ISSN 2228-9860 eISSN 1906-9642 CODEN: ITJEA8

International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

http://TuEngr.com

# Spatial Study Using Space Syntax in the Naval Training Facilities in Norway

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**Paper ID: 15A2A**

**Volume 15 Issue 2**

Received 19 February 2024
Received in revised form 25 March 2024
Accepted 29 March 2024
Available online 20 April 2024

**Keywords:**
Space Syntax; Justified Level of permeability; Level of Wayfinding ; Graph; Navy Base; Training Facility; Military training; Public space; Private space.

## Abstract

Training facilities are buildings where most of the spaces are open to the public due to the facilities. Improper design layout might bring chaos to the user that public spaces and private spaces might be mixed up, making the user confuse their destination to the desired facility. This paper aims to study the spatial permeability and wayfinding of a training facility. That helps to understand the relationship between space and how to lead users to their desired spaces. The selected case study is the Naval Training Facilities in Norway, this building consists of indoor and outdoor training facilities. The result of this study shows how to design training facilities at an acceptable level for permeability. Besides, this study also focuses on the pattern of wayfinding which is how to lead people from one space to another without confusion. Wayfinding can be very simple for the user moving around the public space and challenging for the user to move to the private area.

**Discipline**: Architectural Engineering.



## Cite This Article:

Soon, B.T., Arab, Y., Onubi, H.O., Saeed, M., and Hassan, A.S. (2024). Spatial Study Using Space Syntax in the Naval Training Facilities in Norway. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, 15*(2), 15A2A, 1-12. http://TUENGR.COM/V15/15A2A.pdf DOI: 10.14456/ITJEMAST.2024.7

## 1 Introduction

The Navy is the naval forces or maritime forces are armed forces that are professional and trained to fit naval and amphibious warfare (Wikipedia, 2021a). "Academy" is a school in simple words that allows armed forces to train, practice, test, etc. to be prepared for warfare (Wikipedia, 2021b). Hence, a Navy Academy is an education institute that provides facilities and training programs to prepare the armies ready to serve the nation and their people.

According to Malaysia's ATM Act, there are three regular forces established and maintained The Malaysian Army, The Royal Malaysia Navy, and The Royal Malaysia Air Force. The Royal Malaysia Navy (RMN) is Malaysia's naval armed forces. This mission of the RMN is to protect the sovereignty and interests of maritime countries which refers to the specific tasks entrusted to the RMN in the preparation and arrangement of Navy movements to ensure the safety of the territorial waters of the country and to ensure victory during the war, fighting the enemy that is in the country of the outside of the country to save souls or property of the country (Act 77, 1072).

To ensure the RNM has adequate space or a training facility for their training to fit their duty, the spatial relationship and design are the key. To allow the trainee, trainer, or user can flexibly access the public spaces while keeping the privacy of specific spaces.

The Naval Training Facilities located at Bergen, Norway, designed by Longva Arkitekter has been chosen to be the case study for this paper to study the spatial relationship, and analyze and discuss the quality of space through space syntax. This project was completed in 2011, consisting of several indoor and outdoor facilities for the navy training exercise. It also won a competition award of Honourable mention in the Norwegian National Architecture Award 2012, Winner of Norwegian Defence Estates Agency Architecture Award 2013, and Winner of A. C. Houens fund diploma 2015 (King, 2012).

This study's problem statement as we had identified as a naval training facility is mainly used by the members of the navy, which is usually private from the local residences but is public to the navy member. However, this circumference of public use contains semi-public and private spatial.

Hence, this research aims to study the spatial and space relationship based on permeability and wayfinding for this building. To understand the circulation within the building is it easy to access, whether moving from one space to another is practical, whether the public space and the private space are well planned or how it is planned, and more.

## 2 Literature Review

Hillier and Hanson (1984) indicated that space syntax is a philosophy to analyze the designed space in several components, for example, municipalities, cities, buildings, or landscapes. The central concept of space syntax analyses is based on the in-depth analysis of permeability and wayfinding level in the spatial relationship and interaction with social or cultural meaning in the architecture approach. Besides that, like Hassan et al. (2010), people use two mechanisms for personal space and territorial behavior to regulate their need for privacy. Homes and gardens or personal space within shared facilities are included in the primary territory where we try to have full control. Secondary territories refer to spaces under the occupant's partial control, such as spaces outside the facilities. By providing a theoretical understanding of how people establish and use spatial configurations, Space Syntax attempts to formulate a configuration theory in architecture (e.g., mosque layouts).

