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Salon Space Microclimatic Indicators Evaluation of the Low-floor Bus

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IMPORTANCE OF THE MICROCLIMATE

Today, the importance of a comfortable microclimate in bus salons is invaluable, because a favorable microclimate forms the safety and profitability of transportation. Heating, ventilation and air conditioning systems need to provide the required thermal parameters – microclimatic conditions are regulated by regulations (UNECE) because during the operation of the vehicle, their violation can lead to a road accident.

If the cabin is too hot or cold, the driver's sensorimotor reactions may occur with certain disturbances, is slowing down or feeling worse. In this case, the driver in an emergency situation will not be able to react correctly and immediately to avoid a bus crash. The inconsistency of the main microclimatic parameters will have a bad effect on passengers and, accordingly, such transportation will be unfavorable for carriers from an economic point of view – the customer will look for a more comfortable alternative.

HEAT BALANCE OF THE BUS SALON SPACE

The heat flow to be removed from the bus salon has the following components:

$$Q_{vent} = Q_{rad} + Q_{pass} + Q_{engine} + Q_{busstop}$$

$$Q_{rad} = Q_{roof} + Q_{sides} + Q_{glass}$$

Qvent – heat to be removed from the salon, J;
Qrad – heat from solar radiation entering the cabin through the body, J;
Qpass – heat from passengers, J;
Qengine – heat from the engine compartment, J;
Qbusstop – heat from opening bus doors at bus stops, J.
Qroof – heat coming through the roof, J;
Qsides – heat coming through the side surface, J;
Qglass – heat entering through the glazing side surface, J.

