THERMOVISION MEASUREMENT REPORT

ISOTRA®

FAMILY HOUSE OSTRAVA

1. INTRODUCTION

The measurement was aimed at comparing the differences in thermal images before and after the installation of shading technology (Zetta 70 exterior blinds) to windows.

2. DESCRIPTION OF MEASUREMENT

Thermography is the determination and representation of the surface temperature distribution by measuring the density of infrared radiation emitted by the surface, including the assessment of approximate mechanisms that cause irregularities in thermal images. The thermal image is documented by a computer-generated thermogram.

Pages 3–11 of the annex feature the real views, with details marked out in yellow where necessary, and the respective thermographic image. Each image shows the selected points (letters) and areas (numbers) marked by dashed lines. Right side of each image shows the temperatures of the selected pints, while the upper side of each image features a histogram and the values of emissivity; minimal, average and maximal temperatures [°C]; area [m2]; and heat loss by radiation and convection <P> [J/s.m^2 (=W/m^2)] are indicated for each marked area. The far right side of each image shows the colour range and the corresponding temperature range.

The measurement took place on March from 1930 until 2030. During the measurement, the ambient temperature ranged from **0 °C to 1 °C, at no-wind conditions.** The temperature inside the house was approximately 23 °C downstairs and 24 °C on the first floor according to available information.

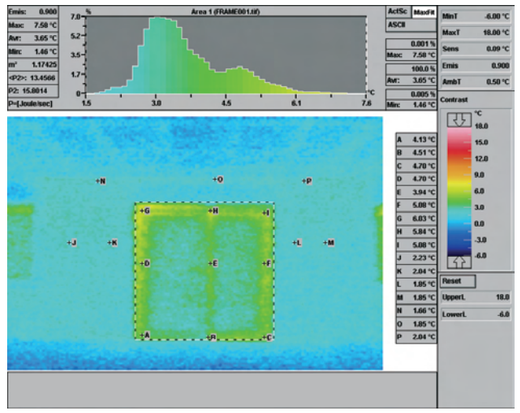
3. CONCLUSION

The assessment of the individual thermograms is carried out in the annex, pages 3–11. In general:

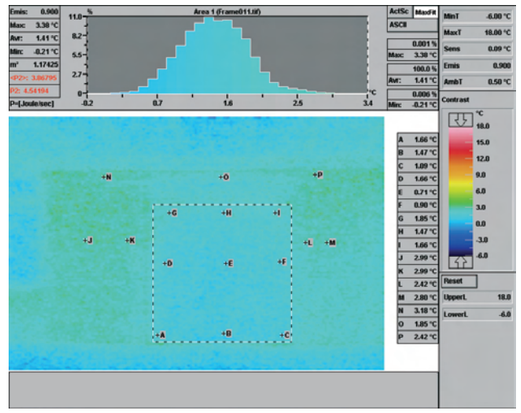
Thermograms before and after the installation of shading technology were taken at 15-minute intervals, where only a slight distortion of surface temperatures could occur.

- Visible temperature differences between the lower and the upper parts of the windows are caused by the temperature differences between the floor zones and the ceiling zones in the individual rooms of the house.
- Comparison of the thermograms with and without the shading technology showed a significant decrease of the heat effect in the windows. The thermograms show excellent shading of the window areas by Zetta 70 exterior blinds. The blinds reduced the heat transmission from the inside by almost 90% on an average.
- Surface temperature of the house walls was low in comparison with the ambient temperature and no thermal unbalance was determined.
- It is possible to use the average exterior surface temperatures, the heat losses by radiation and convection <P> in the marked areas, and the interior temperature to calculate the approximate heat transmission dependent on the actual ambient conditions during the measurement. **(The measurement results and the calculations can be considered only in relation to the conditions indicated in this Report.)**

