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Short report

Final results of the research theme
with no. B/5-80 01 93 - 17

'Techno-physical studies concerning the hygrothermical behaviour of three-layer slabs for perimetrical walls'

Abstract

The joints' width variation of three layer slab perimetrical walls covered by a Thermal Insulation Composite System (TICS) was investigated. The thermical and humid conditons in the external concrete layer influence the joints' variations. The residual temperatur variation of 10 K in the external concrete layer leads to a thermic part of joints' variation of approximately 1 mm. The increase of joints' width due too decrease of balanced air humidity from 90 % to 60 % in external layer concrete are measured in range of 0.5 mm.

1 Subject

The aim of our investigation was to find out in how far joints width change when there is a 'Thermal Insulation Composite System' (TICS).
Object of our research were buildings of the WBS-70-type, typical residential buildings of the former GDR.
Their perimetrical walls are made of concrete slabs having three layers
- load bearing concrete layer
- internal thermal insulation layer
- external concrete layer as weather protection layer

For the reconstruction of damages in the external layer of these walls and to increase the thermal insulation behaivior, the use of TICS was regarded a useful way.
We tried to find out how thermical and humid factors influence the joint width of slabs in perimetrical walls.
An extension of joints can cause crack growth in the TICS and these can be followed by serious damages.

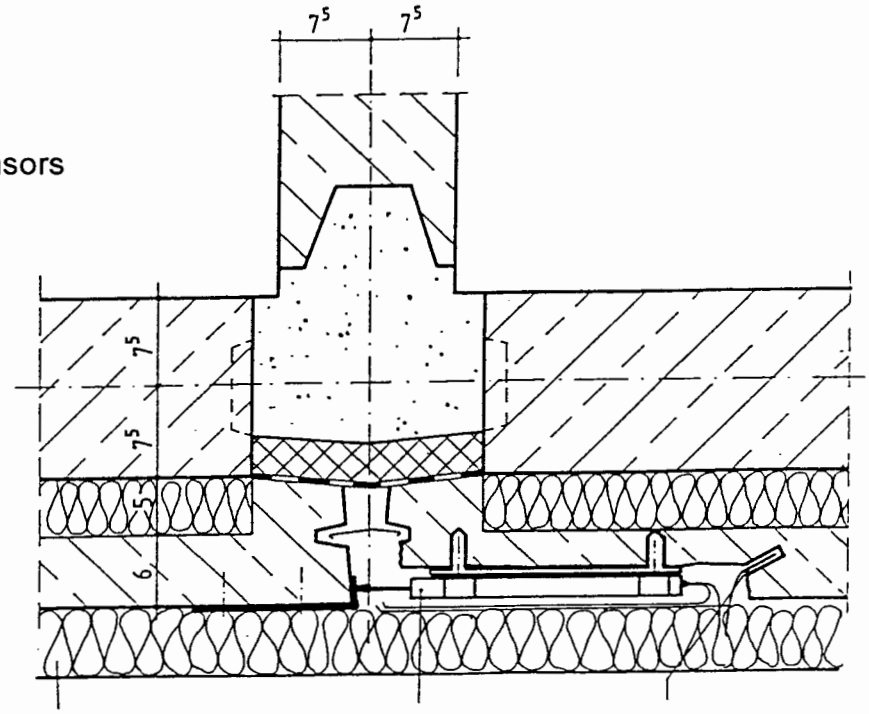
So our task was to investigate the variations of joints width under the practical conditions of a building. As an example we chose a special house which has been covered by a TICS. With these practical measurements results for a maximum joint width growth under a TICS should be found out.