BUSES WITH DIFFERENT ENGINE LAYOUTS

front with a compartment in the interior

front with hood layout

middle horizontally under the floor

middle vertically

horizontally under the rear seats

rear vertically with an offset to the left

CITY LOW-FLOOR BUSES OF THE CITY OF LVIV

Electron A18501

LAZ A183

MAZ-203

MAN A10

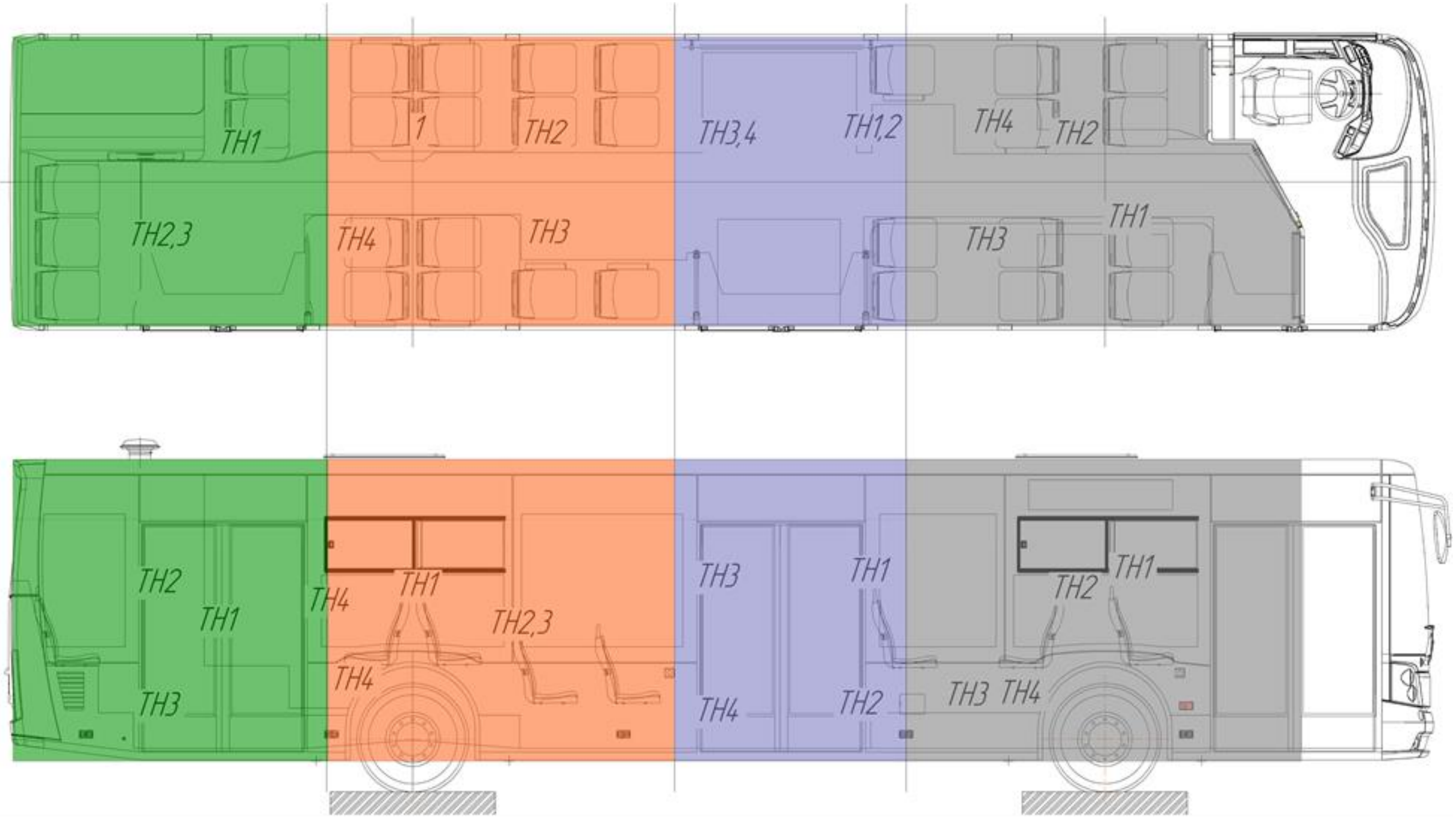
Mercedes-Benz Citaro O503

BUS ELECTRON A18501

TABLE 1. Main parameters and sizes of the bus Electron A18501

Characteristic	Unit	Value
Passenger capacity:		
- number of seats	-	30
- total passenger capacity	-	102
The empty weight of the bus in the equipped condition	kg	11 160
Technically permissible maximum mass of the bus	kg	18 100
Overall dimensions:	mm	
- length		12 100
- width		2 550
- height		2 990
- wheel base		5 880

The layout of temperature and humidity measurement points



#1 – between the wall of the driver's cabin and the storage platform;

#2 – in the area of the storage area;

#3 – between the storage area and the back door;

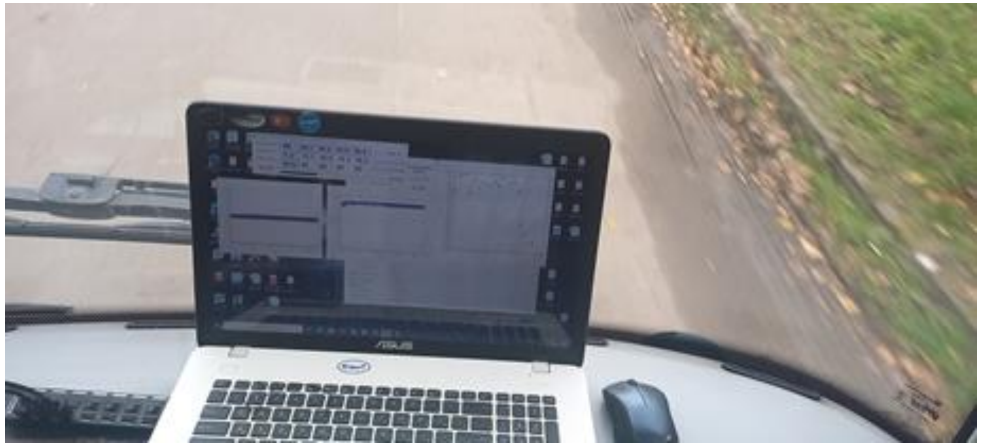
#4 – in the area of the back door.

