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There are 1700 medieval churches in Denmark, and many of these have brick vaults. The thickness is only 12 – 15 cm, and the heat loss through this building component is large. Thermal insulation has not been permitted until now in respect for the antiquarian values and doubts about the effect on water vapour transport through the vault, and the risk of condensation inside the insulation. A new mortar was developed for thermal insulation of bricks vaults, consisting mainly of expanded perlite, mixed with slaked lime. These materials are compatible with the fired clay bricks and the lime mortar joints. The insulation mortar is applied to the top side of the vault in a thickness of 10 cm, and covered by 10 mm lime plaster, reinforced with cattle hair. This assembly is resistant to the weight of a person, working with maintenance of the roof. The thermal conductivity of the insulation mortar was measured to 0.08 W/mK, which is twice the value for mineral wool. It has 1/3 of the resistance to water vapour diffusion as brick, and a high capacity for liquid water absorption. This is a benefit in the case of rain leaking from the roof, because the water does not penetrate further down into the bricks.