

Ergonomic Office Workstation Design that Conforms with the Anthropometry of Each User

Melina Alvita Sjarif¹ Ferdinand Ferdinand^{1*}

¹Faculty of Visual Arts and Design, Universitas Tarumanagara, Jakarta, Indonesia

*Corresponding author. Email: ferdinand@fsrd.untar.ac.id

ABSTRACT

Office workers have to work by sitting in a static posture every day for a long period of time, which can reach up to twelve hours in one day. This situation causes pain to the body, so this design aims to produce an ergonomic workstation design that conforms with the anthropometry of each user to support the user's posture and body health. The design concept prioritizes health, comfort, security, and safety of the user. Therefore, the workstation is made adjustable so that the table height can be adjusted according to the user's anthropometry and allowing dynamic posture. Foot rest to supports body posture, and partition to follows the health protocol are also added to design. The curved table's shape that surrounds the user creates smoother work flow. The curved table corners also support the safety of its users. The configuration of the workstation layout can be changed to create a dynamic environment, so the table legs are installed with wheels for easy displacement.

Keywords: Anthropometric, ergonomic, office, working table, workstation

1. INTRODUCTION

Law number 13 of the year 2003 article 77 paragraph 1 regulates the clause of working hours, namely 40 hours in one week. This system requires someone to work 7-8 hours a day. A study involving 440 respondents from 11 government office buildings in four major cities in Indonesia calculated that the average working time per day is 8.35 hours, with a minimum working time of 6 hours and reaching a maximum of 14 hours. On average, employees work by sitting for 6 hours a day and some others can reach 12 hours a day [1].

Sitting for a long period of time continuously can lead to poor health to the various part of the body. Back pain is a very common problem as static postures can increase stress on the back, shoulders, arms, and legs [2]. The back pain is caused by improper body posture due to limited movement space and non-ergonomic furniture [3]. Pain and discomfort in the body parts can cause a decrease in productivity and efficiency of the employees' working performance. Accordingly, a furniture that is ergonomic and suitable to each human anthropometric standards is needed in order to support the health of its users [4].

Based on the previously stated problem background, a design that is expected to produce an office workstation design which is ergonomic and conforms with the anthropometry of each user is conducted. This furniture design hopefully can allow the user to work in a more dynamic posture choice so that the user doesn't have to always works in a static posture which can cause pain and soreness in various body parts.

2. METHOD

2.1. Case Study

The case study is divided into two parts: location and designing object.

2.1.1. Location

This workstation design is a design project for the Traveloka office. Traveloka is a travel company that offers many kinds of travel need in one online platform such as flight ticket, train ticket, bus ticket, hotel rooms, flight plus hotel packages, tourist attraction places and many fun activities, connectivity products, airport transportation, and also car rental. These offers help the customers in creating beautiful and memorable moments together with their vacation companions in their trips conveniently. This company is also a well-known leading company in Southeast Asia [5].

2.1.2. Designing Object

The object in this design is an office workstation. The word 'workstation' originated from English. Workstation is one of the main facilities in office activities intended primarily to be used for placing things such as laptop, computer, mouse, books, pens, et cetera above the top table and storing things in the shelves or drawers provided. This furniture makes the workflow much easier and brings

more comfort for the employee and in turn increasing the working productivity.

2.2. Method

This design is based on the design process method according to Rosemary Kilmer in the book *Designing Interior*. The design process according to Kilmer is divided into two main stages, which are analysis and synthesis. In the analysis stage, problems are identified, dissected, researched, and analyzed. After the data are collected, following up next is the designing stage where some alternatives ideas of the design solutions begin to emerge in answering to the problems described in the former stage. Some of these design alternatives were then selected as the best and most suitable design solution to be used [6].

According to Kilmer, these two main stages are divided again into several more specific and detailed stages. The analysis stage consists of commit, state, collect, and analyze stages while the synthesis stage consists of ideate, choose, implement, and evaluate stages [6].

