

# The Influence of the Grid Structure on the Function of Architectural Space

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**ABSTRACT** : Some researchers use the theory of utilization, capacity and occupancy to measure room use. Space capacity needs to be determined in the planning of building space, because it gives a big impact on fixed costs, especially building rooms that provide economic value. Planning a room's capacity also determines whether the demand for space can be met, or whether the existing space will be excessive (Martinich, 1997). Architectural works, which appeared as a container to accommodate human activities. Often the arrangement of spatial functions in one building is still not optimally integrated, so that there are one or more functions that are less effective (may be too narrow so uncomfortable to use or may be too broad to cause waste). All functions in the space need to be analyzed functionally so as to get maximum effectiveness in the division of space that is integrated with the column structure modul. This study will discuss the effectiveness of the division of space in building design as an effort to integrate the system of spatial division with the amount of grid column structure.

The research method was carried out qualitatively with a case study approach, and took the location of lecture rooms at the Institut Teknologi Sumatera (ITERA). The study was conducted aimed at knowing how the effect of the determination of the grid structure on space in this case focuses on the function of the lecture room. Broadly speaking, it can be concluded that the selection of the right structural grid can affect the effectiveness and efficiency of space both related to the comfort of the user space and the capacity of the lecture room. Therefore the most effective and efficient grid structure related to lecture space according to the case study above is 6000 mm x 7500 mm with a maximum capacity of 30 people for small classes while large classes can accommodate a maximum of 66 people or standard space requirements of 1.2 m<sup>2</sup> / students with 20% flow. The grid structure is also in accordance with the modular system in SNI 03-1978-1990 which is a multiple of 30 cm.

**Keywords** : grid structure, space function

## INTRODUCTION

Infrastructure The college building has the main function as a place for teaching and learning activities, but has several supporting functions therein. The most common functions encountered include: library function, office & boarding functions. Each of these functions has different space requirements and demands different areas. These functions are arranged in such a way in the form of a building. In the era of modern architecture, machine technology is widely used in the fields of architecture and construction making it easier to make building parts so that the construction process is faster and cheaper, but its use is also limited. The limitation is on the side of the shape that must be easy to make and build like geometric shapes. Geometry shapes can be rectangles, square, triangles, circles and ellipses. This form is what makes the formation of geometric elements in a building in the modern era. Geometry elements are elements that have lines and shapes that cannot be denied anymore in terms of measurements which are then used to determine the size and proportion of buildings. The application of these geometric elements can be done on all types of buildings such as one-function buildings and multi-function buildings. Although later designs can be built, drawing and construction are still fairly difficult, therefore geometry is still the best choice for design (Antoniades, Anthony C., 1992).

In the process of planning architectural forms, structures can occupy diverse priorities (Howard, 1966; in Maer, 2002). From a structural point of view, a structure that is ideally designed to meet three rules, namely safe, efficient, comfortable. For this reason, in the design of building organizations, the design of spaces and structures should be considered simultaneously (Glasser, 1976).

Institut Teknologi Sumatera (ITERA) is one of the state universities that is experiencing rapid development, one of which has a number of lecture building infrastructures and laboratories to support the Tridharma of higher education. If observed, the forms used in the lecture building are geometric forms on all elements of the building including the scoping elements such as the roof, walls, and floor

of the building. The shape of the lecture building at ITERA shows that there is an approach between form, function and structure. The application of geometric shapes is evident from the use of regular structure modules. However, there are striking differences from the structural modules used, this is inversely proportional to the same function that is as a lecture room. Therefore, this study will discuss the effect of the application of grid structure on the function of architectural space with a case study of a lecture building at ITERA.

### Structural Grids

In developing a structural grid for a building concept, there are important grid characteristics that must be considered for their impact on the architectural idea, the accommodation of program activities, as well as the design of the structure. There are 4 things to consider in the use of structural grids, namely:

- Proportions
- Dimensions
- Scale
- Spatial fit

Types of structural grids are (Ching, 2014):

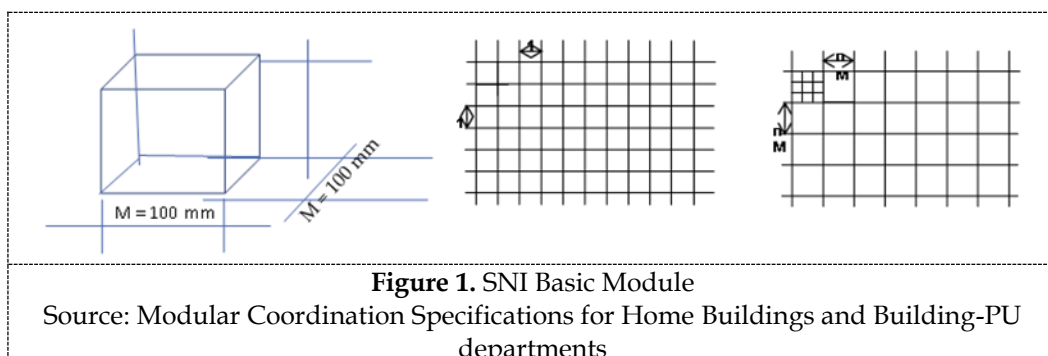
- Regular grids (square grids, rectangular grids, tartan grids, and radial grids)
- Irregular grids (modifying grid, modifying by addition or subtraction, modifying proportion, accommodating large-scale spaces)

### Modular System

Modular-based architectural design is widely applied in the building industry, eg Education, residences, housing, hotels, rental offices and so on. In Japan, it is known as tatami, an aesthetic and ergonomic basic repeating module. The success of architectural design in a modular concept is being able to produce design variants with a limited number of components. The importance of modular systems in the building industry are:

- Fulfilling construction requirements in accordance with standard provisions (strength, safety, comfort, and convenience).
- Increase local potential, namely labor and local materials so as to minimize modifications in the field.
- Sustainability benefits in terms of minimizing waste of building materials if they pay attention to adverse environmental impacts.
- Buildings and components are part of the industry so as to enable quality control and increase productivity in the construction industry.
- Increase efficiency efforts in terms of employment, and material production in factories, namely by increasing skilled workers.
- Solving urgent development problems, flexible design, can be built quickly, can be built in stages.