Space syntax creates the interaction of society and culture in the built environment through space relationships and connectivity (Ackerson & Straty, 1978). Therefore, space syntax seeks to describe how spatial configurations convey a social or cultural sense and how spatial configurations develop social interactions in built environments. A significant number of research and publications have shown that earlier studies of space syntax concentrate on real environments and identify the inherent nature of environments created by people. (Hassan et al., 2013)

There are a few ways to do space syntax, but justified graphs, syntactic steps, and depth graphs are the ways that can be implemented for more comfort to read and analyze. (Hillier et al., 2016). However, a justified graph will be the primary selection for this research, which is preferable for analyzing the depth and level of case studies' permeability. Further, to analyze the space syntax theory usually permeability and wayfinding, where space relationship and connectivity are the cognition aspects.

Permeability can be defined as the relationship between the spaces inside or outside of a building in which movement of the people or vehicles in a direction is allowed or limited. For example, the permeability levels of a space can be defined as public, semi-private, and private. (Halim et al., 2019) Hence, this study's permeability will be defined by the space function and level of space privacy. The higher the space's permeability, the higher the privacy.

Wayfinding is guidance for an architectural design that improves people's understanding and experience of a space, based on a physical environment. (Mohd Yasin et al., 2017) Moreover, it also solves the spatial issue. It gives the people guidance on their desired destination or space and leads them from the current location they are situated to the space they desire to travel within or outside of the building or an environment. (Natapov et al., 2015)

Training facilities are a kind of building or structure similar to the sports complex or center. The difference between training facilities and sports complexes is that training facilities are concentrated on purpose training such as military training. Most of the time, it was designed together with the primary purpose building.

Furthermore, conventional military facilities are concentrated only on physical conditioning and skills training. However, nowadays, the facilities encourage even greater use of various kinds of computer simulations to provide more effective and more hours of training at a lower cost and with lower risk to users and officers in more practical situations. Besides that, those facilities also consist of senior officers' advanced training and development. (Military Building, 2020)

## 3 Case Study: The Naval Training Facilities

This training facility (Figure 1) is designed for navy education and specialized training for Norway's Royal Navy at Haakonsvern Navy Base near Bergen, Norway. The facilities are built beside the shore and serve the naval forces and other military forces of about 5000 people. The typology of this building is a military academy. It is a private training academy that is only open to the base's employed staff and the navy and military forces (King, 2012).

**Figure 1**: Naval Training Facilities Perspective

The academy itself has two facilities indoor facilities and outdoor facilities. The indoor facilities building consists of a 25m depth swimming pool and a 25m depth specialized pool. Other facilities like a multipurpose hall, several group training rooms, a rock climbing wall, and a strength & fitness training room. (King, 2012)

Moreover, these facilities' external space also has several training facilities such as an artificial pitch and running track, ballpark, obstacle courses, and volleyball courts. Near the shore edge, jetties are designed for climbing and assault training.

This building design intends to create a robust building with reliable and maintenance-free materials that can withstand aggressive use. The architect designs it in exposed and raw concrete surface, brick, unglazed tiles, and oiled wood to fit the interior's intention. (King, 2012)

# 4 Method

This research uses justified graphs as tools to identify and study the spatial configuration of the case study through the way of permeability and wayfinding of the space. The justified graph is the graph with labeled alphabets and numbering studied from the plan and stated in the form of data on a graph, which will show the level of permeability and level of wayfinding.

The way to identify the level of permeability and wayfinding is by separating the visitor and the facility staff. To justify the level of permeability and wayfinding, the Likert scale is one of the most straightforward measurements used to measure the level of permeability and wayfinding analysis data for the use of the justified graph (see Figure 2).

