



Analysis of Spatial Configurations in Theatre Buildings: A Space Syntax Case Study on Everyman Theatre Liverpool

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Abstract

Space syntax is a measurement tool used to analyze spatial configurations in buildings through graphical methods to determine the levels of permeability and wayfinding of a space and its relationship with other spaces. This paper presents a space syntax analysis on the Everyman Theatre, a public theater in Liverpool, UK, to study its permeability and wayfinding. The main floors are analyzed through justified graphs, presenting the levels of depth and relationship between spaces, showing each space's level of privacy. The results show that the levels of permeability and wayfinding are different among the two groups of users analyzed, i.e. general public and Staff, as the building spaces are generally segregated by separate entrances from two locations, serving the public and the staff respectively. Due to the nature of this typology, the space syntax performance of this building is a combination of public and private, where the front of the house is open to the public, while backstage areas and offices are restricted to staff only. Such segregation is essential to create a welcoming space for the visitors while preserving the staff's required privacy.

Disciplinary: Architectural Engineering.

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1 Introduction

The Everyman Theatre is a heritage replacement project by architects Haworth Tompkins in Liverpool, United Kingdom, completed in 2013. This theatre is rebuilt from the original theatre which was converted from the 19th century Hope Hall Chapel, located at the historic city center of Hope Street (Frearson, 2014). Being an urban public building, it aims to promote cultural inclusion, community engagement, and local creativity, as well as to express the collective identity of Liverpool's people.

There are three main programs in this building: a theatre, a bistro, and creative workspaces. The main program, the theatre hosts performance events that are open to the public, with facilities that support the production and preparation of the shows, including workshops and performers' dressing rooms. The basement bistro is a bustling gathering area of the local communities, a significant anchoring component that constantly draws the public into this building. On the other hand, creative workspaces, including studios and writer's rooms, are mostly used by the company or members of other arts communities.

In 2014, the Everyman Theatre won the RIBA Stirling Prize, the most prestigious architecture award in the UK for buildings with the greatest contribution to architecture evolution. (Stott, 2014) Besides its notable architectural solutions towards the program and the spirit of the original building, this project is also recognized for its exceptional energy efficiency both in construction and in use. (Theatre and Tompkins, 2014) This BREEAM Excellent Rated building has reused 90% of the nineteenth-century materials on-site, incorporated low-energy technical infrastructures, and features a naturally ventilated auditorium. (Wainwright, 2014)

Despite its size limitations in a historic city center, the building can house the many spaces required and possess clear circulations for both public and private users. Thus, this building is chosen as the case study to investigate further how it has achieved this complex yet functional circulation of a theatre building by analyzing the relations between its spaces.

The objective of this research is to study the permeability and wayfinding of this theatre by analyzing its spatial configuration through space syntax. The spatial arrangement of buildings influences how users perceive and use the spaces (Hassan, 2004), hence it is essential to study the relationship between the spaces and the users' activity patterns of a building to achieve the most efficient spatial design.

2 Literature Review

Space syntax is a theoretical tool for analyzing spatial configurations in buildings and urban areas that involve scientific, digital, and graphical methods (Hillier & Hanson, 1984; Hillier, 1996). It analyses the connections between spaces and how they form a configuration (Sailer et al., 2012). This spatial measurement tool also enables us to analyze the social characteristics of space (Sisman & Cebi, 2017), as space syntax focuses on human behavior and the relational system of a meronymy (Kozikoğlu & Cebi, 2015). The spatial analysis involves two measurable factors, i.e. level of permeability and level of wayfinding (Hillier & Hanson, 1984). Permeability is the relationship

between adjacency (Hillier & Hanson, 1984) and the level of connectivity between spaces (McLane, 2013). The level of permeability is also referred to as the level of accessibility of a space; it is higher when the space is easily accessible (Amani et al., 2019). Besides, it also determines the level of privacy of a space (Mustafa et al., 2010). Meanwhile, wayfinding is referred to as the navigation process that follows psychological patterns based on visual perception (Emo et al., 2012). It is also a system that determines how people go through the spaces and how they perceive the environment (Khairdzir et al., 2020). Therefore, the level of wayfinding is directly influenced by the number of local linkages of a space and its syntactic depth from the building's entrance (Beck & Turkienicz, 2009). The example shown in Figure 1 illustrates the depths of spaces, where the spaces at a higher level of depth generally have more difficult wayfinding and lower permeability from the entrance.

3 The Everyman Theatre

The Everyman Theatre (Figure 1) plays an important role in Liverpool's local life, with its former building serving as a center of creativity and conviviality (Frearson, 2014). However, at the end of the 20th century, to adapt to expanding productions and cater to more repertory companies, the theatre had to be rebuilt (Frearson, 2014; Hatton, 2014). Reopened in 2014, the Everyman has been reborn into a technically advanced and highly adaptable new theatre that features a significant architectural design and outstanding building performance.

With a total floor area of 4690 m², this new theatre holds a 400-seat auditorium, a large rehearsal room, creative workspaces, public foyers, exhibition spaces, a bistro, and other supporting ancillary spaces. (Frearson, 2014) One of the building's unique elements is its west-facing façade, which is made up of 105 movable metal sunshades that feature a life-sized portrait of a Liverpool resident each, engaging the city's community in this huge public artwork. (Everyman Theatre / Haworth Tompkins, 2014)



Figure 1: Exterior View of Everyman Theatre

3.1 Building Typology

A theatre is a public building where theatrical works, dance, or music are performed, which usually has a staging area for the performance to take place and an auditorium for the spectators. Theatre buildings nowadays commonly house supporting spaces such as lounges, eateries, studios, exhibition galleries, and workspaces to increase the functions of the building and enhance visitors' experience. Although the building is open to the public, spaces such as studios, workshops,

dressing rooms, and backstage areas are usually designated for performers or staff only, where the public does not have access to such private spaces.