In Indonesia, for example the design of flats whose dimensions are based on certain modules (basic and multi-module). The basic module is a basic measure in modular coordination with the symbol M, with the provision that  $1 M = 10\text{cm} = 100\text{mm}$ . These dimensions are coordinated into a building that is able to reduce various sizes in components and allow components to be used together without undergoing modification. The dimensional coordination system applies internationally, is stipulated in ISO Standards and adopted in each national standard for each country, for example Indonesia with SNI.



**Figure 1.** SNI Basic Module

Source: Modular Coordination Specifications for Home Buildings and Building-PU departments

Module planning using the modular concept follows the provisions of SNI 03-1978-1990 (selected size specifications for houses and buildings). Referring to the modular provisions, the smallest horizontal

module (Mh) = 30cm, multimodular dimension (Mm) on using the series size of multiples of 3M = 3x30cm = 90cm (shown in the table). Rules for the use of modular sizes allow the use of  $\frac{1}{2}$  and  $\frac{1}{4}$  modules, so in its use in floor plan designs you can use  $\frac{1}{2}$  and  $\frac{1}{4}$ , multimodules:  $\frac{1}{2} \times 3M = 45\text{cm}$ , and  $1 / 4 \times 3M = 22.5 \text{ cm}$ . for the smallest vertical dimension 1Mv = 10cm, it is used to design height dimensions such as height from floor to floor, floor to the threshold below the beam, frame height, and frame height from the floor, door height, and window shutters. The size of the gap is not affected by the size of the module, because it relates to the material used for walls / partitions, the calculation of the structure for floor thickness, and the calculation of the structure for the size of columns and beams.

### Anthropometric Data

Anthropometric data used includes lecturer anthropometry data and student anthropometry data. There are 2 dimensions of lecturer anthropometry data taken for the redesign of the position of the blackboard, namely: 1. Height of standing eye (TMB) The height dimension of standing eyes of the lecturer will be used to analyze the comparison between initial and final design. 2. Upper hand reach (JTA) The upper hand reach dimension functions to determine the height of the stage which will be adjusted to the ability of the lecturer's hand to write on the board.

There are 2 dimensions of student anthropometry data taken for the redesign of the whiteboard position, namely: Sitting Eye Height (TMD), Sitting Body Height (TBD). The results of the calculation of the percentile height of the lecturer's eye, the reach of the teacher's upper hand and the height of the student's sitting eye above can be stated in Table 2 of the results of the percentile calculation of the lecturer and student anthropometric data (Chandra, 2015).

**Table 1.** Dimension of Anthropometry

No.	Dimension of Anthropometry	Percentile (cm)		
		5	50	95
1.	High Eyes Standing Lecturer	143.89	154.2	166.08
2.	Reach the Hands of the Lecturer	195.89	211.45	226.08
3.	College Student Seated Eyes	66.45	75.77	83.75
4.	Student Sitting Height	81.2	88.6	95.15

Sources: Chandra, 2015

There are several factors that can influence the learning process, one of them is physical facilities, such as the condition of classrooms, benches, Whiteboards, laboratories, libraries and other physical devices related to the interests of the teaching and learning process (Muhibbin, 2016). Physical facilities play an important role in the course of the learning process.

Seating Settings with Projector Screens (Ahlstrom, 2007):

1. Measurement of horizontal angles using an arc is done by reference to the center of the screen to the outermost area of the sitting position. While the standard used for this measure is  $45^\circ + 45^\circ$ .
2. The standard for the closest seat distance to the screen is  $2xH$ , where H is the height of the screen, while the standard seat farthest from the screen is  $6xH$ .
3. For the calculation of the vertical angle (visual angle = VA), the seat distance is measured relative to the projector screen. As a standard VA is used at  $30^\circ$ .

## METHODS

This research is an evaluative study using qualitative methods. Evaluative research is carried out in a case study, which is a lecture building at the Sumatra Institute of Technology. In carrying out this research, several stages of the study were carried out as follows:

### 1. Literature Study or Data Collection

Literature study as a source of knowledge and basic discussion and research guidelines for the object of research in the analysis phase. Data needed is based on literature studies, namely:

- Anthropometric standards
- Higher education room standards based on government regulations.
- Modular system

2. Case study data. Case studies are needed as a comparison object from existing standards. The data needed in the form of floor plans. This picture is needed to analyze the magnitude of the function space.

## RESULTS AND DISCUSSION

This study uses two data, primary and secondary data. To get secondary data, it is preceded by collecting data from Literature review both from books, journals, and various government regulations related to research objectives. Whereas primary data were obtained through field surveys of two lecture buildings at the Institut Teknologi Sumatera, namely Building E (Bandar Lampung Lecture Building) and Public Lecture Building (GKU 1 ITERA), which focused on the use of the structural grid of the Building and the capacity of lecture rooms.