NORTHERN SIDE – ENTRANCE DOOR TO THE PORCH



without shading technology



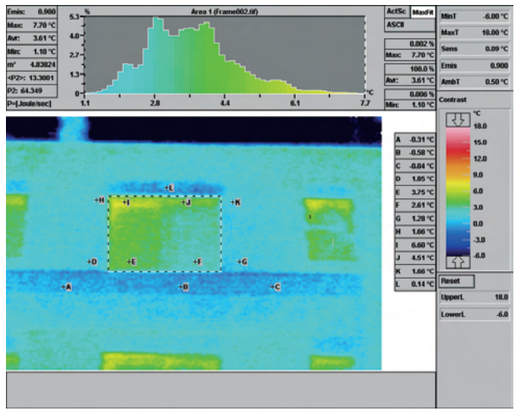
with shading technology

- The dashed areas in the thermograms indicate the area of the entrance door to the porch. The window frame surface shows that the left upper part is warmer (thermal point “G”).
- No thermal unbalance was found in the examined area of the building walls.
- Histograms with the percentage representation of colours (surface temperatures) in the circumscribed areas are shown above the thermal images.
- The exterior blinds prevent the heat transmission with efficiency higher by 71.3%.

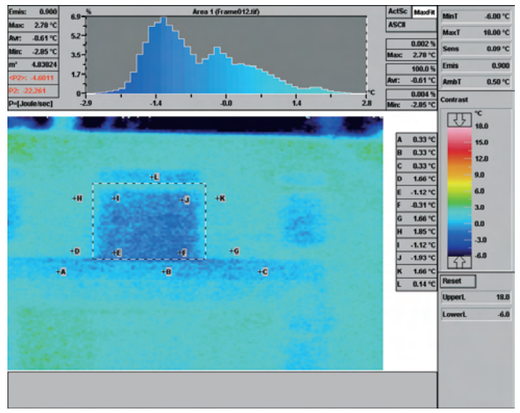
Comparison of heat effects – (calculated using 22.5 °C inside/outside temperature difference)

area	units	without shading technology	with shading technology – Zetta 70 exterior blind	Reduction of heat dissipation with shading technology by
dashed area	Heat flow density <P>	13.45 W.m^{-2}	3.87 W.m^{-2}	
	Average temp. in area T_{Avr}	3.65 °C	1.41 °C	
	Average heat transmission U	0.60 W.m^{-2}.K^{-1}	0.172 W.m^{-2}.K^{-1}	71.3%

NORTHERN SIDE – WINDOWS ON THE 1ST FLOOR



without shading technology



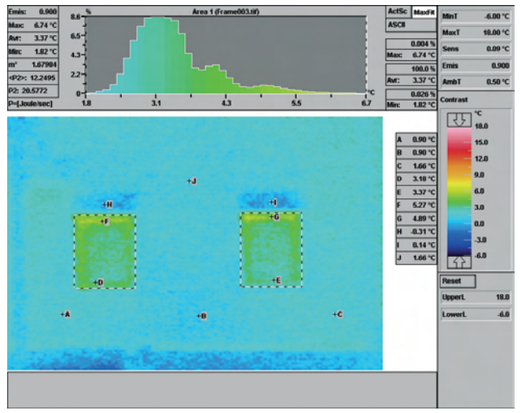
with shading technology

- Thermal points A, B, C indicate the surface temperature of part of the roof above the porch.
- The thermal image of the left and right sides of the middle window shows abnormal differences – possibly caused by open micro-ventilation in the left part of the window.
- In comparison with the ambient temperature of 0.5 °C, the average temperature on the window surface (3.61 °C) is on a very good level. The average heat transmission through the marked window surface is U = 0.578 W.m-2.K-1, according to the given measurement conditions. The heat dissipation was reduced by 100% after shading the window by Zetta 70 exterior blind.
- There is no heat dissipation through the window frames (sufficiently sharp transitions).