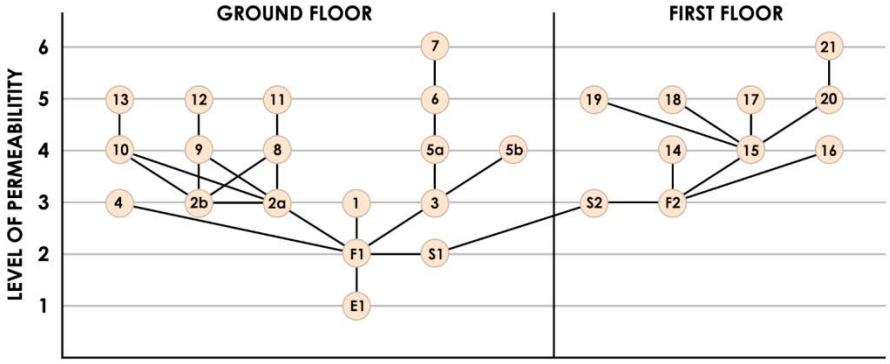



**Figure 2**: Justified Graph

The Likert scale level of the permeability level (Figure 3) will be measured as public space to private space. The scale of measurement will be based on (1) Public, (2) Semi-Private, (3) Private. The scale increases in number as the level of permeability and wayfinding of the space. (Yusoff et al., 2019). Furthermore, wayfinding will be measured based on the accessibility between the spaces. The scale of measurement (Figure 4) will be as: (1) Easy, (2) Moderate, (3) Difficult.

The labeling of the space (Table 1) is categorized based on the type of space. By studying the plan, the type spaces are categorized as a staircase (ST), an elevator (EL), general space (GS), training space (TS), administration (AS), storage & depot (SS), and services (MS), then following with the number (numbering order as ST1, ST2; GS1, GS2; etc.). To prepare the justified graph first identify the space into Ground Floor Level and First Floor Level into two columns.

Following that, translate the information studied and categorize it into a justified graph according to the study of the space relationship and spatial configuration. Hence, the justified graph will show the link of the spaces.

**Table 1**: Numerical and Alphanumeric Labeling of Spaces

| Type of Space | Label of Space |
|---|---|
| Staircase | ST1, ST2, ST3, … |
| Elevator | EL1, EL2, EL3, … |
| General Space | GS1, GS2, GS3, … |
| Training Space | TS1, TS2, TS3, … |
| Administration | AS1, AS2, AS3, … |
| Storage & Depot | SS1, SS2, SS3, … |
| Services | MS1, MS2, MS3, … |

The graph's lower level will be indicated as 0 to the upper level as 10, also known as public to private for permeability and easy to difficult for wayfinding. The greater the number, the higher privacy for the permeability; and the greater the number, the more challenging to access the wayfinding, see Figure 4.

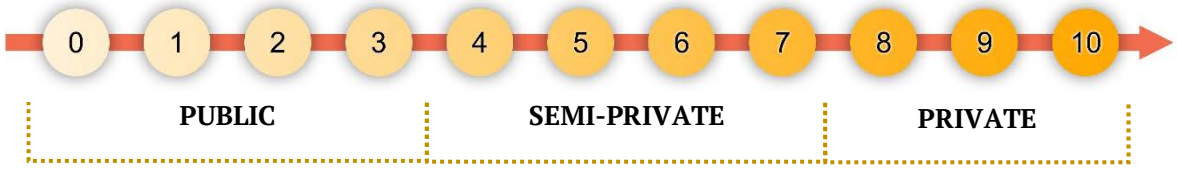



**Figure 3**: Level of Permeability based on Likert Scale.

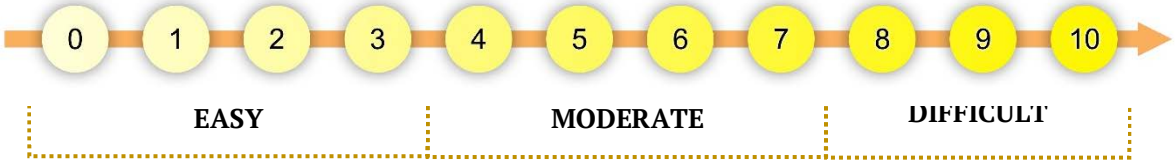



**Figure 4**: Level of Wayfinding.based on Likert Scale.

Based on the analyzed information, the depth of the level of permeability and wayfinding will be indicated as percentages in Table 4. The level of access will be categorized into three levels (primary, secondary, and tertiary) according to the depth of permeability and wayfinding. Hence, the higher the percentage, the lower the privacy and the more comfortable accessibilities.

**Table 4**: Level of Accessibility

| Depth of Level of Permeability and Wayfinding | Level of Accessible | Percentage of Accessibility (%) |
|---|---|---|
| **0-3** | Primary Level | 81-100 |
| **4-7** | Secondary Level | 41-80 |
| **8-10** | Tertiary Level | 0-40 |

# 5 Results

## 5.1 Entrance

Based on the ground floor plan study, two entrances (ET1 and ET2) access the building on the ground floor. ET1 is the entrance connected from indoor training facilities to outdoor training facilities such as a jetty, volleyball court, basketball court, running track, and obstacle course. (OS1, OS2, OS3, OS4 and OS5). ET2 is another entrance connected from indoor training facilities to the car parking area 1 (CP2).

