

## ANALYSIS AND IMPROVEMENT PROPOSAL OF SDN 7 KIARACONDONG BASED ON DIKNAS AUDIT VIEWED FROM ERGONOMICS ASPECT

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### ABSTRACT

*SDN 7 Kiaracandong is one of the primary school located in Bandung. According to the auditor of DIKNAS, SDN 7 Kiaracandong has some weakness, namely the lack of classroom capacity, the physical environment (lighting and noise) is not sufficient that disrupts the teaching and learning activities, and the unavailability of a library. The data required for the processing and analysis includes general data SDN 7 Kiaracandong, interviews with the school, the data of the physical environment (lighting and noise), number of students, the actual dimensions of the physical facilities, anthropometric data of 100 students, and Indonesia National Standard (classes capacity, library design, physical facilities, library).*

*After the analysis, carried out the design of physical facilities (librarians table, student desks, student chairs, clerk chairs, cabinets, and bookshelves), which consists of two alternatives, namely the reference anthropometric data and SNI physical facilities. In addition to the physical facility design, the authors provide suggestions to reduce noise and improve the lighting in the classroom as well as the layout of the library. Things which the author proposed for improvement such as construction of the third floor which contain a library, art instruments storage space and 2 extra classes and light bulbs replacement in each classroom with a 30 watt LED fluorescent lamps, replace the windows with soundproof windows, and creation of physical facilities in the library.*

**Keywords:** Anthropometry, Lighting, Noise, SNI

### 1. INTRODUCTION

Many schools are developing in terms of technology, educators, etc. The school has a willingness to change and to improve the performance of teachers. One of the schools that want to develop education is SDN 7 Kiaracandong Bandung. This is due to the team of assessors / auditors of DIKNAS (National Education Department) which provides an assessment of the SDN 7 Kiaracandong about the weaknesses of the school. Here are the results of the assessment of the assessor team :

- Lack of classroom capacity
- Teaching and learning activities that are not conducive
- Lack of library facilities

To address these weaknesses, effort should be made is to make improvements in terms of ergonomics. Issues to be addressed in this study, related to the actual conditions of classroom at SDN 7 Kiaracandong, the actual lighting conditions and noise in SDN 7 Kiaracandong, proposed adding a number of classroom to meet the required capacity,

designing the layout and physical facilities SDN 7 Kiaracandong library with data SNI (for the physical facilities), child anthropometric data and anthropometric data from the book by Ir. Eko Nurmianto, M.Eng.Sc., DERT. The goal is to be conducive atmosphere to teaching and learning activities.

### 2. THEORETICAL BACKGROUND

Ergonomics was derived from two Greek words: Ergon (Work) and Nomos (Natural Laws) to denote the science of work and a person's relationship to that work. Ergonomics draws on a number of scientific disciplines, including physiology, biomechanics, psychology, anthropometry, industrial hygiene, and kinesiology.

According to Montagu and Ashley (1960) anthropometry is a technique of measuring the human body (anthro = human, pometry = measure) in terms of dimensions, proportions, and ratios such as those provided by the cephalic index. Once the

standard approach to racial classification and comparing humans to the other primates, the technique is now used for deciding the range of clothing sizes to be manufactured and determining the nutritional status of people.

In the design of appropriate workspace lighting, the following variables need to be considered. The amount and type of light emitted by the light sources themselves determines the illuminance delivered to work and other surfaces. The furniture and materials, by virtue of their reflectances, determine the balance of luminances seen by workers and the amount of indirect lighting and glare. The visual demands of tasks should be analyzed in the evaluation of lighting, particularly with respect to visual acuity and the demands on accommodation and adaption of the eye and the avoidance of visual fatigue. (Bridger, 1995)

Humans have the ability to defend the body condition normally (have ability to adapt). The ability to adapt with the temperature outside if the changes of it does not exceed 20% for hot conditions and 35% for cold conditions from normal condition of the body (Sutalaksana, 2006).

Noise also comes from surrounding that can really damage the sense of hearing. There are three aspects that determine the quality of a sound that can determine the level of disruption to the human : the length of time the sound is audible, Intensity (dB), Frequency. (Sutalaksana, 2006).

