CHAPTER THREE: THE INTERNAL DYNAMICS OF RAILWAY TERMINI

This chapter is a study of two selected London railway termini, Victoria and Euston Stations, focusing on their internal configurational structures and the implication these have on space use patterns. The aim is to investigate how far space plays a role in influencing pedestrian behaviour in railway terminus areas, starting from within the termini or the transport node buildings themselves. It is conjectured that although railway termini are point attractors and the movement inside them is largely determined by specific entrances and destinations, such as railway platforms, their internal spatial configuration still plays a significant role in influencing route choices made between specific points, as well as determining other non-transport related use patterns. The findings may then suggest how termini themselves can play a role in creating 'places in context' and also the direction of further urban scale analysis in later chapters.

This chapter is structured into five main sections. Firstly, the programme of study, derived from the arguments proposed in the chapter's introduction, is presented, followed by a description of the selective case studies in the second section. The third section presents the analysis of the stations' internal spatial configuration. The techniques used for the analysis are first introduced followed by the findings. The empirical study is presented in the fourth section, first addressing the methodologies for the observation of space use patterns inside the termini before presenting the empirical findings. The relationship between the spatial patterns and use will be discussed in the final section.

3.1: INTRODUCTION

As discussed in the literature review in Chapter Two, several authors have argued that there is a relationship between the permeability connection of built environments to the wider city and their space use patterns. Hillier et al (1993a) argue that in any urban area it can be shown that a crucial aspect of vibrant 'placeness' is how spatial configuration structures movement from 'all points to all others', so that some locations become naturally busy and others naturally quiet. In railway termini, movement is not from ‘all points to all others’ but very much between entrances and railway platforms. Their current role as major transport interchanges in the city has also made their internal spaces increasingly complex. The mainline termini now accommodate other constrained movement patterns between entrances and exits of other transport modes; underground trains, taxis, buses, private cars, and even bicycles. Furthermore, they include other types of movement related to non-transport functions, such as retail and catering facilities, that have been added inside the stations, largely during the refurbishment of the 1980's.

Due to this complexity, there are several design guidelines set forth for station designers, all aimed at arranging the internal spaces to benefit principally their efficiency, safety, and vitality. Edwards (1997) paraphrases the major design principles from the 1992 British Rail Manual, which mainly emphasize two notions; the convenience and safety of all station users and the maximization of the public interface between passengers and non-passengers inside railway stations. Both are largely manifested through the recommendations on arrangement and provision of station facilities. The guidelines stress that all facilities should be laid out in a simple and easy manner to allow passengers either during arrival, departure or interchange to hasten to their destinations without delay or difficulties. This is especially applicable to designing for emergency situations, stressing the need to be able to evacuate the station quickly and effectively. For local visitors, the station's interior should be well arranged with a good combination of idle and busy intervals of activities. This is intended to encourage the use of the space and facilities as an alternative 'urban room' with the least interruption to the passenger activities.

This suggested 'functionality' of the station's interior spaces provides no clear procedure for how it could be practically applied to varied termini with different layouts and building footprints. It seems that there is a missing link between the 'forms' that need to be created in order to achieve the 'functions' described, making the design guidelines appeared at best rather ambiguous. The problem arises because it is not clear to what extent the terminus spaces play a role in shaping people's activities inside them.

The study in this chapter is an attempt to discover this missing link, setting out from three major propositions based on Hillier's idea of natural movement. The first proposition is that space plays a major role in shaping juxtaposing patterns of movement inside the termini, even though they may at first seem rather constrained. In other words, the movement routes are influenced by the spatial relationship between the origins and destinations. Thus, if the location of 'movement attractors' inside the termini, such as entrances, train platforms, or the Underground access points, (influencing the 'deterministic movement patterns') are more or less congruent with the 'natural movement pattern' (largely affected by the internal spatial configuration of the railway termini), the flow and pause of movement will become natural and synchronised for all groups, both frequent and first time station users. In the railway termini where the flux of movement and activities, as well as the intensity of commercial and directional signage can be overwhelming, it is argued that the first time station users, who are not familiar with their functional layouts, will follow patterns of natural movement.

The configurative description of space syntax not only brings forth the missing link between forms and functions of the termini but also reflects a clear spatial design process for station designers. As described in the last chapter, space is regarded as an independent entity rather than simply a by-product of the arrangement of physical things (Hillier, 1996a: 27). This description of space focuses on the relation of the spatial components in an architectural system rather than the entities themselves, or as Hillier puts it, the relations among relations in a system (Hillier, 1996a: 1). When a railway terminus is built, its form encloses an internal space that constructs a configurative pattern, or a set of relations between parts of the space, designated by the positioning of physical elements inside it, such as walls, columns, and rooms. Importantly, it seems to be this configurative level, not the physical one, that proves decisive in determining the functionality of the terminus itself. Of critical importance are not the station functions but how the relations among the constructed spaces produce different 'across-relations' that not only accommodate specific events but also generate them. Form and function are then inter-dependent, mediated through patterns of relations or 'configuration', with different patterns of relations influencing different patterns of movement. Interestingly, space approached in this way, independent of form though related to function, suggests that termini with varied forms can achieve similar functional success provided that their spatial relations exhibit similar configurational properties. It is only through this approach to space that design guidelines based upon configurational principles may be generated which have the potential to be applied in a variety of station forms, regardless of size, style, footprint, and facilities.

The second proposition , a consequence of the first, is that if space influences the choice of routes between movement attractors, it also determines the degree of reconciliation between moving and static space uses. In railway termini, the 'static activity attractors', both transport and non-transport related, such as ticket counters, train timetables, shops, cafes, and restaurants, largely affect where people sit, stand, and wait. If the location of these attractors generates stationary activities that do not get in the way of the natural movement pattern, both moving and static space uses in the termini will efficiently coexist without any physical difficulties.

The third proposition is that space also determines the visibility fields that creates 'intelligibility', allowing station users to navigate efficiently. The termini with internal layouts that generate good visual fields from their entrances and visual coherence between important functions will promote convenient wayfinding through the building. Zevi pointed out that the key to understanding the building is '...to grasp space, to know how to see it' (Zevi, 1957: 23). Benedikt (1979) stressed the importance of a cumulative understanding of the form of the environment through the visual world and argued that the shape and size of the visual fields, or 'isovists', are salient since they may change with position relative to the environment. They are then a spatial by-product and determined by the spatial arrangements of a built environment. Edwards (1997) noted that the station design guidelines also emphasize the attention to visibility fields, which are considered far more important than the signage system in easing navigation for both first time and frequent users within the terminus buildings, where immense complexity is caused by various functions and large volumes of movement within a restricted space. A good visual field at both station entrances and rail platforms, he stated, provides important knowledge of what is offered, so people can freely programme their own choices before they enter the buildings from the surrounding streets or disembarking trains. In addition, how station facilities are collectively organised inside the building, developing direct visual relationships with one another, will benefit people, he suggested, by anticipating the sequence of actions they typically make. Visual coherence is therefore necessary for people to move without encountering a visual break in their perception of space.

It is argued, then, that space determines the composition of visual fields along the routes people make inside the termini. The important movement routes such as those between station entrances and rail platforms, the origins of a station's inbound and outbound routes, should have visual fields that are coherent and cover the location of the destinations well. The visual field from the entrances, the station's cardinal points, should cover most of the important station facilities such as other entrances, exits to other transport interchanges, booking halls, train timetables, railway platforms and trains, in order to establish overall intelligibility within the buildings.

3.2: PROGRAMME OF STUDY

To explore these three propositions, three main types of investigation are set out, defining the main structure of the study.

Firstly, the analysis will address both one and two dimensional descriptions of space inside the termini. Two methods of spatial analysis are used experimentally to reflect the configurative patterns of the internal spaces in different ways. The first method is referred to in this study as the 'all line axial analysis' (or 'Spacebox analysis') and the second is the 'convex shape analysis' (or 'Pesh analysis'), both developed by Nick Dalton. These two configurational models will represent the spatial properties that are associated with movement (addressed by axial lines: one dimensional organisation) and positions of people in the system (addressed by convex spaces: two dimensional organisation). These methods have been shown in past studies to be useful for the prediction of movement and activity in spatial complexes of substantial open areas, as opposed to street systems where most spaces are linear. Examples are the studies of museum spaces; Tate Gallery at Millbank (1995), office spaces; Mars National Office (1997), PowerGen Operational Headquarters (1997), retail spaces; Selfridges and Harrods Department Store (1999), and public squares in the Broadgate Development (1999)[1]. Both techniques will be introduced in more detail in Section 3.4.1. These spatial analyses are expected to provide the graphic representations of the stations' internal spatial configuration reflecting the relationship patterns of the integrated and segregated parts in their systems. Both the Pesh and Spacebox models will be discussed in terms of how they relate to the empirical findings in Section 3.7.