Figure 2. Building E (left) and GKU 1 (right) as Case Study Objects

In the lecture room in Building E, there are two types of rooms, namely small type rooms of 45 m<sup>2</sup> and 90 m<sup>2</sup>, while in GKU Building 1 also has two types of space, namely rooms with sizes of 80 m<sup>2</sup> and 160 m<sup>2</sup>. As for the spatial configuration, the two are arranged in a square with 1 reference point in front. Based on the table above shows the equation that is the use of regular structure grids, rectangular type. However, Building E uses a 6 x 7.5 meters module while GKU 1 uses an 8 x 10 meters module. Modular system standards in SNI 03-1978-1990 are set as the smallest horizontal module (Mh) 30 CM, thus the 6 x 7.5 meters grid in Building E with respect to the X axis (6 meters) uses multiples of SNI modules, namely 20M, Y axis (7, 5 meters) is 25M. Whereas the GKU 1 Building with an 8 x 10 meter grid both on the x and y axes does not use multiples of the SNI module. For the initial analysis, it is preceded by setting the maximum capacity / capacity with indicators of space layout in accordance with existing standards both the dimensions of furniture and anthropometric standards of the human body. Then proceed the analysis of viewing angles horizontally and vertically.

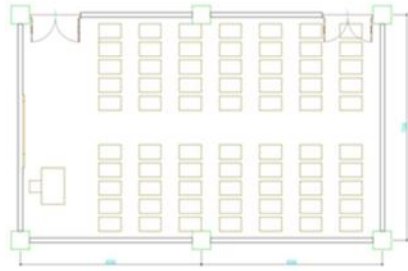
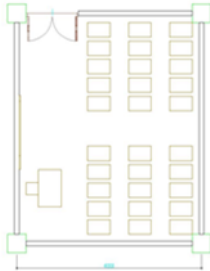
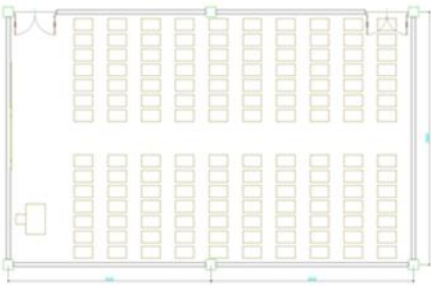
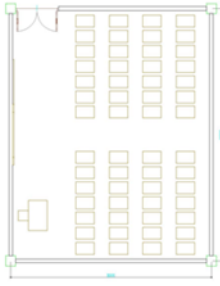
Table 2. Primary Data

No.	Study Objects	Grid Structure	Other information
1	Building E	<p>Grid 6 m x 7,5 m and 3 m x 6 m</p>	Main function: lecture Additional functions: administration, library, student affairs, Small class: 45 m <sup>2</sup> , large class: 90 m <sup>2</sup> 4 floors, reinforced concrete structures
2	GKU 1	<p>Grid 8 m x 10 m and 4 m x 8 m</p>	Main function: lecture Additional functions: administration, library, Small class: 80 m <sup>2</sup> and large class: 160 m <sup>2</sup> 4 floors, steel structure

### a. Configuration of Room Layout and Space Capacity

In doing the layout of several dimensions the standard dimensions of furniture used is a student chair with a size of 474 x 732 mm, a blackboard measuring 1200 x 2400 mm, a projector screen measuring 1780 x 1780 mm. The distance between the rows of seats is taken to a maximum size of 600 mm while the distance between the seat columns ranges from 126 mm (600 mm - width of the chair), and the distance of the rows of the back seat to the wall is a pause to avoid wall damage.

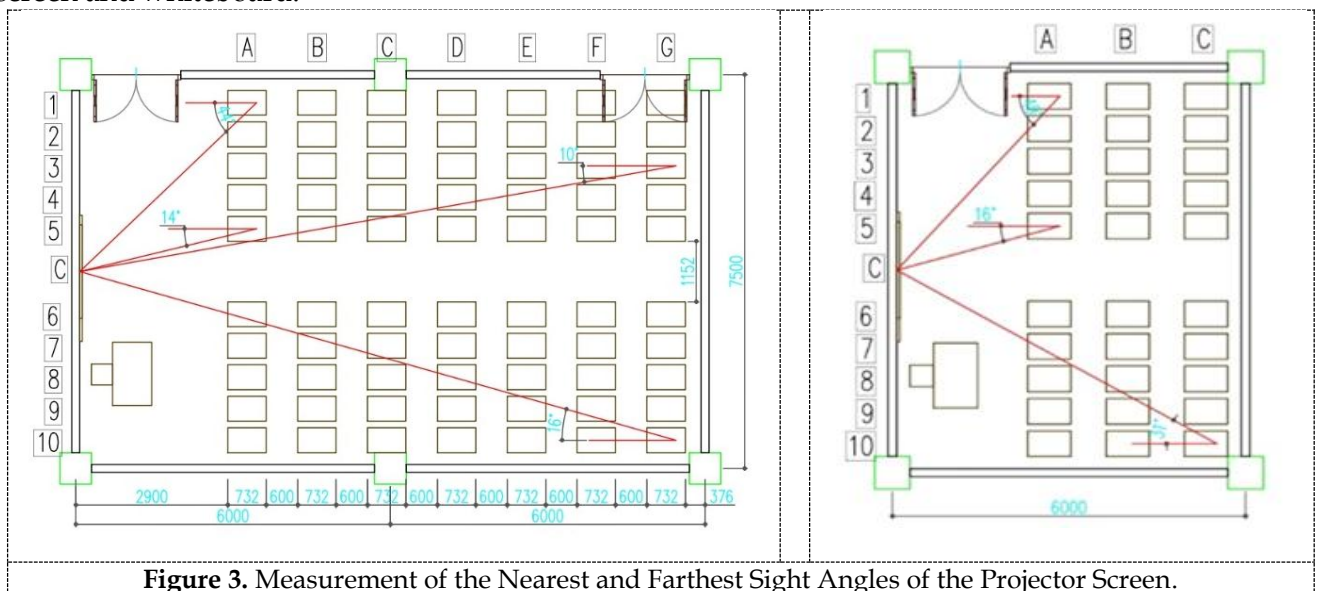
Table 3. Type of classroom layout configuration

