ISSN No:-2456-2165

Simulation Comparison of In-Let and Out-Let Vents Towards Room Temperature Using CFD

Muhammad Arief Yusuf
Lecturer at University of Pepabri Makassar
Indonesia

Abstract:- Architectural solutions that allow the occurrence of air flow in a maximum on the building is very influential in creating internal effect in this architectural aspects on ventilation openings in order to handle the flow of air. This research aims to get the right air flow settings against the comparative dimensions of openings in-let and out-let. To find the optimal aperture quantity comparison in terms of the distribution of the air, conducted simulation Computing Fluid Dynamic (CFD) against some mods i.e. comparison of inlet outlet vents or openings in the building. The simulation took the same day used for simulation and by taking samples in which the highest temperature namely at 12.00 wita, i.e. the sixth day at the highest peak temperature. There are 5 types of Modification comparison openings tested its effect on the quality of temperature and wind speed, including existing conditions i.e. simulation modification 1 window where window and door openings in an open.

The results of a simulation study shows modifications 1 to 5 through comparison and addition of extents openings on some of the walls, so that it is able to raise the wind speed, the area get wind flow directly. While in certain areas, thus lowering the speed of the wind in space. To that end, the expansion of openings should pay attention to the inlet and outlet of magnitude comparisons. Based on a comparison of simulation quantity inlet and outlet against some modifications of natural air flow openings, i.e. modification 4 window, 3 Windows, 2 window, 1 window and ventilation 5, obtained the results that the outlet openings larger than inlet influence of temperature decline retrieved on modification of use 4 Windows, while the worst are obtained on a modification of the use of the 5 openings ventilation openings 4 simulations, this window is able to suppress the temperature of existing conditions with the amount of 1.7 ° c.

Keywords: *Inlet-Outlet, Vent, Temperature, Simulation.*

I. INTRODUCTION

The work of Architecture is the result of human efforts create an environment intact to accommodate human needs seeks resides or socializing culture (Budiharjo, 1997). Flats in addition to functioning as a building can provide a secure and convenient protection for inhabitants should also accommodate the basic activity of its inhabitants. According to Olgay (1963), the level of productivity and human health are strongly influenced by local climate conditions.

Heins Frick 1998, said that the wind and the air continuously give cool indoor air. The move generates the best refresher occurs because the process of evaporation lowers temperatures on human skin as such wind may also be used to set up the air in the room. According to Mangunwijaya (1994) that the horizontal ventilation can be achieved by making Windows or ventilation holes are facing each other as far as possible on the two sides of the building. Not much useful when making the ventilation holes on the walls only one-sided, because the wind will not be able to flow therefore need for a comparison of the air holes (inlet) and hole out on the air ventilation of the building.

Observations on this context is about the change of temperature and comparison of the magnitudes of inlet-outlet vents on the maximum temperature changes at the flats in Makassar that mariso in thoroughly.

II. RESEARCH METHODS

A. Research Variable

According to Somantri (2006), the variables are characteristics that will be observed from the unit of observation. These characteristics are of a particular object is examined. As for the variables of the study consists of three types of variables: variables, variable, and the variable control.

Free variable is a variable that variation affects the other variable or variables that affect other variables like to note. In thermal comfort, which included among other free variables: a comparison of the magnitudes of the openings inlet-outlet, inlet-outlet aperture size, wind speed.

Bound variables are variables the study measured to know the magnitude of the effect or influence of other variables. On the changes of temperature, bound variable, consisting of: temperature (° C), wind speed (m/s). The control variable is the variable that serves as a control variable binding against free. The control variables of the study was the value of standardization of Mom, et al. (1947) has ever done in Indonesia.

ISSN No:-2456-2165

B. Data Collecting Tool

Tools used to measure in this study is to measure air temperature and humidity used tools higrometer and thermometer, and the wind speed is measured by Anemometer, instrument for building elements used rollers meters, more details can be seen in table 1.

