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Space Syntax Analysis on an Educational Building at the University of Strathclyde

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Spatial configuration; Spatial planning; Education Building; Users' accessibility; Visibility graph analysis; Building access; Justified graph; Wayfinding; VGA; Permeability depth level.

Abstract

Space syntax is a research method investigating spatial configuration and human movement patterns inside buildings. This paper focuses on space syntax analysis in educational building typology. The building chosen as a case study is the Technology and Innovation Centre (TIC), one of the educational buildings in the University of Strathclyde, Scotland. The layout plan of the building is used to analyse the building's space syntax. The analysis data will be used to discover the efficacy of social interactions and human behaviour in educational buildings, referring to justified graph and visibility graph analysis. The study finds that TIC combines semi-private areas and spatial zoning, including vertical and horizontal public-private divisions. The building has a high level of wayfinding efficiency, with 36.1% easy accessibility, and is positioned at vertical connections. Private spaces have 60.6% of the total space complying with the workplace layout plan for safety, ease of access, and collaborative work environments.

Disciplinary: Architecture & Built Environment.

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1 Introduction

Research and teaching today are regarded as important across the globe's national agenda. According to Sanni-Anibire et al. (2018), huge quantities of funds are still being invested by several countries in initiatives aimed at advancing research and technology. Furthermore, architectural space organisation influences research, productivity, and work quality (Saeed, 2012). According to Ab Majid et al. (2021), measuring space syntax involves assessing the level of permeability and

navigational ability among different users. Permeability and wayfinding are closely linked when analysing spatial configurations (Khozaei Ravari et al., 2022).

The Technology and Innovation Centre (TIC) is an educational building at the University of Strathclyde in Glasgow, United Kingdom. The building's Standard of Accommodation (SOA) comprises specialist laboratories, research spaces and collaborative meeting spaces with around 900 staff. This building includes conference facilities, meeting rooms, and a 150-seat auditorium. The building's flexible, highly specified accommodation and innovative, green design was recently recognised by The British Council for Offices (BCO), winning the 2014 Scottish Award for Best Commercial Workplace. The Building Research Establishment Environmental Assessment Method (BREEAM) has given excellent awards to this building design. According to Monterosso et al. (2018), the performance of a new building project is evaluated using BREEAM, which considers many factors such as BREEAM rating level benchmarks, minimum BREEAM requirements, environmental section weightings, and BREEAM assessment problems and credits.

This research paper aims to provide a space syntax analysis, an in-depth study based on the design intentions learned from the selected case study building. The layout plans of the case study are analysed using the degree of permeability and wayfinding. This analysis will identify the strengths and shortcomings of education and research-building design and provide a better understanding of users' navigation. Wayfinding performance may be expected when the starting and destination locations are centrally located within a floor (Pouyan et al., 2021).

2 Literature Review

Space Syntax is an investigation program that looks at how human beings interact with space from the perspective of a general theory of the spatial structure in all its varied appearances (Askarizad & Safari, 2020). The main goal of space syntax is to examine the spatial development of human mobility between different locations (Hafeez et al., 2023). Based on Liu et al. (2018), space syntax was defined as a method to study the spatial configuration between the building layout plan and human behaviour. The key elements of space syntax are the connectivity and relationship between the occupants and the liveable areas in a relative manner. The relational feature refers to the shapes that arise from human action (Ahmad Fuad et al., 2023). Evans et al. defined wayfinding behaviour as "a work of recognising and reacting to the complex space environment and guiding sign systems" from the perspective of human perception. According to Yusoff et al. (2019), wayfinding is about signs and many different things coming together to create an environment we can move through. Permeability also indicates the connectivity between spatial units, facilitating convenient and direct entry to each spatial unit inside a structure (McLane, 2013).

3 Background of the Case Study

Located in the centre of Glasgow, the Technology and Innovation Centre (TIC), designed by BDP Architects in 2015, is an eight-story collaborative research and conference centre owned by the University of Strathclyde. The TIC project fosters knowledge exchange with private and public institutions to enhance university-business entrepreneurship, industry engagement, and research

commercialisation through strategic industry-focused partnerships, networks, mutual leverage, and value.

The International Technology and Renewable Energy Zone (ITREZ) in Scotland is based on the TIC, a global centre for research and development that unites industry and academics to collaborate on advancing the offshore renewable sector.

The selected case study building is categorised under semi-public amenities, which consist of an auditorium and research centre. It has a design for a semi-public building, and the research is at the centre of 850 researchers in engineering, science, bio-nanotechnology, business, energy, health, technology, and asset management. The building design has a flexible layout plan for users' accessibility. Social interactions significantly influence urban settings, leading to notable changes in people's behaviour (Askarizad & Safari, 2020). Activity-space segregation refers to the time and space separation of different social groupings (Palmer, 2013).

3.1 Location of Case Study

The University of Strathclyde Technology and Innovation Centre (TIC) is a centre for technological research based in Glasgow, Scotland. The building, designed by Building Design Partnership (BDP), is located at the John Anderson Campus's southern edge within the city centre's Merchant City district. To maximise the diffuse natural light and provide a civic presence on George Street, TIC is elevated along the North frontage, reaching a height of eight stories.

3.2 Building Style

The TIC's design is a triangular layout plan that integrates the surrounding sites. Its form is deliberately expressive rather than form-making, considering the site context.

4 Method

Finding a building case study is the first stage in this research. The Technology and Innovation Centre (TIC) has been chosen to conduct this investigation because of its typology as an educational building. Moreover, getting information about this building from publications and online resources is sufficient. The redrawn data using AutoCAD then converts the building plans' original version. In order to analyse justified graphs, the researcher identifies the spaces inside the building using the labelling and numbering for the coding system. The level of permeability and wayfinding at the Technology and Innovation Centre (TIC) are examined using its floor layout plan. The permeability and wayfinding are studied in different contexts and scales with distinct measurement tools and techniques (Bilgi et al., 2021) to ensure the efficiency of users' movement (Andrade et al., 2018; Bilgi et al., 2021; Ooi et al., 2023).