Building	Room Type		Capacity
	Type 1	Type 2	
Building E			Type 1: 66 people Type 2: 30 people
GKU 1			Type 1: 140 people Type 2: 56 people

After finding out the layout of the classroom layout both in Building E and Building GKU 1, obtained 2 types of classroom layout configurations. In Building E type 1 (TE1) with a capacity of 66 people while type 2 (TE2) has a capacity of 30 people. In GKU Building 1 class type 1 (TG1) has a capacity of 136 people while type 2 (TG2) has a capacity of 40 people.

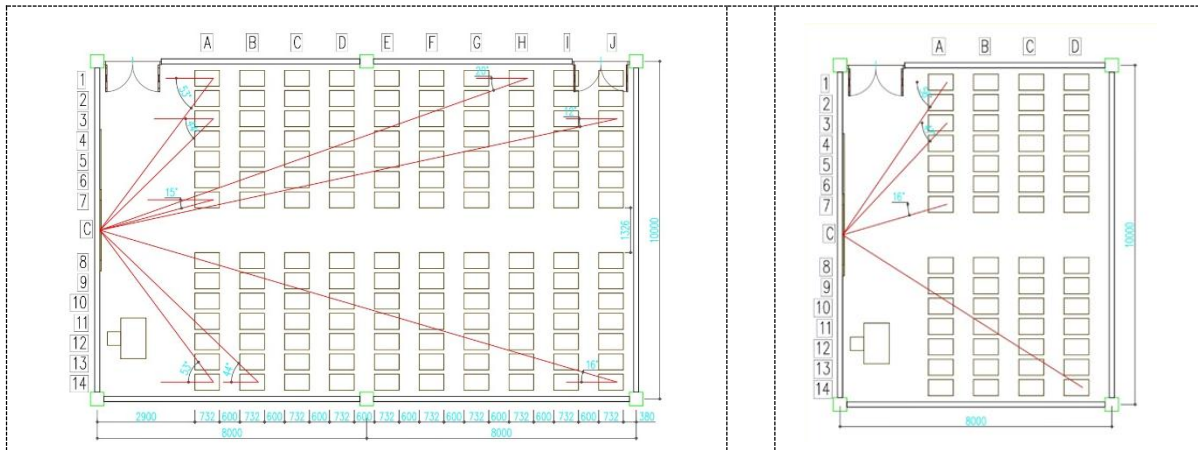
**b. Viewing Angles Horizontally**

Horizontal angle measurements using the help of the AutoCAD program are performed with a reference to the center of the screen to the sitting position area. The projector screen and whiteboard are exactly divided by an equal wall. The standard used for this measure is  $45^\circ + 45^\circ$  (Ahlstrom, 2007). So that the standard viewing angle from the chair farthest to the projector screen is a maximum of  $45^\circ$ . This applies to both the right and left angles of the projector screen and whiteboard. The following is a picture of the measurement angle of view of the farthest and nearest horizontally from the projector screen and whiteboard:



**Figure 3.** Measurement of the Nearest and Farthest Sight Angles of the Projector Screen.

The TE1 lecture room has the farthest viewing angle of  $44^\circ$  on the right and the nearest viewing angle of  $14^\circ$  on A5. The farthest viewing angle of vision shown in the picture (TE2)  $49^\circ$  past  $4^\circ$  from the standard horizontal viewing angle. This resulted in students sitting in the farthest chair area having difficulty seeing the writing on the projector screen and whiteboard. The angle past  $4^\circ$  is not up to standard so it is less than optimal because the screen area of the projector and the whiteboard are too close to the front row curves.