METHODOLOGY OF THE EXPERIMENT

The measurements were carried out in the summer at an outside air temperature of approximately 24–26°C while the bus was traveling along the route from Sknyliv district through Levandivka and Ryasne 1 (“Electronmash” plant) in Lviv.

Measuring equipment

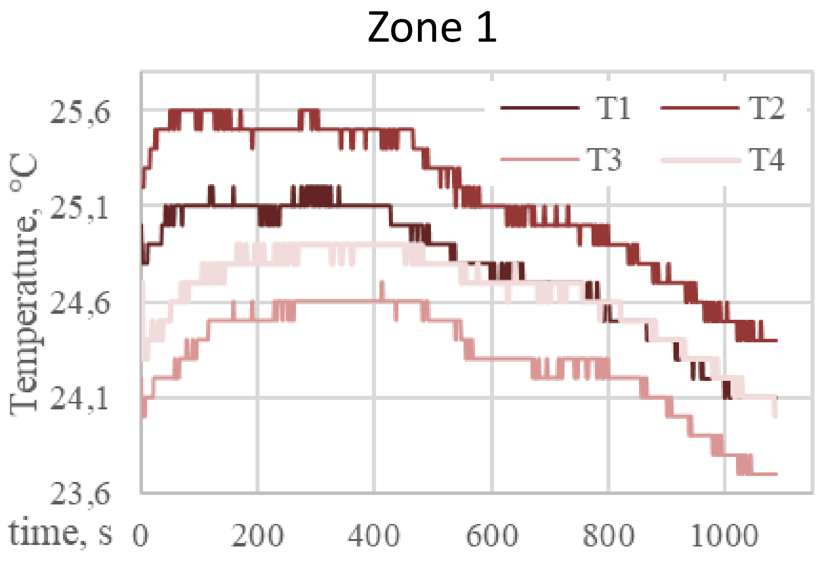
temperature and air humidity measuring device