4.1 Likert Scale

The Likert scale measures participants' perceptions, experiences, or preferences related to their navigation in these educational buildings (Çavuş, 2021). The Likert Scale is used in this study to assess wayfinding analysis and permeability. The Likert Scale classifies areas into five levels of privacy: public, semi-public, semi-private, private, and highly private (Yusoff et al., 2019;

Ponterosso, 2018). Figure 1 displays the quantifiable scales representing the permeability and wayfinding degree.

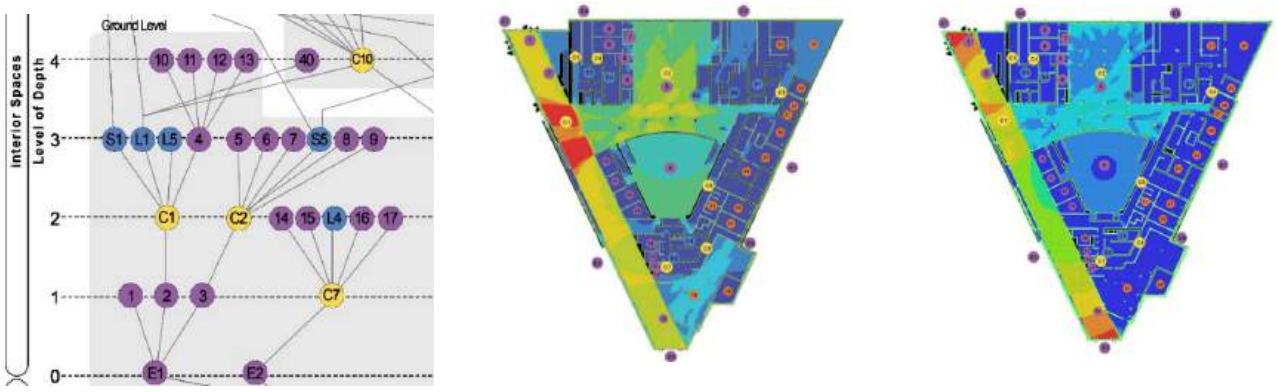


Figure 1: Sample of Justified Graph(left) and visual connectivity and integration graph(right)

4.2 Coding System

Regarding colour labelling, the main functional areas are divided into two categories according to the kind of users: orange is designated for staff-only areas and purple for the public. Corridor spaces are shown in yellow, whereas vertical accesses are highlighted in blue. It is important to indicate spaces in different zones with numbers or alphabetical symbols and colour codes (Chee et al., 2022). The justification graph is further used to transpose all plan labels to examine the wayfinding quality and permeability depth level.

Table 1: Labelling of spaces in hierarchical order

Elements	Design Coding	Design Coding (Hierarchical Order)
Entrance	E	E1,E2,E3,…
Space for Visitors	-	1,2,3,….
Space is restricted for staff.	-	1,2,3,….
Staircase	S	S1,S2,S3,….
Lift	L	L1,L2,L3,…..
Corridor	C	C1,C2,C3,…..

Every area in the case study building is categorised using a numbered system. Alphabetical numbering (E1 & E2) denotes building entrances and access, whereas numerical numbering (1, 2, 3, etc.) designates the main functional areas. Lifts are represented by L1 and L2, and vertical access, such as escalators and stairs, is marked by S1 and S2. Corridor designations include C1, C2, C3, etc.

The permeability and wayfinding quality at each level is evaluated based on the justifiable graph and visibility graph analysis (VGA), specifically the VGA Connectivity Graph and VGA Integration Graph. Figure 1 illustrates how the reference Likert scale might be used to assess the outcome. Permeability depth levels are categorised into four categories: semi-private, private, public, and semi-private. Private space has the greatest permeability depth level. Three quantifiable scales are very easy, straightforward, and difficult—justify the depth levels of

navigation quality, with fewer depth levels corresponding to a more straightforward and superior wayfinding.

Table 2: Likert scale of permeability and wayfinding based on level of depth.

Level of Depth	Level of Permeability	Level of Wayfinding
0	Public	Easy/ Straightforward
1		
2	Semi-Public	Moderate
3		
4	Semi-Private	Difficult
5		
6	Private	Very Difficult
7		

The visibility graph produced by the DepthmapX program, which specifies the degree of visual connectedness and integration, is coloured in Figure 1 according to the colour scale. The lowest connection and integration level, shown in blue, indicates challenging access. The degree of wayfinding grows from blue to red, which signifies the maximum connectedness integration level and simple access. The result will be analysed in terms of visual connectivity, visual integration, level of permeability, and level of wayfinding based on the Likert Scale shown in Table 2. Different colours represent different degrees of visual connectivity and integration and different levels of permeability and wayfinding. The spaces are measured based on the five-category scale in the permeability level: (1) extremely public, (2) public, (3) semi-public, (4) semi-private, and (5) private. The level of wayfinding of spaces is measured based on the five-category scale: (1) very easy or straightforward; (2) easy; (3) moderate; (4) difficult; (5) very difficult.

Table 3: Visual Connectivity, Visual Integration, Level of Permeability and Level of Wayfinding based on Colour Scale

Colour Scale	Colour	Visual Connectivity	Visual Integration	Level of Permeability	Level of Wayfinding
	Red	Very High	Very High Integrated	Public	Very easy/ Straightforward
	Orange				
	Yellow	High	High Integrated	Public	Easy
	Green				
	Mint	Medium	Medium	Semi-Public	Moderate
	Tiffany				
	Cyan	Low	Segregated	Semi-Private	Difficult
	Blue				
	Dark Blue	Very Low	Most Segregated	Private	Very Difficult

4.3 The Analysis

The levels of permeability and wayfinding are determined by calculating the percentage of space allocated to each level. The levels of permeability are determined by determining the percentages of space given to highly public, public, semi-public, semi-private, and private areas. These levels of permeability are then analysed hierarchically. The degrees of wayfinding are

categorised according to the percentages of area allocated for straightforward, easy, moderate, difficult, and extremely difficult. These levels are then explored hierarchically.