## 5.2 Ground Floor Level (Outdoor)

The outdoor space of this training facility consists of training spaces, as the site plans show in Figure 5, there are two volleyball courts (OS2), a basketball court (OS3), a running track plus a football field (OS4), and an obstacle course (OS5). Near to the volleyball courts (OS2), are also linked to jetties (OS1). All of the facilities are linked to the pathway located in the middle of those outdoor training facilities. Furthermore, another car parking area (CP1) is connected to the running track plus a football field (OS4) to access the building.

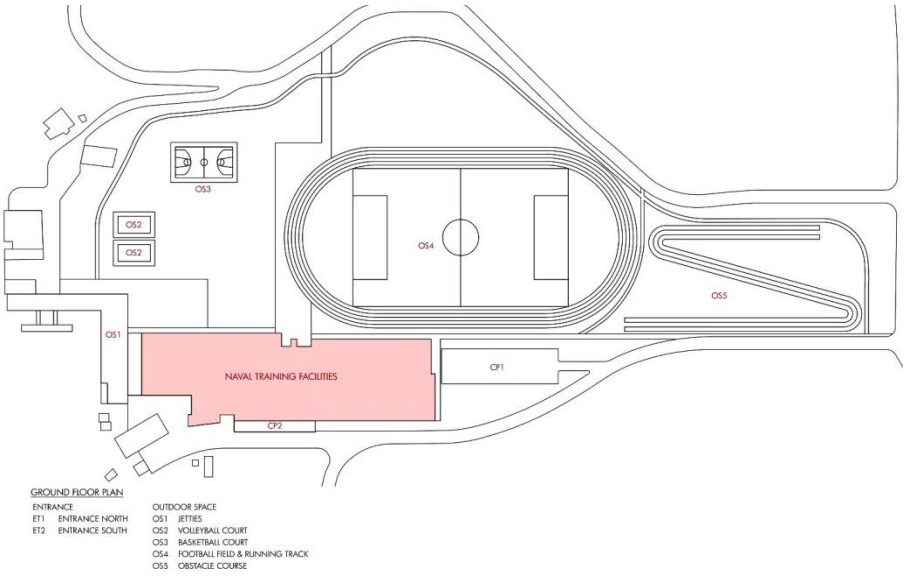



**Figure 5**: Site Plan

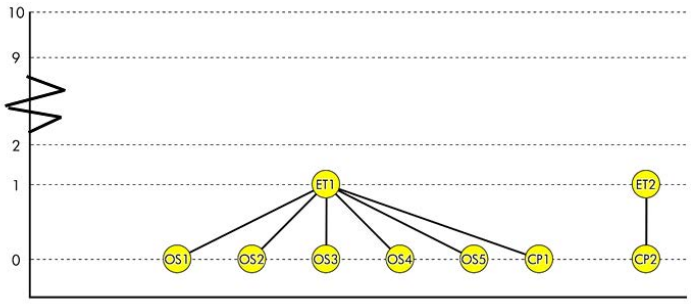
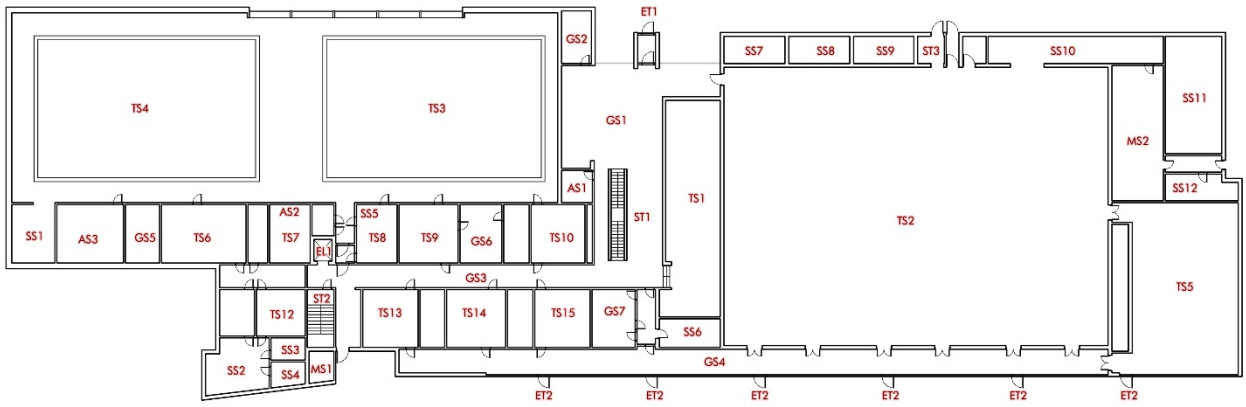



