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A Study on Space Syntax of NOAA Southwest Fisheries Science Center

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Abstract

Space syntax is a tool to analyze the spatial configurations of a building. This paper investigates a study on the building typology of a research center. The objective is to identify the spatial layout of the selected building typology, which influences how people utilize the building spaces. The case study is NOAA Southwest Fisheries Science Center. This study uses an archive of the existing layout plans to configure the space syntax of the building spaces. The study examines the wayfinding and the degree of permeability inside the building using justified graphs as a measurable tool. The result indicates that the overall building's space articulation has a good spatial configuration with 70% private spaces. The layout spaces besides are well defined as the wayfinding of each area has good accessibility. This study shows that space syntax is an effective tool for architects to understand the space function as it demonstrates the building's spatial configurations that quantify the important characteristics of the building typology.

Disciplinary: Architectural Sciences.

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1 Introduction

Public and private space arrangements need to be planned accordingly to design efficient spatial development (Yusoff et al., 2019). This study investigates a research center's public and private spatial configuration to what level of efficiency allows interaction between faculty,

academics, students, and industry to enhance research opportunities, academic excellence, problem-solving, and knowledge development and dissemination (Kumar, 2017). Furthermore, the architectural space organization influences the research productivity and quality of work (Saeed, 2012). As an introduction to the case study, The NOAA Southwest Fisheries Science Center is designed by a Gould Evans-led design team (Evans, 2014b), completed its construction in 2013, and located in San Diego, United States.

The center has a world-class facility that helps talented scientists and promotes ongoing research on the conservation and management of living marine resources. This building is the most suitable for this study because it received ACEC California Chapter Merit Award under the category Engineering Excellence Award in 2013 and AIA California Honor Award under Unbuilt Category in 2008. This building is also certified as LEED Gold Certified building. Furthermore, the building encompasses the vernacular waterfront of outdoor terraces, courtyards, local materials, and local coastal vegetation, all of which bind researchers to the environment they are committed to preserving (Rohr, 2015). This study examines how good the building's space syntax of this research center. This space syntax can be measured by evaluating the extent of permeability and wayfinding of various users. In addition, this paper aims to analyze the arrangement of private and public spaces, their relation, and accessibility.

2 Literature Review

2.1 Space Syntax

The concept of space syntax is that there is probably an observable framework within the built environment defined by human interpretation (Mora, 2009). The study of space syntax is rigorously directed by reason. Instead of discerning identity by observation, space syntax helps the intuitive design process by adding justification (Hillier & Hanson, 1984). The method of learning the syntax of space also requires an elementary graphic representation of the spatial organization. Figure 1 illustrates the elementary descriptions of space syntax using depth level of space and movement.

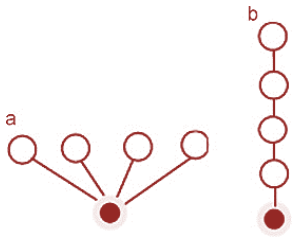

Figure 1: An elementary representation for space syntax analysis - 'a' represents minimum depth (symmetric system), 'b' a linear sequence of maximum depth (asymmetrical system) (Hillier & Hanson, 1984).

2.2 Case Study: NOAA Southwest Fisheries Science Center

The study analyses space syntax of the NOAA Southwest Fisheries Science Center, San Diego, United States, to identify the spatial configuration. When planning efficient space-function, public space and private space must be designed accordingly (Yusoff et al., 2019). Therefore, the practice of studying space syntax involves a graphical representation of the spatial organization

(Munir et al., 2019). The NOAA Southwest Fisheries Science Center is the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service in the Southwest Region (Kruce, 2011). The NOAA Southwest Fisheries Science Center was designed by a Gould Evans-led architect team, providing a world-class facility that will help attract talented scientists and facilitate ongoing research on the conservation and management of living marine resources in the area (Evans, 2014a).