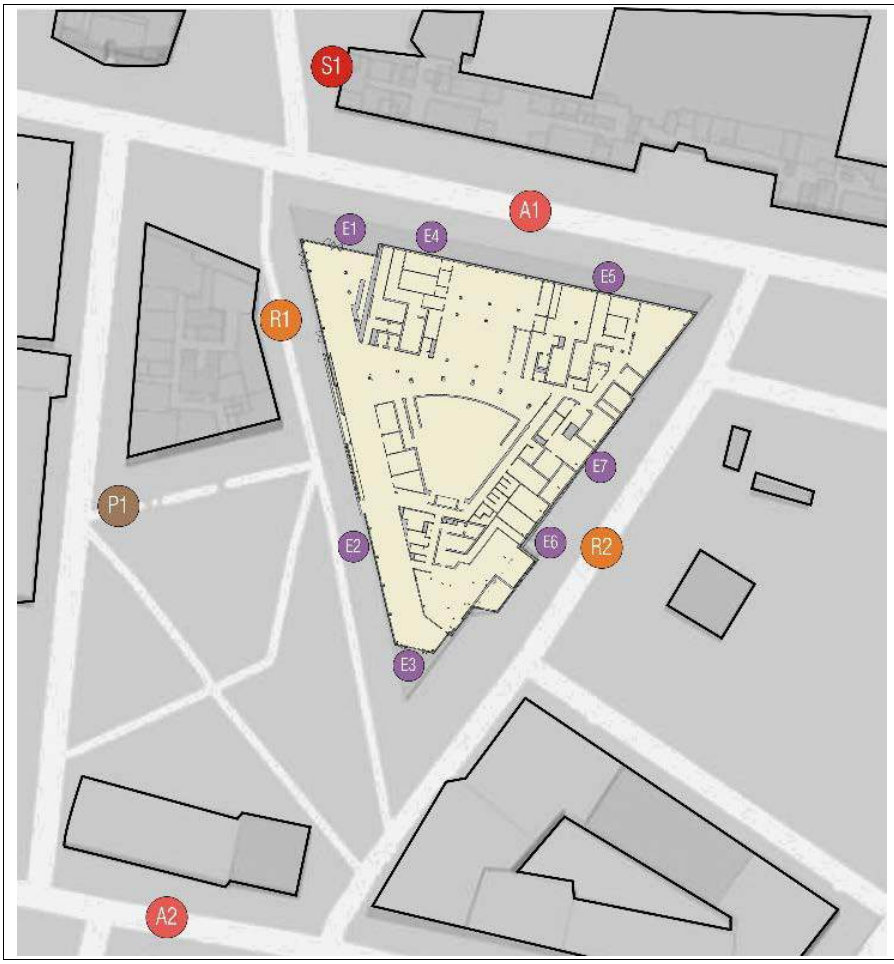
5 Result of Analysis

5.1 User Category

The case study building spatial configuration is examined in relation to users' categories. Two primary identified user categories are visitors, represented in the purple numbering labelling, and staff, labelled in the orange numbering system.

5.2 Site Plan

According to the overall justified graph of the Technology and Innovation Centre drawn in Figure 2, there are 7 depth levels. Based on the justified graph, there are only two depth levels for the site plan, which -1 and -2 are on the ground floor or the site. Furthermore, there are seven depth levels for the ground, lower, and first floors.



Code	Space
A1	George St Road
A2	Ingram St Road
S1	Public Carpark
R1	Entrance Road
R2	Service Road
E1	George Street Entrance
E2	Main Entrance 2
E3	Main Entrance 3
E4	Fire Exit 1
E5	Fire Exit 2
E6	Fire Exit 3
E7	Staff Back Entrance
P1	Basement Parking Entrance

Figure 2: Site Plan of Technology and Innovation Centre (TIC) of the University of Strathclyde.

The main roads, A1 and A2 and the public car park, S1, are the main accesses for vehicles and public transport to reach the Technology and Innovation Centre.

Based on the justified graph in Figure 5, A1, A2, and S1 are classified as extremely public with depth level 2. The internal roads, R1 and R2, can be accessed for visitor drop-off and service

purposes. They go directly to the parking entry, P1, and the loading/unloading bay, E6, demonstrating a clear and direct approach to accessing the appropriate openings.

The entrances, E1, E2, E3, E4, and E5, with depth level 1, are also extremely public and straightforward in wayfinding. Regarding pedestrian access, the public drop-off with a designated public plaza is indicated as A1, which is directly accessible to the Main Entrance 2 (E2). The public's highly walkable access with greenery and urban furniture is a social node connecting to the Technology and Innovation Centre (TIC). E1 is the main point for vehicles transitioning from the internal route, R1. It is publicly classed with a depth level of 2 in the justified graph shown in Figure 5, and it is straightforward to navigate.