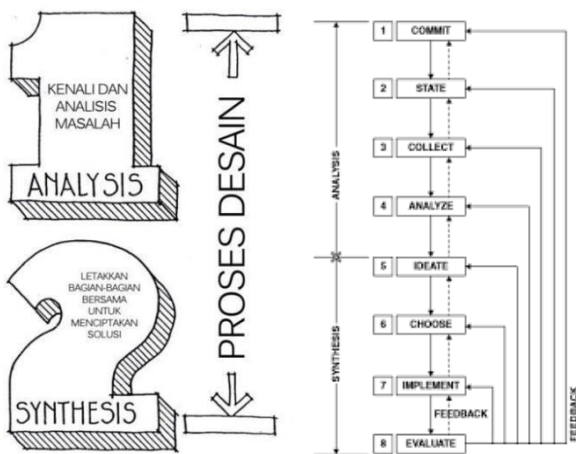


Figure 1 Kilmer’s designing process (source: Kilmer, Rosemary. 2014, pp.181)

The following texts are the detailed description of those stages [6].

- a. Commit is to identify the problems that the designer has to face.
- b. State is the stage to specify the design problem. At this stage, the designer makes a design background, which in this designing case is about office workers who have to work in a static posture for a long time every day which is not a healthy thing to occur to a human body.
- c. Collect is to gather facts and information or data. The designer conducts literature studies, surveys, interviews and makes a programming.
- d. Analyze is a stage to analyze the problem from the data that has been collected. At this stage, the designer creates a design concept to formulate the problems and design solutions needed.

- e. Ideate is producing ideas in the form of design schematics and concepts. The designer creates sketches and alternative designs.
- f. Choose is the stage to choose the most suitable and optimal alternatives.
- g. Implement is a drawing in 2D or 3D form and a presentation that supports them. In this case, the designer creates a 3D visualization of the workstation and a presentation board.
- h. Evaluate is reviewing the finished design. The designer reviews whether the design has answered the design problems, then makes the construction drawing of the final design.

From the information and literature studies that has been collected, the parameters for designing ergonomic workstations according to Nussbaumer [7] can be concluded which are:

- The structure and materials being used are strong, stable, and durable;
- The furniture can be adjusted to bring more comfort for the user;
- There is a partition for health issue;
- Foot rest should also be installed to support the user’s comfort and health;
- The table is curved-cornered;
- Accidents are minimized by using materials that are not rough, reducing sharp edges; and
- Providing a hole on the top table for cables’ path.

Meanwhile, the parameters for designing an anthropometric workstation according to the anthropometric standards based on Human Dimension book by Julius Panero are as follows [8].

Table 1 Anthropometric standard for workstation

No.	Description	Size (cm)
1.	Table length	150-180
2.	Table width	70-90
3.	Normal table height	72-76
4.	Adjusted table’s max height	106-111

Source: Panero, Julius. 1979: 176-177

3. RESULT AND DISCUSSION

3.1. Concept

Ergonomic furniture is a furniture that the design takes optimization, efficiency, comfort, health, security, and safety of its users into serious consideration and uses those mentioned above as a primary thought while designing [7]. The furniture that is being designed has to be strong, stable, and durable. The thing that has the most influence on the strength and the quality is the material that is used. Therefore, the table structure for this design planning uses stainless steel material which is non-corrosive, easy to maintain, and strong—at least stronger than aluminium [7].

During its usage, the furniture is required to minimize the accidents that can occurred, minor and major. The things that can minimize the occurrence of accidents are such as:

- using soft or smooth materials so that they are not rough [7];
- reducing sharp or square edges on the work surface or the top table [7]; and
- providing cable path hole so that the cables are arranged properly and will not cause electric shocks when a short circuit occurs [7].

Considering those things, therefore this workstation design uses a smooth gloss and non-textured HPL material finish for the top table or the work surface, has curved edges at each corner of the work surface, and is provided with cable path holes to organize the many cables.