2 Investigation

The investigations concerning the variation of joints width were carried out in a building of the WBS-70-type in Berlin-Hohenschönhausen. The slabs of the perimetrical walls, 4.80 m and 6.20 m long and 2.80 m high, had open vertical and horizontal joints. To fix the measure dates sensors were installed to get the thermical and hydrical parametres.
The following dates were recorded:
- temperature and balanced air humidity in the external concrete layer
- temperature and air humidity in the joints
- variation of the joints width of perimetrical walls
- temprature of the rendering of the TICS
- temperature and air humidity of the outdoor climate

The arrangement of the measurement sensors can be seen in picture 1 showing a cutting shape.

picture 1:
arrangement of
the measurement sensors
in three layer slabs of
perimetrical walls
as a cutting shape

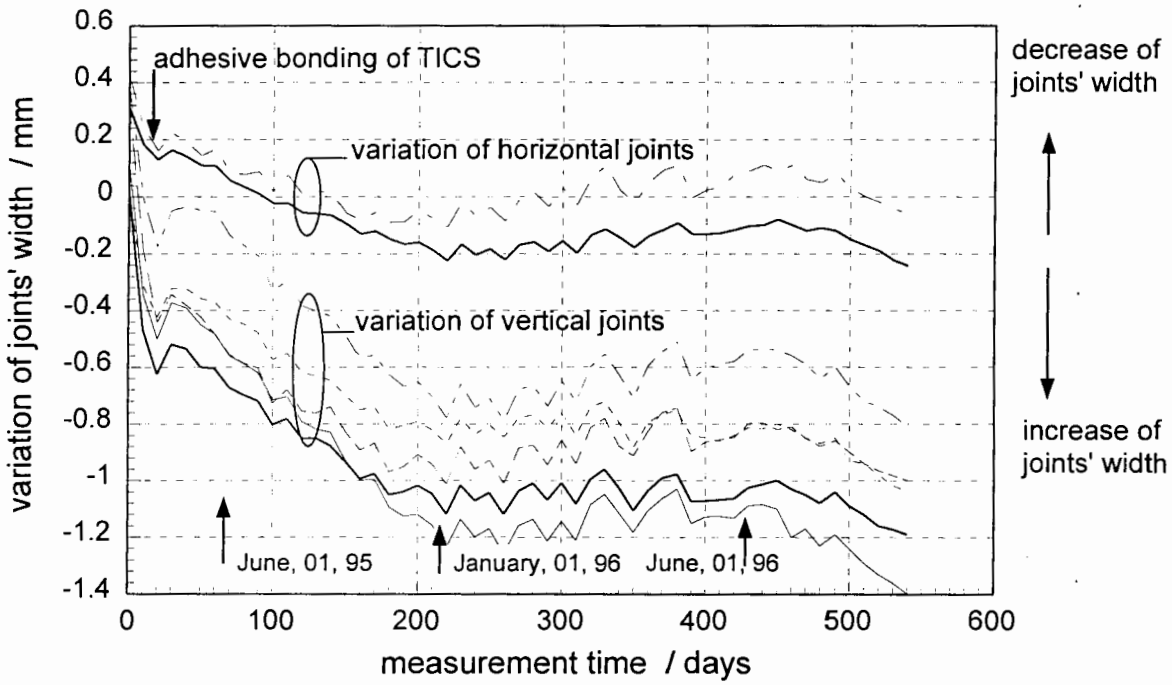


3 Results

The investigations were carried out in the time from May 1995 to November 1996. An interval of 1 hour was taken to get the dates for the variation of the joints width, for the temperature and for the air humidity. This interval was useful to show changes in the run of the day as well as in a longer period of time.

3.1 Measurement results for the variation of the joints' width

Before the TICS was put on the walls, a large change of the joints' width was visible. The variations in the range of 1 mm result from the temperature differences between night and day. After the TICS has been put on, the formerly mentioned variations decrease and a long-term reduction of the joints' width becomes visible.
The reason for this reduction is a rise of the temperature and of the balanced air humidity in the external concrete layer due to the adhesive bonded TICS.
Afterwards an increase of the joints' width was to see in accordance with a temperature decrease and a decrease of the air humidity in the process of drying out.