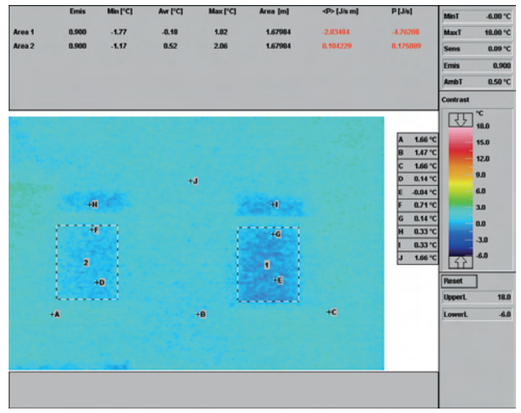
Comparison of heat effects – (calculated using 23.5 °C inside/outside temperature difference)

area	units	without shading technology	with shading technology – Zetta 70 exterior blind	Reduction of heat dissipation with shading technology by
dashed area	Heat flow density <P>	13.3 $W.m^{-2}$	-4.6 $W.m^{-2}$	
	Average temp. in area T_{Avr}	3.61 °C	-0.61 °C	
	Average heat transmission U	0.57 $W.m^{-2}.K^{-1}$	0 $W.m^{-2}.K^{-1}$	100 %

NORTHERN SIDE – GROUND FLOOR WINDOWS ON THE RIGHT SIDE OF THE BUILDING



without shading technology



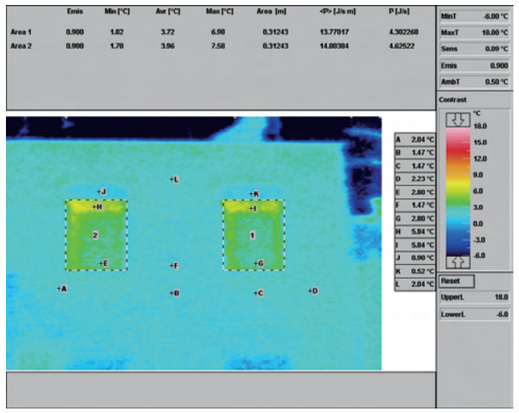
with shading technology

- Window lintels with lower surface temperature (thermal points H, I) are highlighted in the thermogram.
- The window effects are typical, without thermal unbalances.
- Thermal points A, B, C, J indicate the surface temperature of the building envelope.
- Temperature difference between the building envelope and the substructure is minimal (2 °C on an average).
- The thermogram with shading technology used shows that there is no heat dissipation through the closed blinds.
- The blinds show 100% shading of heat effects (leaks) of the exterior surfaces of windows.

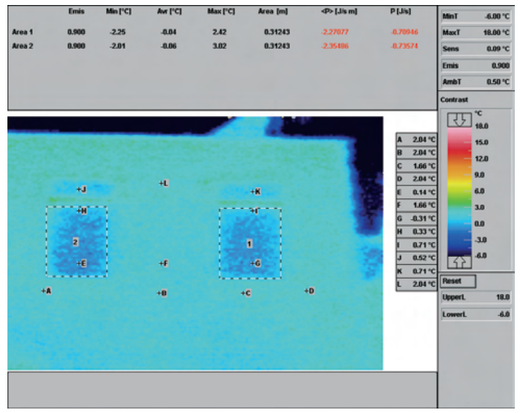
Comparison of heat effects – (calculated using 22.5 °C inside/outside temperature difference)

area	units	without shading technology	with shading technology – Zetta 70 exterior blind	Reduction of heat dissipation with shading technology by
1	Heat flow density <P>	12.25 $W.m^{-2}$	-2.83 $W.m^{-2}$	
	Average temp. in area T_{Avr}	3.37 °C	-0.18 °C	
	Average heat transmission U	0.54 $W.m^{-2}.K^{-1}$	0 $W.m^{-2}.K^{-1}$	100 %
2	Heat flow density <P>		0.1 $W.m^{-2}$	
	Average temp. in area T_{Avr}		0.52 °C	
	Average heat transmission U		0.01 $W.m^{-2}.K^{-1}$	