The designed furniture also has to be designed while keeping the comfort and health of the user's body in mind so that the user can work effectively and productively. Working with an uncomfortable static posture continuously for long periods of time without rest or stretching, especially when looking at a monitor, can cause many soreness and pain to various body parts, especially to the back, waist, and neck [7].

Nussbaumer stated in her book that adjustable furniture is one of the best and main considerations to provide comfort and health for the furniture's user. The reason for this statement is because an adjustable furniture, of which in this design planning case is a workstation, is a working table whose height can be adjusted at will. This adjustable height work table will allow its users to work in a sitting or standing position as desired [7]. This also allows the user to has a more dynamic posture, so that the posture is not static and developing soreness and pain [7].

This powerful adjustable height feature is also useful for adjusting the height of the workstation to conform with the different and various human height of the users [7], especially in a big company such as Traveloka who has many employees. Those employees with various body height will not be restrained with one particular unadjustable workstation height.

Research on the relations between the dimensions of an ergonomic table and chair with comfort while in a sitting position conducted by Putri states that users should rest both of their feet flat on the ground or being supported by a footrest to maintain a healthy posture. Therefore, the office workstation that is being designed in this design planning has a footrest added to support a healthy ergonomic posture for the user [9]. This footrest is located under the table, connecting the two pair of the table's legs. This connection of the legs by the footrest will increase the workstation structure's strength that in turn will also increase the ergonomic quality.

Nussbaumer also stated on her book *Human Factors in the Built Environment* that to maintain a healthy and ergonomic work posture, the location and the arrangement of frequently used work equipments are arranged in a way that has easy access and in a convenient reach for the user to minimize the user's movements to reach out. This accessible reachment can also create a smooth workflow to

increase the working effectivity [7]. Therefore, the designer of this design planning chose a curved or corner desk for work surface of the office workstation that is being designed in this design planning since its shape that surrounds the user will bring the frequently used work equipments closer to the user and make it more convenient for the user to reach them.

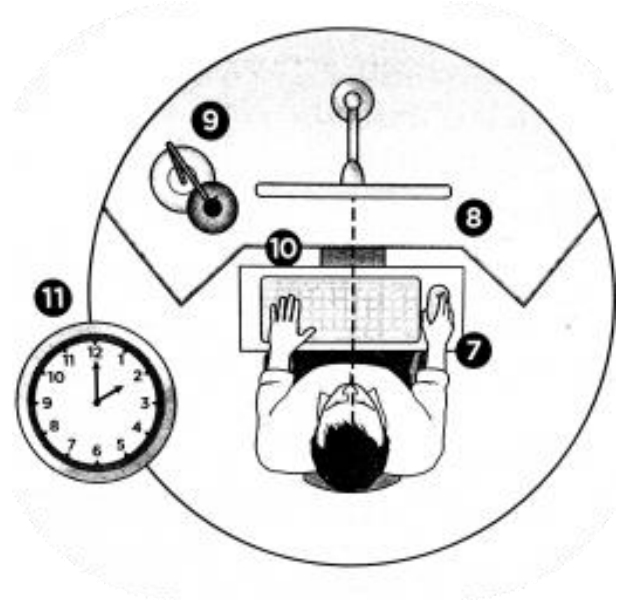


Figure 2 Curved desk that makes the user's reachment more convenient (source: Nussbaumer, Linda. 2014, pp.263)

The design planning that was conducted by Santoso regarding ergonomic computer workstations for learning activities in the classroom also arranged the layout and placements of the frequently used objects above the table close to the user so that the work flow is not wasteful of motions [10].

Partition between users' workstations is also designed on the design planning of the office workstation design as apost-covid-19 necessity and also to comply with the health protocol regulations issued from the government. Naturally, this partition will also support the health of the furniture's user and conforms with the ergonomic parameters.

According to Nussbaumer, anthropometry and ergonomics are closely related. Comfort while working in a sitting or standing position is also influenced by the compatibility between the dimensions of the human body with the access to their works. In addition, if the workstation is designed according to the dimensions of each individual user, it will create a safe, healthy, and comfortable workspace [7]. This reason can make the adjustable feature in this workstation design as the main solution answering to the design problem in this design planning.