The building location naturally blends into the contours of the local hills and coastal habitat, as shown in Figure 2, and integrates a comprehensive program of offices, laboratories, meeting rooms, parking, a library, and an ocean technology innovation tank all within a specific building footprint (Rohr, 2015). This research center is built as a Semi-Private building. This building is for the scientists to conduct marine biological, economic, and oceanographic research, observations, and monitoring of living marine resources in their environment (Koch, 2019).

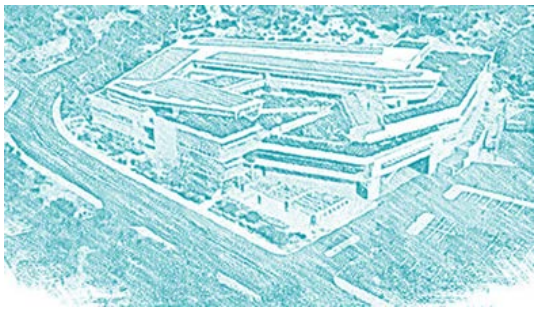

Figure 2: Exterior view NOAA Southwest Fisheries Science Center. Redrawn by Abdul Hakim
Source: Assassi Productions

The NOAA Southwest Fisheries Science Center is located in San Diego, United States (Figure 3). Evans (2014a) stated that the building is perched at the La Jolla Canyon head, a bathymetric feature that allows researchers access to the deep Pacific Ocean (Figure 4). Inspired by the ocean's topography and Southern California culture, the building design sets a new benchmark in sustainable laboratory design with low impact, thus creating innovative synergies between marine scientists and their surroundings (Rohr, 2015).

The Southwest Fisheries Building integrates the local microclimate while accommodating research scientists' ever-changing needs (*Architizer*, 2013). The new research facility continues the Californian style, tradition with an open architectural environment, and the courtyards interacting researchers from different disciplines (Evans, 2014a). According to Evans (2014b), the 124,000 square foot structure design emphasizes ocean views from the road, built into a steep contour. The building facilitates offices, labs, meeting rooms, parking, a library, and a 528,000-gallon ocean technology production tank. The Ocean Technology Development Tank of NOAA southwest fisheries science center encourages NOAA's investment in new observation systems and innovative survey technologies (Hewitt, 2020). Terracotta sunshades, green roofs, and photovoltaic panels help this building set a new benchmark in sustainable architecture design (Evans, 2014b). The split floor plan with a narrow floor maximizes natural daylight and natural ventilation (Rohr, 2015). In

addition, Al-Ashwal & Hassan (2017) explained that natural daylight is an alternative source of light to artificial lighting in sustainable building designs.

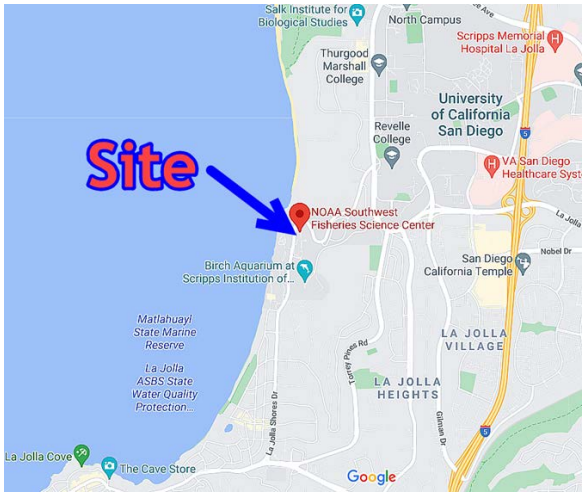

Figure 3: Location Plan of NOAA Southwest Fisheries Building, San Diego, USA.
(Courtesy of Google Map, Geolocation 32.8701038153346, -117.25111171879419).

3 Method

This research is an analytical study that uses quantitative analysis using graphs to define the permeability and level of wayfinding of spatial networking quality. First, a literature review on the academic discourse of spatial syntax and typology of the building is carried out to identify a framework on which case studies can be better analyzed.