3.2 Location

The Everyman Theatre is a new building renovated from the original theatre that occupied the same historic site at Hope Street in Liverpool (Figure 2), United Kingdom. The building is located right beside Liverpool's Catholic Cathedral and is surrounded by historical buildings from the 18th and 19th centuries. (Frearson, 2014)



Figure 2: Key Plan and Location Plan

4 Method

Before the analysis, a study of previous publications on Space Syntax from various authors is done to understand its background, theory, and usage. Additionally, the case study's information and spatial details, including the floor plans are obtained from articles and websites related to the project.

Sisman & Cebi (2017) mentioned that a link between science and design could be shown through space syntax by graphical and mathematical methods. The levels between spaces are expressed in a numerical way to show clear links between spaces and human activities, presented visually using a justified graph (Hillier, 1996). In this space syntax study, a quantitative survey using Justified Graphs is carried out to analyze the levels of permeability and wayfinding of this selected building.

This analysis will focus on two categories of users identified as the primary users of this building, i.e. General Public (audience and other visitors) and Staff (administrative staff, performers, company members, maintenance and service personnel, etc.).

Permeability and Wayfinding levels are categorized into four hierarchies of depth in this study: public, semi-public, semi-private, and private. The levels of depth are graphically presented using a Likert Scale in the Justified Graph, the higher the level, the more private a space is.

4.1 Justified Graph

Graphic-based methods are one of the methods used to decipher the spatial relations in space syntax analysis. (Hillier & Hanson, 1984; Hillier, 1996) To analyze the spaces' levels of depth using a justified graph, the entrance is first identified as Level 0, and the other spaces will be placed

at different levels based on their respective numbers of intervening lines about each other, connecting to each previously linked spaces.

The case study is a six-story building, including a basement. In this study, only the main floors, i.e. Basement, Ground Floor, First Floor, Second Floor, and Third Floor, will be analyzed. The basement spaces will be shown at the negative axis of the depth levels on the justified graph.

To ease the visualization of the analysis, both justified graphs and building plans use the same labeling system, as shown in Table 1. This system consists of a combination of a letter and a number on a colored shape. The letter specifies the function of a space; the numbering follows the sequence of the spaces from the entrance of the building; the color shows the function of the space (green = for the public; yellow = creative activities; orange = for performance; red = company; blue = washroom; grey = maintenance; purple = transportation), whereas the shape indicates whether it is a room (circle) or a transitional space (triangle).

Table 1: Labelling System used in this study.

Function	Example of Spaces	Labeling
Public Spaces	Bistro, Café	1 2
Creative Activities	Studios, Workshops	C1 C2
Backstage Spaces	Dressing rooms, Stores	B1 B2
Office Spaces	Management, Admin.	O1 O2
Amenities	Washrooms	W1 W2
Services & Maintenance	Plant Rooms, Technical	M1 M2
Circulation	Staircases, Elevators	S1 S2

The levels of permeability and wayfinding are directly proportional to a space's levels of depth labeled on the Justified Graph.

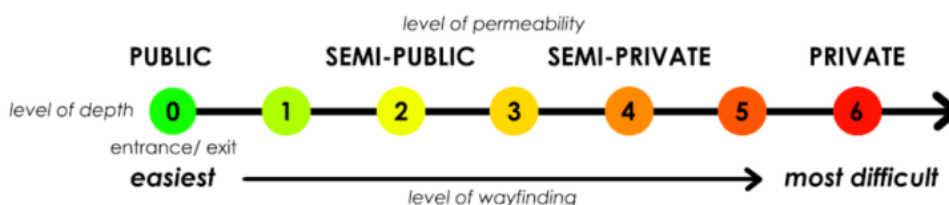


Figure 3: Level of Depth about Levels of Permeability and Wayfinding.

Referring to the levels of depth illustrated in Figure 3, the levels of permeability and wayfinding are categorized into four hierarchies, i.e. Primary Level, Secondary Level, Tertiary Level, and Quaternary Level. Primary Levels refer to the most accessible spaces with easy wayfinding and visibility, while Quaternary Levels refer to the most private or hidden spaces that usually prohibit public access.

5 Results

This analysis focuses on two categories of users of this building, i.e. General Public (audience and visitors) and Staff (administrative staff, performers, maintenance and service personnel, etc.). The spaces' levels of depth on the justified graph (Figure 4) are plotted based on their permeabilities from the main entrance (1) from Hope Street, while the levels of wayfinding and permeability perceived by these two categories of users will be analyzed in Table 2 to Table 6 according to respective entrances.