Table 2 Anthropometric concept of the design plan

No.	Description	Size (cm)
1.	Table length	180
2.	Table width	70
3.	Normal table height	72
4.	Adjusted table's max height	111

3.2. Design Result

The work surface of the office workstation has a curved shape. The shape of the workstation is curved to facilitate the flow of user's activity in reaching the objects on the table and increasing the effectiveness and productivity of the user's work. The top table's edges of the corners are also curved like a quarter circle so that they are not sharp to increase the user's safety.



Figure 3 Workstation design with curved shape and corner edges.

The office workstation design of this design planning has an adjustable height feature; therefore, the height of the office workstation can be adjusted according to the wishes and needs of each user. Users can choose to change the height of the workstation when their body starts to get sore and in turn enabling them to work with a more healthy and dynamic posture. The height of the table can also be adjusted to the various body dimensions of each individual and makes this office workstation to be very anthropometric and ergonomic. The table height in standard or normal conditions is 72cm, while the maximum height of the table after being raised is 111cm creating comfort to various users.

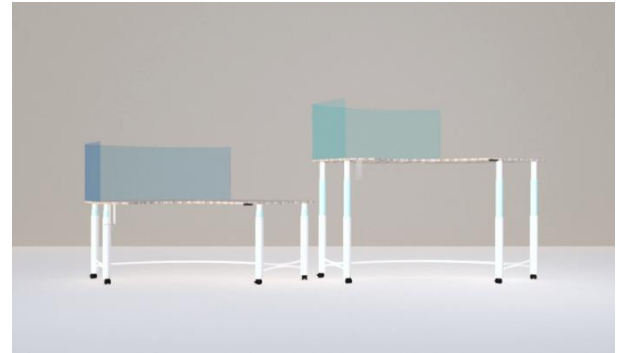


Figure 4 Workstation design with adjustable height. This figure shows the comparison of the workstation's height while in standard or normal height with the adjusted to maximum height position.



Figure 5 Workstation design with adjustable height. This figure shows the visualisation of the user's working posture while sitting and standing.

The workstation layout configuration can be changed as the users' need and desire to produce a more dynamic layout configuration. To facilitate the dynamic movement, there are wheels on each leg of the table which are equipped with a stopper to prevent undesirable movements of the workstation during static or normal conditions. These wheels provide comfort for the users as they make it easier and more convenient for them to move the workstation.

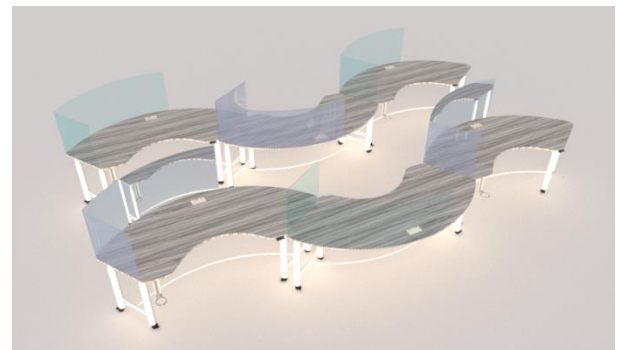


Figure 6 First example of the workstation layout configuration.

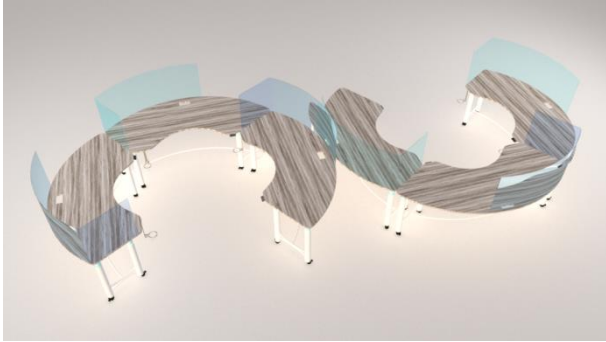


Figure 7 Second example of the workstation layout configuration

4. CONCLUSION

A quite lengthy office hours make workers, mainly office workers, have to work by sitting in a static posture continuously for a long duration of time. This static posture can cause pain and soreness in various body part such as the neck, back, shoulders, arms, and legs which is quite unhealthy to some extent. This pain and soreness are caused by improper static posture due to limited movement space while working for a long duration and also caused by non-ergonomic office furniture.