NORTHERN WALL – 1ST FLOOR WINDOWS ON THE RIGHT SIDE OF THE BUILDING



without shading technology



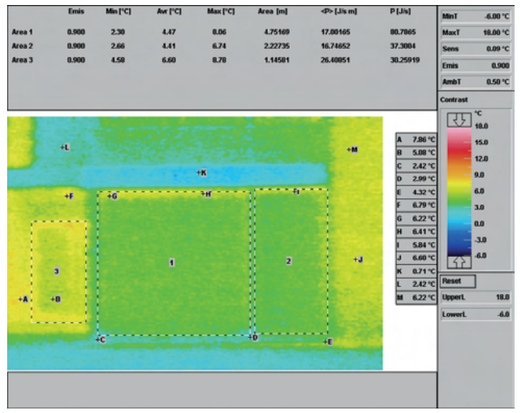
with shading technology

- The heat flow density in the first thermal image is higher than the heat flow density shown in the thermal image of the ground-floor windows (see previous page), as the interior temperature on the 1st floor was approximately 1 °C higher when the measurement took place.
- No thermal unbalances were found on the building envelope, except for colder window lintels (thermal points J, K).
- The thermal points show the local surface temperature of the building envelope.
- The shading technology prevented 100% of heat transmission through window surfaces.

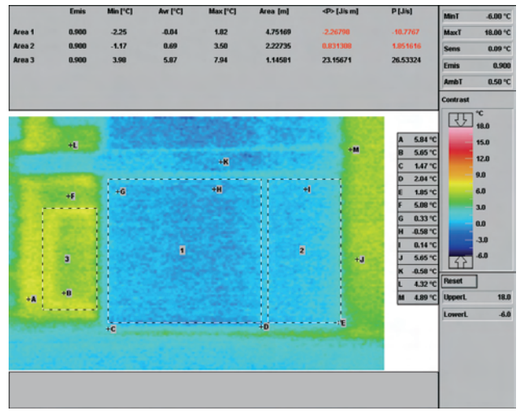
Comparison of heat effects – (calculated using 23.5 °C inside/outside temperature difference)

area	units	without shading technology	with shading technology – Zetta 70 exterior blind	Reduction of heat dissipation with shading technology by
1	Heat flow density <P>	13.77 $W.m^{-2}$	-2.27 $W.m^{-2}$	
	Average temp. in area T_{Avr}	3.78 °C	-0.04 °C	
	Average heat transmission U	0.58 $W.m^{-2}.K^{-1}$	0 $W.m^{-2}.K^{-1}$	100 %
2	Heat flow density <P>	14.8 $W.m^{-2}$	-2.35 $W.m^{-2}$	
	Average temp. in area T_{Avr}	3.96 °C	0.52 °C	
	Average heat transmission U	0.63 $W.m^{-2}.K^{-1}$	0.06 $W.m^{-2}.K^{-1}$	100 %

EASTERN SIDE – GLAZED AREAS ON THE GROUND FLOOR



without shading technology



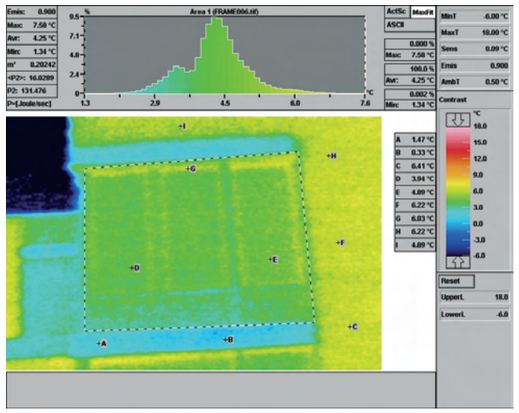
with shading technology

- No thermal unbalances and/or leaks through window frames were found on the glazed areas.
- Thermal points M, J indicate that the surface temperature of the building envelope is higher by almost 5 °C in comparison with the northern side.
- There is no heat dissipation through the closed blinds.
- The thermogram with shading technology used shows very good thermal-insulating properties.