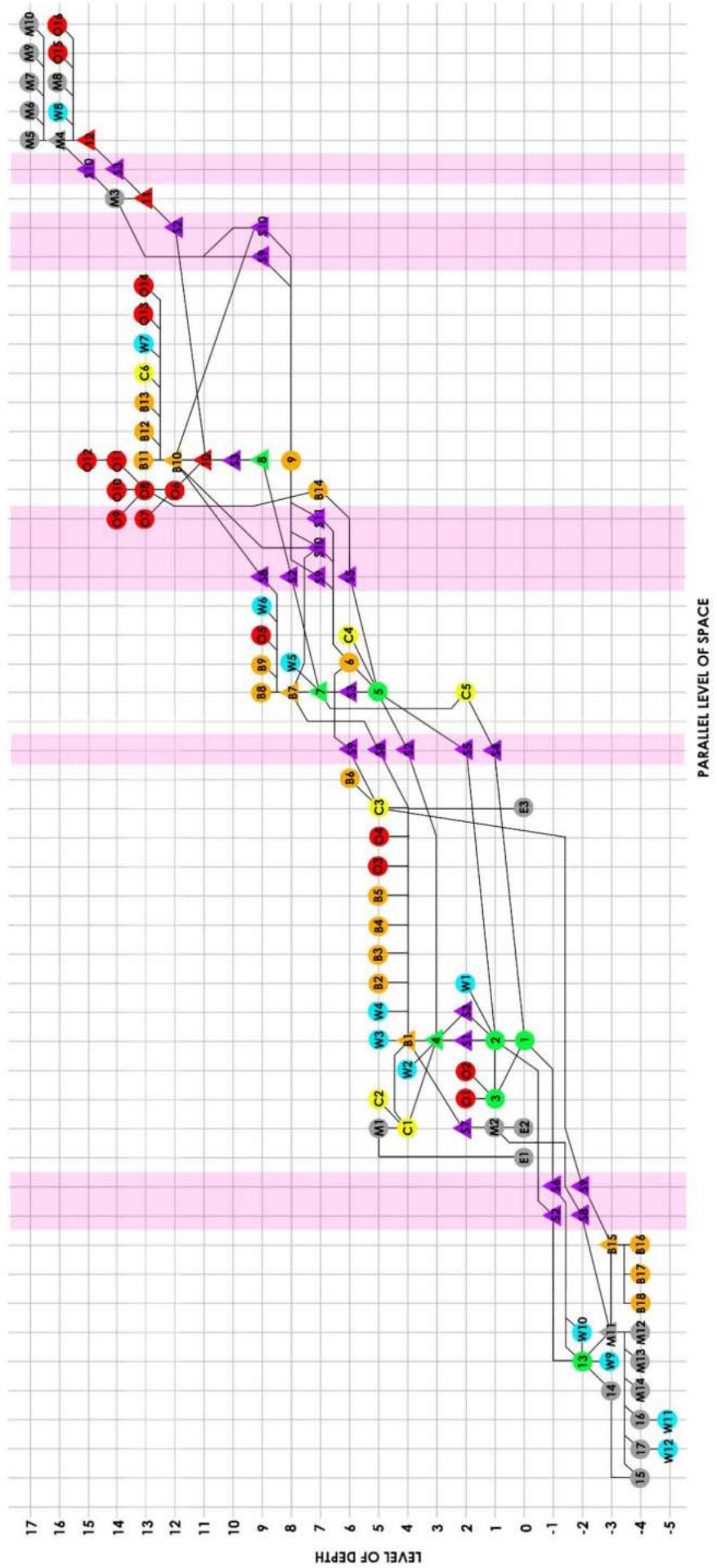


Figure 4: Overall Justified Graph for Everyman Theatre

5.1 Site and Ground Floor Plan

As shown in Figure 5, the Everyman Theatre is bounded by Hope Street at its main entrance and Arrad Street at its back entrance. From Hope Street, the public can enter directly through the Main Entrance (1) to the Café (2), where the staircases (S1, S2, S3) will connect them to the basement Bistro (13) or the Foyer (4) that leads to the Bar (5) and Auditorium (6) on the first floor.

Besides (1), there are three smaller entrances from Hope Street. Staircase S4 is a private entrance to the Writers' Room (C4) on the first floor, staircase S5 (usually used by staff) leads to the Bar (5) on the first floor, while staircase S6 serves direct access to the basement Bistro (13).

Facing Arrad Street is the back of the house, where staff enter through Stage Door (E2) to backstage spaces, while scenery is unloaded at E3 to Workshop (C2). Garbage is collected at the Refuse Exit (E1). According to Figure 6 and Table 2, these spaces have low levels of permeability and wayfinding for Staff as they enter from E2 and E3, but are relatively more private and difficult for the public to reach from the main entrance.