➢ *Data analysis techniques*

- *Modeling*

Modeling done in advance in the form of three-dimensional, initial steps do depictions of the model in the form of a volume of air that will be simulated. The model illustrated in the form of 1 unit of space occupancy will be in simulation in volume. Geometry and Mesh. The process of meshing is a follow-up step is done after the process finished depictions. The mesh size of which is present on an object will affect the accuracy of CFD analysis (Computational Fluid Dynamics) is going to do. The smaller the mesh size on an object, it will be the more meticulous the results obtained. It appears the result of mesh objects are drawn and the determination of the boundary areas of the inlet, outlet and the wall. Then change the solver to form FLUENT. In addition, in order to read and is detected on the CFD for the process simulation, image on the mesh must be exported first into a file with the extension.

- *The selection of the Solver*

In the window at the beginning of opening the FLUENT, there are several options of solver. 2D solver is used to analyze the components of the drawn 2 dimensions, while 3D solver is used to analyze the components with 3-dimensional field. If the selected 2d/3d (double precision), then the analysis will result in more accurate data due to the solver is a solver with accuracy.

- *Importing and checking the Mesh*

Mesh models that have been created within must be opened first in FLUENT in order to do the analysis and the files selected for yan opened in FLUENT is a file with the extension (*.msh) is the file of the case that contains the mesh and the parameters have been entered into.

- *Prescribing conditions Limit*

After that we determine the condition of the model used for simulation. There's that serves as a wall (wall) and there are function as outlet-inlet. It needs to be ensured that the parameters have been entered in accordance with the real conditions.

- *Process of Iteration*

The next step, all of which have been in the specify condition limit put into the software and tailored and matched with the condition of the software before running the literacy/reacted looks on a chart, so it will know the result convergent or divergent. If the results are diverging, means there is an error in entering data or in the restrictions on the boundary condition.

After the iteration, which is the scope of the overall process of reaction occurs, then it brings the look of contour areas analyzed, then generate value in the output.

III. RESULTS

A. Existing Conditions

The results demonstrate the value obtained from the measurements on the 4th floor is one of the measurement results, things can be explained as follows:-

- at 06:00 measurements in temperature conditions start with floor 4 bedrooms still low-value temperature 26 ° C outdoor 26.6 ° C and wind speeds of 0.2 m/s, the solar conditions in a State will rise, the value of the temperature and wind speed appropriate standard of comfort, this condition has not experienced an increase in temperature due to the rising sun.
- at 07:00 s/d at 12:00 caused an increase in the Sun was risen which produced 31.9 ° C value of s/d 33.4 ° C but the existence of a significant increase in temperature due to radiation and convection radiation factor however is not too influential because the position of the rooms are on the 4th floor of the Western position reply not notable directly by solar radiation, but the value of wind speed increased 0.2 s/d 0.9 m/s with an increase in the value of wind speed it is capable of pressing the increase temperature in the space of a room on the building's flats.
- at 13:00 s/d at 18:00 temperature value has increased dramatically in the aftermath of the solar radiation on the West side lasted for 5 hours but an increase in wind speed on the outside of the building is 1.4 m/s it is able to suppress the increase in temperature in the space room but these numbers are lower limit d comfort of occupants.
- at 19:00 at 00:00 s/d value of temperature decline declining temperature 27.8 ° C, due to the sunset and the decrease in wind speed on the outside of the building 0.9 m/s wind it is able to suppress the increase in temperature on the room space.
- at 01:00 s/d at 05:00 temperature value declining seem that comfortable conditions of the building lasted only for 6 hours in a day i.e. between 1 am-6 am, early morning

B. Simulation of temperature Element Modification

To find the optimum building design in terms of the distribution of air in terms of thermal comfort, performed a simulation of some modifications or ventilation openings in the building. The simulation took the same day used for simulation and by taking samples in which the highest temperature namely at 12.00 wita, i.e. the sixth day at the highest peak temperature.

There are 5 types of modifications to openings that tested its effect on the quality of temperature and wind speed, including existing conditions i.e. simulation modification 1 window where window and door openings in the State Open.