Secondly, the analysis focuses on the isovist as a tool for studying the spatial nature of the railway termini by examining the visual fields at some key points and along some significant deterministic routes. These methods, developed by Benedikt, are referred to as the 'point isovists' and 'moving isovists'. Point isovists will be used to represent the visibility field inside the termini from all entrances; the points where people start their journeys into the buildings. Moving isovists will present the visibility field at serial positions along some key routes such as an inbound route from the major street

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1 These projects have all been carried out by the Space Syntax Laboratory examining the spatial configuration of large open areas and the implication for their space use patterns. See more details in: ***Tate Gallery, Millbank,*** *London, 1995, study of existing layout visitor circulation and masterplan proposals, for the trustees of the Tate Gallery:* ***Mars National Office,*** *1997, space use evaluation for design briefing with Buschow Henley architects:* ***PowerGen Operational Headquarters****, Coventry, 1997, space use and interaction study for PowerGen PLC.:* ***Selfridges Department Store,*** *Oxford Street, London, 1999, customer movement, urban location and internal layout analysis study, with Foster and Partners.:* ***Harrods Department Store,*** *Knightbridge, London, 1999, customer movement,, browsing and buying study, relating sales performance to internal layout design, for Harrods:* ***Broadgate Redevelopment,*** *London, 1999, analysis of public space redesign options, for British Lan Company PLC.*

outside each terminus building, through its concourse hall to one of its rail platforms, and an outbound route from a rail platform toward its main underground station's entrance. This is sufficient to discover how the station's internal spatial properties affect the visual fields acquired by people while navigating through the spaces, both for those who come from outside to board trains and those who interchange between modes of travel. The methods and the analysis of the findings will be presented in Section 3.5.

Thirdly, the analysis will turn to the empirical investigation of two kinds of space use pattern inside the termini; moving and static activities. The observation methods are referred to as 'people following' and 'static snapshots'. The first method records the route choice of individuals within the station's concourse spaces, starting from their entry points, which includes all entrances from the surrounding streets, the adjacent buildings or different floors (if any), as well as from the train platforms. The records of all individual routes will be accumulated and graphically presented in order to examine the pattern of key routes and destinations inside the termini. The second method represents how and where stationary people cluster inside the termini and how the quantity and location of clusters are affected by different time periods. Both observation techniques will be clarified and followed by the presentation of the empirical findings in Section 3.6.

Ultimately, in Section 3.7, both space use patterns will be critically reviewed in relation to each other as well as to the spatial patterns modelled by Pesh and Spacebox. In order to examine clearly the inter-relation between spatial configuration patterns, space use patterns, and functional layout inside each terminus all at once, the final analysis mainly focuses on the graphical representation of the syntactic models. This is done by layering the observed space use patterns onto the spatial maps. The results will be analysed and discussed in relation to the three propositions already discussed in this chapter’s introduction. The discussion seeks to conclude how far the movement patterns in the railway termini are affected by their internal spatial configuration, modelled by Spacebox; to what extent the static activity patterns relate to the location of the station facilities as well as to the spatial configuration, modelled by Pesh; and how the visibility fields inside the termini influence movement patterns along some of their key routes. The effect of configurational properties on the overall performance of railway termini will be addressed at the end of the discussion.

3.3: THE CASE STUDIES

The three types of investigation, presented above, will be carried out on two London termini; Victoria and Euston Stations. Both stations were selected because they represent two completely different building layouts and architectural styles. The classicist Victoria Station, visually rather enclosed from its surroundings, has a complex spatial arrangement with linked double concourses, while the modernist Euston Station has a simpler open plan concourse well-lit by natural light from the transparent building envelope and is thus more visually exposed to the outside. The study will examine these two distinctive terminus spaces as a comparative case study.

Both termini were formerly operated by the same company, Railtrack, and so they share a similar refurbishment approach. Both have had their internal spaces remodelled as well as their retail and catering facilities expanded recently with the aim of generating greater profits[2]. However, according to Railtrack's 1999 'key station user statistics', shown in Table 3.1, although Victoria Station has a total area of non-transport facilities and a total number of station users per annum of almost double the size of Euston Station (3,234 to 1,816 sq.m. and 76.1 to 39.9 million people, respectively), both termini attract the same percentage of non-passengers (as opposed to passengers) to their internal spaces (18%). This means that despite their different sizes and functional components, Victoria and Euston Station are on average frequented by the same ratio of station users, and thus can be appropriately compared in terms of their space use patterns. The survey on their current urban conditions, presented earlier in Section 1.1, also reveals that both termini are located in urban settings with rather similar characteristics; a combination of busy front and side areas with mixed activities and rather quiet residential neighbourhoods to the rear. The external factors of both termini will then be disregarded in this internal study. The degree to which they are integrated into the surrounding urban fabric and how this might have an effect on the use of their internal spaces will be further investigated in Chapters Five and Six.

Additionally, both termini have their station concourses located more or less on the street level. Therefore there will be no level difference between streets and the stations which might have an effect on the flow of pedestrian movement and activity

[2] Of the twelve London mainline railway termini that are included as the case studies for this thesis, Railtrack has operated all but four of them. These are Cannon Street Station: operated by Connex Railways, Marylebone Station by Chiltern Railways, Fenchurch Street Station by c2c, and St.Pancras Station by Midland Mainline.

between the streets and the terminus buildings as well as the visual relationship between the internal and the external spaces.

TABLE 3.1: Key Station User Statistics
(Railtrack Major Stations; March 1999 / Source: Major station user survey, Pragma, November 1998)

Terminus	Users (per annum)		
	pass.	non pass.	total
Charing Cross	24,111,844	6,027,961	30,139,005
Euston	32,739,205	7,186,655	39,925,860
King's Cross	24,104,564	4,591,345	28,695,909
Liverpool Street	46,646,554	31,097,702	77,744,256
London Bridge	29,527,185	4,026,434	33,553,619
Paddington	16,769,584	1,955,234	18,724,818
Victoria	62,478,050	13,714,694	76,192,744
Waterloo	42,467,212	12,685,012	55,152,224
Terminus		**User Type (%)**	
		pass.	**non pass.**
Charing Cross		80	20
Euston		82	18
King's Cross		84	16
Liverpool Street		60	40
London Bridge		88	12
Paddington		91	9
Victoria		82	18
Waterloo		77	13
Terminus	**Current Total Space (sq.m.)**		
	retail	**catering**	**total**
Charing Cross	481	563	1,044
Euston	604	1,212	1,816
King's Cross	308	729	1,037
Liverpool Street	2,310	2,103	4,413
London Bridge	738	540	1,278
Paddington	415	1,053	1,468
Victoria	1,830	1,404	3,234
Waterloo	812	1,550	2,362

3.3.1 Introduction to the station location, layout plan and functional arrangement

3.3.1a Victoria Station

Figure 3.1 presents the local map around Victoria Station. The station is located in the City of Westminster, about half a kilometre south of Buckingham Palace and Green Park. Victoria Bus Station and Victoria Street are attached to the north of the terminus. Buckingham Palace Road leads from the south of Buckingham Palace to the station's west side with Wilton Road wrapping around its northeast corner and

Eccleston Bridge located to the south, separating the terminus from the Victoria Place commercial and office complex.

Victoria Station was built originally in 1859 by the architect J.T. Knowles. Jackson (1969) noted that the terminus housed the first railway to cross the Thames, the London-Brighton and South Coast Railway, located in the 'Brighton side' concourse. Later, the station was widely known as the 'Gateway to the Continent' as it also sent trains to the south-east of England, leading to the other concourse being chiefly known as the 'Continental side'. The terminus building was built in the Italianate style with a railway hotel named the Grosvenor, one of the earliest in Great Britain, constructed at the station's front side in 1861. Betjamin (1972) noted that both concourses served different rail lines and had different atmospheres. The Brighton side was more urban and flashier than the Continental side which was quiet, less fashionable and more suburban. Both concourses were later renamed the 'central' and 'eastern' concourses, respectively.

Victoria Station is currently one of the busiest major transport interchanges in London (Railtrack, 1997). The layout plan of its concourse level (Figure 3.2) shows both station concourse halls placed parallel to each other and connected through brick arches (Figure 3.3a). The eastern concourse (Figure 3.3b) serves train platforms 1-7, the International Rail Centre and the Railtrack reception area and is less busy than the central concourse (Figure 3.3c) which houses platform 8-17, the main ticket office and an entry to the upper floor Victoria Place Shopping Arcade, built over platforms 14-17. Each concourse has its own timetable billboard placed above the rail platform exits. The concourses function as the transition spaces from the station entrances (marked with dark blue circles) to the platform exits (red circles), the Underground exits (London Underground symbols), a bus station and a taxi queue. The platforms also accomodate the new Gatwick Express, the high speed train linking central London with Gatwick Airport to the south. Victoria Bus Station, located next to the terminus, provides several local bus services, the 'Stationlink', connecting all mainline termini across the capital, and the 'Airbus', connecting to London's Heathrow Airport. Victoria Coach Station is located to the south side along Buckingham Palace Road. A short stay car park is placed underground next to Victoria Place and can be entered from Eccleston Bridge at the back of the terminus. A cycle storage and hire facility is located between platforms 7-8.

The station has a total of ten entrances from outside. The main entrance (E3) is marked by the grand vault of the prominent station facade on Wilton Road. The eastern concourse can also be entered from Hudson Place and Wilton Road from the east (E1) and the northeast side (E2). Another four entrances (E4-E7) are located next to a roof-covered taxi queue area. The central concourse can also be entered from Buckingham Palace Road through the Grosvenor Hotel (E8) or directly from the road itself into the waiting area in front of platforms 16-17 (E9). Pedestrians from Eccleston Bridge at the back can also enter the station from the upper floor shopping arcade through steps and escalators located in the central concourse (E10 - Figure 3.3d). There are three exits from the underground train station (UE1-UE3).

The terminus was refurbished in 1994 by the developer Greycoat with British Rail Property Board to accommodate more shops, cafes, stalls and other public facilities such as cash machines, a medicentre, a tourist information centre, a hotel reservation centre, restrooms and transport police offices (Railtrack, 1997). Figure 3.3e shows how the existing brick arches have been transformed to accommodate retail and catering spaces such as cafes, shops and a large book store, WH Smith's, which is recorded as the most profitable branch in Britain (Hill, 1995). A number of cafes, pubs, and restaurants are located around both concourse halls with their seating areas at their shop frontages in designated spaces in the same manner as outdoor seats on public streets (Figure 3.3f-h).