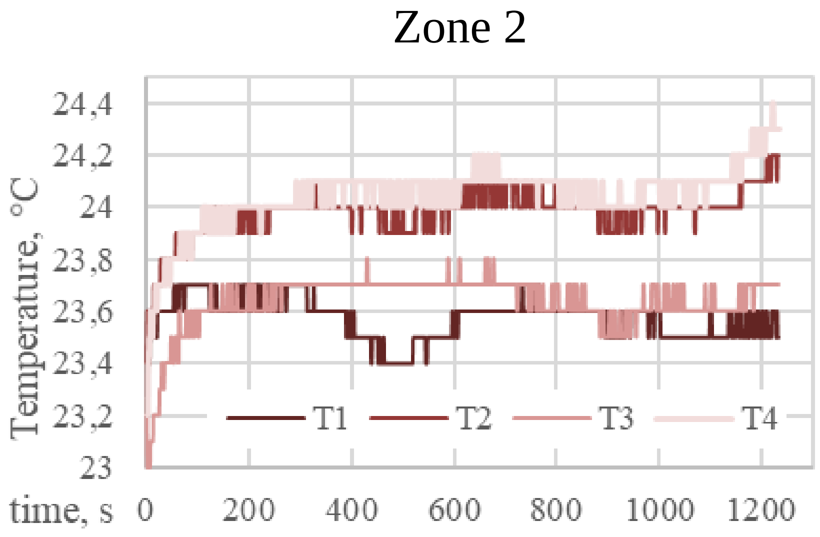


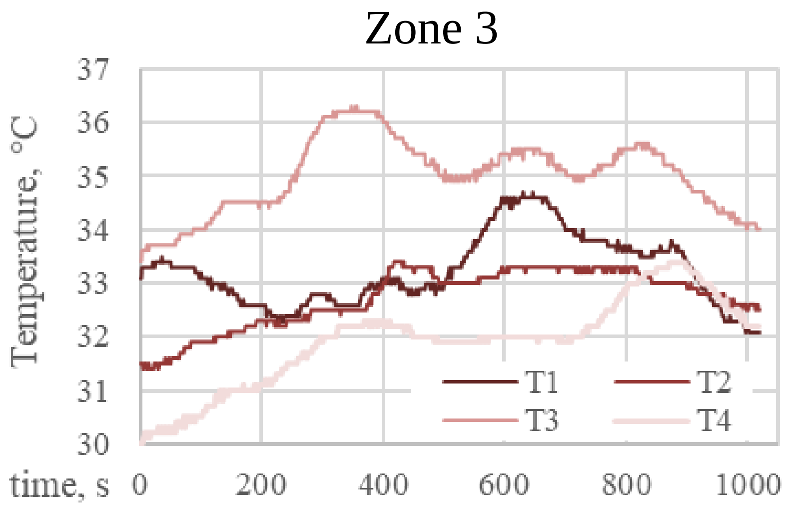
connected laptop with the custom software

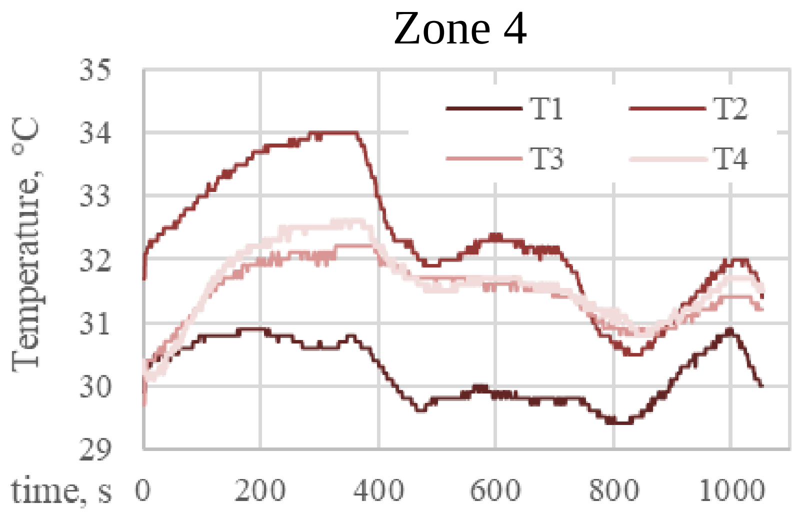
The sensor provides temperature and humidity indicators with accuracy to one decimal place, which is its advantage compared to similar ones. This sensor can measure relative humidity (RH) values in the range of 20–90% and temperature in the range of -25 to 50°C. The sampling period of the sensor is 1 s.

EXPERIMETAL RESULTS (themperature)