ISSN No:-2456-2165

➢ *Simulation Of Modification 1*

there are 1 the window as an air distribution (inlet) on a single occupancy flats As it is known that daytime air in humid tropical climates cause an uncomfortable conditions in the rooms of the House because of the high the temperature of this caused a lack of air distribution on the space of bedroom and living room, from the results of the simulation of air distribution in a modified 1 not enough distributes the air inlet openings since the amount and wide openings inlet is not comparable to the openings outlet.

➢ *Simulated Modification 2*

There are 2 Windows as air distribution (inlet) on a single occupancy flats As it is known that daytime air in humid tropical climates with room temperature room 32.5 ° C, living room 31.1 ° C and outdoor space 33.7 ° C causing an uncomfortable condition in the rooms of the House because of the high temperatures caused this lack of air distribution on the space of the bedrooms and the living room only two geometric openings of doors and Windows in the living room then supplied into spaces with openings while out-let room window, there are two bedrooms and a kitchen window, from the results of the simulation of air distribution in a modified 2 not enough air distributes the number of openings inlet and wide openings inlet outlet openings will be comparable to but distribution the air has not been spread evenly in space caused the inlet is still comparable to the outlet.

➢ *Simulating Modification 3*

Explanation of some mods 1 and 2 that the need inlet distribution in space is already insufficient, however, necessity of circulation on cross ventilation has not been fulfilled because the distribution outlet yet greater comparison between inlet and outlet, there are two the window as an air distribution (inlet) on a single occupancy flats As it is known that daytime air in humid tropical climates with room temperature room 32.5 ° C, living room 31.1 ° C and outdoor space 33.7 ° C causing an uncomfortable conditions in rooms of the House because of the high temperatures caused this lack of air distribution on the space of the bedrooms and the living room only two geometric openings of doors and Windows in the living room then supplied into spaces with openings while out-let room window, there are two bedrooms and a kitchen window, from the results of the simulation of air distribution on a modified 3 not enough air distributes the number of openings inlet and wide openings inlet outlet openings will be comparable to but distribution the air has not been spread evenly in space caused the inlet is still comparable to the outlet.

➢ *Simulation Modification 4*

The existence of limitations expanded ventilation openings on the flats, on the modification of the inlet distribution needs 4 in space already suffice because on the front side of the front and back side flats has been fullest while the left and right side not met for openings due to rises in the form of model coupling but modifications 4 cross-ventilated circulation needs enough meets due to distribution outlets simply by the addition of a maximum of 4 window on a larger outlet position a comparison between the inlet and outlet, there are 2 Windows as air distribution (inlet) on a single occupancy flats. From the results of the simulation of air distribution in a modified 4 meets distributes the air space in the bedroom with a size comparison of 1 metre above the floor, the number of openings inlet and wide openings smaller inlet with the outlet openings.

➢ *Modified Simulation 5*

On modification of 5 they saw the same window with the existing conditions, there are two Windows but 1 window in the closed state and the front door flats dalma closed but there are additions to the inlet or outlet jalousi as air distribution on one residential flats As it is known that daytime air in humid tropical climates with room temperature room 32.5 ° C, living room 31.1 ° C and outdoor space 33.7 ° C causing an uncomfortable conditions in the rooms of the House because of the high the temperature of this caused a lack of air distribution on the space of the bedrooms and the living room is only one geometry openings IE window in the living room then supplied into spaces with openings while out-let your window space there is 1 bedroom and 1 the kitchen window and the addition of a simulation result jalousi, air distribution on a modified 1 insufficient air distributes the number of openings inlet and wide openings inlet outlet openings will be comparable to but distribution has not spread in air distribution evenly space caused the inlet is still comparable to the outlet.