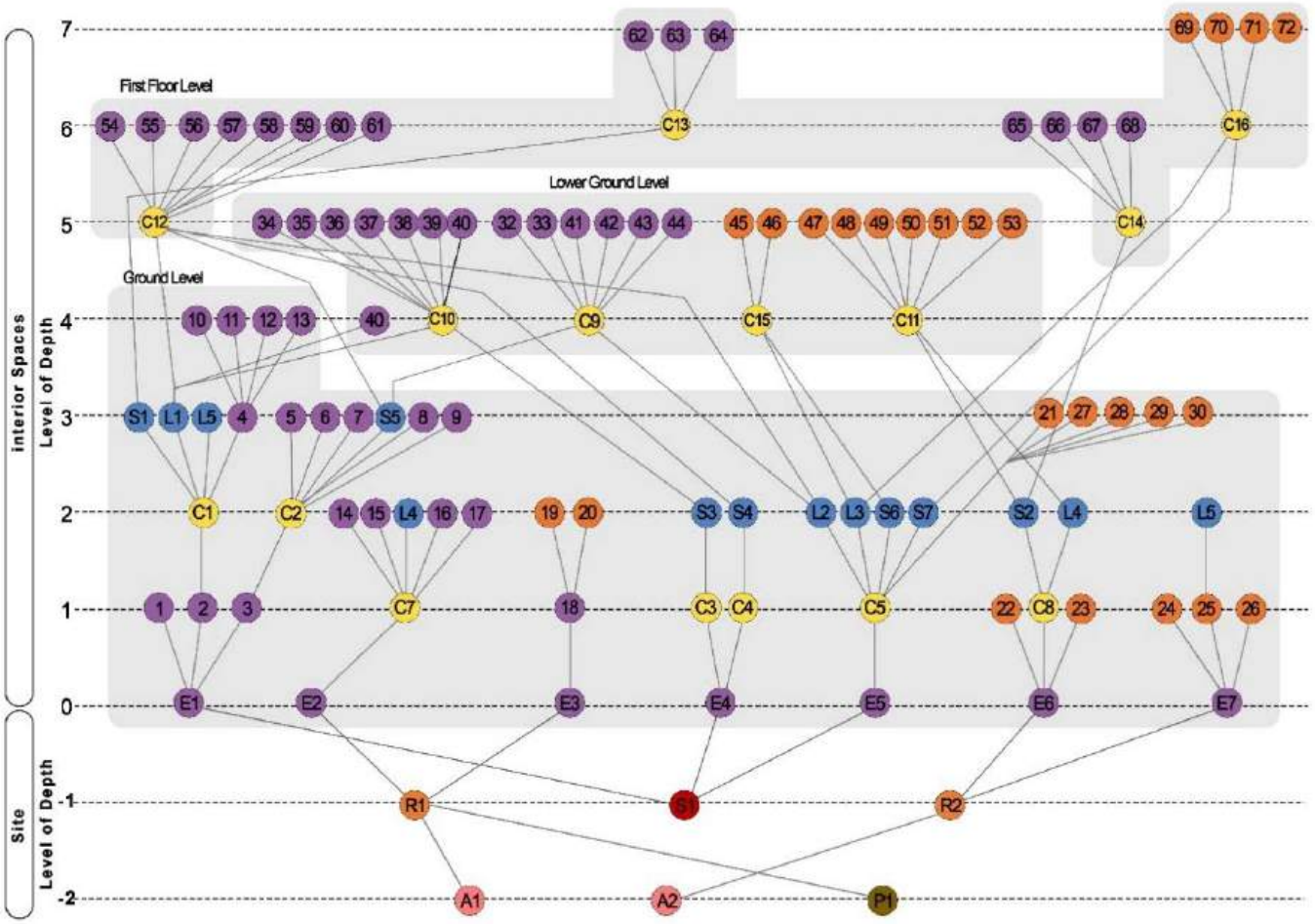
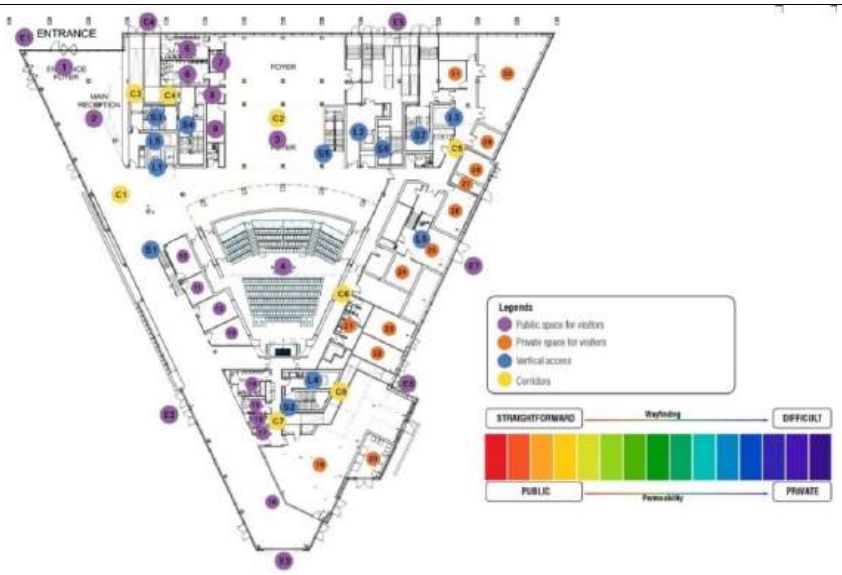


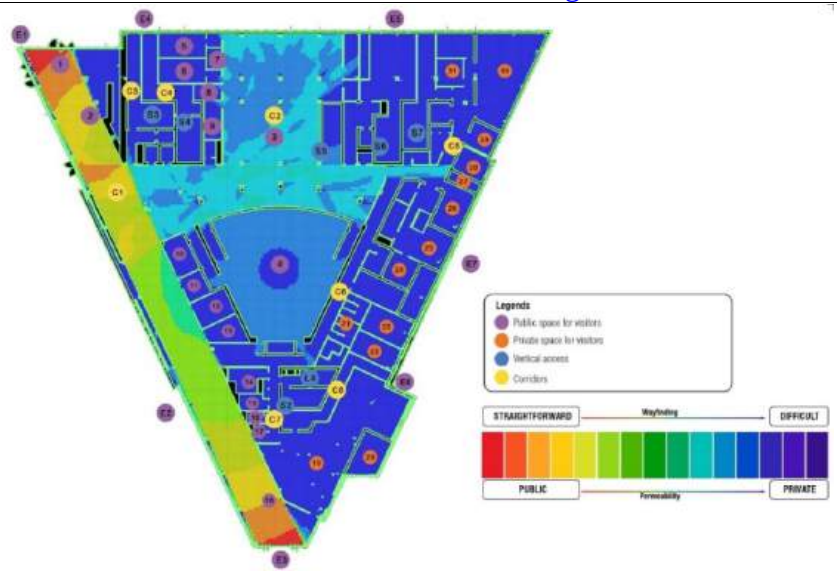
Figure 3: Site Plan and Overall Justified Graph of Technology and Innovation Centre (TIC), of University of Strathclyde (Source: Author)

5.3 Ground Floor Plan

There are five depth levels from level 0 to level 4 for the ground floor of the Technology and Innovation Centre (TIC) in the justified graph, as illustrated in Figure 3. Based on the justified graph in Figure 5, most of the spaces on the ground floor of the Technology and Innovation Centre (TIC) are placed at the lower levels of the justified graph.