3.3.1b Euston Station

Euston Station is located in the borough of Camden to the east of Regent's Park (Figure 3.4). The terminus has its main access from Euston Road at its south side and secondary ones from Eversholt and Melton Street attached to its east and west sides, respectively. To its front, between the station building and Euston Road, lies Euston Square Garden and a paved open space, known as the Piazza, which functions as the station forecourt. Within this area of land to the front is a complex of office buildings, Thornton House, Railtrack House, and No.1 Eversholt Street, as well as a bus station.

As already described in Chapter Two, the old Euston Station, designed by Philip Hardwick, housed the first trunk railway in the world and was the first mainline terminus in London, in operation since 1837. The Hardwick terminus building, with its huge doric portico and classical great hall, was demolished and rebuilt in 1967 as a concrete-frame construction trying to imitate the modern London Airport (Jackson, 1969). More retail stalls, units and a food court have recently been added in the concourse hall to generate more income for Railtrack.

The terminus is a major transport interchange in London. Not only is it the rail gateway to the North of England, North Wales and Scotland, but it is also served by underground rail lines, buses, coaches, cars, taxis, and bicycles. The station has a traffic control system, separating vehicular and pedestrian flows into different levels. The car parking and taxi queue are placed at the basement level beneath the station and the pedestrian routes at the street level. The bus station is located at ground level in front of the station building.

Figure 3.5 shows the layout plan of Euston Station's concourse level. There is only one concourse hall with a total of five entrances connecting from the outside: four of them are from the front piazza (E1-E4: marked with dark blue circles) and another one from Melton Street at the west (E5). There is one exit from the Underground train station through escalators (UE1) and another one to the basement car park and taxi queue through stairs (UE2). The station has four exits to fifteen rail platforms (PE1-PE4: marked with red circles), all spread along the east-west corridor to the north side of the concourse.

The station's concourse can be seen as a large open plan area (Figure 3.6a). Situated at the west end of the concourse hall is the self-contained travel centre for ticket sales, seat reservations as well as general and special enquiries (Figure 3.6b). On the opposite side, facing the travel centre, is an area of waiting lounges, a food court, refreshment bars, and some retail shops (Figure 3.6c). The train timetable billboard is placed in the concourse above the waiting area before the rail platform corridor (Figure 3.6d). Three retail units have been constructed around the central columns in the form of pavilions (Figure 3.6e-f). There are also several retail stalls and vending machines placed inside the concourse hall (Figure 3.6g). The platform corridor has more shops and cafes and also the entrances to the station office, left luggage, lost property services, and public toilets. There are additional facilities such as a grill room, snack bar and licensed bar located on the first floor above the food court.

3.4: THE INTERNAL SPATIAL REPRESENTATION

The two types of spatial analysis referred to earlier, all line axial analysis (or 'Spacebox') and convex shape analysis (or 'Pesh') will now be presented and discussed following the description of their methodologies.

3.4.1 Methods

Two methods of spatial analysis, Spacebox and Pesh, are used to provide a detailed analysis of the spatial layout of Victoria and Euston Station. Both analyses are carried out by computer software constructed on the basis of an accurate scale map, in this case, the interior layout plans of both termini, which include all public accessible areas of their concourse floor levels. Because this study focuses on how the space affects the public use patterns only, the supporting areas such as staff areas and offices, storage and maintenance areas, which are inaccessible to the station customers, will not be included in the analyses. However, in order to examine also how the station entrance spaces relate to their immediate surroundings, and whether this has an effect on how people move from the flanking streets through the entrances into the concourses, the Spacebox analysis will cover two ranges of the study area for comparison. These are the internal spaces only and the internal spaces with their immediate urban surroundings included. Pesh, the spatial model which mainly refers to the static activity patterns inside the termini, focuses on representing the configurative patterns of internal spaces only.

The idea of Pesh is similar to Axman. While Axman constructs a graph of the configuration of axial lines, interpreting the lines as the graph nodes and connections between lines as the edges of the graph, Pesh uses the same principle of calculation on any graphical object. In this case it is applied to, square, rectangular and polygonal shapes representing the convex elements in the system that form the nodes of the graph. Its sophisticated intersection tests, between all of these types of objects, produce the edges of the graph. Pesh calculates the integration of convex shapes and their linkages by layering one on top of the other. The integration is calculated by first selecting a convex space then calculating how many other spaces must be used wholly or in part to reach every other space in the model. The 'integrated' space is more easily accessible than the 'segregated' one as it can be reached by simpler routes from other spaces. It is then more likely to be chosen as part of a route between other pairs of spaces. The Pesh analysis can then represent the station's internal layout as a set of relational systems from the most to the least accessible spaces.

The principle of integration is the same for Spacebox analysis, which represents all the lines that pass through all spaces in the system, as opposed to the spaces of the convex model. The computer programme generates a complex representation of axiality to resolve the spatial structure of large open areas within a complex spatial arrangement such as, in this case, the terminus building. The computer finds the vertex of each object in the space and then defines the opposite quadrant of the vertex - the region of open space lying within two lines projected from the edges of the facades continuing each vertex. It then draws the straight line from the vertex to the nearest point on another island within the opposite quadrant so defined. The result shows a band of axial lines rather than a single line and represents the larger two dimensional extent of the axial line system than the least set. The all line axial map essentially picks up all the potentials for movement, using the vertex of each built form - not only linearly along a space but also the segmental opportunities for movement. The most integrated band of axial lines depicts the route from which one needs to pass through the least number of lines in order to reach all other lines in the system, and conversely the most segregated line, through the most number of lines.

3.4.2 All Line Axial Analysis - SPACEBOX

The all line 'global integration' or 'integration-N' analysis of Victoria and Euston Stations are shown in Figure 3.7 and 3.8 , respectively.

For Victoria Station, the spacebox model of its internal space (Figure 3.7a) shows the primacy of the diagonal band of east-west routes that connect both concourse halls through the narrow archways located between the two concourses. The eastern concourse appears to have fewer highly integrated routes criss-crossing its space than the central concourse. Several bands of significant integrators, shown in hot tone colours from red to yellow, fan out from the entrance foyer area in front of UE2, crossing the concourse hall to the opposite rail platforms and the escalators connecting to the first floor of the Victoria Place Shopping Arcade (E10). The seating area located in front of the left luggage counter and the corridor leading to platform 1 in the eastern concourse are passed through by relatively segregated lines in the system. The ring route that wraps around the WH Smith Bookstore and functions as an alternative link between both concourses shows no significant axial integration with the overall system.

When the adjacent street spaces of Victoria Station are included (Figure 3.7b), the new Spacebox model shows that the diagonal band of routes connecting both concourses gains in integration value even more. The map also reflects more clearly the importance of each station entrance in relation to the annexed surroundings. E6 defines the most important integrated band of routes connecting from the outside taxi queue in front of the bus station to the middle of the central concourse. The other two entrances, E3 and E7, define longer bands though comparatively less integrated routes that directly link the internal with the external spaces. The first one connects the western part of the central concourse through E7 to Terminus Place and the second one links the corner of Victoria Street through the main entrance (E3) right to platform 7. There is another important link running from Buckingham Palace Road, parallel to the taxi queue area and passing along UE2 and UE3 into the eastern concourse.

For Euston Station, the spacebox analysis of its internal space (Figure 3.8a) shows a prominent band of highly integrated routes located along the east-west platform corridor at the back of the terminus building, picked up in red. There are also several bands of important integrators, picked up in yellow, crossing diagonally the main concourse hall with their intersections located in the middle of the concourse before the train timetable billboard. When its internal space is analysed alone, Euston Station's main hall appears to have relatively less integration than the supporting corridor at the back, with no important integrator connecting the concourse space to the station's main entrances located at the front side or to the escalators leading down to the Underground station.

When the adjacent street spaces of Euston Station are included (Figure 3.8b), the new Spacebox model depicts highly integrated bands to the east and the west sides of the main concourse hall including the front colonnade connecting Melton and Eversholt Street. The most highly integrated band is located at the west side of the concourse connecting the area between platforms 11 and 12 through the front entrance (E2), the west end of the piazza, to Euston Square Garden in front of Railtrack House. Another prominent band of movement picked up in yellow is located at the east side of the concourse in front of the food court and connects the area in front of platforms 4 to 7 through the front entrance (E3) to the east side of the Piazza. However, there appear to be no prominent routes directly connecting the inside of Euston Station to Euston Road, the major thoroughfare at the south side of the terminus.

Both Spacebox models of Victoria Station illustrate a rather similar pattern of axial integration where the integrated routes from the internal analysis and the ones from the internal-external analysis are more or less coherent with each other. On the other hand, the axial integration patterns of the Spacebox models of Euston Station are very different. The important integrators in both maps are located in different areas.

3.4.3 Convex shape analysis - PESH

The convex break up of all publicly accessible spaces at concourse level inside Victoria and Euston Stations are shown in Figure 3.9a and 3.10a, respectively. Figure 3.9b and 3.10b depict the integration analysis of both systems, in which the convex elements and their linkages are coloured from red, the most integrated, through the spectrum to blue, the more segregated spaces.