IV. DISCUSSION

On Typical flats window openings only one surface of the wall resulting in a flow of air in and out very little, and it's hard to address it should be made so that the openings face cross ventilation occurs. Wind speed in this home range 0.1 m/s up to 0.4 m/s doesn't taste and has no effect on the comfort of the outside air is also a high-temperature 33.80 ° C but the wind speed is quite convenient i.e. amounting to 1.6 m/dt. by looking at this House as a home, then it is not able to freely create openings except on the space of the bedrooms and the addition of the dimension of the opening of kitchen space, so too with some openings using glass dead on the living room window is not very precise because it cannot freely enter the air.

The quality of the thermal Comfort If in terms of average temperature (° C) on floors 1 and 2 generally still under standard 33.8 ° C while in the 3rd and 4th floors of the value of the average temperature (° C) a little lower and shows the value of a bit of difference. If in terms of building height by a factor of wind speed (m/s) conditions: 12.00 hours, then in general the average temperature (° C) during 7 days measurements were still under the standard Mom and Wiesebrom in (Soegijanto, 1998) is a cool, comfortable

ISSN No:-2456-2165

temperature between 20.5 ° C up to 22.8 ° C (TE), optimal comfortable the temperature between 22.8 ° C up to 25,8 ° C (TE) and warm comfortable temperature between 25,8 ° C up to 27.1 ° C (TE)%

Simulated results of modifications through the addition of external openings extends in some zones are able to raise internal wind speeds. These zones get wind flow directly with Cp value is positive. While at a specific zone, thus lowering the speed of the wind in space. To that end, the expansion of openings should pay attention to the inlet and outlet quantities comparison Hedy c. Indrani (2008).

The architectural configuration that has become the common type for applied tropical humid regions, namely the existence of the shadow of the barrier to direct sunlight. The geometric form of barrier affects the magnitude of the numbers. But this Cd numbers are not affected by the position of the openings according to height Sangkertadi et al (2001).

The use of numerical simulation techniques with CFD package devices can produce output that is representative for visually presented due to the use of the numeric simulation technique at the end can make it easier for us to declare them It turns out that the quantitative factor of wind speed and magnitude of the ventilation openings is very instrumental in achieving the level of comfort of the occupant space Kussoy Wailan John (2001).

V. CONCLUSION

In terms of average temperature factor, according to figure 2, then the modification has the best value is the use of simulation 4 modification window, and the lowest average temperature value simulation is the use of mods 4 window. This applies to the 2nd floor and the 4th floor. In addition, the value of the average temperature of all modifications to the floor still can be summed up under the 2-4 standard, since most of the value is still under number 29 ° c. but from the opening of the simulation window 4 is capable of pressing the temperature of existing conditions with a total of 1.79 ° c.