To analyze the spatial networking system, this study uses the justified graph to show both the degree of permeability and wayfinding of the case study spaces. The justified graph refers to a survey from Hillier and Hanson (1984), which shows the permeability level for the layout plan and the internal building configuration.

The level of permeability is from 0 (Entry Level) to 5 (Most Private) for the vertical scale. Each number in the circle refers to the space labelled on the building's floor plans with the same number. The horizontal axis illustrates the depth level. The separate lines connecting the circles indicate that a connection occurs between the connected spaces. The justified graph in Figure 5 shows the depth level of accessibility between the entrance to the site and the house entry, which will differ their scales on the graphs. The greater the number, the greater the depth level, which shows, the larger the permeability

For this case study, three indicators differentiate the user type, which is indicated by three different colors. The pink color means space restricted for staff, and the brown color indicates the vertical connectivity, while the blue color indicates the space that is permeable by the visitor. This indicator will aid in assessing the level of permeability in the case study. The staircase and lift are indicated in brown color. The floor plan's staircase is shown as (S1, S2, L1, L2, etc.). Entrances are classified as E1, E2, and E3, which marks the first space to navigate. However, transition spaces like corridors are described as C1, C2, etc., to understand better how people navigate various spaces in

the NOAA Southwest Fisheries Science Center. The degree of permeability is measured by the depth levels in the graph (Figure 5).

3.1 Synthesis of Data

Determining the level of permeability and wayfinding according to the user types, divided into staff and visitors, will aid navigability. With the aid of the floor plan (Figure 6), depth levels will help analyze the permeability and wayfinding of NOAA Southwest Fisheries Science Center. The justified graph is measured based on five- scale categories: (1) public; (2) semi-public; (3) semi-private; (4) private; and (5) extremely private. The numberings will illustrate whether the wayfinding and permeability are positive or negative. From the result of the justified graph, the level of permeability and wayfinding will refer to spatial networking quality.

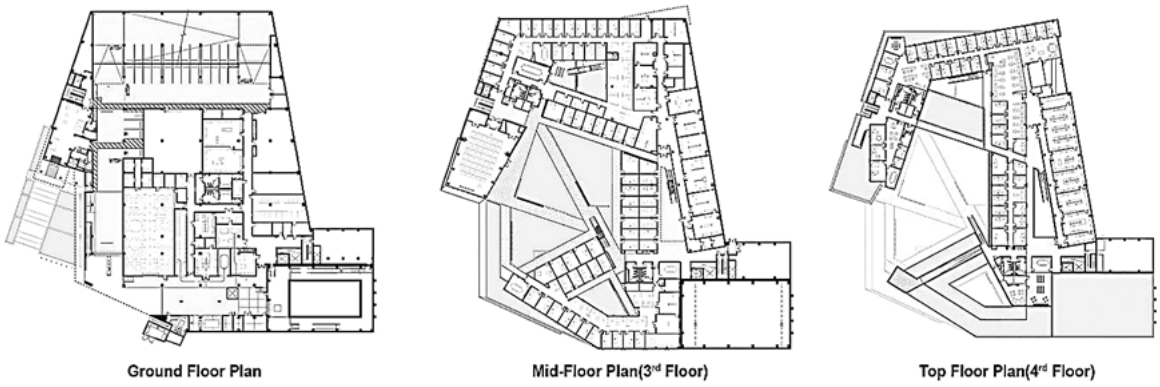

Figure 4: First Floor, Third Floor Plan and Fourth Floor Plan of NOAA Southwest Fisheries Science Center, Redrawn based on images retrieved from archdaily.com

4 Result

Selected Ground, Mid- and Top Floor Plan will be analyzed for permeability and wayfinding. The circulation throughout the space will be translated into a graph format to verify the depth levels of permeability. Two user categories are differentiated using different colors in the justified graph: Public (Visitors) blue color, and Private (Staff, Researches and Services) pink. The vertical circulation of the building, including Stairs and Lifts, is indicated in brown color.