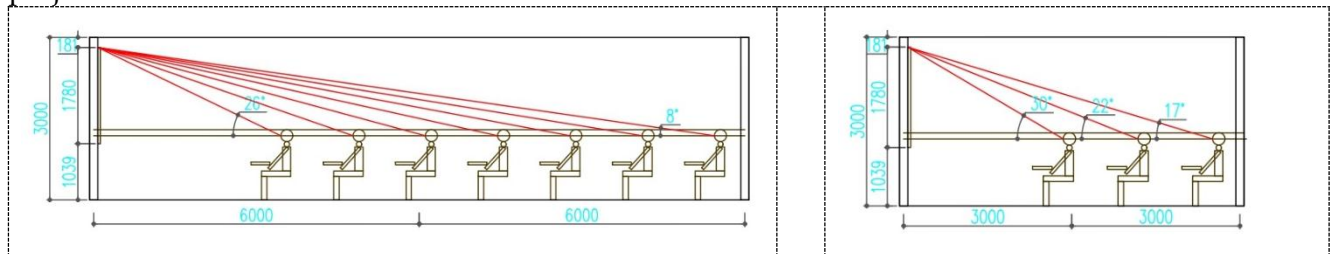


**Figure 4.** Measurement of the Nearest and Farthest Sight Angles of the Projector Screen

TG1 lecture room has the farthest viewing angles of 53 ° and 49 ° on the right and left of the projector / whiteboard and the nearest viewing angle of 15 ° on A7 and A8. TG2 lecture room has the farthest viewing angle of 47 ° - 56 ° on the right and left of the projector / whiteboard and the nearest viewing angle of 16 ° on A7 and A8. The farthest viewing angles of view shown in the pictures (TG2) 49 ° and 53 ° past 4 ° - 8 ° from the standard horizontal viewing angle. This resulted in students sitting in the farthest chair area (A1, A2, A13, and A14) having difficulty seeing the writing on the projector screen and the whiteboard. Whereas the farthest viewing angle shown in TG2 image passes 2 ° - 11 ° (A1, A2, A3, A12, A13, and A14) not according to the standard so it is less than optimal because the projector screen and whiteboard areas are too close to the line curators front.

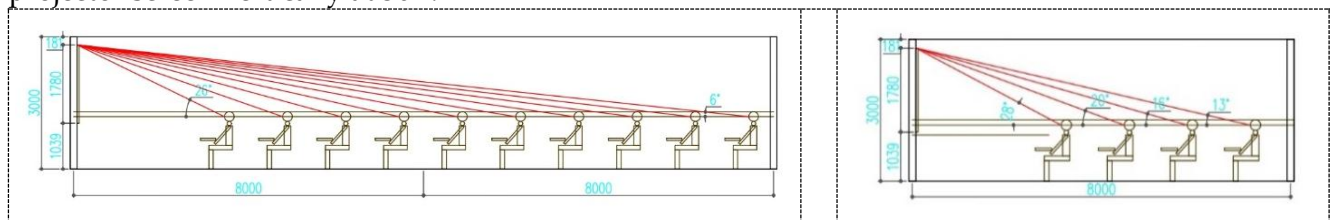
**c. Viewing Angle Vertically**

Horizontal angle measurements using the arc are carried out by measuring the distance of the chair to the projector screen and whiteboard. The standard used for this measure is 30 ° (Ahlstrom, 2007). This applies to angles in the foremost and backward positions of the projector screen and whiteboard. The following is a picture of the measurement angle of view of the furthest and nearest vertical from the projector screen:



**Figure 5.** Measurement of Vertical Sight Angle from TE1 and TE2

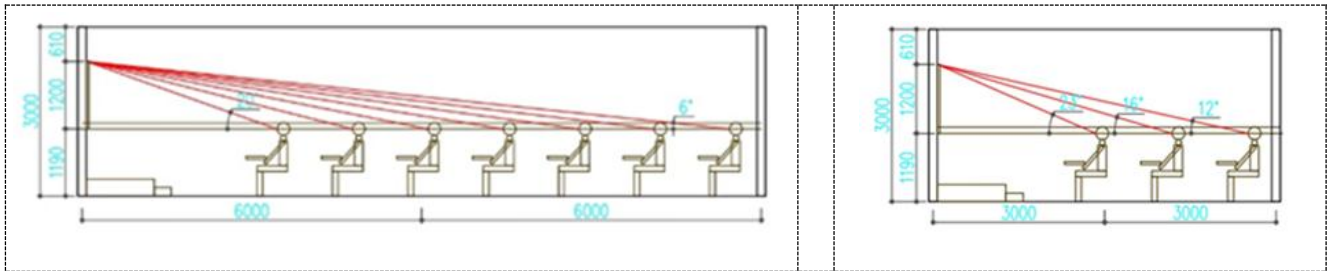
There are 7 rows of sitting position when viewed vertically. The height of the perpendicular sight from the floor is 1039 mm. The height of the perpendicular sight to the projector screen is 1780 mm. Projector screen height from the floor is 2819 mm. The TE1 room has the nearest viewing angle of 26 ° and the farthest 8 °. Whereas the TE2 room has the nearest viewing angle of 30 ° and the farthest is 17 °. In this lecture room, the nearest and farthest vertical viewing angles meet the standard viewing angle to the projector screen vertically at 30 °.



**Figure 6.** Measurement of Vertical Sight Angle from TG1 and TG2

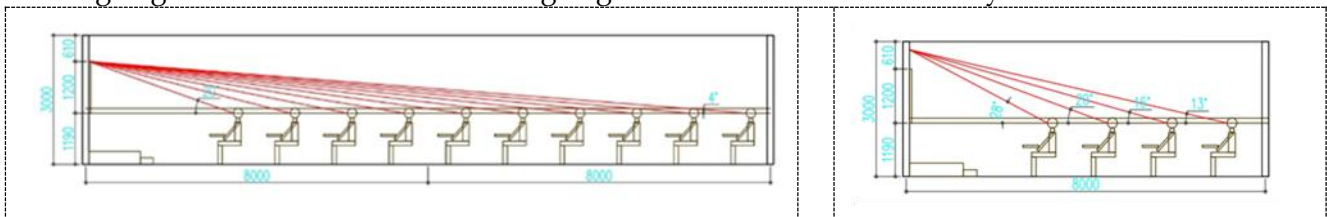
There are 10 rows of seating positions in the TG1 room and 4 rows in TG2 when viewed vertically. The height of the perpendicular sight from the floor is 1039 mm. The height of the perpendicular sight to the projector screen is 1780 mm. Projector screen height from the floor is 2819 mm. TG1 room has the nearest viewing angle of 26 ° and the farthest 6 °. While the TG2 room has the nearest viewing angle of 28 ° and the farthest 13 °. In this lecture room, the nearest and farthest vertical viewing angles meet the

standard viewing angle to the projector screen vertically below 30°. Drawings measuring the angle of view of the furthest and nearest vertical view of the whiteboard.