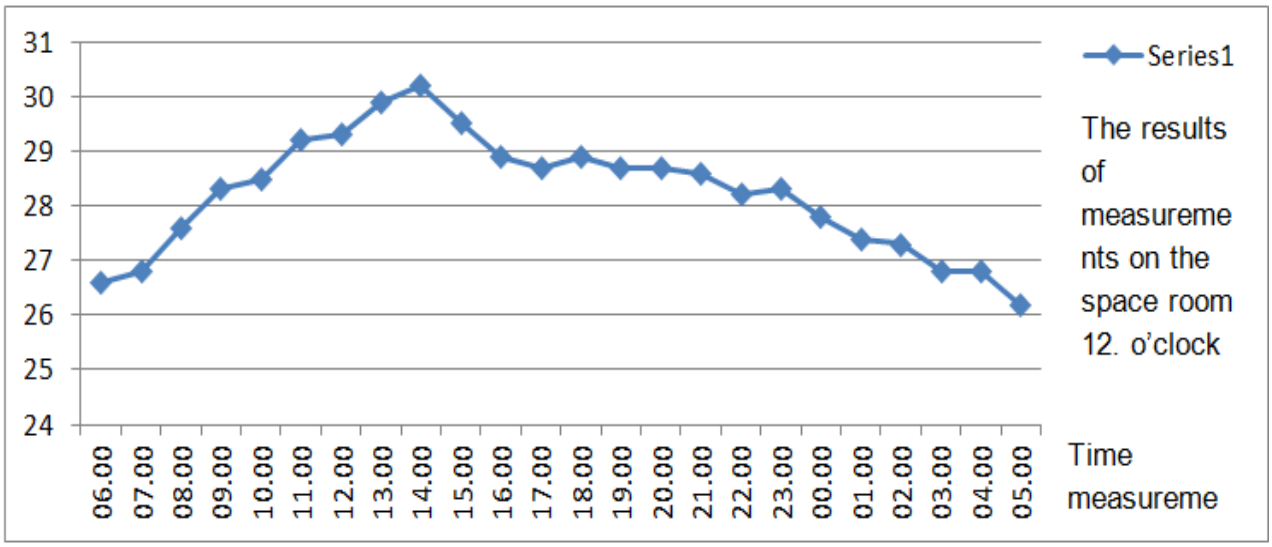
REFERENCES

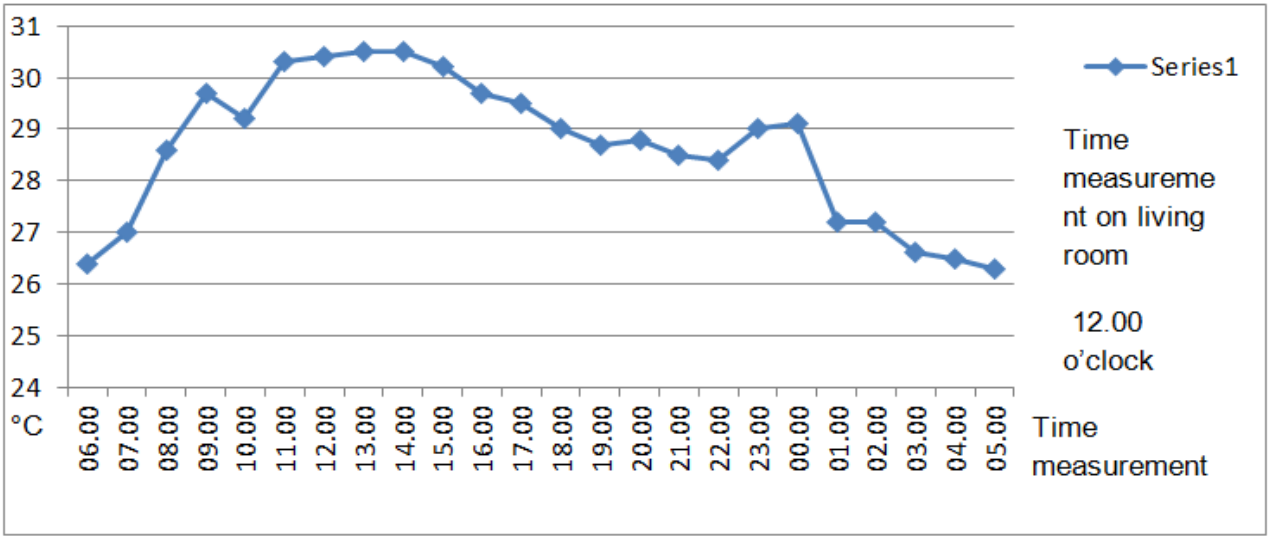
[1]. Eko Budihardjo. (2009). The influence of Climate and Culture in the design of architecture. Pt Alumni, Bandung.
[2]. Frick, Heinz, Ardiyanto & Antonius, Darmawan AMS. (2008). Physical Science building. The Publisher of Canisius. Yogyakarta.
[3]. IndraniHedy c. (2008). Interior dimensions, vol. 6, no. 1, June 2008:9-23 10.
[4]. Kussoy Wailan John (2001) scientific journal Science vol. 11 no. 1, April 2011.
[5]. Mom, c. p., Wiesebron, j. a., Courtice, r. & Kip, c. g. (1947). The application of the effective temperature of the scheme to the comfort zone in the Netherlands Indies. Chronica Naturae.
[6]. Norbert Lechner. (2007). Heating, Cooling, Lighting: design Method for Arsiitektur. Pt. RajaGrafindo. Jakarta.
[7]. Lippsmeier, Georg. (1984). The buildings of tropical, Erlangga, Jakarta.
[8]. Lindley, James A. And James H. Whitaker. (1996). The Agricultural Buildings and Structures: Revised Edition. ASAE. St. Joseph, USA.
[9]. Olgay, v. (1963). Design with Climate: a Bioclimatic Approach to Regionalism, By Arvhitectural University Press, By.
[10]. Somantri, Ating and Sambas Ali Muhin. (2006). The application of statistics in research. Bandung: Pustaka faithful.
[11]. Soegijanto. (1999). The buildings in Indonesia with a Damp tropical climate in terms of Building Physics Aspect. Teknonolgi Institute of Bandung.
[12]. Szokolay, SV. (1980). Environmental Science Handbook, Longman Press, London Construction.
[13]. Sangkertadi et al (2001). Dimensions of architectural engineering vol. 29, no. 2, December 2001:147-150.