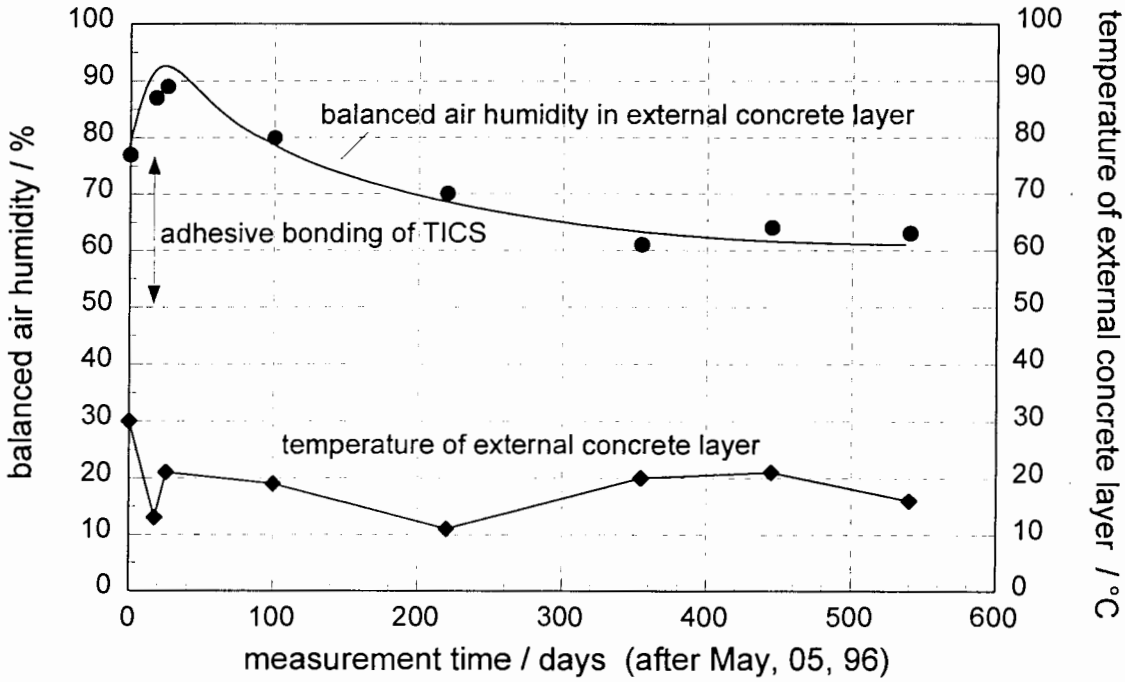
picture 2: measured variation of joints' width

The measured increase of the joints' width is 0.8 mm in the vertical joints and 0.35 mm in the horizontal joints respectively. The next period (from day 220 of the measurement) shows a slight decrease of the joints' width respectively only low changes for the joints over a period of 8 month. In picture 2 there is a graphic showing the changes of the joints' width over the hole time span of measurement. The mentioned time spans for an increase respectively a decrease of joints' width is clearly visible.

3.2 Results for temperature and air humidity measurements

The taken temperatures in the external concrete layer show only slight variations after the adhesive bonded TICS, the minimum temperature is 10 °C (winter), the maximum tempearture is 25 °C. The balanced air humidity in the concrete of external layer rises from 80 to 88 per cent through the adhesive bonded TICS.

After reaching the maximum point there is a tendency towards a continuous decrease of the balanced air humidity. In the course of the 18 month lasting measurements there is a decrease of the balanced air humidity in the external concrete layer from 88 to 60 per cent. Now the drying-out-process of the concrete can be regarded as almost fulfilled.
Picture 3 shows the tendencies for temperature and balanced air humidity in the external concrete layer for the hole measurement time.



picture 3: measured temperature and balanced air humidity in external concrete layer

4 Summary

With the help of the measurements could be found out that the reduction of the balanced air humidity in the external concrete layer has as a consequence a decrease of

0.5 mm

of the joints' width for slabs of 5.5 m lenght.
Over a period of 1 year the taken temperature variations of in maximum 15 K lead to a thermical part of the variation of the joints' width of approximately

1 mm.

So the thermical parameters have a bigger influence on the variations of the joints' width than the humid one.