If a room has people, machinery, or activities in it, the air in the room will deteriorate due the release of odors, the release of heat, the formation of water vapor, the production of carbon dioxide, and the production of toxic vapors. Ventilation must be provided to dilute these contaminants, exhaust the stale air, and supply fresh air. In a building with only a few work areas, it would be impractical to ventilate the whole building. In that case, local ventilation can be provided at a lower level, or perhaps in an enclosed area, such as a ventilated control booths or crane cab. (Niebel, 2003)

Based on the Regulation of the Minister of National Education in 2007, the maximum number of one class are 28 people with the following conditions :

Minimum area =  $5 \times 6 \times 1 \text{ m}^2 = 30 \text{ m}^2$ , or  $2 \text{ m}^2 \times \text{number of learners}$

### 3. RESEARCH METHOD

Preliminary data collection is done by conducting interviews with the headmaster and teacher in SDN 7 Kiaracondong. Data collection was taken after preliminary research are school profile, physical environment data (lighting and noise), the number of students, the actual dimensions of the physical facilities, anthropometric data of 100 students, and additional data from the book by Ir. Eko Nurmianto, M.Eng.Sc, Dert and the Indonesian National Standard (capacity class, library design, library physical facilities).

#### Calculation classroom capacity

Compare actual number with standard capacities:

1. Knowing SNI classroom capacity. Maximum capacity in one class of students is 28 people, while class for less than 15 students the minimum area of the classroom is 30 m<sup>2</sup> with a minimum width of 5 m.
2. Number of students per classroom actual
3. Calculation of the number of additional classroom

For the number of students who exceed the standard capacity, proposed additional classrooms at SDN 7 Kiaracondong. Below is a summary table of the results of the calculation of the number of additional classes:

Table 1. Calculation Amount Class Addition

Class	Number of Students	Actual number of classroom	Added Classroom
1	48	1	1
2	46	1	1
3	56	1	1
4A	38	2	1
4B	40		
5	44	1	1
6A	48	2	2
6B	48		
Σ	368	8	7

Example :

Class 1 =  $48 / 28 = 1,71 \approx 2$

Actual number of classroom = 1

Addition = 2 – 1 = 1 classroom

**Physical Environment**

Activities undertaken by teachers and students is influenced by the physical environment. So physical environment must support teaching and learning activities. Here is an analysis of lighting and noise according to the audit team in an issue in SDN 7 Kiaracondong:

Table 2 Lighting dan Noise Data

Class	Lighting	Noise	Conclusion	
1	42-350	67.5-80.8	Not ergonomic	need corrective
2	23-132	71.2-82.5	Not ergonomic	need corrective
3	53-765	60.5-73	Not ergonomic	need corrective
4A	46-171	63.6-77.6	Not ergonomic	need corrective
4B	52-821	63.8-78.1	Not ergonomic	need corrective
5	95-913	67.6-76.4	Not ergonomic	need corrective
6A	24-323	67-87.8	Not ergonomic	need corrective
6B	40-418	67.6-82.1	Not ergonomic	need corrective

One of the physical facilities that affect the lighting and noise are the windows. Window effect on the level of noise that was heard by students and teachers. SDN 7 Kiaracondong there are 3 types of window size does not fit all standard windows in the school in general, it should be designed to improve noise reduction windows that noise will be discussed in the design chapter.

**Physical Facilities**

Authors designed a physical facility in the library accordance with the Indonesian National Standard (SNI) in 2012 regarding the physical library facilities and anthropometry. Physical facilities to be designed is a table (for students and librarians), chairs (for students and librarians), bookcases, and cabinets. Physical facilities such as cupboard, does not exist in ISO 2012 regarding the physical facilities library, but with consideration of the writer, cupboard needed for librarian to store important files. Cupboard size obtained from ISO 2012 regarding the physical facilities in the classroom.

Before doing design with anthropometric, author processing anthropometric data to be considered that would be used in the design. The processing will be discussed in the points below.

1. Summary of test results (normal, uniform, and adequate).

The data collection was done collecting anthropometric data from 100 children at SDN 7 Kiaracondong. After accumulating data then do a normal test, standardized testing and test adequacy. After testing the anthropometric data, it can be calculated percentiles of anthropometric data. Below is a table of percentiles calculated:

Table 3. Percentile

Data Antropometri	Dalam (cm)		
	P5	P50	P95
TBD	34,6	42,5	50,4
TSD	14,1	18,7	23,4
TPO	31,1	36,7	42,3
LB	27,8	33,4	38,9
LP	22,4	28,1	33,7
PPO	30,8	36,8	42,8
PLB	26,6	33,5	40,4
RT	119,8	142,3	164,8
RT ke depan	44,3	54,3	64,3
TBB	88,9	105,0	121,1

The table above is used for the analysis of the design of physical facilities in the library. Anthropometric data are used for reference material consideration the size that will be used by the author.