For Victoria Station, most spaces in both of its concourse halls are picked up as the main spatial integrators. However, the most integrated spaces in the system are the waiting areas of both concourses located in front of the train timetable billboard, including the foyer spaces of E3 (main entrance), E5 (from the Underground entrance), E6 and E7 (from the outside taxi queue). The convex spaces in the central concourse are relatively more integrated than those in the eastern one, where its east end corridor spaces leading to platform 1 are rather segregated from the concourse as a whole. Both concourse halls are wrapped around with intermediately integrated spaces (depicted in green) such as the ticket office and all retail spaces. The most segregated spaces in the system are Railtrack's reception office, public toilets, a police branch office, and a tourist information centre, all depicted in dark blue.

For Euston Station, the Pesh analysis represents a less wide-ranging spectrum than the Victoria Station model. Due to its open plan and less complicated spatial layout, most convex spaces in Euston Station are highly integrated and well-connected with one another. This means that they share approximately the same value of shallowness from all other spaces in the system and are thus all easily accessible. However, the most integrated spaces in the system are found in the east end of the main concourse hall, which is a transition space between the waiting area and the food court, including the central part of the platform corridor. Most retail spaces are also very well integrated in the system, mostly picked up in yellow and only some in green. The ticket office and food court spaces are relatively deeper than the concourse spaces but the most segregated spaces of all are the station's public toilets, located along the east end of the platform corridor.

Both convex shape analytical models represent two different configurative patterns. The internal layout of Victoria Station appears to have a better hierarchical system of convex integration well-related to the station's functions compared with Euston Station. In Victoria Station, the most integrated spaces include the concourse halls, especially the waiting areas where the train timetable billboard is placed, and the entrance foyers connecting to the street frontage and seating areas. The least integrated spaces include the ticket office and shops, which function as supporting spaces, and finally the trivial functions that require relatively little public accessibility such as the station's reception office and public toilets, the least integrated spaces in the system. The convex shape analysis of Euston Station's internal layout shows a lower ranging integration model, with fewer convex elements but in a more continuous system than Victoria Station. The Pesh model of Euston Station reveals that most of its internal spaces are easily accessible and have no hierarchical order of approachability. However, it shows that the most integrated spaces are not those of the main waiting area, where the train timetable billboard is located, but rather the surrounding circulation spaces. The station functions, such as the entrance foyers, concourse hall, ticket office, left luggage, retail shops, corridors and rail platforms show no clear hierarchical spatial pattern and appear to reflect equally important positions in the system.

3.4.4 Discussion on the spatial models of Victoria and Euston Stations

The Spacebox and Pesh models reviewed above reveal different spatial characteristics of both termini. They also reflect the different degrees of significance placed upon the station's functions in each terminus, not in terms of their functional roles but defined through their spaces and the routes that pass through them in relation to all other spaces and routes in the system. Although the concourse halls of Victoria and Euston Stations reveal their comparable spatial significance as the most highly integrated spaces with highly integrated routes passing through them, both termini have different functional layouts that make the relationships between all the station's functions and the spatial patterns, both axial and convex models, distinctive.

In Victoria Station, the central concourse appears to have integrated bands of routes taking up highly integrated convex shapes in a way more complementary to the station's functions than in Euston Station. The integrated axial bands in Victoria Station, from its internal all-line analysis (Figure 3.7a), are found to be coherent with the routes metrically linking its Underground station entrances with the train platforms, which are considered to be the most significant internal routes for passengers interchanging between these two key modes of travel. In addition, from its internal-external all-line analysis (Figure 3.7b), the integrated routes appear to connect its important entrance spaces to the train platforms, reflecting the most significant deterministic routes between entrances and platforms. The integrated bands pass through the significant convex spaces in the central concourse but leave out the spaces that represent waiting areas located before the train timetable billboard and the ticket office. The convex shape analysis of Victoria Station (Figure 3.9b) also reflects a hierarchical integration value ranging from the most integrated convex spaces, which are also the most significant functions, to the least integrated spaces, the functions requiring least accessibility.

In Euston Station, the internal all line analysis (Figure 3.8a) reveals no significant axial band that constitutes the interchanging routes between the train platforms and Underground entrance. The most integrated routes are located at the platform corridor at the back of the station, which has no functional significance except in distributing people from the concourse hall to all platforms and to the support and staff areas. The internal-external all-line analysis (Figure 3.8b) depicts the important connections between the station entrances and the train platforms and between the station and its side streets; Melton and Eversholt Streets. However, the connection between the station and Euston Road, the major road to its front, is not picked up as a significant integrator due to the complicated spatial arrangement of the office complex and a series of gardens and open spaces located between them. In the first model (the internal all line analysis), the waiting area before the train timetable billboard in the concourse hall is intersected by important integrators. Euston Station also appears to reflect no hierarchical order of functional significance in relation to the convex integration analysis as previously revealed in the Pesh analysis (Figure 3.10b). The waiting area, considered to be the most significant space in the concourse hall which passengers have to reach first to confirm their train times as well as to wait for their departure, is less integrated than the circulation spaces - the platform corridor at the back and the east end of the concourse.

These distinctive spatial integration patterns of both termini will be examined in terms of how they affect the space use patterns in Section 3.6. The following section presents the isovist analysis which reveals some additional spatial logic of both internal layouts through the range of visual fields people acquire through some important locations and routes inside the termini.

3.5: THE ISOVIST ANALYSIS

The two types of isovist analysis referred to earlier as 'point isovist' and 'moving isovist', will be presented and discussed in this section following a description of their methodologies.

3.5.1 Methodology

The isovist method is the analysis of 'location-specific patterns of visibility'. It is a representation of everything that can be seen directly from a point - like a beam of light spreading out and illuminating all the space it reaches and casting a shadow wherever objects stand in its path (Benedikt, 1979). 'Point isovists' are defined as two dimensional visibility fields from vantage points in space, constructed from its layout plan drawing. In this study, the single point isovists from all station entrances in each terminus will be examined both separately and together by overlapping one on top of the others. The intention is to see how well the entrance spaces provide the necessary visibility fields into the station building, covering important spaces such as the concourse hall, train timetable billboard, rail platforms, ticket office and the Underground station entrance, which are the significant primary destinations for all rail passengers. The 'moving isovists' are a series of 'point isovists' that belong to a given path through a given environment. In this study, two samples of important pedestrian routes will be examined, an inbound route starting from the station's street frontage and moving into the concourse hall and an interchange route leading from a rail platform to the Underground station entrance. This investigates whether the isovist fields along the routes are coherently linked with one another to form a visual continuity between the origins and the destinations and if there are any crucial visual breaks along the way that might make people lose sight of their destinations.

3.5.2 Point isovists

Figure 3.11a-g shows the point isovists at Victoria Station's seven entrances from its surrounding streets. At the eastern concourse, the visual field at E3 (main entrance) covers most of the concourse hall including the Underground station entrances and the outside taxi queue (Figure 3.11c) while at the other two entrances of the same concourses, E1 and E2, the isovists cover only parts of it (Figure 3.11a-b). None of them provide a visual link to the central concourse. The isovists from three entrances of the central concourse, E5-E7, cover well most of the concourse hall, its train timetable billboard and rail platforms, and have visual connection toward the eastern concourse (Figure 3.11d-f). The visual fields at E3 and E5-E7 include some surrounding areas, which in turn help establish the presence of the station's internal environment when viewed from the outside streets. The visual field from E9, a small entrance located on Buckingham Palace Road, is rather limited as it covers only the waiting area and the train timetable billboard for platforms 16-17 (Figure 3.11g). The combined point isovists of all Victoria Station's entrances is shown in Figure 3.11h . It reveals that the visibility field from the station's entrance spaces covers the station's internal spaces well without any significant blockade. It also reveals that, despite being flanked with major streets to all sides, Victoria Station has a very limited visual connection with its urban surroundings as the visibility fields are largely blocked by the bus station located to the front as well as by other visual blockages in the immediate surroundings.

For Euston Station, the point isovists at its two main entrances (E1/2 and E3/4) cover the outside piazza space at the station's front side well but only the western and eastern parts of its main concourse hall (Figure 3.12a-b). Most parts of the waiting area, where the train timetable billboard, rail platforms, the Underground train entrance, and ticket office are located, are visually blocked by the core structure located near both entrances. The core contains an enclosed waiting room, escalators and steps that connect to the Underground station level. From the front entrance spaces, although there are some visual links to Euston Road, a series of colonnade structures that support one of the Railtrack's office buildings and covers the bus station largely obstruct the visibility fields. The isovists from another entrance at the west end of the platform corridor (E5) are very limited. It covers only the length of the corridor itself and does not have any link to the main concourse space (Figure 3.12c). The Underground entrance can be seen only partly from E3/4 but is totally obscured from E1/2 and E5. When all three point isovists are overlaid, as shown in Figure 3.12d , it reveals more clearly that the middle part of the concourse space, the most significant space where people gather in front of the train timetable billboard, is not included. Despite the open plan interior layout and the transparent front façade of Euston Station, significant visibility fields from its entrances toward the concourse hall and the major road to the front are obstructed by internal and surrounding structures.

3.5.3 Moving isovists

In this section, a series of point isovists along two determined routes in each terminus building will be presented as a 'moving isovist'. Figure 3.13a-e shows the moving isovists along an inbound route through Victoria Station, starting from the corner of Victoria Street and Wilton Road, moving through the main entrance into the eastern concourse hall. It reveals that from the outside street, the isovists do not reach inside the terminus building until the vantage point moves to the corner of Wilton Road and Terminus Place. However, the visibility field gradually decreases once the point gets closer to the main entrance because the line of sight is blocked by a ventilation shaft and the structure marking the Underground station access, located just before the entrance itself (Figure 3.13a-c). The isovists upon entering the eastern concourse hall become again vast, covering well the concourse space and its important functions (Figure 3.13d-e). However, the visibility fields from the waiting area in the eastern concourse do not reach the other important spaces located in the central concourse such as the ticket office (for passengers) and the entry point to the Victoria Place Shopping Arcade on the first floor (for shoppers). The moving isovists along an interchange route leaving platform 15 and moving diagonally through the central concourse to the Underground access point (UE2) through E5 are shown in Figure 3.14a-e. The isovists do not reach the destination until the vantage point itself arrives almost at the destination. This is because the Underground station entrance is hidden beyond a long and narrow corridor.