Floor Plan and the Coding



VGA Connectivity

VGA Integration

CODE	SCHEDULE OF ACCOMMODATION
E1	George Street Entrance
E2	Main Entrance 2
E3	Main Entrance 3
E4	Fire Exit 1
E5	Fire Exit 2
E6	Fire Exit 3
E7	Staff Back Entrance
S1	Public Staircase
S2	Fire Staircase 2
S3	Fire Staircase 3
S4	Fire Staircase 4
S5	Staircase 5
S6	Fire Staircase 6
S7	Fire Staircase 7
L1	Lift 1
L2	Lift 2
L3	Lift 3
L4	Lift 4
L5	Lift 5
L6	Loading/unloading Lift
C1	Corridor 1
C2	Corridor 2
C3	Fire Corridor 1
C4	Fire Corridor 2
C5	Corridor 3
C6	Corridor 4
C7	Corridor 5
C8	Fire Corridor 3
	Entrance Lobby
	Main Reception
	Foyer
	Auditorium
	Female Toilet
	Male Toilet
	OKU Toilet
	Janitor Room
	Cloakroom
	Conference Room 1
	Conference Room 2
	Conference Room 3
	Conference Room 4
	Female Toilet
	Male Toilet
	OKU Toilet
	Janitor
	Cafe Area
	Catering Kitchen
	Cold Storage
	Staff Toilets
	M&E
	M&E
	Control Room
	Loading/Unloading
	General Storage
	M&E
	M&E
	IT Room 1
	Main LV Room
	IT Room 2

Figure 4: Ground Floor Plan (Top) and Visual Analysis Graph of First Floor Plan (Bottom) of the Technology and Innovation Centre (TIC) of the University of Strathclyde

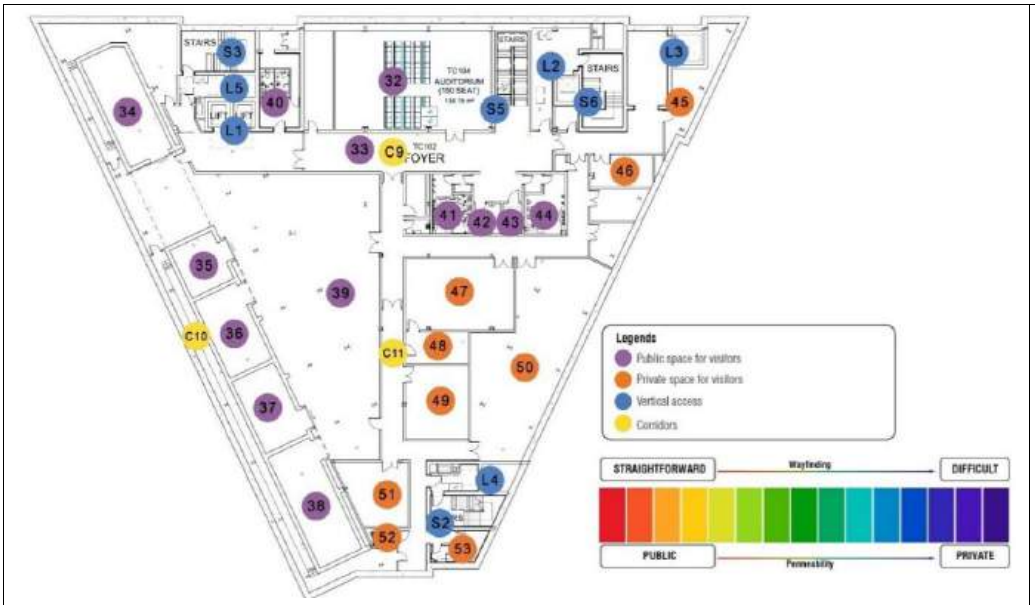
Concerning the Likert Scale in Table 2, depth levels 0 and 1 are classified as public space; depth levels 2 and 3 are classified as semi-public space, whereas depth levels 4 and 5 are classified as semi-private. The public spaces in TIC are the entrance foyer (purple 1) and Cafe area (purple 18), with depth level 1 in the justified graph because both the Entrance foyer (purple 1) and Cafe area (purple 18) are designed as the main entrance from R1, which acts as the main public space of the building. The VGA connectivity graph in Figure 7 and the integration graph in Figure 8 further validate these spaces as public spaces with yellow and orange colours, respectively. Based on the justified graph (Figure 3) and VGA graph Integration (Figure 4), corridor 1 (yellow C1) is validated as the higher user movement (Permeability) as it shows the colour red. The auditorium (purple 4) is the semi-public space placed in-depth level 3 to encourage higher user movements at the foyer of corridor 2, where there is vertical access like Lift 1, Lift 5, and fire staircases 3 and 4. In general, spaces on the ground floor of the building are mainly open to the public except for some storage spaces, and services are only restricted to staff.

Based on the justified graph (Figure 3) and VGA graph Connectivity (Figure 4), the main reception (purple 2) and the Cafe area (purple 18) are very easy to wayfinding. With this, visitors can easily get to the building and use the facility like the auditorium (purple 4). Corridor (C6) and spaces for services (orange 19-31) are designed at depth levels 1 and 2 to allow easy wayfinding for loading and unloading. Therefore, the arrangement of the ground level is straightforward, with a clear distinction between public areas for guests and private areas for workers.