**Figure 7.** Measurement of Vertical Sight Angle TE1 and TE2 (whiteboard)

There are 7 rows of sitting positions on TE1 and 3 rows of sitting positions on TE2 when viewed vertically. The height of the perpendicular sight from the floor is 1190 mm. The height of the perpendicular sight to the board is 1200 mm. The height of the blackboard from the floor is 2390 mm. The TE1 room has the nearest viewing angle of 20° and the farthest 6°. While the TE2 room has the nearest viewing angle of 23° and the farthest 12°. In this lecture room, the nearest and farthest vertical viewing angles meet the standard viewing angle to the whiteboard vertically at 30°.

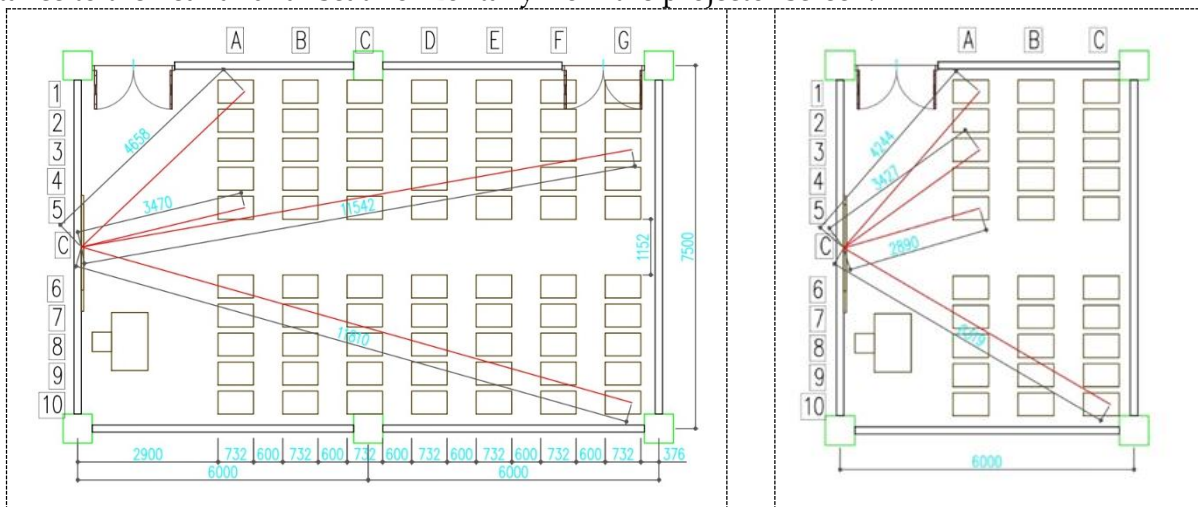


**Figure 8.** Measurement of Vertical Sight Angle TG1 and TG2 (whiteboard)

There are 10 rows of seating positions in the TG1 room and 4 rows in TG2 when viewed vertically. For the calculation of vertical viewing angles, the maximum standard of sight is 30°. This is used both sitting in the furthest position to the nearest position. TG1 lecture room has the nearest viewing angle of 20° and the farthest viewing angle of 4°. Whereas in the TG2 room it has the nearest viewing angle of 28° and the farthest 13°. In this lecture room, the nearest and farthest vertical viewing angles meet the standard of viewing angles to the projector screen vertically below 30°. Even though the TG1 room with a viewing angle below 30°, the 3 rows of the back seat may still be obstructed by the row of chairs in front of it so that it will affect the inconvenience of students' vision on the board.

**d. Distance chair nearest and farthest from the whiteboard and projector screen**

The distance measurement is done by measuring the distance of the chair to the projector screen. The standard for the near seat distance to the screen is  $2xH$ , where  $H$  is the height of the screen, while the standard seat far from the screen is  $6xH$  (Ahlstrom, 2007). The following is a measurement image of the distance to the near and far seat horizontally from the projector screen:

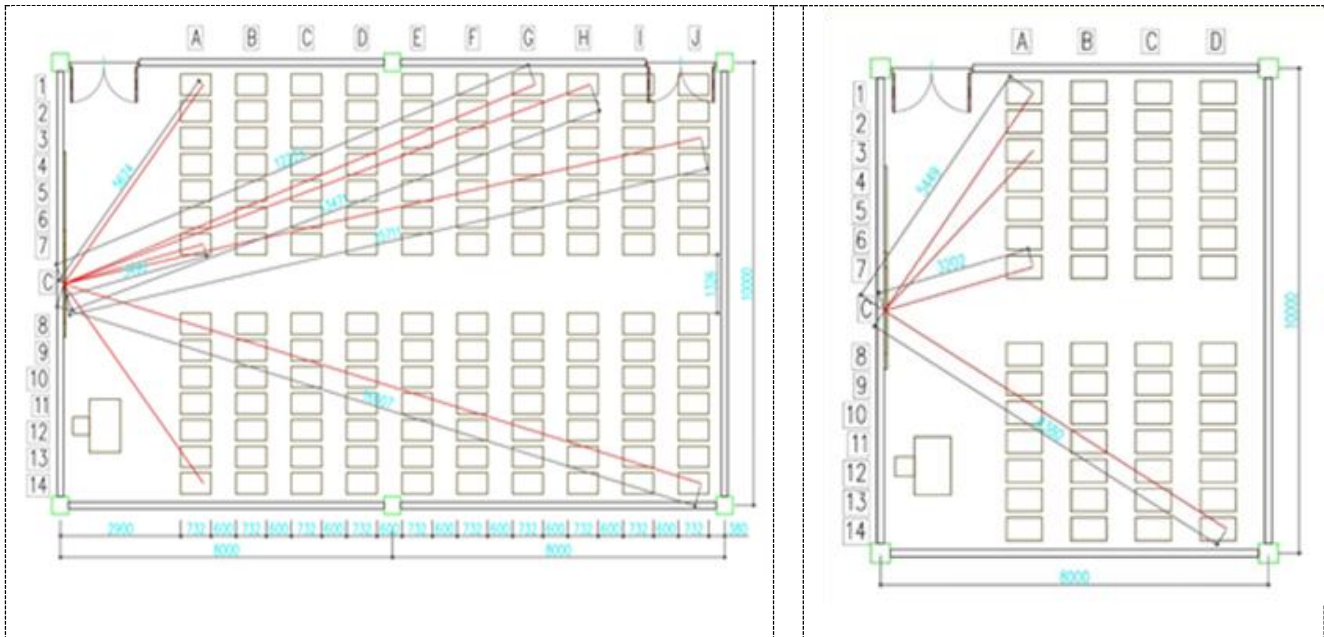


**Figure 9.** Horizontal Chair Measurement for TE1 and TE2 Spaces

The TE1 room consists of 7 seated positions named A, B, C, D, E, F, and G, there are 10 vertical seated positions named 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10. Based on the measurement results there is the closest and farthest distance to the projector screen and whiteboard. The TE1 room has the closest distance is in A5

and A6 positions which is 3470 mm. The farthest distance is in the position of G10 which is 11810 mm. While the TE2 room has the closest distance of 2890 mm in A5 and A6 positions. The farthest distance is in position C1 and C10 which is 6319 mm. In accordance with the standard for the closest viewing distance to the horizontal screen is  $2xH$  (3560 mm) and the farthest distance to the projector screen horizontally is  $6xH$  (10680 mm).

The TE1 lecture room has the farthest visual distance of 11810 mm and the closest visual distance of 3470 mm. The shortest distance from the chair to the projector screen (3470 cm) is less than the standard that is less than 90 mm from the standard distance closest to the position of the chair to the projector screen. This affects the vision of students sitting in the front position because they are too close to the screen. The farthest distance to the projector layer (11810 mm) is more than the standard, which is more than 1130 mm. While the farthest distance from the chair to the projector screen (11810 mm) does not meet the standard because it exceeds the farthest distance which is 10680 mm.



**Figure 10.** Horizontal Chair Distance Measurement for TG1 and TG2 rooms

TG1 room there are 10 horizontal seating positions named A, B, C, D, E, F, G, H, I, and J, there are 14 sitting positions vertically named 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14. Based on the measurement results there is the closest and farthest distance to the projector screen and whiteboard. TG1 room has the closest distance is in position A7 and A8 which is 3490 mm. The farthest distance is in position J14 which is 16007 mm. While the TG2 room has the closest distance of 3202 mm, positioned A7 and A8. The farthest distance is in positions D1 and D14 which is 8380 mm. In accordance with the standard for the closest viewing distance to the horizontal screen is  $2xH$  (3560 mm) and the farthest distance to the projector screen horizontally is  $6xH$  (10680 mm).

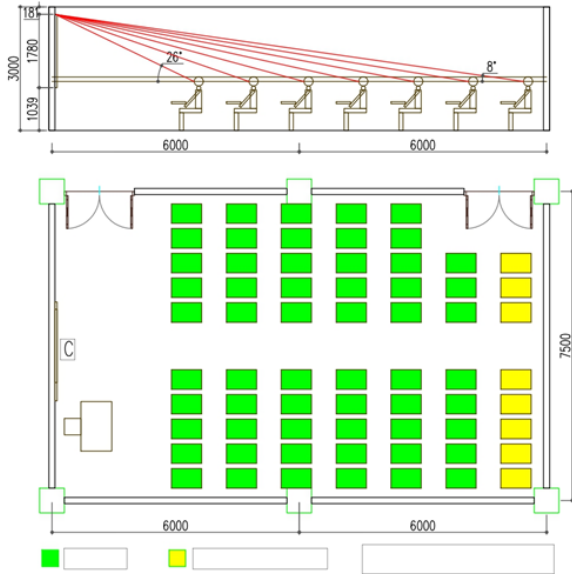
TG1 lecture room has the furthest visual distance of 16007 mm and the closest visual distance of 3490 mm. The nearest distance from the chair to the projector screen (3490 cm) is less than the standard that is less than 70 mm from the standard distance closest to the position of the chair to the projector screen. This affects the vision of students sitting in the front position because they are too close to the screen. The farthest distance to the projector screen (16007 mm) is more than the standard of more than 5327 mm. While the farthest distance from the chair to the projector screen (16007 mm) does not meet the farthest distance standard because it exceeds 10680 mm.