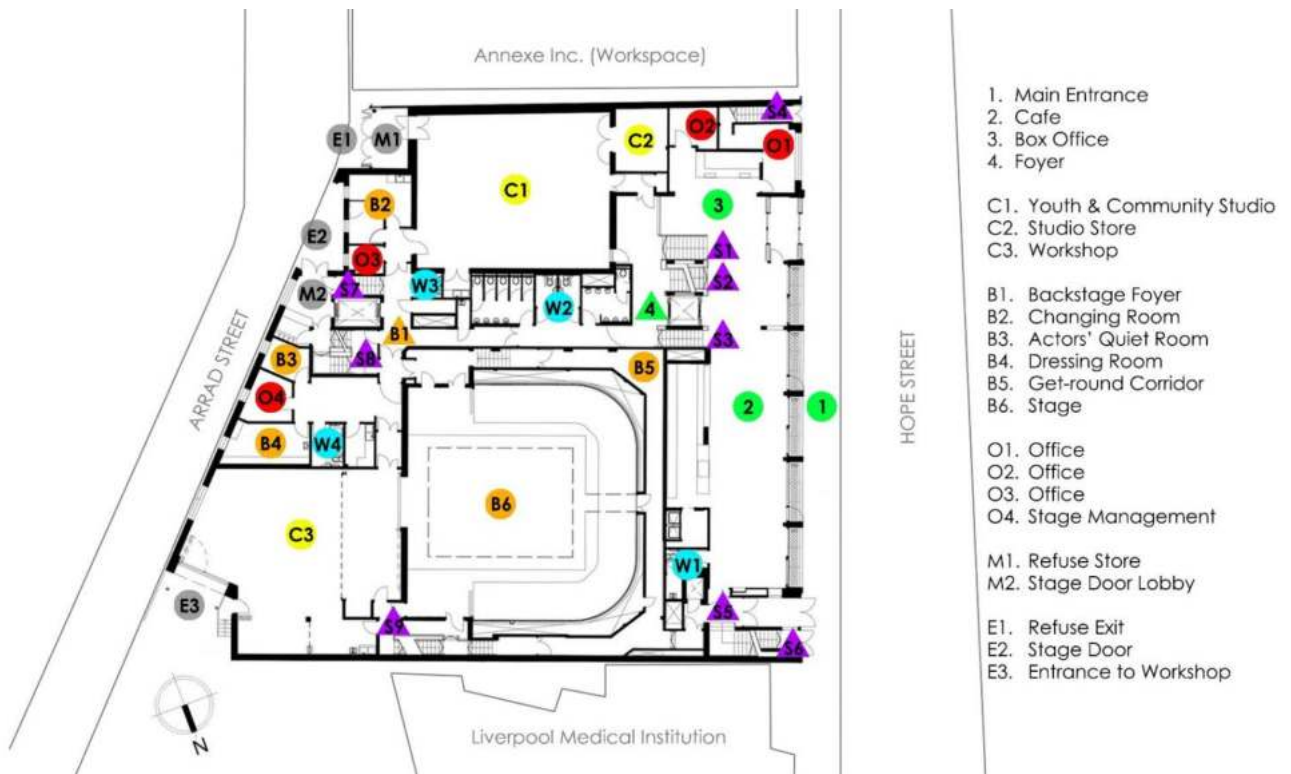


Figure 5: Ground Floor Plan

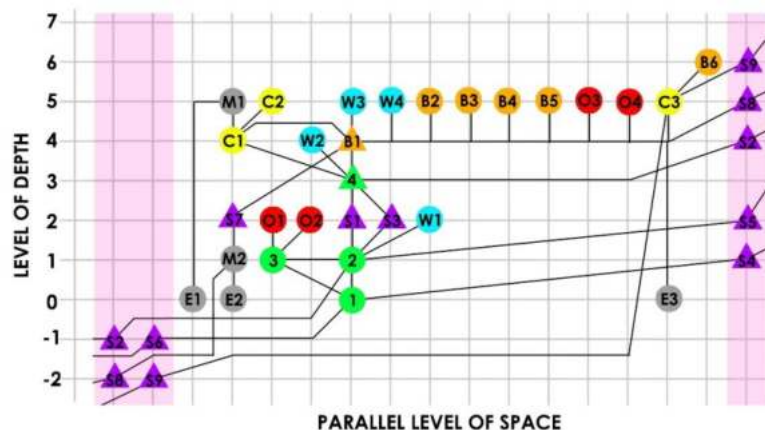


Figure 6: Justified Graph for Ground Floor

Table 2: Level of Permeability and Level of Wayfinding for Ground Floor.

Space	Level of Depth from Main Entrance	Level of Permeability	Level of Wayfinding	
			General Public (Entrance from 1)	Staff (Entrance from E2 & E3)
1	0	Public	Very Easy	V. Difficult
E1, E2, E3	0	Public	V. Difficult	Very Easy
2, 3	1	Public	Very Easy	Difficult
M2	1	Semi-Private	Difficult	Very Easy
W1	2	Semi-Public	Easy	V. Difficult
O1, O2	2	Private	Medium	Difficult
4	3	Public	Easy	Medium
C1, W2	4	Semi-Private	Medium	Medium
B1	4	Semi-Private	Difficult	Easy
C2	5	Private	V. Difficult	Medium
W3, W4, B2, B3, B4, B5, O3, O4	5	Private	V. Difficult	Medium
C3	5	Semi-Private	V. Difficult	Very Easy
M1	5	Private	V. Difficult	Very Easy
B6	6	Private	V. Difficult	Easy

