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Nordic earthen constructions. Building physics requirements

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ABSTRACT

Historical earthen constructions can be found all over Norway. These include all types of constructions, rammed earth, adobe, and as part of framework at interior and exterior walls, floors and pipes, even roofs.
The challenge for earthen constructions is the harsh humid climate in Nordic environments. Thus, surface treatment is of crucial interest when exploring possible solutions for modern buildings with earth as both an industrialized and standardized building material in Scandinavia. Historically, tar, cod liver oil, lime, wooden coverings and sometimes concrete have been used in this respect.
The research of the historical earthen heritage in Scandinavia, in regard to damage analysis and repair experience is of vital scientific importance in establishing standards and guidelines for the use of earth as a building material in constructions.
The so-called summer castle Skinnarbøl near Kongsvinger, built in 1848, is the biggest and oldest rammed earth construction in Norway.
The construction surfaces were originally protected against weather and climate by lime plaster and lime paints. The analysis of the maintenance of surface damages with concrete and modern non-vapour diffusive paints verified more building physics issues.
Inside earthen constructions surface treatment and modern insulation can influence the interior climate and the hygrothermal behaviour in a negative way, resulting in construction damages caused by trapped moisture.
In other cases, like the rammed earth tannery building in Trondheim, built in 1854, the surface treatment as weather protection works well with later concrete plaster layers.
Pre-industrial natural surface treatment with traditional materials requires strict temporary routines for maintenance of cultural heritage in Nordic climates. The repair of the rammed earth construction at Skinnarbøl summer castle, as well as the adobe brick constructions at the eleven Frølichbyen dwellings in Oslo, built 1870 to 1872, illustrate this point.
Rammed earth dwellings north of the polar circle were usually covered with wooden cladding, like the Fossli house, built in 1930 in the Tana valley in Finnmark county. The only historical construction method that is not covered is the so called "kubbe"-technique, which comprises earthen mortar layers with "wooden bricks" and horizontal layers of timber plank.
The study exemplifies that there is not one specific technical solution for weather protection in earthen constructions in Nordic climates. The in-situ research of the historical cases in Norway show that the efficiency of protection always depends on relevant factors, the geographical site, the local climate conditions, the type of earthen material used, and the interaction between the earthen construction and the type of surface treatment, including its maintenance.
The damage analysis proves that modern vapour-proof, or high vapor diffusion resistant coatings, and low moisture diffusivity plasters are to be strictly avoided in Nordic climates. Mainly due to the cold and humid climate, with rapid zero freezing/melting point changes. However, earthen constructions tend to handle these conditions well.
Consequently, building regulations in Scandinavia regarding building with earth as a building material and primary construction should apply the experience from failure analysis of historical earthen cultural heritage in Scandinavia.

KEY WORDS:

place management and branding, place identity and attachment, green infrastructure, aesthetic amenability, Pedios River