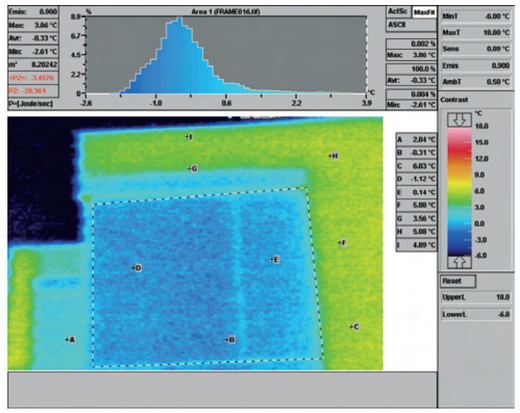
Comparison of heat effects – (calculated using 23,5 °C inside/outside temperature difference)

area	units	without shading technology	with shading technology – Zetta 70 exterior blind	Reduction of heat dissipation with shading technology by
1	Heat flow density <P>	17 $W.m^{-2}$	-2.26 $W.m^{-2}$	
	Average temp. in area T_{Avr}	4.47 °C	-0.18 °C	
	Average heat transmission U	0.72 $W.m^{-2}.K^{-1}$	0 $W.m^{-2}.K^{-1}$	100 %
2	Heat flow density <P>	16.74 $W.m^{-2}$	0.88 $W.m^{-2}$	
	Average temp. in area T_{Avr}	4.41 °C	0.69 °C	
	Average heat transmission U	0.71 $W.m^{-2}.K^{-1}$	0.04 $W.m^{-2}.K^{-1}$	94 %
15-minute interval in the measurement of the surface temperature				
3	Heat flow density <P>	26.4 $W.m^{-2}$	23.15 $W.m^{-2}$	
	Average temp. in area T_{Avr}	6.68 °C	0.69 °C	
	Average heat transmission U	1.12 $W.m^{-2}.K^{-1}$	0.99 $W.m^{-2}.K^{-1}$	

EASTERN SIDE – GLAZED AREAS ON THE 1ST FLOOR



without shading technology



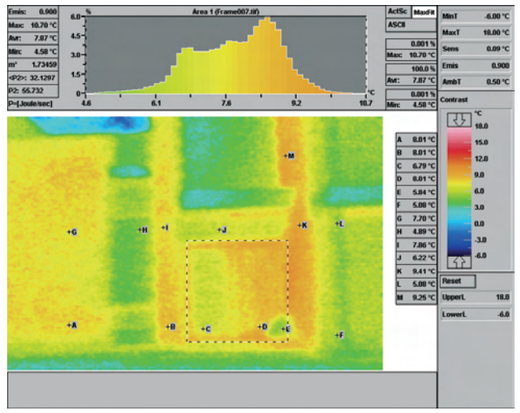
with shading technology

- Thermal effects of the monitored glazed areas shown in the 1st thermogram do not show any unbalances.
- Visible temperature differences in the lower and upper parts of the glazed areas are caused by temperature differences between the floor zones and the ceiling zones in the room.
- Thermal points C, F, H, I indicate that the surface temperature of the building envelope is higher by almost 5 °C in comparison with the northern wall.
- There is no heat dissipation through the closed blinds.