4.1 Ground Floor Plan Circulation

Figure 5 shows that the depth levels in the justified graph are until level 4. This graph indicates that the levels of permeability are semi-private. However, the building already has great control access towards the private and public access towards the building. All the users can access the building except for the east side of the building, which is only for private access, including staff, researchers, and service technicians. The public and private accesses are from the parking area. For example, the staff can quickly access the east side of the building from the parking and loading bay (P1, P2, and L) via E4, E5, and C1.

The building's private users can access the private part of the building from those entrances as indicated in Figure 5 with pink color. The visitors can access the building through the main entrance and parking (P1 and P2) through E1, E2, and E3, where they can only access the building's public space that indicates blue color in Figure 6. The levels of wayfinding are quite straightforward. As shown in Figure 5, all the private areas of the building are directly accessible

from Corridor (C1 and C2), and the visitor can access vertically of the building through Lift and Staircase (S1, S2, L1, and L2) from Lobby (1) and Lift Lobby (LL1).

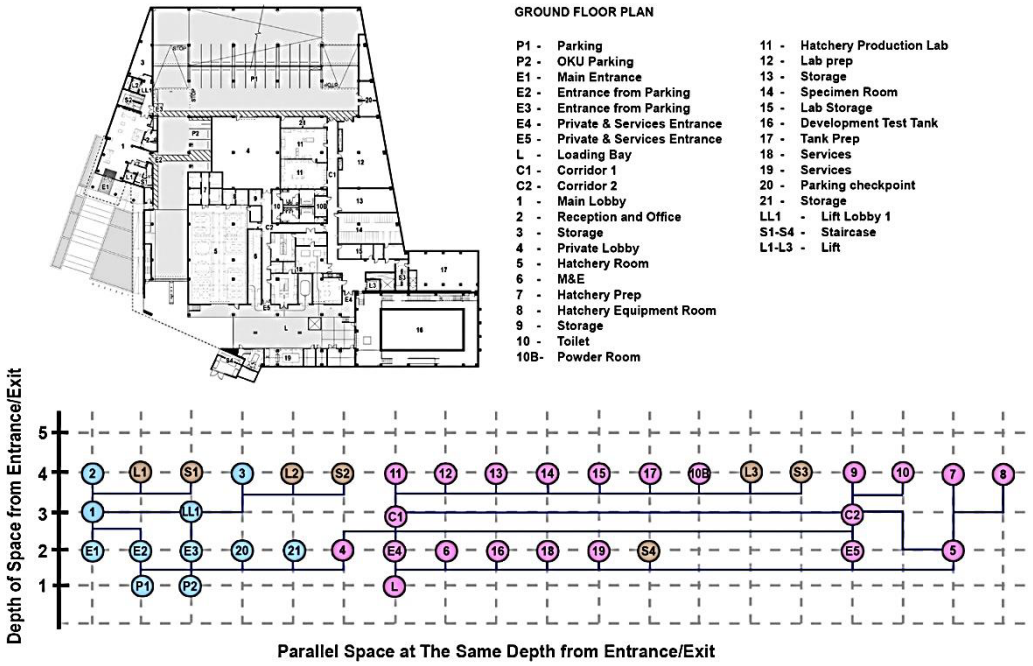

Figure 5: Ground Floor Plan, Legend and Justified Graph showing Ground Floor plan's circulation in NOAA Southwest Fisheries Science Center

