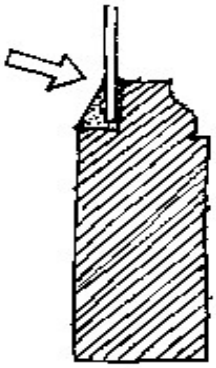
Preventive measures eg. execution of water noses, water boards, removal of rubber joints that are too dense, remove plastic paint that is too dense, unsuitable terrain or planting.

1 Keep an eye on the "small things" and understand the materials' own "maintenance signals"
eg. material collision, cracks, holes, wetting, peeling, etc.

2 General building services
eg. cleaning gutters, underlining tiled roofs, mowing thatched roofs, etc.

3 Limited, gentle and graduated interventions
eg. scrape off loose paint and spot paint on top of this, change plinth plaster, apply linoleum on linseed oil painted surfaces, scrape off salts, algae etc.

4 System and structure in the work, systematic and well-defined checks and gentle interventions at regular intervals,
e.g. routine check, every year, preventive maintenance, every 5 years and gentle repair every 10-15 years. year.
   a. close critical cracks, material clashes, etc. in roofs, external walls and windows with capillary-open materials, e.g. air lime mortar, tar putty, wooden strips.
   b. seal gutters and downspouts.
   c. grind and treat rust spots in iron and cast iron.
   d. underline tiled roofs, etc. regularly, where the subpages are available.
   e. wash and clean the surfaces of moss, algae, dirt, etc.

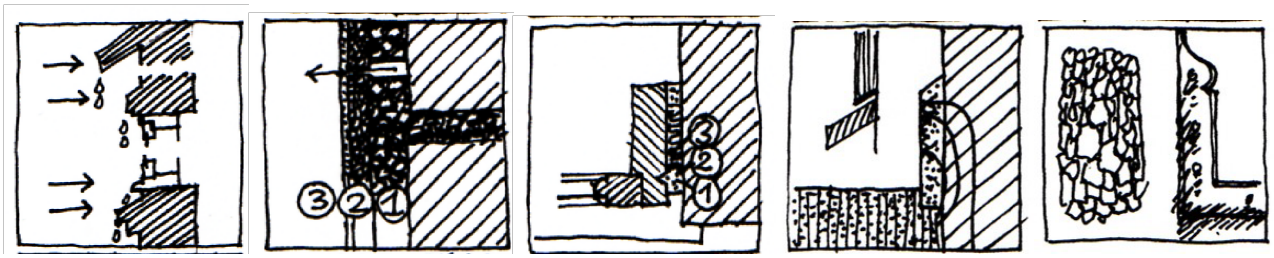


An example of systematic, strategic and preventive maintenance of buildings is the important joint between glass and wood on wood windows.

If you one time a year check especially the horizontal linseed-putty joints, and tight them with linseed-oil, it will influence on the further maintenance on the window.

A leek at this point, which is very often the case, will very soon cause cracking of the putty, accumulation of moisture in the wood, cracking and peeling of the paint, rot, fungus and serious damages. It all starts at this relatively simple, but important, spot.

Another example is the linseed oil-putty seal or joint on wooden windows. Another example is the adding of a thin linseedoil-layer on linseedoil-painted surfaces. Other preventing activities could be cleaning, clearing, removal of obvious threats from water collection.



If unsuitable, new materials have been applied to an older building, as part of ongoing maintenance, the resulting construction errors should be rectified, e.g. by removing the new materials and replacing them with traditional materials and solutions.

This applies, for example:
- Hard and dense cement plaster on plinths or asphalt on plinths
- Plastic vapor barriers in wooden walls
- Rubber joint masses, especially for wooden windows
- Plastic and acrylic paint on external wood and wall
- Nail and screw fittings on half-timbered timbers

However, older buildings may in themselves contain a number of construction technical errors or inabilities, which, among other things, through the conscious use of new materials and methods, can remedy. This applies, for example:
- Installation of moisture barriers in plinths, which can reduce rising ground moisture
- Drainage plates on the outside of the foundation, below ground
- Scope drain for drainage of ground water
- Excavation of embedded beams in basement walls
- Covering uncovered facade projections.

From: Vadstrup, Søren (red.): *Vedligeholdelse af fredede og bevaringsværdige bygninger*. Information om Bygningsbevaring 2014

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