5.2 Basement Plan

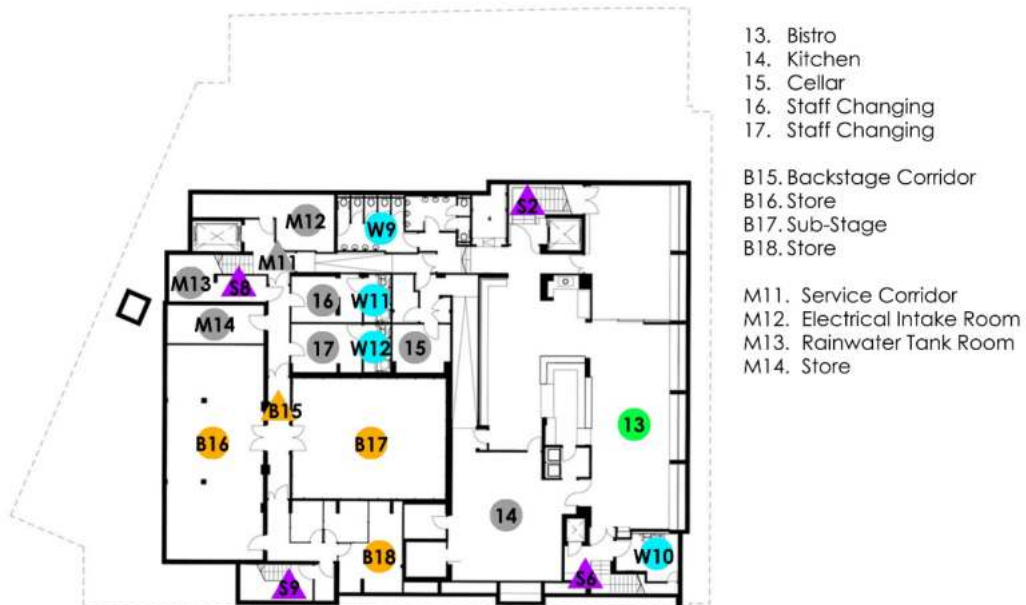


Figure 7: Basement Plan

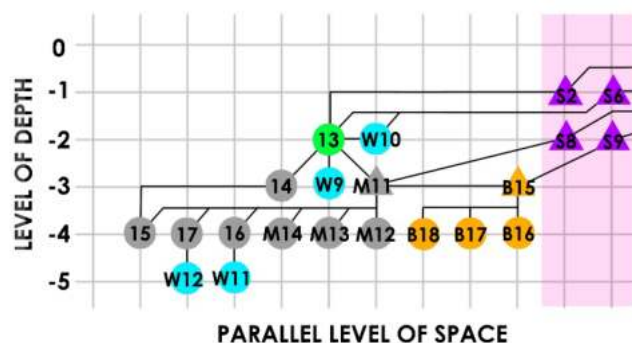


Figure 8: Justified Graph for Basement

According to Figures 7 and 8, Mechanical Services (M11, M12, M13, M14) are accessed from Staircase S8 from Stage Door Lobby (M2), while Sub-Stage Spaces (B15, B16, B17, B18) are accessed from Staircase S9 from Workshop (C2). As analyzed in Table 3, Both these groups of spaces are private and difficult for the public to access, but easier for the staff.

Table 3: Level of Permeability and Level of Wayfinding for Basement.

Space	Level of Depth from Main Entrance	Level of Permeability	Level of Wayfinding	
			General Public (Entrance from 1)	Staff (Entrance from E2 & E3)
13, W10	-2	Public	Easy	Difficult
14, W9	-3	Semi-Private	Medium	Medium
M11, B15	-3	Private	Difficult	Easy
15, 16, 17, M12, M13, M14, B16, B17, B18	-4	Private	V. Difficult	Medium
W11, W12	-5	Private	V. Difficult	Difficult

5.3 First Floor Plan

Figures 9 and 10 show that the public enters the Auditorium (6) for shows through the Bar (5), and goes up to the Second Tier Auditorium (9) through Staircase S11. Table 4 shows that the Backstage Foyer (B7) has easy wayfinding for staff as Staircase S8 connects Performers from the Dressing Rooms (B8) to the Backstage Foyer (B1) and the Stage (B6) on the ground floor.