The moving isovists along an inbound route entering Euston Station's main concourse hall from the corner of Euston Road and Melton Street are shown in Figure 3.15a-i. From the starting point approaching the terminus building through the footpath in Euston Square Garden, the visibility fields hardly reach the terminus building as they are largely obscured by the office complex and the colonnade structures of the bus station located at the front of the terminus (Figure 3.15a-c). The visual connection between the inside and outside becomes clear at the point when the vantage point moves to the southeast corner of the Railtrack House (Figure 3.15d-e). However, similar to the point isovists analysis at Euston Station's main entrances already mentioned in 3.5.2, once the west entrance is approached, the isovist become limited and cannot reach the main concourse space, especially the waiting area, due to the obstruction of the core structure (Figure 3.15f-g). The concourse space becomes fully visible only once the point moves into the space itself (Figure 3.15h). However, once the point reaches the middle part of the concourse, there is no longer a visual connection between the interior and exterior of the station building due to the obstruction of the core structure, despite the building's transparent front facade (Figure 3.15i). The moving isovists of an interchange route leaving platform 1 bound for the escalators connecting to the Underground train station are shown in Figure 3.16a-g. As the escalators and the sign 'Underground Entrance' are hidden behind the retail kiosks constructed around the central columns in the concourse hall, the visual fields from the origin to the destination are totally obstructed. From the starting point, the isovists along the platform corridor do not reach the concourse hall until the point almost moves into the concourse itself (Figure 3.16a-c). Nevertheless, the visual fields inside the concourse hall are still limited and do not reach either the sign or the Underground entrance (Figure 3.16d-e) until the destination is almost reached, becoming evident only at a very short distance (Figure 3.16f-g).

The photographic views illustrating the moving isovists along the same inbound and interchange routes at Victoria and Euston Stations are shown in Figures 3.21 and 3.22, respectively.

3.5.4 Discussion on the isovist analyses of Victoria and Euston Stations

As already discussed in Section 3.1, a good visual field at the station entrance provides the knowledge of how all internal functions are organised so people can programme their routes before navigating through the station. The point isovist analysis reveals that despite the more complicated spatial arrangement and sophisticated architectural style, Victoria Station provides better visibility fields from its entrances than Euston Station as its isovists cover most parts of the concourse spaces well. In contrast, the visibility fields are rather impaired at Euston Station's entrance spaces as only the trivial parts of its concourse space can be seen. A good visual link to the train timetable billboard and the ticket office is necessary for all travelers and commuters as they need to confirm their train times as soon as they enter the building. The point isovist and moving isovist analyses reveal that it is more difficult to spot the train timetable billboard from Euston Station's entrances than in Victoria Station. The billboard at Victoria Station is clearly visible both from its street entrances and the Underground station entrances.

A good visual coherence between inside and outside spaces is also necessary for all public buildings so people can choose how to connect their internal and external routes. For Victoria Station, although there is no strong visual connection between its internal space and the surrounding streets, the visual links that the station has from its entrances are relatively stronger than at Euston Station.

Although Euston Station may at first appear to have clearer and more extensive visibility fields than Victoria Station because of its open plan internal layout, with fewer and more continuous convex spaces revealed in the Pesh analysis in Section 3.4.3, it has physical interventions that break down the visual links along its important inbound and interchange routes, such as the front colonnades, the central core structures, and the retailing units. The layout of Victoria Station appears also to suffer from a problematic visual break along its major routes, though to a lesser degree than Euston Station. How the visual obstruction affects movement patterns will be discussed along with the empirical studies in the next section.

3.6: THE EMPIRICAL OBSERVATION OF SPACE USE PATTERNS

In this section two types of empirical studies using the observation techniques referred to earlier as 'people following' and 'static snapshots' will be presented, and their findings will be discussed, following the introduction of their methodologies.

3.6.1 Methodology

The patterns of pedestrian activity inside both termini were recorded during one weekday when a good combination of various groups of people are found in the station buildings. The first observation study was carried out using a people following technique to trace the individual routes in the station concourses dispersing from all distributing points of movement. These included the entrances from the station's surrounding streets, the annexed buildings or different floors as well as from the Underground access points and the railway platforms. These points are designated as the 'gates' from which an observer would trace a number of randomly selected adults until they left the observation area (the concourse hall) or stopped for any type of activity for more than five minutes. The purpose of this exercise is to record individual movement patterns and to represent key routes and destinations inside the terminus buildings.

The number of adults to be followed from each gate is calculated using 'gate counts.' In making these counts, the observer stands at each gate for three minutes and counts the total number of adults walking past in both directions. The counts are carried out during two peak time periods (8:00-10:00 and 16:00-18:00) in order to record the maximum levels of movement through the gates. Then the mean movement rates for the morning and evening peak periods are converted into per hour equivalent figures and one percent of these figures will have their routes traced. For the gates at railway platforms, because the number of people alighting from trains into the concourses actually depends on train schedules rather than the natural distribution of movement into the stations, all platform gates of the same terminus will then be assumed to have an equal percentage of movement level in this study. The result of the gate count observation of Victoria and Euston Station including the detailed calculations are included in Appendix E.

The second empirical study was carried out using static snapshots. This is the technique for recording static patterns of pedestrian activity in a built environment. It is conducted by an observer randomly walking through the space at a constant rate and noting down the position of stationary people (such as the ones who sit or stand) onto a floor plan. The procedure begins by working out a route that takes in all spaces which are to be observed. The observer then walks along the pre-determined route and records the location of all stationary people within each space in a short period of time or 'snapshot'. In this study, the static snapshot was carried out during one weekday in the concourse space of each terminus. A round of snapshots was made during each two hour time period, totaling altogether five periods; 8:00-10:00 (early morning), 10:00-12:00 (late morning), 12:00-14:00 (lunch time), 14:00-16:00 (mid-afternoon) and 16:00-18:00 (evening). This sensitivity reveals if the patterns of static activity inside the termini vary across different times of the day.

At the end of the presentation of both empirical findings, the accumulative patterns of pedestrian movement and all day stationary activities of each terminus will be analysed in relation to each other. By overlaying the moving activity pattern onto the Spacebox model and the static activity pattern onto the Pesh model, the study will then discuss and conclude how far the spatial configuration of the railway termini affects how people use their internal spaces.

3.6.2 Pedestrian Movement Dispersal Pattern

Figure 3.19 and 3.20 illustrate the movement routes that were traced from fifteen gates at Victoria Station and eleven gates at Euston Station respectively. Each tracing route is depicted by a red line. The red circles along the lines represent the temporary stops people made en-route for less than five minutes, while the red dots at the end of the lines represent where people stop to engage in any kind of activity for more than five minutes, which marks the end of the route tracing for that person.

In Victoria Station, it appears that the four entrances located at the eastern concourse, E1-E4 and UE2 are used by people who go into both concourses (Figure 3.19a-e). Most of the routes were made directly toward the waiting areas before the train timetable billboard or directly to the train platforms. For the other three entrances of the central concourse that connect to the Terminus Place, E5-E7, people used them to enter the central concourse only (Figure 3.19f-h). Most of the routes were exploratory and people made several stops at shops and other facilities rather than moving deliberately towards the trains. Only some of them continued their journeys to the train platforms in the central concourse. Despite several en-route stops, most of these exploratory routes still cut across the concourse hall in a diagonal manner. The movement traced from E8-E9 located along Buckingham Palace Road (Figure 3.19i-j) were more directed toward the Underground access points but in a more detailed examination, people who moved from E9 made several 'hesitating' stops along the way looking for the direction although still moving across the hall diagonally.

The pattern of diagonal crossing through the central concourse is clearly revealed from the individual routes traced from another two entrances; UE3 and PE6. Both are located opposite each other across the hall and share the same diagonal path crossing each other (Figure 3.19k-l). However, most people from UE3 moved directly and deterministically toward the platforms, while most people from PE6 appeared to have difficulties in locating the Underground access point. They again made several 'hesitating' stops along the way to look around for the direction. As already discussed in the moving isovist analysis in Section 3.5.3, the Underground entrance ((UE3) is hidden beyond a long and narrow corridor and is visually blocked from the point where people alight from trains or enter the central concourse hall from the far side. It is clearly seen here in the observation result that the poor isovists and the lack of coherent visual fields between origins and destinations cause confusion for people who navigate through such space.

These hesitating stops en-route also occurred along most movement routes from IE1, the entry point from the Victoria Place Shopping Arcade, and from the train platform access points, PE4 and PE5 (Figure 3.19m-n). For the latter gate, some individuals used the back corridor in front of the left luggage area to reach the Underground entrance in the eastern concourse (UE2). In detailed examination, they all are commuters who seem to be familiar with the space. The movement routes from PE2 and PE3 were mostly toward the Underground entrance, UE2 (Figure 3.19o). Some were toward the outside and the central concourse.