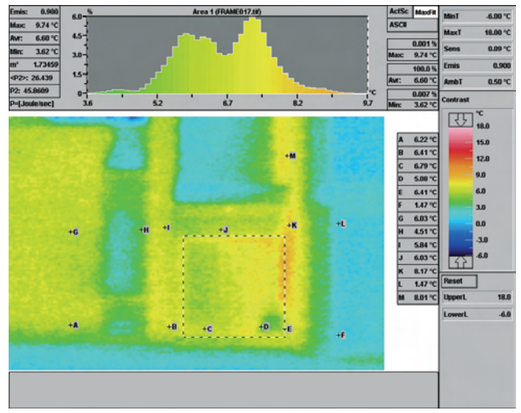
Comparison of heat effects – (calculated using 23.5 °C inside/outside temperature difference)

area	units	without shading technology	with shading technology – Zetta 70 exterior blind	Reduction of heat dissipation with shading technology by
1	Heat flow density <P>	16.3 W.m^{-2}	-3.46 W.m^{-2}	
	Average temp. in area T_{Avr}	4.25 °C	-0.33 °C	
	Average heat transmission U	0.69 W.m^{-2}.K^{-1}	0 W.m^{-2}.K^{-1}	100 %

EASTERN SIDE – ENTRANCE DOOR



without shading technology



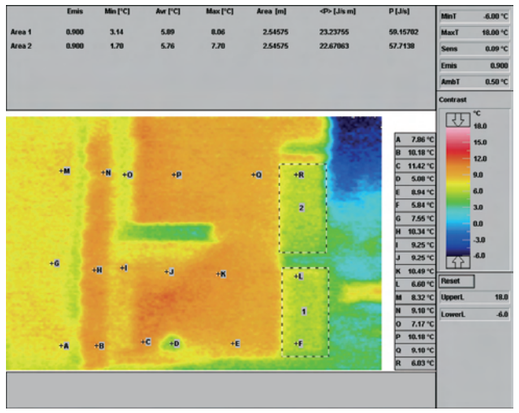
with shading technology

- Heat accumulates in the structural corner of the building (the thermal linking is indicated by thermal points K, M) – it is the critical place of the building.
- The dissimilar image of both halves of the door is abnormal, as the right side shows higher temperature (this fact could be caused, for instance, by opening the right side of the door, even for a short stretch of time, and subsequent heating of the exterior surface of the door). No thermal unbalance was determined on the door frame.
- Thermal points D and E indicate a flower pot in front of the door, see the real photo.
- The eastern wall left of the entrance door (thermal points A, G) has a surface temperature around 8 °C. Differences in the surface temperatures of thermograms before and after the installation of the shading technology are caused by the 15-minute interval.

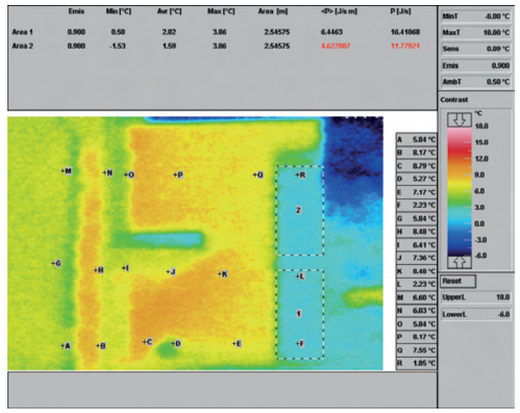
Comparison of heat effects – (calculated using 22.5 °C inside/outside temperature difference)
15-minute interval in the measurement of the surface temperature

area	units	without shading technology	with shading technology – Zetta 70 exterior blind	Reduction of heat dissipation with shading technology by
1	Heat flow density <P>	32.13 W.m^{-2}	26.44 W.m^{-2}	
	Average temp. in area T_{Avr}	7.87 °C	3.36 °C	
	Average heat transmission U	1 428 W.m^{-2}.K^{-1}	1.18 W.m^{-2}.K^{-1}	100 %