**Figure 6**: Justified Graph of Site.

## 5.3 Ground Floor Level

Naval training facilities building ground floor plan is drawn, see Figure 7. Figure 8 gives the analysis results in term of justified graph.




GROUND FLOOR PLAN

STAIRCASE & ELEVATOR
ST1 STAIRCASE 1
ST2 STAIRCASE 2
ST3 SPIRAL STAIRCASE
EL1 ELEVATOR

ENTRANCE
ET1 ENTRANCE NORTH
ET2 ENTRANCE SOUTH

GENERAL SPACE
GS1 FOYER
GS2 CHIRLDCARE
GS3 CORRIDOR 1
GS4 CORRIDOR 2
GS5 SAUNA 1
GS6 SAUNA 2
GS7 TOILET

TRAINING SPACE
TS1 CLIMBING WALL
TS2 MULTI-PURPOSE HALL
TS3 SWIMMING POOL 1
TS4 SWIMMING POOL 2
TS5 TRAINING AREA
TS6 CHANGING AREA 1
TS7 CHANGING AREA 2
TS8 CHANGING AREA 3
TS9 CHANGING AREA 4
TS10 CHANGING AREA 5
TS11 CHANGING AREA 6
TS12 CHANGING AREA 7
TS13 CHANGING AREA 8
TS14 CHANGING AREA 9
TS15 CHANGING AREA 10

ADMINISTRATION SPACE
AS1 FRONT OFFICE
AS2 GUARD
AS3 RESTITUTION

STORAGE & DEPOT SPACE
SS1 STORAGE 1
SS2 STORAGE 2
SS3 STORAGE 3
SS4 STORAGE 4
SS5 STORAGE 5
SS6 STORAGE 6
SS7 STORAGE 7
SS8 STORAGE 8
SS9 STORAGE 9
SS10 STORAGE 10
SS11 STORAGE 11
SS12 STORAGE 12

M & E SPACE
MS1 REFUSE CHAMBER
MS2 HVAC 2

**Figure 7**: Ground Floor Plan.

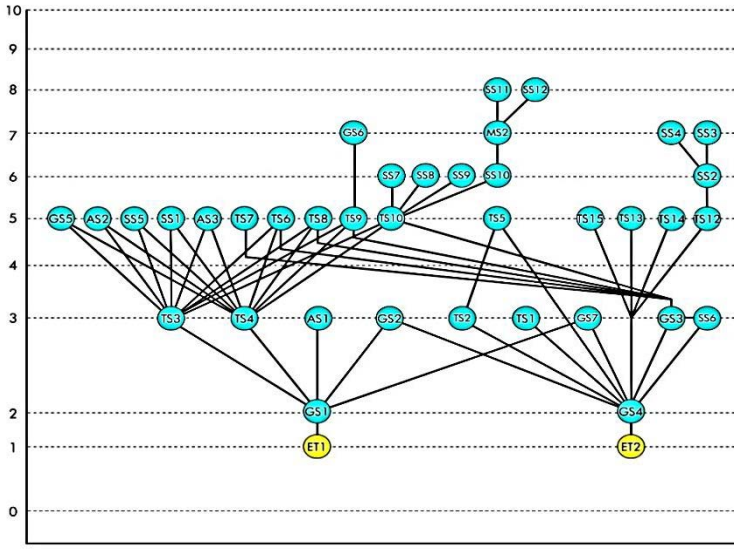



**Figure 8**: Justified Graph of Ground Floor

The primary space on the ground floor level is the foyer (GS1), after entering the entrance (ET1). The foyer (GS1) is the main reception area with a reception counter positioned, to lead to the swimming pool (TS3 & TS4), climbing wall (TS1), multipurpose hall (TS2), childcare (GS2), front office (AS1), corridor 1 (GS3), and first-floor level by a staircase (ST1). Figure 8 shows the justified graph of ground floor.