The cumulative movement dispersal patterns of all gates in Victoria Station are shown in Figure 3.21 . It reveals that the locations of the Underground access points, the entrances and the rail platforms have a strong effect on the movement patterns inside the terminus. As a result, there are two predominant movement patterns in Victoria Station. The first one comprises the routes between the Underground access points and the train platforms, shown in the map as a diagonal path crossing the central concourse and a less dense one across the eastern concourse. The second one comprises the movement between the rail platforms and the station entrances. The diagonal movement across the central concourse consists of both deterministic and exploratory movement routes. There is only a small number of routes connecting both concourse halls.

At Euston Station, most people entering from the four main entrances, E1-E4, the back entrance, E5, and two entrances from its Underground train station and taxi queue, UE1 and UE2, move directly toward the main concourse hall and spend time waiting in front of the train schedule billboard before approaching the train platforms (Figure 3.20a-g). People mostly spent time standing and walking around in the waiting area. Only some movement routes from these gates were made toward its only Underground access point. It appears that the movement routes from these seven entrances intersect with one another in the main concourse hall while the east and west corridors of the concourse are not used extensively for movement.

At the four gates in front of the platforms (PE1-PE4) most people who alight from trains move diagonally across the hall toward the Underground entrance (Figure 3.20h-k) whose escalators and signs are located in the middle part of the station's core, but rather hidden behind the central retail units. It is clearly shown in the diagrams that, as with the outbound routes in Victoria Station, some people found it difficult to reach the destination as the location of the Underground entrance is visually blocked when approaching it from the north side of the concourse, as already illustrated in the moving isovist analysis (section 3.5.3). People made several hesitating stops along the way to look for the direction. Nevertheless, they appeared to flow along the diagonal route and reached the Underground entrance naturally. However, these 'pausing and looking' people caused a great deal of interruption to other moving passengers including the ones who made their inbound routes into the concourse halls. There were some commuters, already familiar with the space, who opted to use the eastern end corridor to reach the escalator (Figure 3.20j).

All movement routes observed in Euston Station are shown overlapping in Figure 3.22. As at Victoria Station, it is here clearly depicted that the location of the train platforms and the Underground access point in Euston Station has a great effect on the movement patterns inside the terminus and the movement between these two functions is the predominant movement pattern inside Euston Station. However, unlike Victoria Station, the movement traced between Euston Station's entrances and its rail platforms does not appear to be the key dominant routes. Most movement routes appear to converge with one another in the middle of the concourse while there is only a small number of people moving north-south along both sides of the concourse and even fewer moving east-west along the back platform corridor.

3.6.3 Pedestrian Stationary Activity Pattern

The weekday static snapshots of Victoria and Euston Stations are shown in Figure 3.23a-e and 3.24a-e, respectively. Both termini appear to have a similar pattern of static activity in general. The numbers of static people in the stations are very low in the early hours (8:00-10:00) then gradually build up and reach their peak at lunchtime (12:00-14:00). The numbers subside in the afternoon then increase again to their maximum levels during the evening rush hour (16:00-18:00).

The main attractors of stationary people in both termini are the train timetable billboard and ticket counters. The clusters are generally restricted to the areas in front of these facilities. In both stations, during the two peak periods (lunchtime and evening hours), the clusters appear to be more compact than in the other periods. This results from the intensity of moving activities that occur at the same time as the intensity of static activities in peak periods when two pattern types share the same spaces.

Because at Victoria Station the food court is located separately on the second floor inside the Victoria Place Shopping Arcade, there is no other significant attractor of stationary uses besides those station functions. However, there are some static activities such as eating, drinking, and sitting, recorded where seats are placed outside the catering units but these are scattered around in both concourse halls. In Euston Station the designated food court area attracts a large number of people with peak levels during the lunchtime and the evening periods.

The cumulative static snapshots for all five periods of Victoria Station is shown in Figure 3.23. The clusters of static activities suggest the trail of diagonal movement paths in its central and eastern concourses. Following from the first empirical finding on moving patterns inside Victoria Station, where most station users make diagonal crossing through both concourse halls, it is clearly seen that the stationary activities are mostly gathered on the concourses but offset from the main pedestrian movement routes.

Figure 3.24 shows static snapshots for all periods at Euston Station. It clearly depicts the two clusters of stationary activities located in front of the train timetable billboard and in the food court. The cumulative static pattern suggests that although the stationary activities are largely offset from the diagonal intersecting routes of movement that people make between the train platforms and the Underground access point, the middle part of the hall area is claimed by both static and moving activities.

3.6.4 The relationship between moving and static activity patterns in Victoria and Euston Stations

The combined movement dispersal and stationary activity patterns of Victoria and Euston Stations are shown in Figures 3.25 and 3.26, respectively. As already suggested in the findings on static snapshots, both illustrations clearly show how the static space uses in both termini are largely offset from the main flows of movement. However, they also highlight some locations, such as the areas in front of the train timetable billboard, where both moving and static activities interrupt each other. Euston Station appears to have a more serious right-of-ways conflict between static and moving people than Victoria Station, as all activities in Euston Station appear to converge and intersect with one another in the central part of the main, and only, concourse hall. People who move between the train platforms and the Underground access point or the station entrances have to make their way through a cluster of people waiting in front of the train schedule billboard.

In Victoria Station, although there are also some areas of conflict between the two space use patterns, the diagonal routes that are the major circulation in both concourse halls retain clear right-of-ways among the clustering of static people. The interference of static and moving activities in both waiting areas of Victoria Station's concourse halls is not often extreme and sometimes does not occur at all as both activities share the same space at different moments. Alternate patterns constantly occur as, for example, when trains terminate and alighting passengers leave the platforms and the waiting passengers move forward to board trains, freeing the concourse before new clusters of waiting passengers start to build up again in front of the train timetable.

3.7: DISCUSSION AND CONCLUSION

Figure 3.27a-b and 3.28a-b represent the combined all line axial and movement dispersal patterns of Victoria and Euston Stations respectively, in both versions of internal and internal-external spatial analysis. As already revealed in Section 3.6.2, the pattern of movement between the Underground access points and the rail platforms is predominant in both Victoria and Euston Stations, while the movement between the railway platforms and the station entrances is also dominant in Victoria Station. From the overlayed maps, it is clear that despite such fixed origins and destinations, the route choices made between them are very much coherent with the axial bands of integration depicted in the Spacebox models. However, in both termini, it appears that the first predominant pattern, which is considered to be the internally interchanging routes that people make between the train platforms and the Underground entrances, is found to be more coherent with the integrator bands of the Spacebox models of internal spaces. In Victoria Station it is clearly shown that the diagonal movement routes across the central concourse are coherent with the diagonal bands of highly integrated lines (Figure 3.29a). Similarly in Euston Station, the Underground entrance to rail platform movement routes are also more coherent with the Spacebox model of internal spaces, where the intersecting bands of integrated axial lines in the main concourse hall reflect the intersecting bands of movement routes (Figure 3.30a).

The second predominant movement pattern in Victoria Station, the movement that people make between the outside streets, through the entrances and to the platforms, is more coherent with the internal-external Spacebox model (Figure 3.29b). Although the same kind of movement is not found to be the dominant pattern in Euston Station, it appears that its internal-external Spacebox model is more or less coherent with the movement routes being traced from the station's entrances, as well as the east-west route that people make through the colonnades that link the adjoining Melton and Eversholt streets (Figure 3.30b).

It is thus clear that the influence of spatial configuration upon how people move inside the termini is strong, although initially the only primary factor shaping movement patterns appeared to be the location of deterministic origins and destinations. This is also confirmed by the fact that when the visual connection to these locations is obstructed, the station users, especially the ones who are not familiar with the station's functional arrangement, appear to follow the 'natural movement'. Their movement reflects the more powerful integrators in the space until they re-establish the visual link with their destinations, as already reviewed in the people following observations in Section 3.6.2 along the routes studied by the moving isovist in Section 3.5.3. In Victoria Station, some people who alight from trains at the central concourse make several stops along the way trying to locate the Underground entrance while they still move naturally along the diagonal path across the concourse. Finally, appear to find it 'by chance' when they reach the corridor that leads to the Underground entrance itself. In Euston Station, these hesitating stops along the rail platform to Underground entrance route are caused by the lack of visual coherence between these two points. Again, people move across the concourse hall naturally following the most integrated pathway until they spot the sign or the escalator that leads to the Underground train station.

It can be said, then, that to arrange the station functions to be coherent with the natural movement pattern is crucial in an environment where the commercial as well as directional signs in the buildings can be overwhelming. There are also times when the visibility fields inside the terminus buildings can be blocked by the flow of movement itself, especially during peak periods or in emergency situations, and the informational signage system alone cannot help people to navigate efficiently through the space. For first time station users, both passenger and non-passengers, who tend to follow exploratory routes to find their destinations, the empirical study reveals that their movement patterns are largely influenced by spatial configuration, following the integrators or the shortest routes that connect to all other routes in the system, similar to the frequent station users who are already familiar with the space.

However, the combined static activity and convex shape integration patterns of both termini, shown in Figure 3.31-3.32 , reveal that stationary people are attracted to the locations of important station facilities such as the train timetable billboards, ticket offices and in the case of Euston Station, the food court, rather than affected by the spatial configuration. According to the Railtrack's station user statistics in Table 3.1 and the predominant movement dispersal patterns of both termini in Section 3.4.2, it appears that most station users in both Victoria and Euston Station are passengers (82%) whose movements are mainly made between transport related functions. These passengers tend to move in and out of the station within a short period of time or spend time briefly queuing for tickets or waiting for their trains in front of the timetable billboards only. The stationary people are then more attracted to these important facilities than influenced by any other factors.