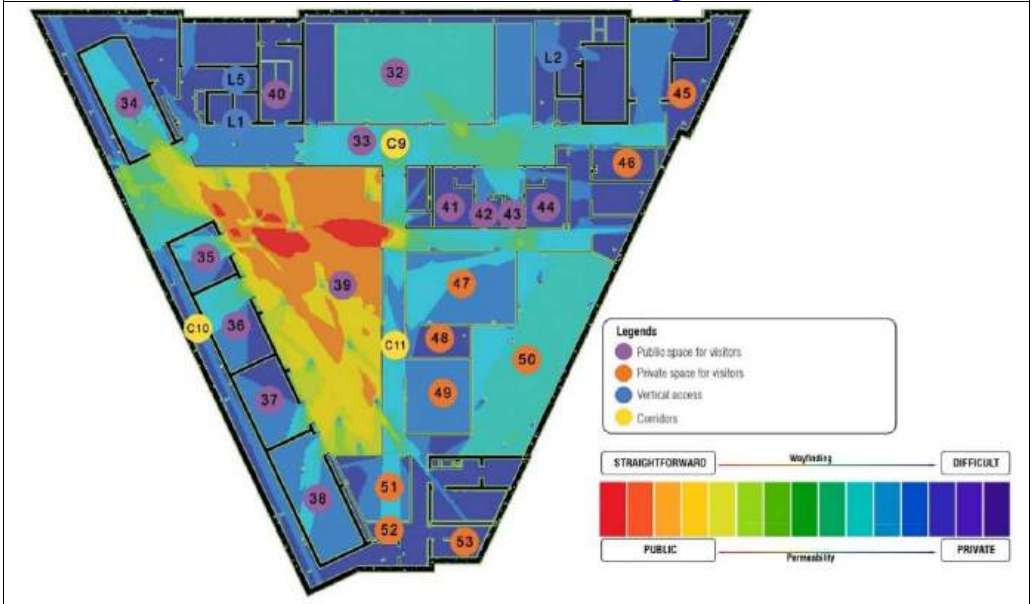
5.4 Lower Ground Floor Plan

There are two depth levels from level 4 to level 5 for the lower ground floor of the TIC in the justified graph, see Figure 3. The foyer (purple 39) and catering foyer (purple 33) are classified as semi-private, with a depth level of 4 in the justified graph (Figure 5). However, it shows a slightly different result in VGA connectivity (Figure 10) and integration graph (Figure 11). The green colour in these spaces, as shown in the graphs, indicates that these spaces are public. These spaces are designed for students and staff. The auditorium (purple 32) and discussion rooms (purple 35, 36, 37) were designed for semi-formal activities, with direct access from Lift 1. Meanwhile, the spaces like the lab and control room (orange 45-53) are the private spaces used by the staff.

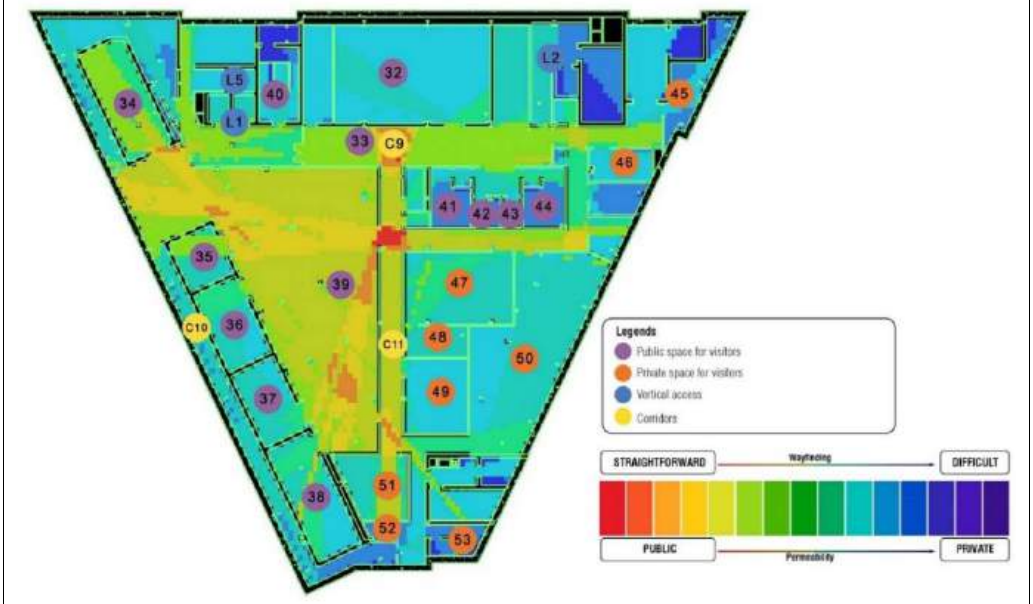
The wayfinding for students and staff is easy as the foyer (purple 39) and catering foyer (purple 33) direct them to the auditorium room (purple 32), discussion rooms (purple 35, 36, 37), the spaces like lab and control room (orange 45-53) and semi-private space with a depth level of 5, with moderate wayfinding. It is further validated by the result in the VGA connectivity and integration graph (Figure 5). It is believed that the foyer (pink 39) is mainly used for the activities that involve users in the discussion and break rooms, and this space is used as a multipurpose area for some activities. Therefore, it has moderate wayfinding from the entrances at the lower ground floor of the building. The active ageing hubs (pink 24 and 27) are categorised as semi-private spaces with difficult wayfinding. The Technology and Innovation Centre (TIC) staff and certain students can only access these areas.



Floor Plan and the Coding



VGA Connectivity



VGA Integration

CODE	SCHEDULE OF ACCOMMODATION
S2	Fire Staircase 2
S3	Fire Staircase 3
S5	Staircase 5
S6	Fire Staircase 6
L1	Lift 1
L2	Lift 2
L3	Lift 3
L4	Lift 4
L5	Lift 5
C9	Corridor 6
C10	Corridor 7
C11	Corridor 8
32	Auditorium
33	Catering Foyer
34	Discussion Room 1
35	Break Room
36	Discussion Room 2
37	Discussion Room 3
38	Discussion Room 4
39	Foyer
40	Toilet
41	Female Toilet
42	OKU Toilet
43	Janitor
44	Male Toilet
45	Store
46	Control Room
47	Lab 1
48	Break Room
49	Lab 2
50	Lab 3
51	Toilet
52	Janitor
53	OKU Toilet

Figure 5: Lower Ground Floor Plan (Top) and Visual Analysis Graph of Lower Ground Floor Plan (Bottom) of Technology and Innovation Centre (TIC) of the University of Strathclyde