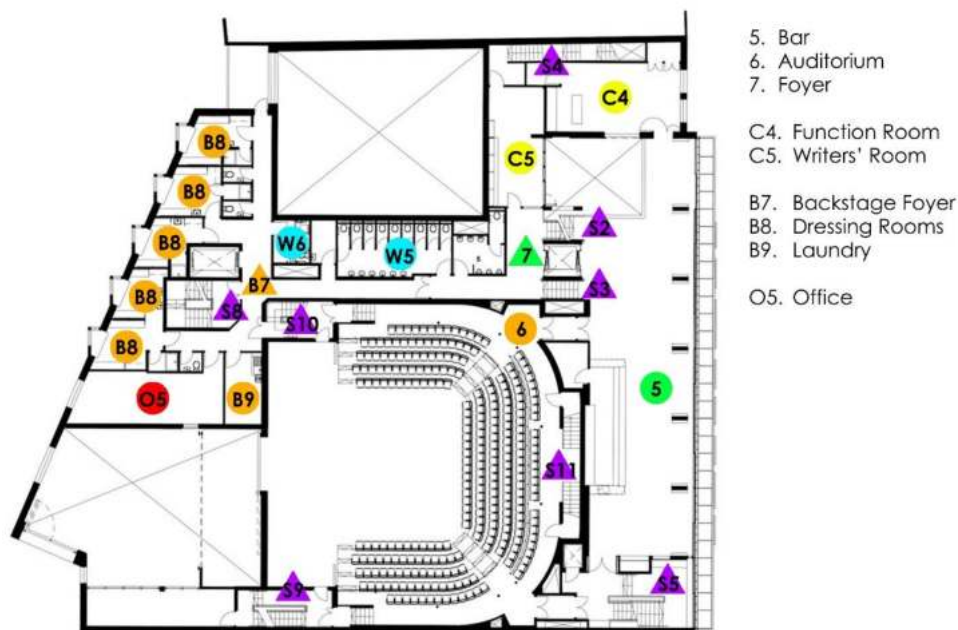


Figure 9: First Floor Plan

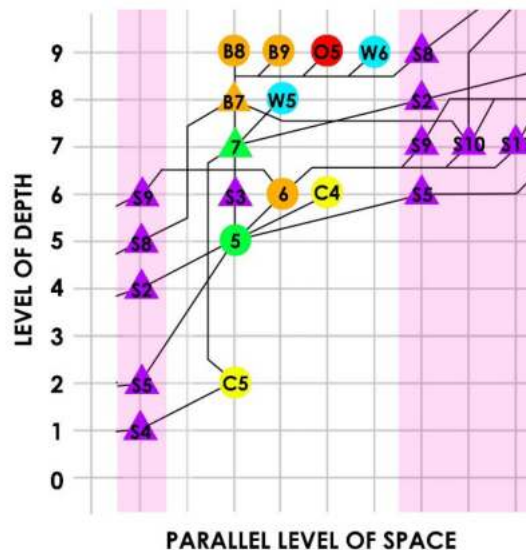


Figure 10: Justified Graph for First Floor

Table 4: Level of Permeability and Level of Wayfinding for First Floor.

Space	Level of Depth from Main Entrance	Level of Permeability	Level of Wayfinding	
			General Public (Entrance from 1)	Staff (Entrance from E2 & E3)
C5	2	Semi-Private	Easy	Difficult
5	5	Semi-Public	Easy	Difficult
6, C4	6	Semi-Public	Medium	Difficult
7	7	Semi-Public	Medium	Medium
W5	8	Semi-Private	Medium	Medium
B7	8	Private	Difficult	Easy
B8, B9, O5, W6	9	Private	V. Difficult	Medium

5.4 Second Floor Plan

In Figures 11 and 12, except for Second Tier Auditorium (9), the other rooms (backstage spaces and offices) and Technical Gallery (M3) on the mezzanine are not open for public access, hence they have higher levels of permeability and are more difficult wayfinding for the public as shown in Table 5.