However, the combined moving and stationary patterns of both termini, shown earlier in Figure 3.25-3.26 , reveal that Victoria Station has less interruption between both patterns of activity than Euston Station. It can then be said that although the internal spatial configuration does not directly affect the stationary uses inside the termini, the location of the static activity attractors determines how efficiently the buildings can function, or in other words, how well all space uses coexist with one another without any physical interruption. In the case of Victoria Station, its ticket office and train timetable billboards in the central concourse are located just offset from the major natural movement route. Thus they attract static activities, like sitting and standing, that do not block the main movement routes. However, its waiting area in the eastern concourse appears to have both moving and waiting people interrupting each other to a certain degree, especially during peak periods due to its limited space. For Euston Station, its train timetable billboard attracts a large cluster of people in the waiting hall where the main movement routes, crossing between all train platforms and the Underground access point, also converge. This results in having both space use patterns being severely interrupted, especially during peak periods.

As the movement activity pattern is influenced by the spatial configuration and the stationary pattern is largely determined by the location of the attractors, the efficient use of space inside the railway termini depends on how well the station facilities are arranged in relation to the internal spatial configuration in order to make all types of activity well-related to the natural movement pattern. The visibility field at the station entrances as well as along the important inbound and outbound routes, which are a by-product of the spatial configuration, enhances the intelligibility of the station's presence in its surroundings and of its internal spatial arrangement. Additionally, a clear hierarchical order in the spatial arrangement of all station functions, as revealed in the Pesh analysis in Section 3.4.3, also helps generate a good distribution of varied space uses in the building. In this respect, Victoria Station's internal functions have a better hierarchical spatial arrangement than Euston Station’s, since most of its important facilities are focused in a single space. Victoria Station has a better distribution of moving and static activity patterns inside the terminus compared with having all space uses focused within a limited area like Euston Station's concourse hall.

Through configurative analysis, the missing link between the forms and functions of the railway termini is established by the finding in this study that the space use patterns inside the terminus buildings are largely affected by their own internal configurations of space. The configurative properties influence the movement patterns of the station users and thereby determine the efficiency of the station build’s arrangement of functional activities.

It is also clear that although transport related uses are still dominant in both Victoria and Euston Stations, what at first seems a deterministic movement pattern is in fact shaped by the spatial configuration. While the local scale movements made between two points within the buildings are influenced by their internal spatial configuration, the study suggests that the movements from their immediate surroundings into the buildings are related to the larger scale of spatial configuration, including the external spaces. This internal study points out that as public buildings, the movement patterns inside the railway termini are not affected by their internal spaces alone but also by their larger scale urban spatial networks. As Hillier (1996a) claimed, movement and encounters between types of people in the interior spaces contribute to the sense of community or separation. Therefore, the creation of railway termini as places in context should be considered through the relationship of inside and outside as determined by the whole complex's spatial configuration. Another interesting fact and research finding that supports this is that although Victoria Station has almost double the area of retail and catering spaces of Euston Station and its internal spatial configuration also generates a better performance in space uses, both termini still attract the same percentage of non-passengers (18%). This fact indicates that despite the difference in their internal spatial configurations, both termini might in fact be related to their urban surroundings and other influential external factors in a rather similar way. It also crucially suggests that internal spatial analysis alone is not enough to understand how the terminus complex can be transformed into fully-integrated urban place.

Consequently, the following three chapters will start to examine all London's railway termini at an urban scale, with their urban contexts included in the analyses, in order to build up a holistic understanding of the terminus areas as a complex configuration. The study begins by investigating their urban physical contexts through a figure and ground study in Chapter Four, gradually building up to the detailed analyses of their spatial configurations, using the space syntax methodology, in Chapter Five. In Chapter Six, the empirical study of movement patterns within each terminus area will be presented.

Figure 3.1: VICTORIA STATION
Local map around the terminus building

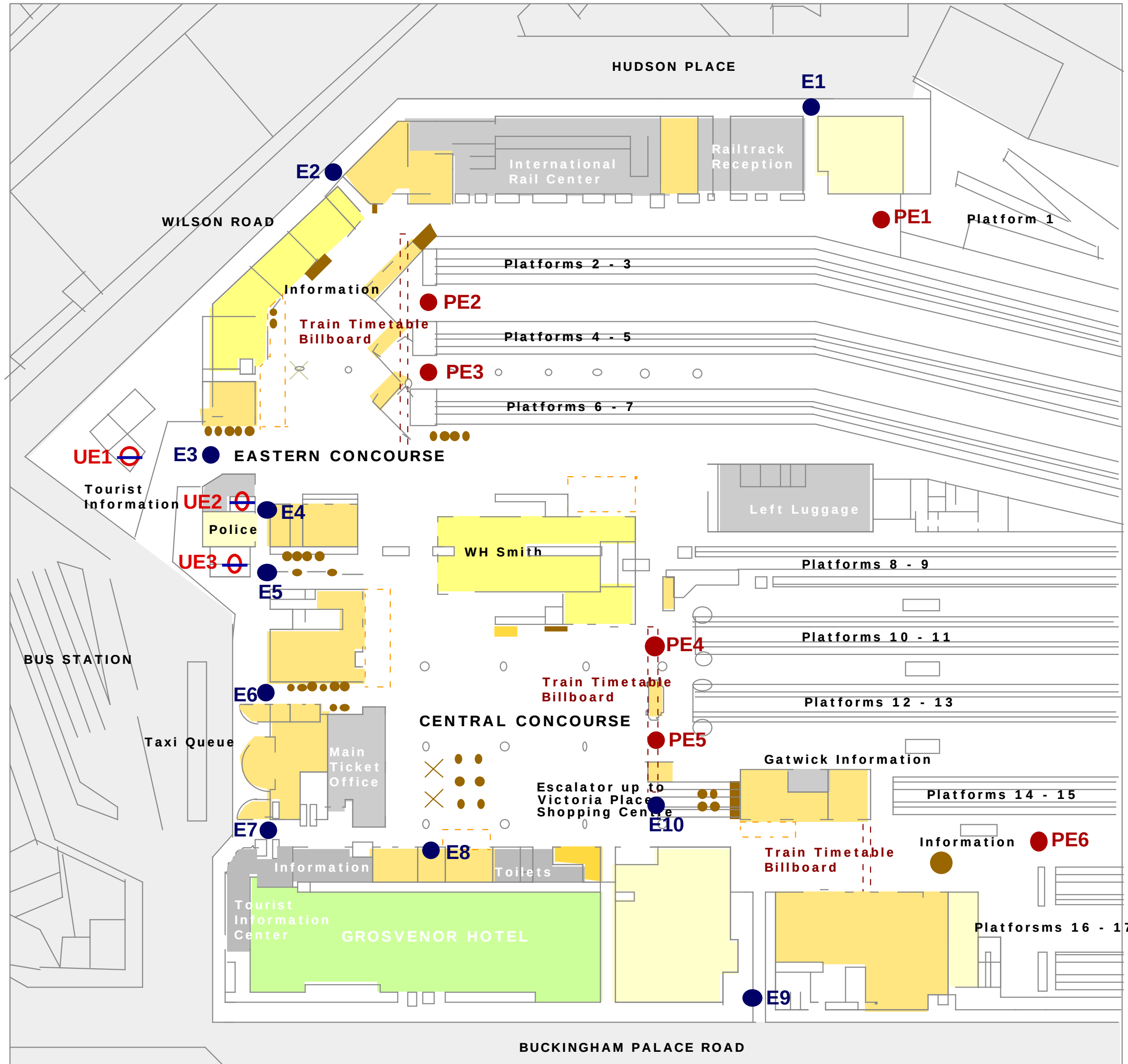


Figure 3.2: VICTORIA STATION
Main concourse level layout plan / functional arrangement

- Train timetable billboard
- Seating area
- Retail and catering facilities
- Station office area
- Passenger support facilties
- Service facilities (telephone, information board, cash machine)
- Entrance to rail platforms
- Entrance to concourse hall
- Underground access points

Figure 3.3: LONDON VICTORIA STATION - Interior space

a: Transition space between the eastern and the central concourses.
b: The eastern concourse hall
c: The central concourse hall
d: The escalators connect to the first floor Victoria Place Shopping Arcade.
e: The existing brick arches have been refurbished as retail and catering units.
f-h: Seating areas are placed in front of some cafes and restaurants around the concourse halls.

