

**Zeitschrift:** IABSE reports = Rapports AIPC = IVBH Berichte  
**Band:** 77 (1998)

**Artikel:** Repair of concrete sandwich walls fasteners and layers in residential buildings  
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**DOI:** <https://doi.org/10.5169/seals-58239>

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## Repair of Concrete Sandwich Walls Fasteners and Layers in Residential Buildings

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### Summary

Sandwich walls have found a wide range of applications in constructing residential buildings in Poland. Investigations show that there are a lot of imperfections in fixings of elevation layers in existing buildings. They come from manufacture reasons, for the most part consisting of using non-stainless steel for production of fixings. This may result in decreasing the durability of fixings but also in lowering the safety level of inhabitants. The method of checking the fixings as well as the way of repairing buildings has been elaborated.

**Keywords:** durability, walls, concrete, reinforcement, fixings, wall insulation, repairs, residential buildings.

Construction of residential buildings from prefabricated units has been started in Poland in sixties. It was planned that the buildings would last for 70 years. Buildings of this type are currently used for 20 to 30 years and one can expect an advancement of the degradation of building units. Experience shows that plenty of defects occur which can significantly affect the durability of the buildings, especially those generated in stage of construction of objects and during production of units.

The sandwich wall units used in Poland are composed from the following layers:

- facade reinforced concrete slab,
- heat insulation layer,
- internal reinforced concrete construction slab.

Observations and investigations have shown that the most important threat for walls is abnormality in the coupling between the facade concrete layer of the wall and the construction slab. The Building Research Institute has performed investigations of sandwich units used in

residential buildings in different parts of the country for the last 11 years. It was decided that investigated buildings ought to be erected before 1984, because up to that time the production of the units was very high and in the same time there was shortage of building materials and supervision over all type of work was insufficient. At least over 500 wall plates were investigated.

The condition of the concrete of facade plates mostly exposed to interaction of climate agents was sufficient in 90% of the cases. They were made from good quality concrete. No corrosion effects of reinforcement meshes and anchor bars were found. Measurements of the carbonisation rate shows that in the next 50 years corrosion should not occur. Only in 10% of the cases low concrete quality or non-adherence to the requirements with respect to heat insulation thickness were found.

The most important threat for the slabs comes from steel fixings. It was stated that:

- The thickness of facade slabs was overextended in comparison with the designed one (on average by 8 mm), while the thickness of mineral wool layer was simultaneously lowered.
- Incorrect positions of hangers in comparison with design requirements were found in 80% of the cases.
- Incorrect anchoring of fixings in facade layers (absence of anchor bars or too low diameters of bars) in occurred in 60% of the cases.
- Only in 10% of the cases the quality of steel was consistent with requirements. Ordinary steel of the St3SX, St3SY, St0 type or stainless steels, which were incorrect for this purpose, considering their brittleness were used most frequently.
- Despite of the fact that considering it's corrosion resistance incorrect steel was used, no threats coming from steel corrosion were found.
- In half o the investigated cases concrete bridges between internal and outer slabs were found.

Unfavourable symptoms in the buildings were freezing of walls and cracked facade walls.

The necessity of saving energy caused a change of the insulation requirements for buildings. One of the results was improving the insulation of outer walls. All the partitions made before 1982 do not adhere to the current requirements.

Repair of facade layer consists on making strong and permanent connection with the construction layer. In most cases it consists on introducing additional connectors. All connectors should be made of steel resistant to corrosion.

1. The most important problem of durability of outer sandwich walls in Poland is related to the efficiency of fixing the facade slab to the construction slab. No defects of concrete and reinforcement were observed in the facade plate.
2. Despite using connectors made of steel not resistant to corrosion there was no significant threat caused by the development of corrosion. However incorrectness of performing of the units and use of not appropriate materials causes that violation of adherence is possible.
3. In the case of wall insulation it is necessary to check the state of fixings and in the case of abnormality, additional connectors should be used.
4. Investigating the state of anchoring is very arduous and employing of non-destructive methods is limited due to small spacing of steel bars and use of stainless steel. For this reason it is necessary to continue looking for less labour consuming methods for checking the state of the anchors.