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Long-term Performance of External Thermal Insulation Systems

Since the early 1960s, External Thermal Insulation Composite Systems (**ETICS**, EOTA name used below) also called External Wall Insulation Systems (UK and Ireland) or Exterior Insulation Finish sytems (**EIFS**, North America) have been applied to insulate external façades. Right from the start, these thermal insulation systems were investigated by the Fraunhofer Institute for Building Physics in the laboratory, at outdoor testing sites as well as at already existing buildings. The results were published among others in IBP Reports No. 192, 316, 382 and 438. There the state of external thermal insulation systems at existing buildings is reported. Investigations were carried out several times over a period of three decades and at defined intervals, at the end of 2004 for the last time, to assess the long-term performance. **Fig. 1** gives an example of the state of the building at different time intervals.

As was the case with previous investigations, the state of the investigated façade was classified according to three assessment groups. A survey on the investigated objects, the time periods of production, inspection and assessment of state is given in the diagram **(Fig.2)**, which also indicates the classification criteria.
The age of the investigated external thermal insulation composite systems (ETICS) is between 19 and 35 years. All ETICS, older than 20 years, were refurbished using one or two coatings. After the first inspection in 1975, half of the buildings had to be classified within the group 2 and 3 (minor or major defects) according to the diagram in Fig.2. After the latest inspection at the end of 2004, however, all buildings were assessed "without defect" (group1) after refurbishment. The refurbishment essentially consisted of applying new coatings, providing for a continuous improvement of the state of the façades over the years. This may result from the fact that in the early 1970s, the techniques to apply ETICS had yet to be optimized and the defects occurring were removed by refurbishment measures. The results of the assessment at the end of 2004 are as follows:

Fig. 1: View of the western façade of object 16 in Munich, 4 years (1989) and 19 years (2004) after application of ETICS without refurbishment in between. The insulation system remained the whole period without technical defects.

Pollution – Development of Algae

In former decades, the pollution of façades was the main cause for refurbishment by applying new coatings. The pollution of the façades was mainly visible at wall areas with differing exposure to rain: Areas with a high exposure to rain were

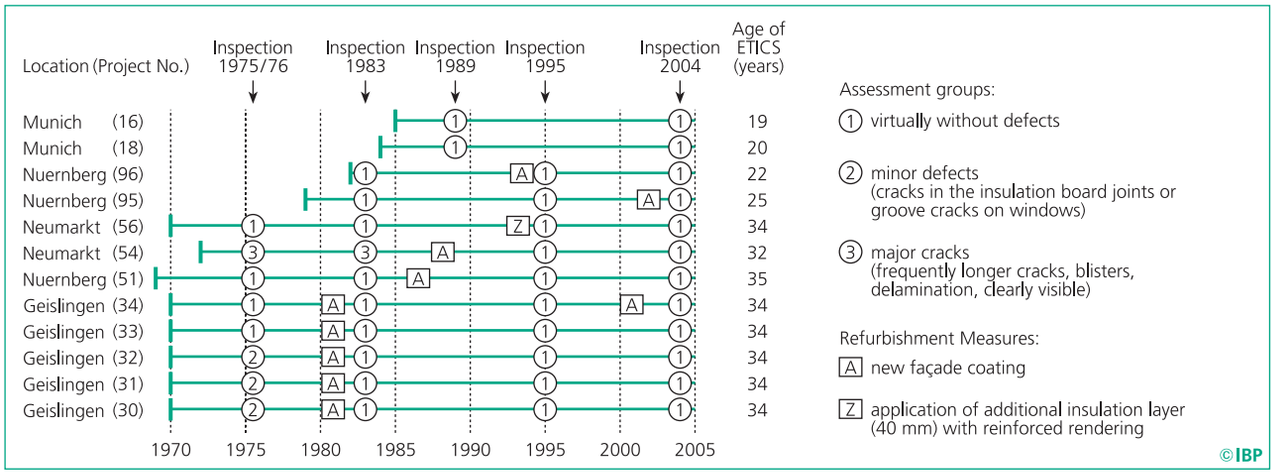

Fig. 2: Diagram of the time intervals between production, inspection and refurbishment of the ETICS in practice and classification of the state of the façade according to the assessment groups 1, 2 or 3.

explicitly cleaner than protected areas, e.g. below projecting roofs or window sills. By filtering the exhaust air of industrial plants, air pollution was reduced as well as the concentration of gaseous pollutants in the air, especially the concentration of sulphur dioxide SO_2. Because SO_2 is a strong biocide, its disappearance stimulated the growth of micro-organisms on façades, such as algae, fungi and bacteria. This is the reason, why those areas of the façades, which are frequently exposed to rain, might be infested with algae growth, because moisture is a prerequisite for the development of algae. The inspected buildings showed a "cleaning effect" as well as the development of algae on surfaces, frequently exposed to rain. This may refer to the local air quality or to the kind of fungicide additives in plasters or protective coatings. The development of algae is not assessed as being a technical defect but a "visually adverse effect".

Resistance and Durability

It is frequently supposed that the small thickness of the exterior plaster (stucco, render) and a smooth insulation material as substrate are possible causes for damage from mechanical impact. Yet, even after several inspections, there were no signs of a special susceptibility to any real damage. On the contrary: Conventionally constructed buildings in the immediate neighbourhood of the inspected objects frequently showed damage of the plaster due to normal deformation of the masonry walls.

Maintenance Effort

On average the frequency of refurbishment of the inspected ETICS amounts to a period of approximately 20 years. This value approaches the upper limit for refurbishment periods of façade coatings and synthetic resin plasters in general according to previous investigations.

Summary and Conclusions

The results of repeated inspections of larger, multi-storey buildings with an external thermal insulation composite system (ETICS) are as follows:

- Damage of façades occurs more rarely than with conventional masonry façades as a result of the de-coupling effect of the soft insulation layer between the exterior plaster and the brickwork. Damage caused by mechanical impact on the surface is negligible.
- A greater susceptibility of ETICS to microbial growth due to rain or night-time surface condensation can obviously be compensated by appropriate additives in the exterior plaster or coating. In some cases, the formation of algae was visible, in other cases however, the cleaning effect due to rain prevailed. It is important to provide an adequate drainage of the rain water hitting the building in order to avoid a local concentration of run-off water on the façade, causing algae growth, which may be judged to be visually unacceptable.
- Costs and frequency of maintenance for external thermal insulation composite systems (ETICS) are equivalent to those of conventional wall structures consisting of rendered masonry. The same holds for the durability and life expectancy.

References

Detailed results and references are published in Künzel, H. Künzel, H.M. & Sedlbauer, K.: Long-term Performance of External Thermal Insulation Systems (ETICS). ACTA Architectura 5 (2006) vol.1, pp. 11-24. Download from www.building-physics.com.

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