5.5 First Floor Plan

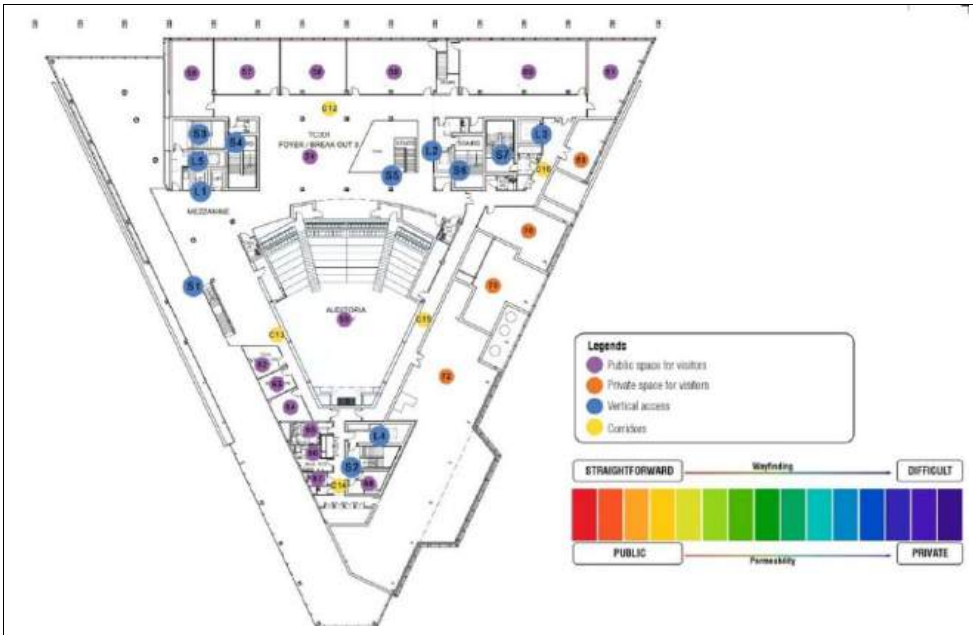
There are three depth levels from level 5 to level 7 for the first floor of the Technology and Innovation Centre (TIC) in the justified graph, as illustrated in Figure 3. The depth level of the first floor varies from levels 5 to 8. These levels can be considered semi-public for the visitors at the Foyer (54) and the Auditorium (purple 55), designed as the main space of the building where the visitors have events. Concerning the Likert Scale in Figure 1, these spaces are designed to be private. However, visibility graph analysis gives slightly different results. The auditorium (purple 55) shows a large area of orange colour in VGA connectivity but a large area of Tiffany colour in the VGA integration graph in Figures 13 and 14 which indicate it as a public or semi-public area.

Meanwhile, spaces like conference rooms and meeting rooms (purple 56-64) are marked as blue in both VGA connectivity and integration graphs. These spaces are semi-private areas specifically used by students and staff. Some private spaces, like the management office and storage rooms used primarily by staff, are considered private and located at depth level 7. However, visibility graph analysis shows a slight difference, as these spaces are blue in both VGA connectivity and integration graphs, showing them as semi-private.

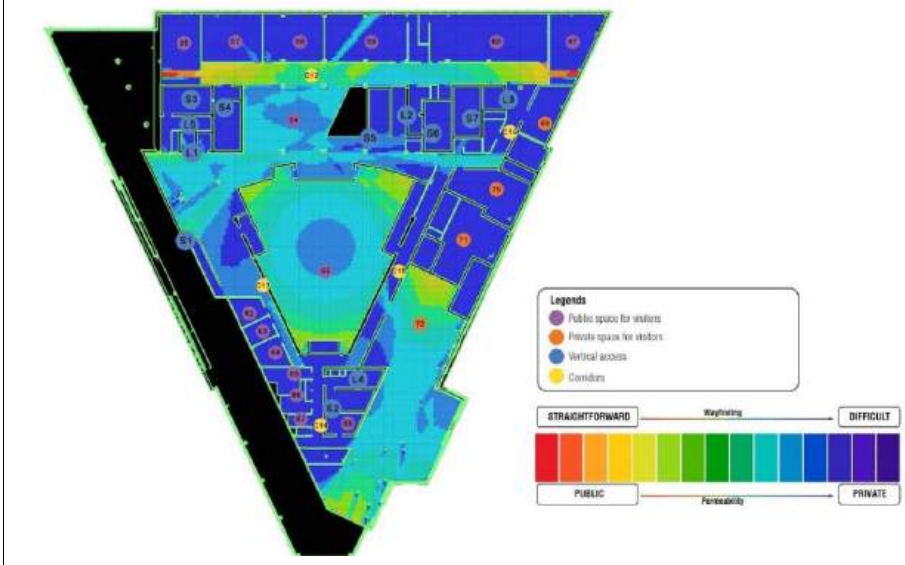
The first-floor layout is considered straightforward for the staff and researchers since it is designed to serve all the private spaces, such as the meeting rooms and management office. For the visitors, the layout of the first floor is considered very difficult to access since visitors are only accessible to the public spaces on the first floor through the public staircase and lift, such as Staircase 1 (S1), Staircase 2 (S2) and Lift 1 (L1). From the VGA connectivity and integration graphs in Figure 6, the foyer (purple 54) is yellow in connectivity but cyan in the integration graph. The management office (orange 72) is validated with colour in both VGA connectivity and integration graphs as a moderate level of wayfinding. The staff must enter the management office through the long corridor (C15). In general, the first-floor layout of the Technology and Innovation Centre (TIC) performs good spatial planning, where the segregation of public spaces for visitors and private spaces for residents is apparent.

6 Discussion

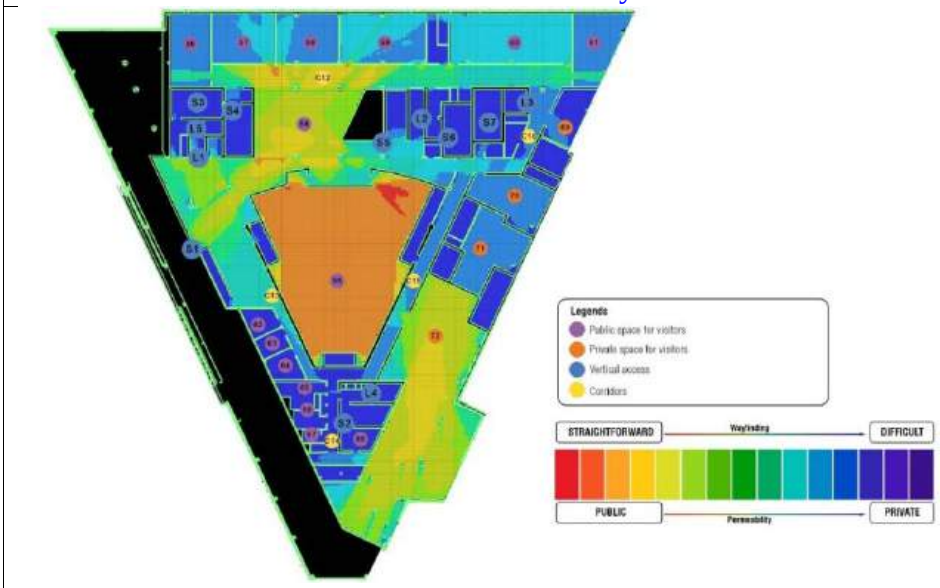
As illustrated by the justified graph in Figure 5, the lower depth level forms an asymmetrical structure with a Public entrance (E1, E2, E3), staff entrance (E7), main lobby (1 & 2) and vertical access (S1, S2 & L1) as main users' movement spaces. Each branch is interconnected by employing a symmetrical framework, creating several alternate pathways to the spaces. The building typology is characterised by a spatial plan that begins with asymmetric buildings and is subsequently followed by an array of symmetric structures, resulting in a generally semi-private configuration. Most of the spaces gather in the latter portion of the deeper levels, as they may be accessed by traversing a sequence of additional spaces.