### 5.3.1 Swimming Pool (TS3 & TS4)

Swimming pool (TS3 & TS4) is one of the building's training facilities. Swimming pool (TS3 & TS4) is linked to the several changing areas such (TS6, TS8, TS9 & TS10), storage (SS1 & SS5), restitution (AS3), and lifeguard room (AS2). In between, some of the sauna room is linked to changing rooms such as, changing room (TS6) is connected to sauna room 1 (GS5), and changing rooms (TS9 & TS10) are linked to sauna room 2 (GS6).

### 5.3.2 Corridor 1 (GS3)

Corridor 1 (GS5) is the corridor located horizontally in the center on ground floor level. It linked to several facilities such as climbing wall (TS1), changing rooms (TS6, TS7, TS8, TS9, TS10, TS11, TS12, TS13, TS14 & TS15), staircase 2 (ST2), an elevator (EL1), and refuse chamber (MS1).

### 5.3.3 Corridor 2 (GS4)

Another corridor, corridor 2 (GS4), is linked to the entrance 2 (ET2) from the car parking area 1 (CP1). Besides that, this corridor is also linked to changing areas (TS13, TS14 & TS15), toilet (GS7), storage (SS6), corridor (GS3), and the training facilities such as climbing wall (TS1), multipurpose hall (TS2) and training area (TS5).

### 5.3.4 Multi-purpose Hall (TS2)

According to the layout, the multipurpose hall (TS2) is one of the largest spaces, which is linked to the foyer (GS1), training area (TS5), corridor 2 (GS4), spiral staircase (ST3), and some of the storages (SS, SS8, SS9 & SS10). Besides, storage (SS10) is linked to HVAC 1 (MS2), which is linked to storage (SS11 & SS12).

### 5.3.5 Training Area (TS5)

The linkage of training area (TS5) is linked to lesser space which is just a multipurpose hall (TS2) and corridor 2 (GS4) only.

## 5.4 First Floor Plan

Figure 9 shows the first floor plan. Figure 10 gives the justified graph of first floor.

### 5.4.1 STAIRCASE 1 (ST1), STAIRCASE 2 (ST2) & ELEVATOR (EL1)

Staircase 1 (ST1) on the first-floor plan is landed on foyer 2 (GS8). Furthermore, foyer 2

(GS8) is linked to corridor 3 (GS9), group training room (TS20), and fitness room (TS21), which are linked to the spiral staircase (ST3). On the other hand, staircase 2 (ST2) and an elevator (EL1) are linked to the corridor 3 (GS9).

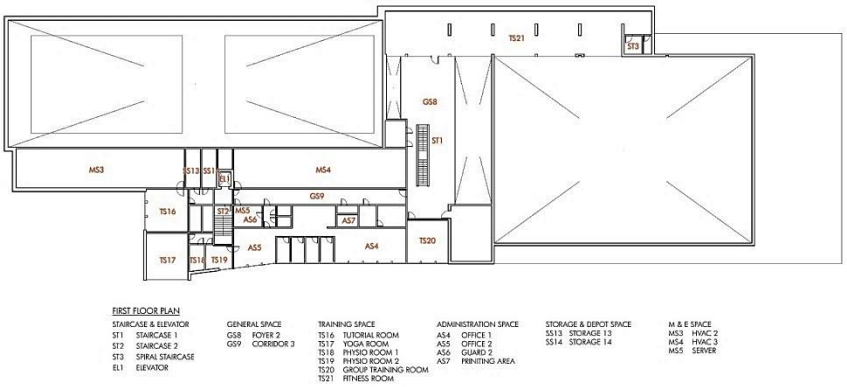



**Figure 9**: First Floor Plan.

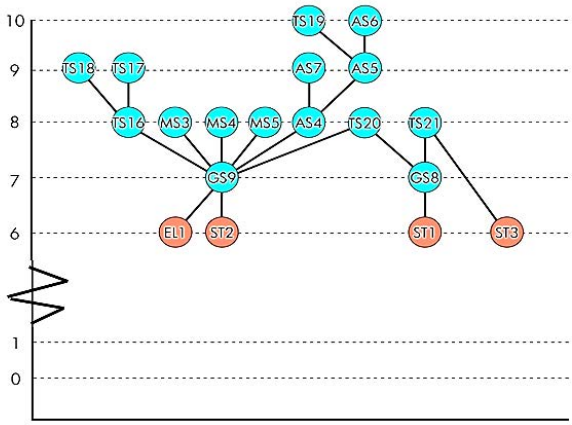



**Figure 10**: Justified Graph of First Floor

### 5.4.2 Corridor (GS9)

Corridor 3 (GS9) is linked to most of the space on this level. These are linked to training facilities such as the tutorial room (TS16), and yoga room (TS17), and yoga room (TS17) are also linked to physio rooms (TS18 & TS19). Besides that, Corridor 3 (GS9) is also linked to office areas such as office spaces (AS4 & AS5), and printing area (AS7). Nevertheless, Corridor 3 (GS9) is linked to some services such as HVAC 2 & 3 (MS3 & MS4), server room (MS5), guard room (AS6), and storages (SS13 & SS14).

