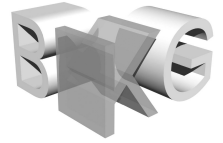


Constructive Design and Building Construction



Master thesis – Leon Böttger Analysis of the future potential of reed for the building industry

Motivation

As the construction sector remains the world's largest consumer of natural resources, it must rethink its approach. Increasing awareness of sustainability and environmental protection is driving the search for environmentally friendly and ecological solutions, beginning with material selection. Reed is now experiencing a renaissance. Therefore, its future potential was evaluated.

Thatch, or reed, is a natural building material historically used for roofing dating back to the Neolithic period. It grows in wetlands and is harvested under strict environmental regulations, with around 80% currently imported due to local shortages. Reed's applications include mainly roofing and insulation. Houses with thatched roofs are mainly found in the north of Germany.



Fig. 1 Locations of thatching companies in Northern Germany (Becker 2020 p. 9)

Material properties

Thatch provides effective heat insulation by trapping air within reed stalks, reducing heat transfer. Its porous structure efficiently absorbs and regulates moisture, naturally controlling humidity. The reed's structure also offers good sound insulation, though its flammability requires additional protective measures. These properties make thatch suitable for various construction applications.

Construction variants

Modern construction techniques have adapted traditional methods like stitched, bonded, with innovations like the screw technique improving efficiency. Reed is also used for exterior wall insulation, offering good thermal properties and aesthetic appeal. Modern architecture also uses thatch as façade cladding.

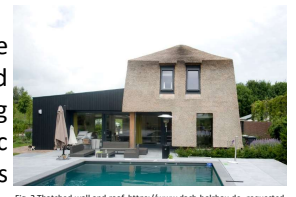


Fig. 2 Thatched wall and roof, <https://www.dach-holzbau.de>, requested 15.12.2023

Hygrothermal simulation

The hygrothermal simulations for a reference building in WUFI analyzes the effects of different roofing materials on indoor climate. Three cases were investigated: a thatched roof and a tiled roof with ventilation, a strongly ventilated thatched roof and an unventilated tiled roof, and both roof types without insulation. The results show that the thatched roof provides slightly cooler indoor temperatures in summer due to its lower thermal conductivity, better heat storage capacity, and lower solar absorption rate, while also absorbing more moisture, leading to higher relative indoor humidity.

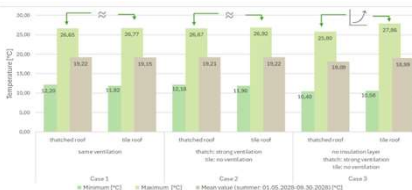


Fig. 3 Summary of the main figures of the inner air temperature in all three cases (Own figure)

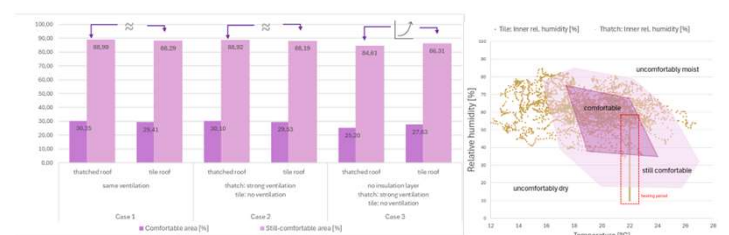


Fig. 4 Summary of the data points inside the comfortable areas (Own figure)

Fig. 5 Case 1 as example: Comfort field as a function of humidity and indoor temperature for the year 2020 (Own figure)

In an uninsulated construction, the thatched roof's natural properties more significantly influence indoor climate, highlighting its potential for improved thermal comfort in summer and winter.

Economical analysis

The cost analysis for external wall insulation and roofing compares the costs of the construction using reed panels versus mineral wool for external thermal insulation composite systems (ETICS), and thatched roofs versus tiled roofs. For exterior wall insulation, the use of reed panels arise 32.4% more expensive, compared to mineral wool. In roofing, thatched roofs are 36.88% more expensive than tiled roofs. Additionally, thatched roofs have higher maintenance and insurance costs, further impacting their overall expense.

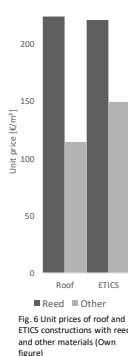


Fig. 6 Unit prices of roof and ETICS constructions with reed and other materials (Own figure)

Future potential

Thatch, as a renewable building material, has significant environmental potential, promoting biodiversity and carbon capturing. However, its widespread use faces challenges due to a heavy reliance on imports, which negatively impacts its CO2 balance, and the high costs of acquisition, processing, and maintenance. Strict fire safety regulations and the need for cost-effective fire protection measures further limit its application. Despite these challenges, thatch offers cultural and aesthetic value, supports local economies, and has the potential to see increased demand if combined with other natural materials.