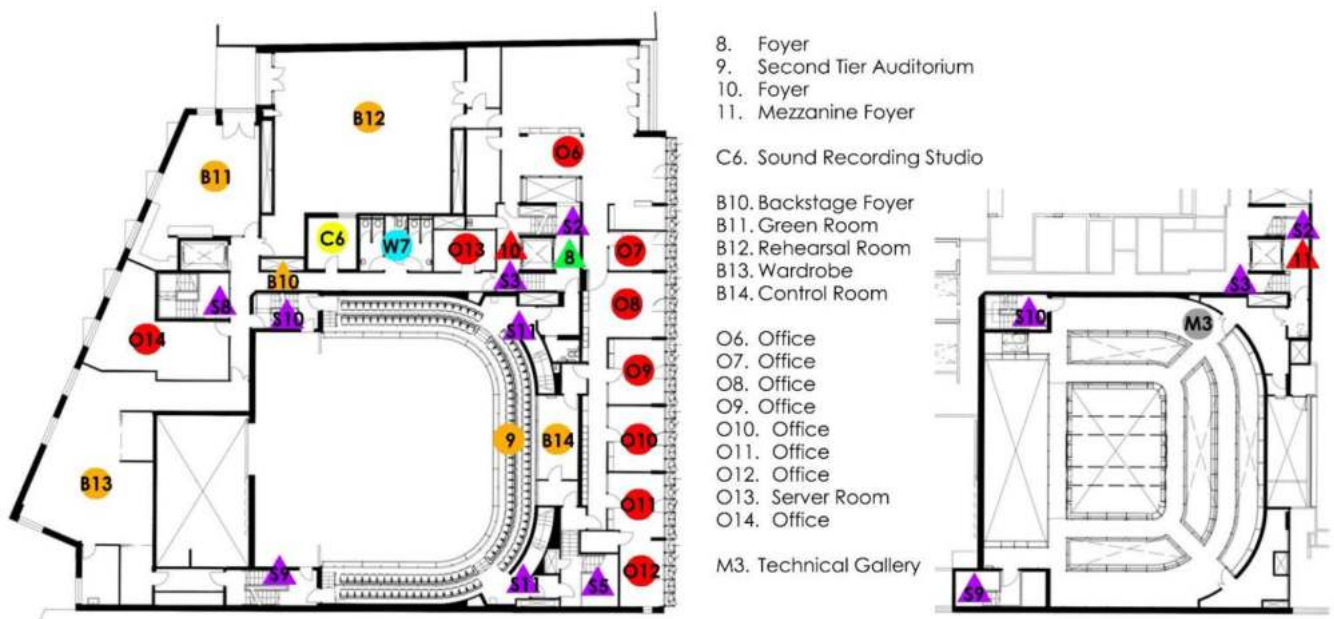


Figure 11: Second Floor and Mezzanine Plan

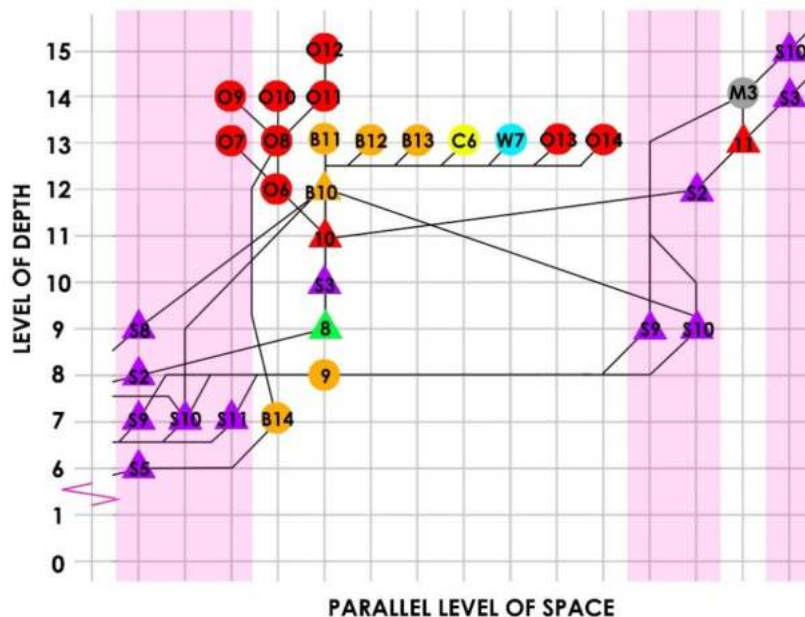


Figure 12: Justified Graph for the Second Floor and Mezzanine

Table 5: Level of Permeability and Level of Wayfinding for Second Floor and Mezzanine.

Space	Level of Depth from Main Entrance	Level of Permeability	Level of Wayfinding	
			General Public (Entrance from 1)	Staff (Entrance from E2 & E3)
B14	7	Private	V. Difficult	V. Difficult
9	8	Semi-Public	Difficult	Difficult
8	9	Semi-Public	Medium	Medium
10	11	Semi-Private	Medium	Medium
B10	12	Semi-Private	Difficult	Easy
O6	12	Private	Difficult	Difficult
B11, B12, B13, C6, W7, O13, O14	13	Private	V. Difficult	Medium
O7, O8	13	Private	V. Difficult	Difficult
11	13	Semi-Private	Difficult	Difficult
O9, O10, O11	14	Private	V. Difficult	V. Difficult
M3	14	Private	V. Difficult	V. Difficult
O12	15	Private	V. Difficult	V. Difficult

5.5 Third Floor Plan



Figure 13: Third Floor Plan

12. Foyer

O15. Meeting Room
O16. Meeting Room

M4. Maintenance Corridor
M5. Dimmers & Amps
M6. Plant
M7. Lighting Workshop
M8. Plant
M9. Technical Grid
M10. Extract Plenum

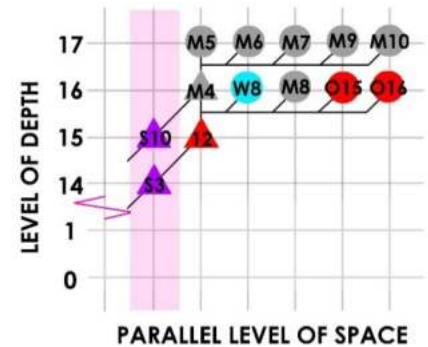


Figure 14: Justified Graph for Third Floor

The levels of permeability and wayfinding are the highest on the third floor (Figure 13) for both categories of users as shown in Figure 14 and Table 6, as these spaces are restricted to authorized personnel for maintenance and service purposes.

Table 6: Level of Permeability and Level of Wayfinding for Third Floor.

Space	Level of Depth from Main Entrance	Level of Permeability	Level of Wayfinding	
			General Public (Entrance from 1)	Staff (Entrance from E2 & E3)
12	15	Semi-Private	Difficult	Difficult
W8, M8, O15, O16	16	Private	V. Difficult	V. Difficult
M4	16	Private	V. Difficult	Medium
M5, M6, M7, M9, M10	17	Private	V. Difficult	Difficult

6 Discussion

The overall shape of the justified graph for Everyman Theatre is a shallow tree form with many branches. Generally, the permeability levels are closely related to the functions and users of the spaces. As analyzed, the front-of-house areas including the Foyer, Café, Bar, and Box Office have very direct permeability and straightforward wayfinding from the main entrance at Hope Street, allowing the public to access these spaces easily. On the other hand, the back-of-house

areas such as backstage spaces, offices, and services are designed to be private and have difficult wayfinding for the public, but are easily accessible for staff from the back entrances at Arrad Street.

In Table 7, only 10.5% of the building is Public, and 8.1% is Semi-Public, while the rest are Semi-Private and Private. The percentage of these restricted spaces is very high (81.4%) due to the small area of some spaces, including dressing rooms and offices.

Table 7: Percentage of Number of Spaces according to Level of Permeability

Level of Permeability	Level	Spaces	Number	Percentage (%)
Primary (Public)	Ground Floor	1, 2, 3, 4, E1, E2, E3	7	
	Basement	13, W10	2	
			9	10.5
Secondary (Semi-Public)	Ground Floor	W1	1	
	First Floor	5, 6, 7, C4	4	
	Second Floor	8, 9	2	
			7	8.1
Tertiary (Semi-Private)	Ground Floor	M2, C1, C3, W2, B1	5	
	First Floor	C5, W5	2	
	Second Floor	10, 11, B10	3	
	Third Floor	12	1	
	Basement	14, W9	2	
			13	15.1
Quaternary (Private)	Ground Floor	O1, O2, O3, O4, C2, W3, W4, B2, B3, B4, B5, B6, M1	13	
	First Floor	B7, B8, B9, O5, W6	5	
	Second Floor	O6, O7, O8, O9, O10, O11, O12, O13, O14, B11, B12, B13, B14, C6, W7, M3	16	
	Third Floor	W8, O15, O16, M4, M5, M6, M7, M8, M9, M10	10	
	Basement	15, 16, 17, M11, M12, M13, M14, B15, B16, B17, B18, W11, W12	13	
			57	66.3
Total			86	100

As visitors and staff enter the building from different entrances, the level of wayfinding for the same space may differ as perceived by different users. From the Public's perspective, most of the spaces (75.5%) are hard to reach due to restricted access. However, the percentage is significantly lower (40.7%) for Staff, see Table 8.