## 6 Discussion

As the result shows, it is proven that the main training facilities such as a swimming pool, climbing wall, multipurpose hall, fitness room, and outdoor training facilities are the most popular spaces in this building. Wayfinding of those spaces is easy to access from any of the entrances after dropping by from the car parking space. Besides that, those spaces are considered public spaces based on permeability study where the location and layout of the space are designed for navy public users.

Furthermore, from a wayfinding perspective, the indoor training facilities are very straightforward. It is directly linked to the training facilities' supporting space such as a changing

area, sauna, storage, and more. The ideas of locating the supporting space close to the training facilities known as the public space allow the user of the training space to more conveniently access the supporting space while having their training. That made the most of the supportive space in these facilities a semi-private space.

Also, other semi-private spaces are located on the second floor, such as office space, which serves only these facilities' staff. The public users might find it challenging to enter the spaces unless they are the staff of this building or the training facilities' users. Moreover, there are private spaces that no one enters unless it is necessary. Those spaces are M&E services spaces such as HVAC rooms, storage areas, and more.

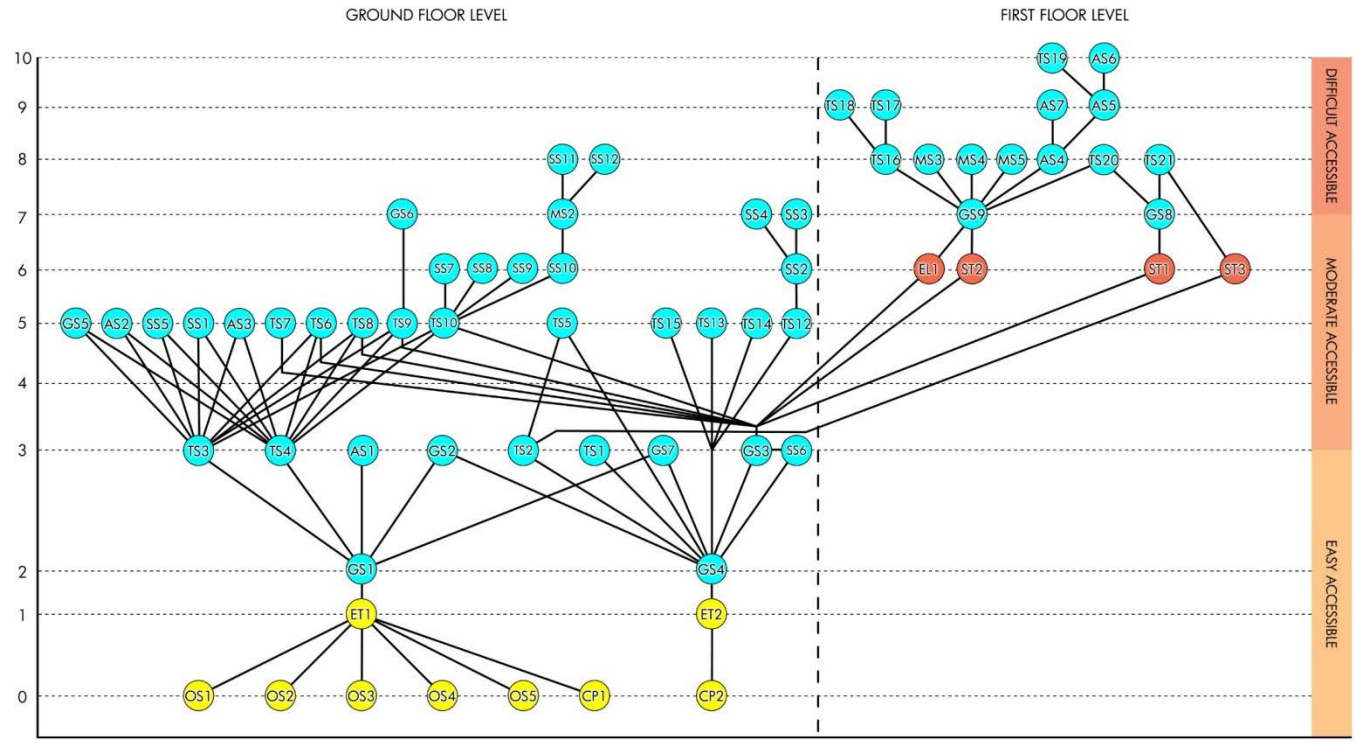



**Figure 11**: Overall Justified Graph

Understanding wayfinding through justified graphs and layout plans (Figure 11) shows that the most used spaces such as the swimming pool, climbing wall, multipurpose hall, outdoor training facilities, and more located close to the entrance and the foyer which are easily accessible according to wayfinding. As same as the first-floor level, the fitness room and group training room are also closer to foyer 2 and staircase 1.

Besides that, the semi-private space such as office space in this building is located along the middle corridor or next to the public space which is not so private but allows the staff of this facilities can be easy to access but are not easy to be accessed by the navy public user. The path for office space is just linked near staircases 1 & 2 and the elevator but partitioned with a wall to enhance the space's privacy.

Lastly is the private space, those being the most private in the wayfinding behavior that the Navy public user or the staff cannot easily access. As a result, shown, the path is not easily

recognized by maintenance technicians unless they have been accessing it before.

To shortly define the public, semi-public, and private spaces accessibilities in these facilities can be understood in ways such as in public space; the user can reach the destination during their first approach; in semi-public space, the user might need to approach the public space first or approach several times to the destination before they can recognize the space; private space, only the staff or the maintenance people familiar to the spaces.