Floor Plan and the Coding



VGA Connectivity



VGA Integration

CODE	SCHEDULE OF ACCOMMODATION
S1	Public Staircase
S2	Fire Staircase 2
S3	Fire Staircase 3
S4	Fire Staircase 4
S5	Staircase 5
S6	Fire Staircase 6
S7	Fire Staircase 7
L1	Lift 1
L2	Lift 2
L3	Lift 3
L4	Lift 4
L5	Lift 5
54	Foyer
55	Auditorium
56	Conference Room 1
57	Conference Room 2
C12	Corridor 9
C13	Corridor 10
C14	Corridor 11
C15	Corridor 12
C16	Corridor 13
58	Conference Room 3
59	Conference Room 4
60	Conference Room 5
61	Conference Room 6
62	Meeting Room 1
63	Meeting Room 2
64	Meeting Room 3
65	Female Toilet
66	Male Toilet
67	OKU Toilet
68	Janitor
69	Storage
70	Break Room
71	Filing Room
72	Management Office

Figure 6: First Floor Plan (Top) and Visual Analysis Graph of First Floor Plan (Bottom) of Technology and Innovation Centre (TIC), of University of Strathclyde (Source: Author)

6.1 Level of Permeability

As Table 5 shows, semi-private spaces contribute the highest percentage to the overall schedule of accommodation. The case study building has 30.56% semi-private and 19.44% private spaces, with only 19.44% public spaces.

Table 5: Level of Permeability

Hierarchical Order	Level of Permeability	Visual Connectivity	Corresponding Justified Graph Depth Level	Number of Spaces	Overall Percentage
Primary Level	Public	High	0,1	21	19.44%
Secondary Level	Semi-public	Medium	2,3	33	30.56%
Tertiary Level	Semi-private	Low	4,5	33	30.56%
Quaternary Level	Private	Very Low	6,7	21	19.44%

6.2 Levels of Wayfinding

The case study building is 36.11% very straightforward in wayfinding, as shown in Table 6. As the spatial layout is carefully designed with restricted private access for the staff, including administrative personnel, researchers, and scientists, public access is controlled by the asymmetrical spatial structure, which leads to higher depth levels and lower wayfinding quality.

Table 6: Level of Wayfinding

Hierarchical Order	Level of Wayfinding	Visual Integration	Corresponding Justified Graph Depth Level	Number of Spaces	Overall Percentage
Primary Level	Very Straightforward	Very High Integrated	0,1,2	39	36.11%
Secondary Level	Straightforward	High Integrated	3	15	13.89%
Tertiary Level	Moderate	Medium	4	9	8.33%
Quaternary Level	Difficult	Segregated	5	24	22.22 %
Quinary	Very Difficult	Most Segregated	6,7	21	19.44%

6.3 Other Aspect

60.61% of the spaces are composed of end rooms with dead ends. The objective is to provide privacy for the researchers and personnel staff in their everyday activities and responsibilities. Vertical connections, such as staircases and lifts (elevators), are evenly dispersed throughout various depth levels to accommodate certain public and private purposes and provide access.

Table 7: Type of Spaces

Level of Wayfinding	Space	Number	Percentage
End Room	1,5,6,7,8,9,14,15,16,17,19,20,21,27,28,29,30,10,11, 12,13,40,34,35,36,37,38,39,40,32,33,41,42,43,44,45,46,47, 48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63, 64,65,66,67,68,69,70,71,72	60	60.61%
Single (1) connecting space	E2,E3,E5,2,3,C3,C4,25	8	8.08%
Double (2) connecting space	E4,18,C8,C15	4	4.04%
Triple (3) connecting space	E1,E6,E7,C13	4	4.04%
Quadruple(4) connecting space	C1,C5,4,C14,C16	5	5.05%
Quintuple (5) and more connecting space	C7,C2,C9,C10,C11,C12	6	6.06%
Staircase	S1,S2,S3,S4,S5,S6,S7	7	7.07%
Lift	L1,L2,L3,L4,L5	5	5.05%

7 Conclusion

The spatial arrangement of the case study building, designed as an educational building, is suitable in terms of its level of permeability and the quality of wayfinding, as evidenced by the justified graph and VGA. The spatial configuration aligns well with the architectural typology of the case study building, an educational facility consisting of a publicly accessible visitor centre and a privately operated research institution. The building's asymmetrical construction enables a controlled internal circulation system with restricted access to public and private areas. At the same time, the highly integrated symmetrical spatial plan promotes visual connectedness and influences the actions of all users.

The spatial arrangement of the case study building, designed as an educational building, is suitable for its permeability level and wayfinding quality, as evidenced by the justified graph and VGA. The permeability analysis shows that TIC has a layout plan design for a semi-private building, with the main users being the university staff. These semi-private and private spaces account for 50% of the total room space with high VGA connectivity. The building also has 60.61% dead-end rooms to give the researchers and personnel staff privacy. Besides, the overall wayfinding has a very straightforward wayfinding with 36.11% for the user movements.

8 Availability of Data and Material

All information is included in this article.

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