**4. RESULT AND DISCUSSION**

Proposal for better classroom and facilities for library will be discussed in this stage, such as additional classroom to meet the capacity of the school, the design of the physical environment (lighting and noise) in the classroom, and library design and physical facilities. Here is the proposal given by the author:

a. Class Capacity

From processing and analysis, it appears that the capacity of the class does not meet the standards of the government. Thus, the authors propose to add a classroom on the 3<sup>rd</sup> floor. On the 3<sup>rd</sup> floor, class that can be built is 2 classes with a capacity of students in each class are 25 student for classroom with large 50,05 m<sup>2</sup> and 24 student for classroom with large 49,4 m<sup>2</sup>.

To determine the number of students who are in class design is by dividing the class with class capacity SNI (2 m<sup>2</sup>/number of students). Judging from the amount of the proposed class, there is still a shortage of

classrooms, because of limited space for the class will be tolared to the shortage of school policy. Policies that can be done by the school is to adjust the class by the number of students there. Here is a 3 floor layout designed by author:

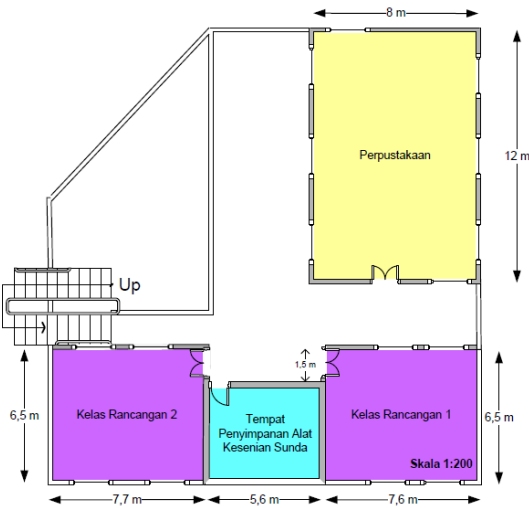


Figure 1 Third floor layout

**b. Anthropometric Data**

Here is the anthropometric data used for the author that can be used as additional data for further research:

Table 4 Children Anthropometric of SDN 7 Kiaracondong Student

Data Antropometri	Dalam (cm)		
	P5	P50	P95
TBD	34,6	42,5	50,4
TSD	14,1	18,7	23,4
TPO	31,1	36,7	42,3
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TBB	88,9	105,0	121,1

**c. Physical Environment**

**Lightning**

To design improvements to lighting the authors propose LED type and number of lights as follows:

Table 5 Number of Lamp

Class	Number of Lamp
1	5
2	5
3	4
4A	3
4B	4
5	4
6A	4
6B	4

**Noise**

To design improvements to reduce noise authors propose the soundproof window. The windows are designed to be installed on the side close to the road, while to the side of the school continue using windows that can be opened, so that there is fresh air in the classroom. Windows affect the incoming light into the classroom. To anticipate class become dark can use the maximum amount of light that have been proposed.

**d. Physical facilities**

Physical facilities that will be designed by the author based on SNI in 2012 on the library physical facilities and anthropometric data (student and additional data from the book Eko Nurmianto). Here is the proposed physical facilities designed by the author:





Figure 2. Physical Facilities by SNI and Anthropometric

**5. CONCLUSION**

- Actual conditions in the study area of SDN 7 Kiaracandong does not meet capacity. The assessment results of the auditor team on the weaknesses in SDN 7 Kiaracandong are correct. The number of students per class is over capacity, which make it difficult for the students and teachers to carry out activities in the classroom.
- We propose to add a new building on the 3rd floor, but the additions can't fulfill all classes. Due to the limited space on the 3rd floor, the classrooms that will be built and changed on the 3rd floor, will

depend on school policies. Additional classes that can be built on the 3rd floor are 2 classes only, because of the building capacity. The author proposes the UKS room formerly used as the classroom moved near the principal's office. The space is a small hallway which was used as a storage of art instruments, which will be moved to the 3rd floor.

- The lighting and noise issues were not reached NAB lighting and noise. Lighting proposed for each class use a predetermined amount of light. LED lamps with 30 watt output flux 300 lumen/watt were recommended. The number of lights can be seen in Table 5. In terms of the noise problem, the authors propose that the windows which can muffle the sound would be installed on the side closer to the edge of the highway, so more effective teaching and learning in schools could be expected.
- The library can be built on 3<sup>rd</sup> floors, because in 2009 the foundation of the school building has been overhauled by the school, so the design of the library can be implemented.

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