## 7 Conclusion

Throughout the study of these facilities, Naval Training Facilities found that this facility has a very straightforward layout plan. These facilities consist of indoor and outdoor facilities that connect with an entrance, and another entrance only connects to the indoor facilities.

Regarding permeability, those spaces such as training facilities like a swimming pool, climbing wall, multipurpose hall, fitness room, and outdoor training facilities are the main spaces, which are also public spaces. Secondly, the semi-private spaces such as changing areas, saunas, storage, offices, and more are the supporting spaces for the facilities' public spaces. Lastly, private spaces are located in a less visual location that does not allow people to enter unless necessary.

The wayfinding of this building is very straightforward. The entrances are connected to the foyer or corridor, then the foyer and corridor are connected to the public space. The facilities' corridor is very straightforward: only 1-2 corridors per floor in a linear form. That leads to all of the space without confusion.

In conclusion, these facilities are constructed straightforwardly and serve the purpose. It has the best wayfinding layout, which allows the user to have better accessibility.

## 8 Availability of Data and Material

All information is included in this article.

## 9 References


Ackerson, B. J., & Straty, G. C. (1978). Space Syntax in Architectural Design. The Journal of Chemical Physics, 69(3), 1207–1212. DOI: 10.1063/1.436655

Halim, N. F. A., Hassan, A. S., Arab, Y., & Angood, R. S. A. B. (2019). Ocean Conservation and Waste Prevention Centre: the Study of Space Syntax in Recycling Facility. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies*, *10*(19), 1-11, Paper ID: 10A19Q. DOI: 10.14456/ITJEMAST.2019.45

Hillier, B. & Hanson, J. (1984). *The Social Logic of Space*. New York: Cambridge University Press.

Hillier, B., Hanson, J., Bartlett, T., & Benedikt, M. (2016). *What is Space Syntax*. (June), 3–5.

King, V. (2012). *Naval Training Facilities*. Retrieved 2020, from https://www.archdaily.com/221459/naval-training-facilities-longva-arkitekter

Natapov, A., Kuliga, S., Dalton, R., & Hölscher, C. (2015). Building circulation typology and Space Syntax predictive measures. *10th International Space Syntax Symposium (SSS10)*, 30.1-30.16. http://nrl.northumbria.ac.uk/21985

Wikipedia (2021a). *Navy*. https://en.wikipedia.org/wiki/Navy

Wikipedia (2021b). *Academy*. https://en.wikipedia.org/wiki/Academy

Yasin, N. M., Hassan, A. S., & Al-Ashwal, N. T. (2017). Investigation of mental mapping in urban design: Case of Queensbay, Penang. *International Transaction Journal of Engineering Management & Applied Sciences & Technologies*, *8*(4), 261-273.

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