# MONITORING OF THE HEAT TRANSFER IN BUILDINGS

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**Abstract:** *In paper is introduced measurement method for monitoring of temperatures on big objects. Measurement equipment used in method and results on known object are also introduced. When temperatures are monitored for a long period of time (at least 14 days), the lost of heat, quality of isolation and quality of heat regulation can be estimated.*

**Keywords:** *heating, termal isolation, data acquisition.*

## 1. INTRODUCTION

In paper is introduced measurement system with 20 temperature sensors arranged in room vertically and horizontally on inside and outside points, designed to estimate lost of heat. Points with heat transfer were defined by termovision. The need of improvement of heat isolation of the critical wall can be estimated by monitoring of points of heat transfer and points in room arranged in 3D space.

## 2. MONITORED OBJECT

12-m per 12-m sized lecture room on faculty was monitored in winter. The room had on north wall windows in steel frames as showed on fig.1.

**Fig.1 -** ***Windowed Nord wall***

The thermal wall's photo was taken by termovision AGA 750. Critical heat transfer points showed by thermo photo were on positions of radiators (heat generator), points on steel frame and in the middle of windows.

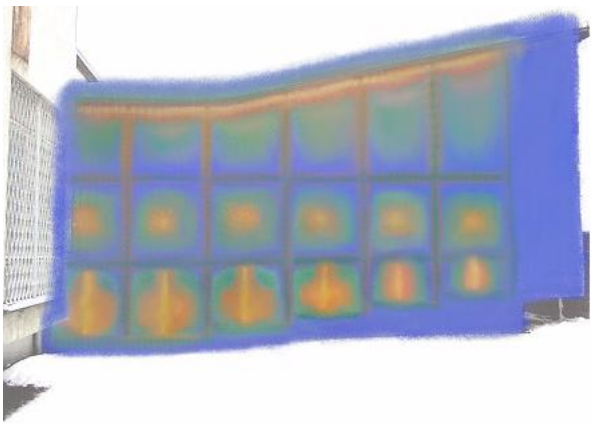

**Fig.2 -** ***Thermal picture of a Nord wall***

## 3. MEASUREMENT SYSTEM

Hewlett Packard 3852A unit did measurements. In unit was used voltmeter HP 44701A and 20 channel multiplexer with thermocouple compensation HP 44710A. Thermoelements type T were used for temperature sensors. HP 3852A unit was connected to personal computer via HP-IB (IEEE 488.2) bus. Measurements were controlled by program on computer. The program is running in windows operating system. The outlook of the program is on a fig. 3.

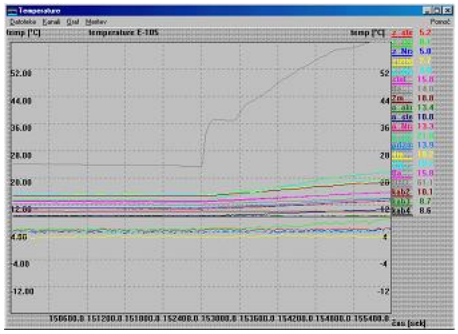

**Fig.3 –** ***Outlook of the program running in windows***

Program prepares a HP 3852A unit and runs subprogram on it every 20 seconds. Data is stored in computer memory and every 40 minutes transferred to hard disk. In period of many days a lost of power supply can be expected. Program is designed to run automatically after computer is started. At autostart HP 3852A is again programmed and new measurement data is added to old data. Measurement results are stored in text format for analysis in any other program.

## 4. MEASUREMENT RESULTS

Temperatures were measured in 20 points. Positions of points are defined in table 1.

**Table 1 –** ***positions of measured point***

| n | description |
|---|---|
| 1 | window frame at 4m high, outside |
| 2 | wall behind radiator, outside |
| 3 | wall near radiator, outside |
| 4 | out side temerature |
| 5 | middle of the window, outside |
| 6 | back row chair |
| 7 | back row floor |
| 8 | back row at 2m high |
| 9 | middle of the window, inside |
| 10 | window frame, inside |
| 11 | wall near radiator, inside |
| 12 | wall at radiator, inside |
| 13 | upper windows, inside |
| 14 | back wall, high 4m, inside |
| 15 | back wall, high 2m, inside |
| 16 | back wall, floor, inside |
| 17 | radiator |
| 18 | kabinet 1 |
| 19 | kabinet 2 |
| 20 | kabinet 3 |

Inside points were defined by remote laser temperature sensor Optex Thermo-hunter PT-3LD. Sensor is used for fast testing of temperatures on unreachable points. Measurement was taken from 29th January to 15th February. On figure 4 and 5 are displayed some typical days with outside temperature around 0°C. Data was analysed in MS excel.

Temperatures can be introduced in three groups. In lower group are temperatures from out points and on Nord wall. Temperatures follow outside temperature. In the middle group are inside room points. Temperatures in this group are more stabile and follow radiator and outside temperature. In upper group is temperature from radiator. Temperatures on radiator are high in the mornings, when heating is started. Over day heat supply is unstable. Heat lost can be observed on 5 days period with no heat supply. In this period temperature of radiator dropped to 20°C, and all (also on 4-m high) inside temperatures to 10°C.