Therefore, the design of this office workstation is expected to be able to produce an ergonomic office workstation design which can conform according to each of its user's anthropometric standards. The main solution to the problem in this design planning is to use an adjustable height feature on the workstation. This feature allows for a more dynamic postures while working and is compatible with the anthropometry of various users' height.

The shape and edge corners of the workstation's top table are curved to advocate ergonomic parameters such as comfort and safety. Footrest is constructed to sustain health and comfort to user while also increasing the security quality of the workstation as the footrest connects the table legs and in turn increasing the strength of the workstation. Partition is also added on the office workstation to sustain a healthy working space in the pandemic of covid-19 era. Meanwhile, the table legs are also installed with wheels and their stopper so that the workstation layout configuration can also be more dynamic and decrease boredom of office workers.

The advantage of this design planning of office workstation is that it follows an authentic and structured method which is based on the Kilmer method. Meanwhile, the drawback of this design planning of office workstation is that it's opportunity to explore the respondents, the site office, and others is limited. The limitation of this design planning is due to the Covid-19 pandemic regulation that requires the public to stay at home, so the designer could not observe directly at the Traveloka office.

Suggestion for the next design planning is to conduct a more in-depth survey so that all needs and other problems that are not yet known can be met.

ACKNOWLEDGMENT

Thank you to all the interviewees who have agreed to be interviewed and have contributed to the collection of information and data in this design planning.

REFERENCES

- [1] N. F. A. Muhammad, H. Yuri, W. Rani, Studi Ergonomi Terhadap Rancangan Ruang Kerja Kantor Pemerintah Berdasarkan Antropometri Indonesia. *Journal of Pemukiman*. 7(3) (2012)126–137.
- [2] Sulung, Lahitani. (2020). 8 Kebiasaan Buruk Saat Duduk Ini Dapat Bahayakan Kesehatan Pekerja Kantoran. URL: <https://www.liputan6.com/citizen6/read/4265272/8-kebiasaan-buruk-saat-duduk-ini-dapat-bahayakan-kesehatan-pekerja-kantoran> (accessed February 16 2021, 18:17 WIB).
- [3] Fitri, Haryanti Harsono. (2020). Latihan Kebugaran untuk Pekerja Kantoran yang Kelamaan Duduk. URL: <https://www.liputan6.com/health/read/4188650/latihan-kebugaran-untuk-pekerja-kantoran-yang-kelamaan-duduk> (accessed February 16 2021, 18:27 WIB).
- [4] P.K. Suma'mur. *Higiene Perusahaan dan Kesehatan Kerja*. Jakarta: PT. Toko Gunung Agung, 1996.
- [5] <https://www.traveloka.com/en-id/about-us>
- [6] K. Rosemary & K.W. Otie. *Designing Interiors*. New Jersey: John Wiley & Sons, Inc., 2014.
- [7] Nussbaumer, Linda L. *Human Factor in The Built Environment*. New York: Bloomsbury Publishing Inc., 2014, pp. 50-262.
- [8] Panero, Julius & Zelnik, Martin. *Human Dimension*. New York: Watson-Guptill, 1979.
- [9] R.S. Putri, Hubungan Ukuran Meja dan Kursi Ergonomis dengan Kenyamanan Melalui Posisi Duduk Murid Taman Kanak-Kanak Dewi Sartika Surabaya. *Journal of Bio Kultur*. 3(1) (2014) 277-291.
- [10] G. Santoso, Stasiun Kerja Komputer secara Ergonomis untuk Kegiatan Belajarjari Kelas. *Journal of Teknik WAKTU*. 9(2) (2011) 59-62.