4.2 Mid-Floor Plan Circulation(3rd Floor)

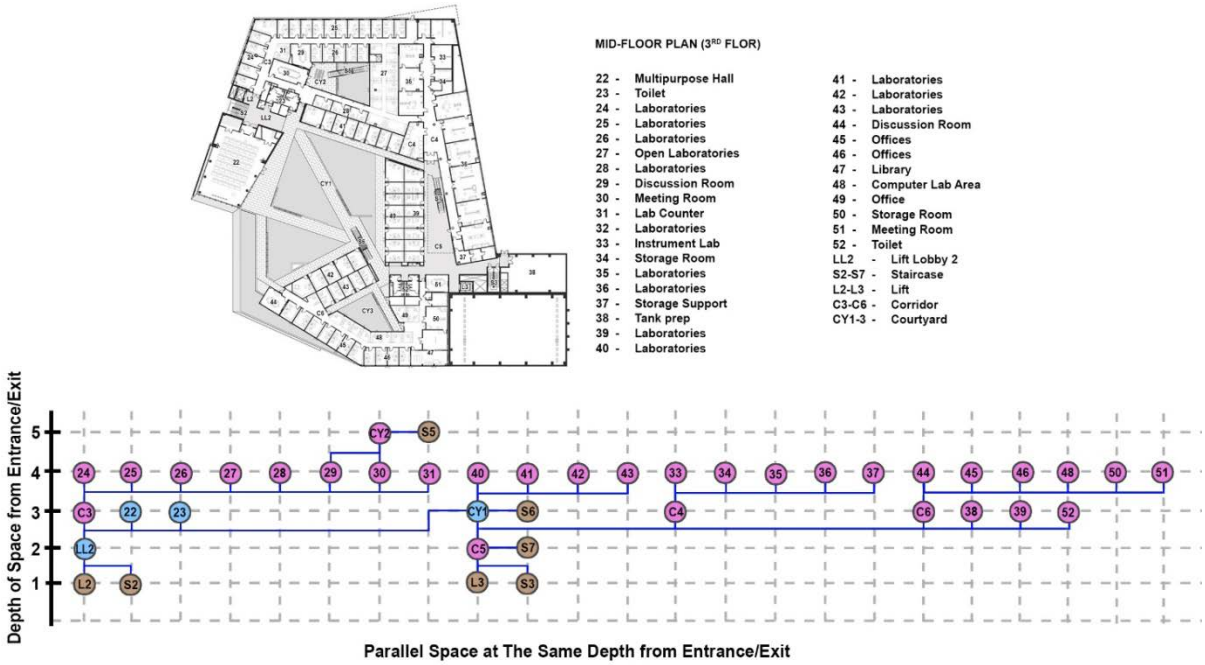

Figure 6: Mid-Floor Plan(3rd Floor), Legend and Justified Graph showing Mid-Floor plan's circulation in NOAA Southwest Fisheries Science Center

The depth level (Figure 6) in the justified graph of Mid-Floor circulation is until level 5. This graph indicates that the levels of permeability are private. As explained, this building is a semi-private building, which is a Research Center. Most of the building spaces are for research purposes. As the users going up to the building, the space is mostly private spaces, including laboratories, as shown with the graph's pink color. The only access for the public is space (22 & 23) through LL2.

Courtyard (CY1) is a space to connect between public and private users to allow interaction. The other courtyard is for private users only, including the deepest area in the graph, CY2, and S5, accessed from rooms 29 and 23. The levels of wayfinding are quite straightforward. As shown in Figure 8, the building spaces are linked together and directly accessible through the Corridor (C3, C4, C5, C6) and Courtyard (CY1, CY2, CY3).

4.3 Top-Floor Plan Circulation(4th Floor)

Figure 7 shows the depth levels in the justified graph of Top-Floor Plan's circulation. This graph indicates that the levels of permeability are private. The areas are mostly private spaces, including laboratories, as shown with pink color in the graph. However, the numbers are lesser compared to the mid-floor level. Two accesses for the public space are Discussion & Meeting Area (53) and Toilet (54) from Lift Lobby (LL3) through the Lift and Staircase (L2 and S2). The courtyards are spaces to connect between the private users to allow interaction. The other courtyard is for private users, including the deepest area in the graph, CY2, which can be accessed from Staircase (S5) from the Corridor (C7). The levels of wayfinding are quite straightforward. As shown in Figure 9, all the building spaces are linked together and direct access through Corridor (C7, C9, C9, C10) that can be accessed from the staircase and lift (L2, L3, S2, S3, S7).