Table 8: Percentage of Number of Spaces according to Level of Wayfinding

Level of Wayfinding	Level	General Public (Entrance from 1)			Staff (Entrance from E2 & E3)		
		Spaces	Number	%	Spaces	Number	%
Very Easy	Ground Floor	1, 2, 3	3		E1, E2, E3, M1, M2, C3	6	
			3	3.5	6	7.0	
Easy	Ground Floor	4, W1	2		B1, B6	2	
	First Floor	5, C5	2		B7	1	
	Second Floor	-	0		B10	1	
	Basement	13, W10	2		M11, B15	2	
			6	7.0	6	7.0	
Medium	Ground Floor	O1, O2, C1, W2	4		4, C1, C2, W2, W3, W4, B2, B3, B4, B5, O3, O4	12	
	First Floor	6, 7, C4, W5	4		7, W5, W6, B8, B9, O5	6	
	Second Floor	8, 10	2		8, 10, B11, B12, B13, C6, W7, O13,	9	

Level of Wayfinding	Level	General Public (Entrance from 1)			Staff (Entrance from E2 & E3)		
		Spaces	Number	%	Spaces	Number	%
					O14		
	Third Floor	-	0		M4	1	
	Basement	14, W9	2		14, W9, 15, 16, 17, M12, M13, M14, B16, B17, B18	11	
			12	14.0		39	45.3
		Sub-Total	21	24.5		51	59.3
Difficult	Ground Floor	M2, B1	2		2, 3, O1, O2	4	
	First Floor	B7	1		5, 6, C4, C5	4	
	Second Floor	9, 11, B10, O6	4		9, 11, O6, O7, O8	5	
	Third Floor	12	1		12, M5, M6, M7, M9, M10	6	
	Basement	M11, B15	2		13, W10, W11, W12	4	
			10	11.6		23	26.7
Very Difficult	Ground Floor	W3, W4, B2, B3, B4, B5, B6, O3, O4, C2, C3, M1, E1, E2, E3	15		1, W1	2	
	First Floor	B8, B9, O5, W6	4		-	0	
	Second Floor	B11, B12, B13, B14, C6, W7, O7, O8, O9, O10, O11, O12, O13, O14, M3	15		O9, O10, O11, O12, B14, M3	6	
	Third Floor	M4, M5, M6, M7, M8, M9, M10, W8, O15, O16	10		W8, M8, O15, O16	4	
	Basement	15, 16, 17, M12, M13, M14, B16, B17, B18, W11, W12	11		-	0	
			55	63.9		12	14.0
		Sub-Total	65	75.5		35	40.7
		Total	86	100		86	100

There are many small private rooms such as offices, dressing rooms, and stores to serve different purposes in this building, hence the number of single-connected spaces is the highest as shown in Table 9. Excluding the 11 staircases, 21% of the building comprises foyers and transitional spaces that connect multiple rooms.

Table 9: Percentage of Number of Spaces according to Spatial Connectivity

Type of Space	Spaces	Number	Percentage (%)
Single-Connecting	E1,E2,E3,16,17,C2,C4,C6, O1,O2,O3,O4,O5,O7,O9,O10,O11,O12,O13,O14,O15,O16, W1,W2,W3,W4,W5,W6,W7,W8,W9,W11,W12, B2,B3,B4,B5,B6,B8,B9,B11,B12,B13,B16,B17,B18, M5,M6,M7,M8,M9,M10,M12,M13,M14	55	63.9
Double-Connecting	8,9,14,15, C5,W10,B14,M1	8	9.3
Triple-Connecting	6,11,O6,M2,M3	5	5.8
Multiple-Connecting	1,2,3,4,5,7,10,12,13,C1,C3,O8,B1,B7,B10,B15,M4,M11	18	21.0
Total		86	100

7 Conclusion

The Everyman Theatre is designed to be a public building as well as a workplace for the staff and performers with required privacy. As such, this building's overall space syntax performance is a combination of Public and Private, depending on the spaces' functions and designated users. To achieve the required levels of privacy, the backstage and production areas are segregated from

public access, resulting in high levels of depth. As analyzed, the public spaces are generally arranged closer to Hope Street for easy public access, while the back of the house is accessed from Arrad Street. The front-of-house spaces such as Café, Bistro, and Auditorium have high permeability levels with easy wayfinding, allowing the visitors to reach their destination in a short time without getting lost. On the contrary, spaces like dressing rooms, stores, offices, and workshops are only intended for staff and performers, hence these spaces have difficult wayfinding and low permeability levels for the public. Notably, the spaces' wayfinding perceived by Staff is different from the public as they enter the building from Arrad Street. Nevertheless, spaces on the third floor are private and difficult to access for everyone due to the high level.

This study has presented a review of the spatial configurations in a theatre building, depicting the considerations of different privacy levels to suit different groups of users. As the results suggested, it is important to segregate private rooms from the public while preserving easy access for the staff in theatre buildings. Thus, the entrances from two different streets have successfully complemented such spatial arrangements in this project.

8 Availability of Data And Material

All used data is included in this article.

9 References

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