## CONCLUSION

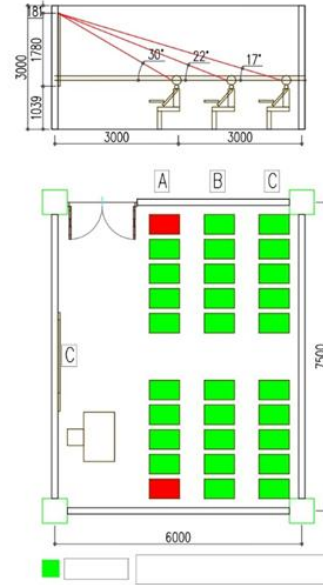
In the discussion mentioned sitting position affects the effectiveness of student learning. The factors of the sitting position that affect the viewing angle both horizontally and vertically from the seat to the projector screen and the distance of the seat to the projector screen. Here are the effects of viewing angles both horizontally and vertically from the seat to the projector screen and the distance of the seat to the projector screen on learning effectiveness:

**Table 4.** The Effect Of The Structure Grid On The Effectiveness Of Student Learning

**Grid Structure 7500 mm X 12000 mm**



**Grid Structure 6000 mm X 7500 mm**



**Horizontal Sight Angle**

The minimum angle meets the standard.

There are 2 seats that do not meet the standards of A1 and A10

**Vertical Sight Angle**

For vertical angle calculations, the standard of vision is 30°

The classroom has the nearest viewing angle of 26 ° and the farthest viewing angle of 8 °. In this lecture room, the closest and farthest vertical viewing angles meet the standard of vision from a vertical angle

The classroom has the nearest viewing angle of 30 ° and the farthest viewing angle of 17 °. In this lecture room, the nearest and farthest vertical viewing angles meet the standard of vision from a vertical angle

**Nearest Distance And Farthest Seating**

Nearest: 3560 mm; farthest 10680 mm

The shortest distance 3470 mm, seat A5 and A6 is less than the standard 90 mm.

The shortest distance 2890 mm, seat A5 and A6 less 670 mm.

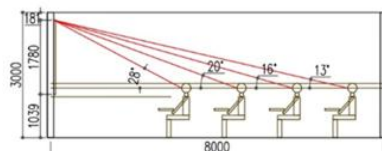
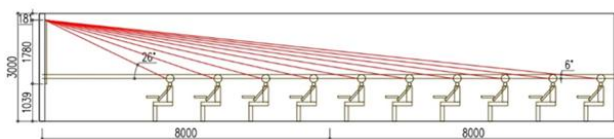
Grid structure used is quite ideal

Grid structure used is quite ideal

**Table 5.** The Effect Of The Structure Grid On The Effectiveness Of Student Learning

**Grid Structure 10000 mm X 16000 mm**

**Grid Structure 8000 mm X 10000 mm**



**Horizontal Sight Angle**

There are 4 chairs that do not meet the standards, namely A1, A2, A13 and A14, this has an impact on the difficulty of seeing writing

There are 6 seats that do not meet the standards of A1, A2, A3, A12, A13 and A14

### Vertical Sight Angle

For vertical angle calculations, the standard of vision is 30°

The classroom has the nearest viewing angle of 26 ° and the farthest viewing angle of 6 °. In this lecture room, the closest and farthest vertical viewing angles meet the standard of vision from a vertical angle

The classroom has the nearest viewing angle of 28 ° and the farthest viewing angle of 13 °. In this lecture room, the closest and farthest vertical viewing angles meet the standard of vision from a vertical angle

### Nearest Distance And Farthest Seating

Nearest: 3560 mm; farthest 10680 mm

The shortest distance 3490 mm, seat A5 and A6 (less than 70 mm from the standard), the farthest distance beyond the standard is 11041 mm (G7 and G8) less 361 mm of the highest standard and 16007 mm (J14) 5327 mm more than the standard. This results in difficulty seeing the writing

The shortest distance 3202 mm, seat A7 and A8 (less than 358 mm from the standard), this affects the students look too close to the layer. The furthest distance is 8380 mm (D1 and D14), this is according to the standard.

### Impact on Grid Structures

Grid structure used is not ideal, especially from the long side of the room. The last 3 back lines do not support the effectiveness of student learning so that the existing space is too excessive. Maximum space capacity is reduced by 38 people (27.94%), so there must be an adjustment to the grid on the long side of the classroom.

There are 6 ineffective seats which are reduced by around 10.71% of the maximum capacity. Therefore, it is necessary to adjust the grid width side of the room.

The analysis shows that the sitting position (both horizontal and vertical) influences the effectiveness of students in the learning process. In the lecture room in Building E ITERA generally meets the standards. Whereas in lecture hall Building GKU 1 in general does not meet the standards. As for those who do not meet the standards, namely at the point of view horizontally beyond the maximum standard. This resulted in students having difficulty seeing their writing and focus being disturbed. In addition, the farthest distance from the seat to the projector screen and whiteboard.

Broadly speaking, it can be concluded that the selection of the right structural grid can affect the effectiveness and efficiency of space both related to the comfort of the user space and the capacity of the lecture room. Therefore the most effective and efficient grid structure related to the lecture room according to the case study above is 6000 mm x 7500 mm with a maximum capacity of 30 people for small classes while large classes can accommodate a maximum of 66 people. The grid structure is also in accordance with the modular system in SNI 03-1978-1990 which is a multiple of 30 cm.

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