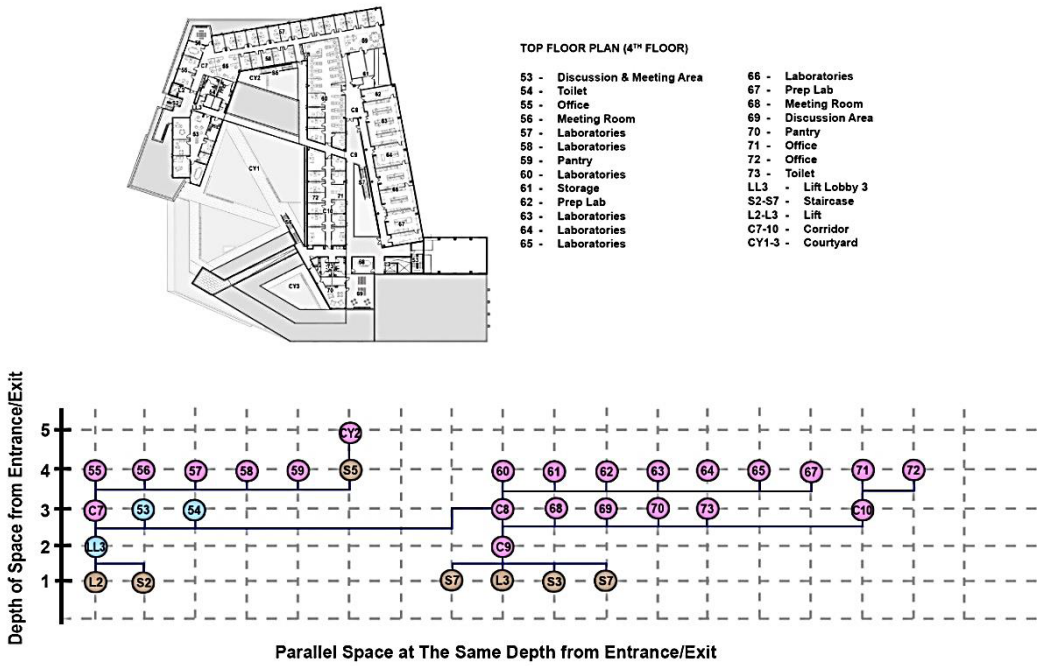

Figure 7: Top Floor Plan(4th Floor), Legend and Justified Graph showing Mid-Floor plan's circulation in NOAA Southwest Fisheries Science Center.

5 Discussion

The NOAA Southwest Fisheries Science Center's space syntax analysis identifies two user categories: public users (visitor) and private users (administrative staff, researchers, and trainers). The overall result shows that the levels of permeability are 70% private of the total number of spaces. This building typology is a semi-private users' category. Most building spaces are research laboratories and offices. The justified graphs from Ground Floor, Mid Floor, and Top Floor Plan, the chart shows that their depth is 4th to 5th level. The space is mostly private spaces, including

laboratories, as shown with pink color in the graph as go up to the building. The level of permeability for the public user category is until the 3rd level, indicating blue color in the graph.

The level of wayfinding is 60%, where its overall access is quite straightforward. The overall result shows that the depth level is from 4th to 5th in the justified graph. The reason is that the building has private spaces directly accessible from the corridors, and the visitor can access the building vertically through Lift(L1) and Staircase(S2). The building's spatial organization accessible with corridors, courtyards, and vertical connectors make the building's wayfinding straightforward. It is connected with seven staircases (S1-S7) and three lifts (L1-L3).

6 Conclusion

The case study of NOAA Southwest Fisheries Science Center seems to embody a certain degree of segregation. It focuses on each user group's spatial organization that their public and private access are clearly defined with limitations to the private users. It is particularly helpful in buildings that are very private-oriented design typology. The spatial configurations are generally straightforward for 70% of the private users: staff, researchers, and trainers. While the public users can still access the building with spatial arrangement limited access by 40% to the general users.

7 Availability of Data and Material

All information is included in this study.

8 Acknowledgment

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