PARAMETER	ALAT	JUMLAH
Air temperature Air temperature	Thermo – Hygrometer	6
Moisture	Hygrometer	2
Wind (speed)	Anemometer	1
Get The Wet Bulb Temperature	Psychometric Diagram	-
Effective temperature (ET) – from the DBT	Diagram Of The Temp. Effective (ET Monogram)	-
Standards Of Comfort	Mom, *et al.*, 1947	-
The calculation of the rate of turn of the air	Formula Boutet, 1987.	-

Tabel 1:- Alat-alat perekam dan pengukuran

ISSN No:-2456-2165





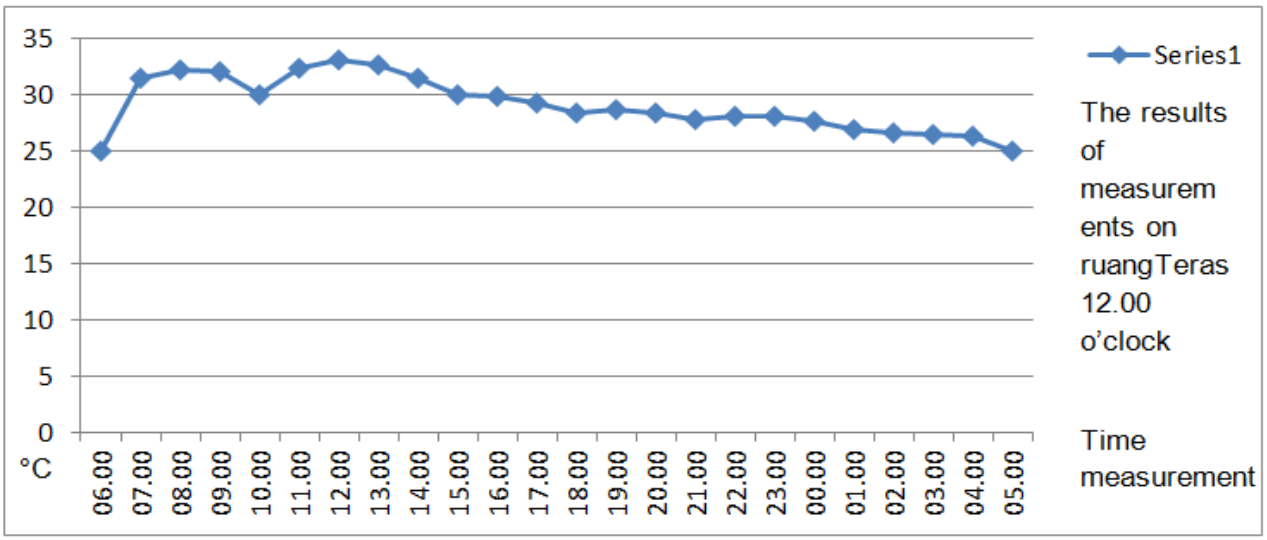


Fig 1:- Graph of temperature hygrometer measurements of the 4th floor

ISSN No:-2456-2165

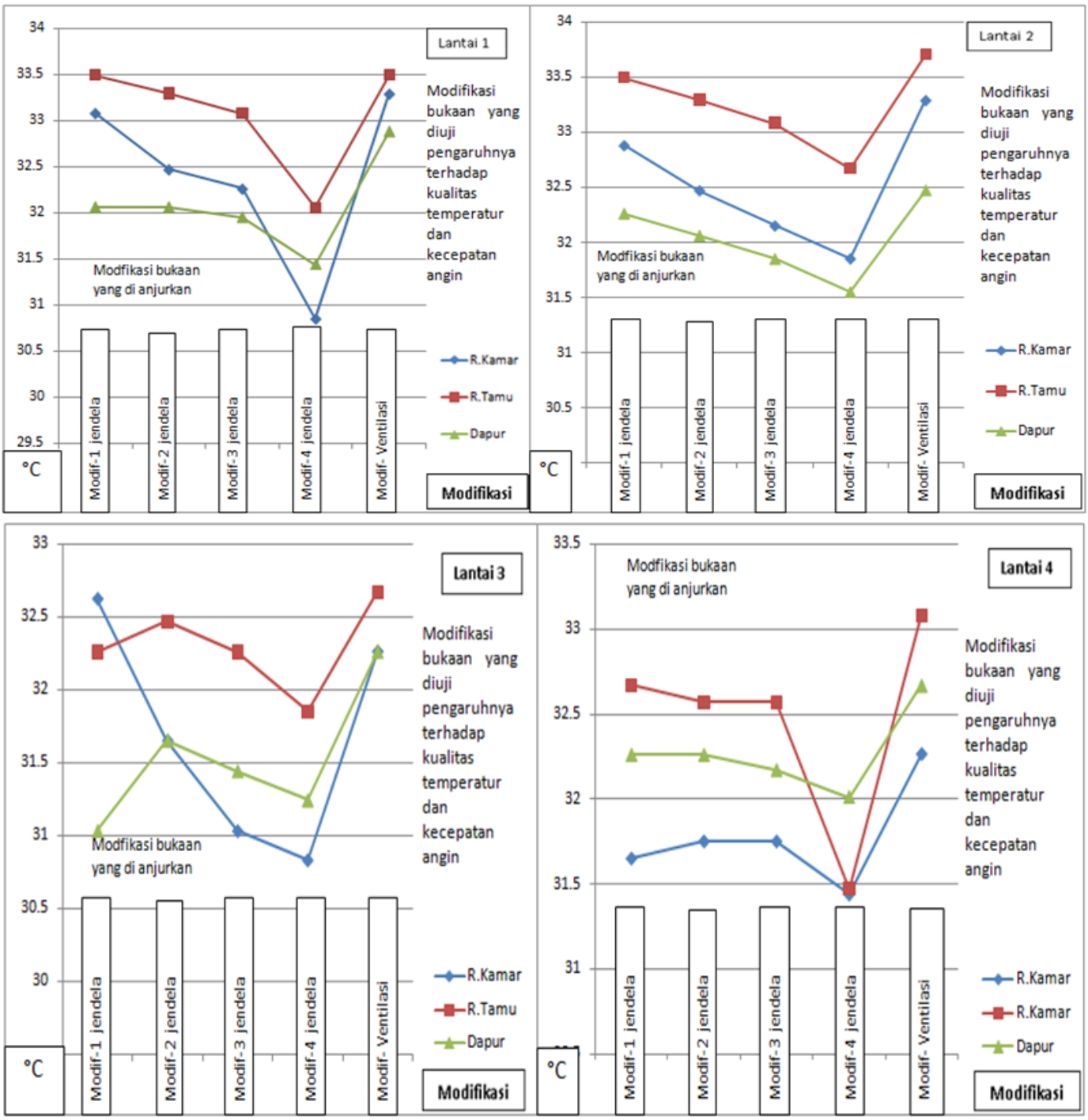


Fig 2:- Comparison table of values of temperature modification simulation, floor 1 to floor 4