SOUTHERN SIDE – VIEW OF THE FRONT NEAR THE ENTRANCE TO THE BUILDING



without shading technology



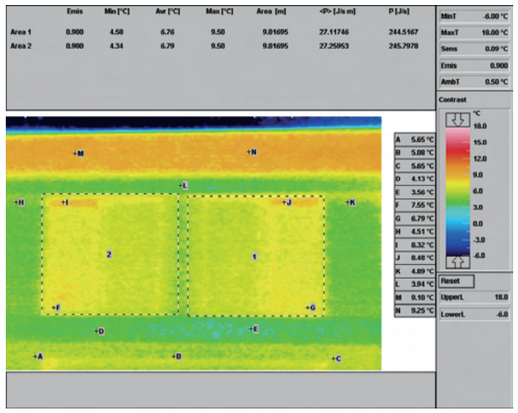
with shading technology

- Thermal points indicate the course of surface temperatures on the building envelope.
- Significant drop of the surface temperature is visible when comparing the areas 1, 2 in the thermograms, while the values of heat flow density (<P>) and heat flow (P) can be compared in the table above the thermograms.
- Heat accumulates under the canopy above the entrance.

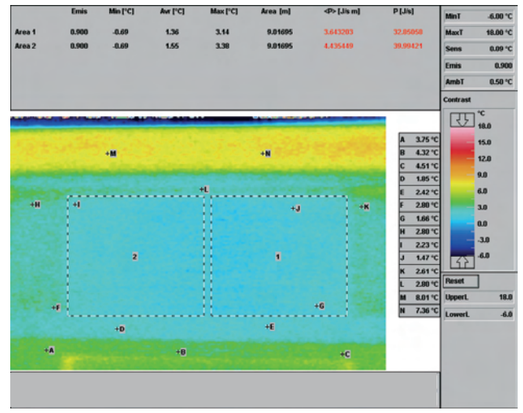
Comparison of heat effects – (calculated using 22.5 °C inside/outside temperature difference)

area	units	without shading technology	with shading technology – Zetta 70 exterior blind	Reduction of heat dissipation with shading technology by
1	Heat flow density <P>	23.23 W.m^{-2}	6.45 W.m^{-2}	
	Average temp. in area T_{Avr}	5.89 °C	2.01 °C	
	Average heat transmission U	1.03 W.m^{-2}.K^{-1}	0.29 W.m^{-2}.K^{-1}	71.8 %
2	Heat flow density <P>	22.67 W.m^{-2}	4.62 W.m^{-2}	
	Average temp. in area T_{Avr}	5.76 °C	3.36 °C	
	Average heat transmission U	1.01 W.m^{-2}.K^{-1}	0,21 W.m^{-2}.K^{-1}	79.2 %

SOUTHERN SIDE – VIEW OF THE FRONT NEAR THE ENTRANCE TO THE BUILDING



without shading technology



with shading technology

- The thermogram of the roof area indicates a linear thermal bridge having a surface temperature up to 9 °C (thermal points M, N).
- Surface temperatures of the windows are slightly different – see the 1st thermogram.
- Thermal points A, B, C indicate thermal linking between the canopy above the garage and the residential part.
- Thermal points H, K indicate a window lintel in the area above the windows.
- Zetta 70 exterior blinds significantly prevented the heat transmission, reducing the heat dissipation of the windows by up to 85% according to the given measuring conditions.

Comparison of heat effects – (calculated using 22.5 °C inside/outside temperature difference)

area	units	without shading technology	with shading technology – Zetta 70 exterior blind	Reduction of heat dissipation with shading technology by
1	Heat flow density <P>	27.11 W.m^{-2}	3.64 W.m^{-2}	
	Average temp. in area T_{Avr}	6.76 °C	1.36 °C	
	Average heat transmission U	1.2 W.m^{-2}.K^{-1}	0.16 W.m^{-2}.K^{-1}	86.6 %
2	Heat flow density <P>	27.26 W.m^{-2}	4.43 W.m^{-2}	
	Average temp. in area T_{Avr}	5.76 °C	1.55 °C	
	Average heat transmission U	1.21 W.m^{-2}.K^{-1}	0,19 W.m^{-2}.K^{-1}	84.3 %

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