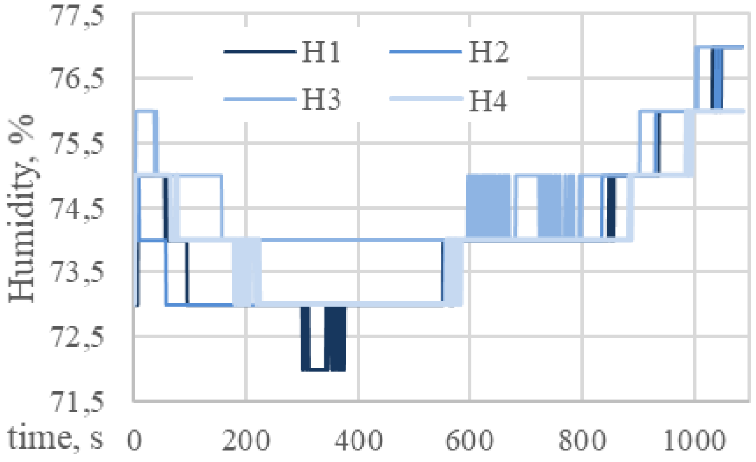




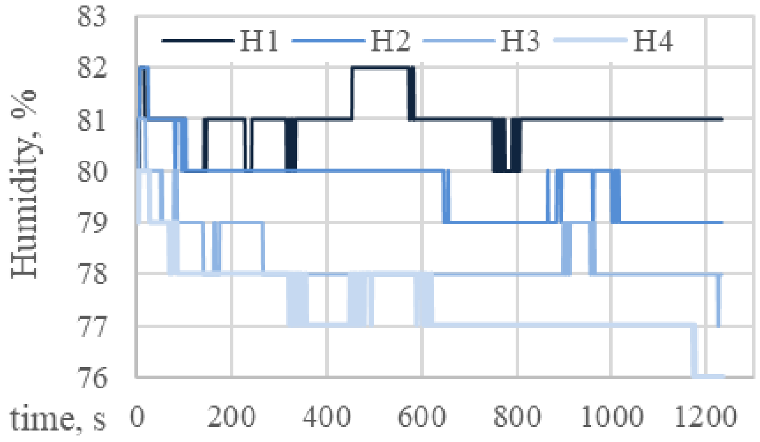


EXPERIMETAL RESULTS (humidity)

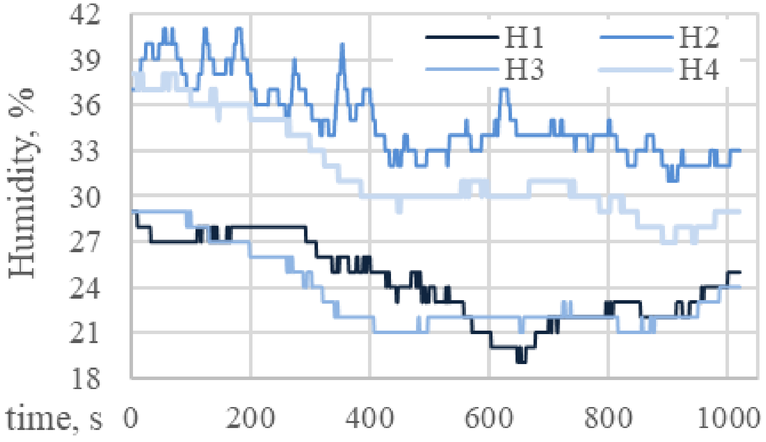
Zone 1



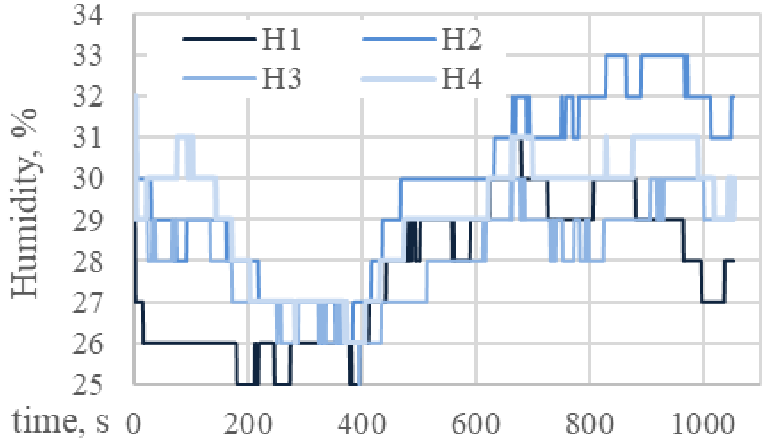
Zone 2



Zone 3



Zone 4



CONSLUSIONS

As follows from the studies conducted, the issue of organizing the microclimate of the interior of large vehicles remains relevant and in many aspects unresolved, requiring rationalization measures. It was established during the experimental studies that there are points in the bus salon where the microclimate indicators do not correspond to the normative values (zone #1 – TH1 and TH2 temperature – 24-25,50C, humidity all the points – 72-77%, zone #2 – TH4 temperature – 24-24,50C. Humidity all the points – 77-82%, zone #3, #4 – all the points – 29-360C and 21-38%). It follows that the existing salon ventilation system needs further development both analytical and experimental to verify the modeled CFD results in turn. The obtained experimental data can serve as a basis for further optimization of the interior configuration to improve microclimate indicators. The introduction of additional ventilation channels in zone #4 (rear overhang near the engine zone) looks especially relevant taking into account 30-36°C in this location.