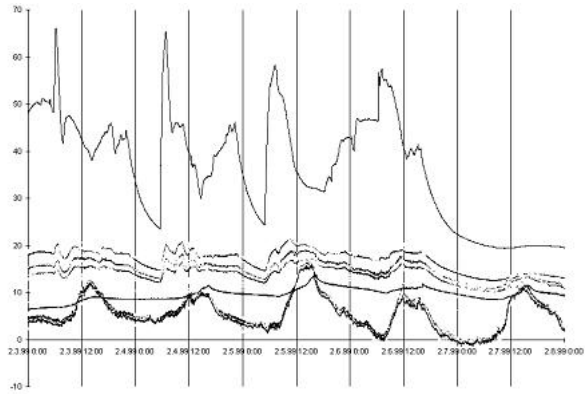

**Fig.4 -** ***Temperatures in time from 3rd February to 8th February***

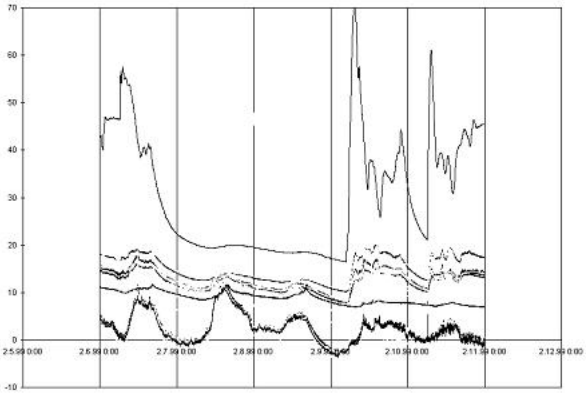

**Fig.5 -** ***Cooling period from 6th February to 9th February***

In analysis are interesting temperatures distributed vertically and respond on quick temperature changes. In analysis of vertically distributed temperatures were used three points on back wall at highs of 0-m, 2-m and 4-m. Additionally were used three points in back chair row 1m from back wall.

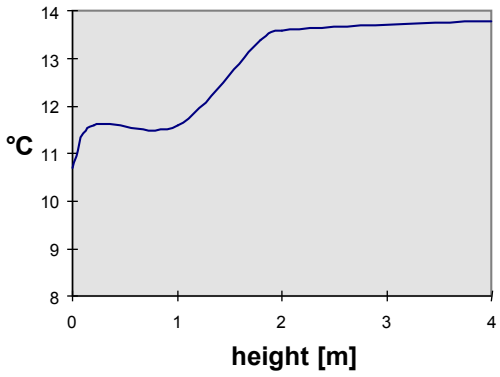


**Fig.6 -** ***Vertical temperature field***

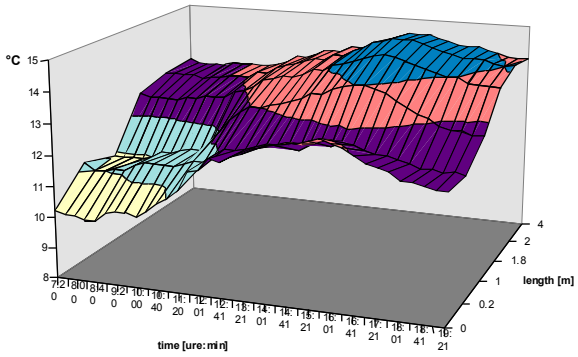


**Fig.7 - *Heat current on the floor***

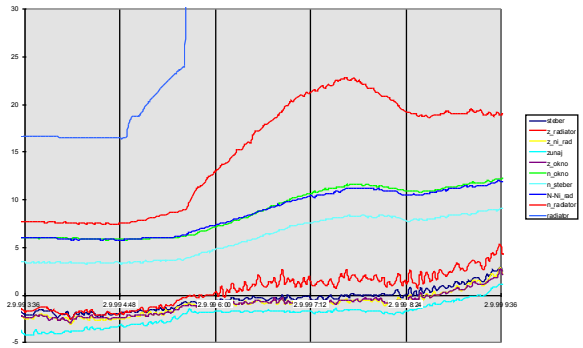

**Fig.8 - *Change in temperature in heating procedure***

Temperatures in vertical field on figure 6 are displayed in 5 days period with no heating. Temperatures above 2-m are not much higher. Temperatures can not be higher due to lose of heat in upper windows frame and bad roof isolation. In 5 days period another phenomena was observed. When outside temperature were increased, temperature at points closer to the Nord wall were increasing faster than other points. Phenomena indicated, that isolation is not good, and that there were some heat currents on the floor.

Quality of isolation can be tested on quick changes on radiator temperature. When temperature on radiator raised, also outside temperature of the wall at radiator raised, as showed on figure 8. Bad quality of isolation is also confirmed with inside temperature of the wall, which is near outside temperature.

## 5. CONCLUSION

When big object is monitored, measurement points must be carefully selected. Monitoring must last for several days and gained data must be carefully analysed. In demonstrated example only quality of thermal isolation was tested. With data in computer there could be done some analysis of heat regulation of the heating system.

## 6. REFERENCES

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