Figure 3.4: EUSTON STATION - Local map around the terminus building

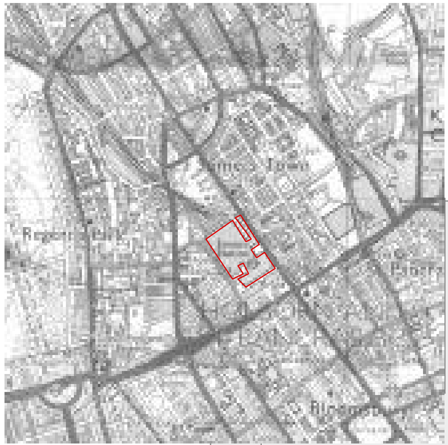
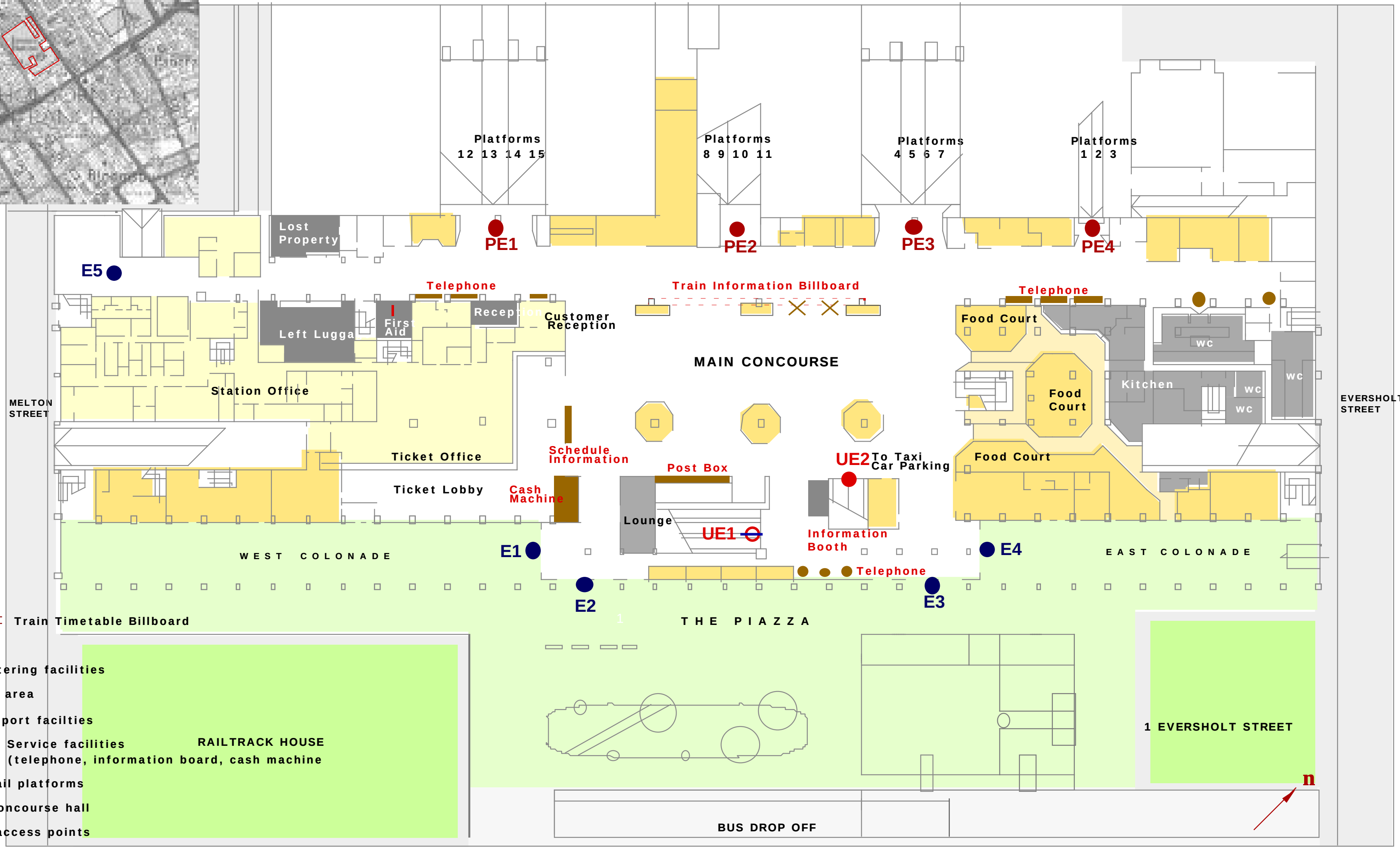


Figure 3.5: EUSTON STATION Main concourse level layout plan / functional arrangement



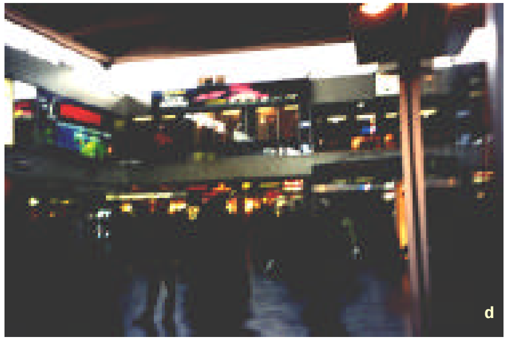


Figure 3.6: LONDON EUSTON STATION - Interior space

a: The main concourse hall
b: The west part of the concourse hall is where the ticket and information centre is located.
c: The food court, refreshment bar and waiting lounge is at the east part of the hall.
d: The train timetable billboard is placed over the platform corridor facing the waiting area.
e-f: Three central columns in the concourse hall have been refurbished as retail units.
g: One of Euston Station's several retail stalls and vending machines.

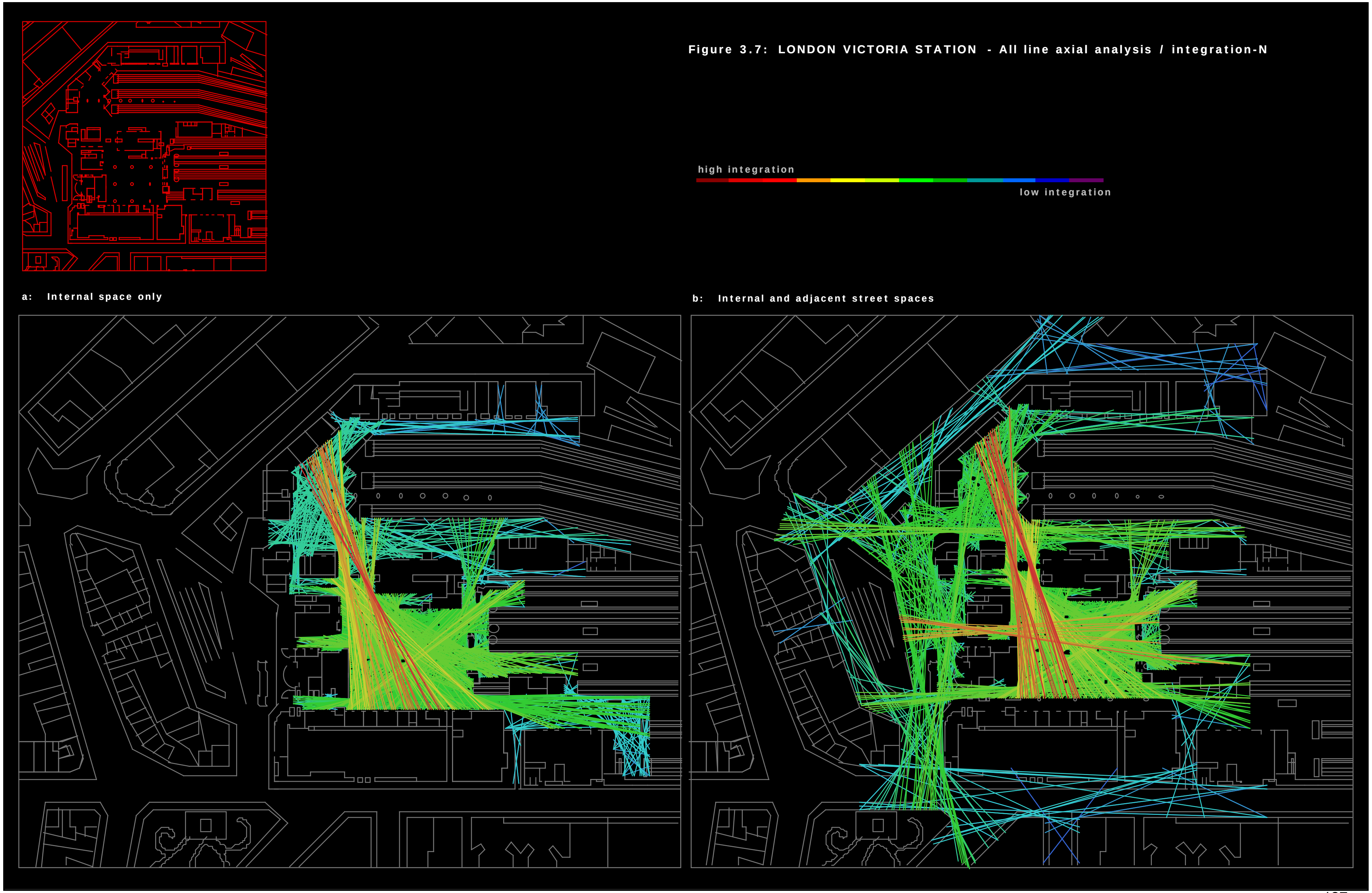


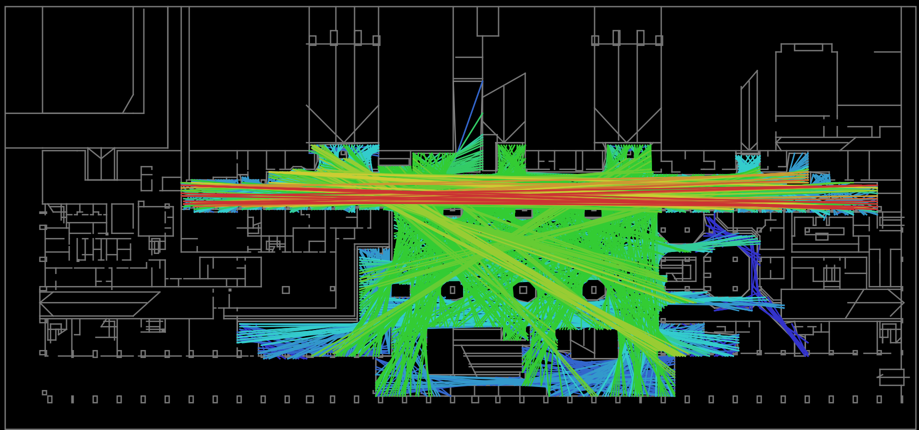
Figure 3.7: LONDON VICTORIA STATION - All line axial analysis / integration-N

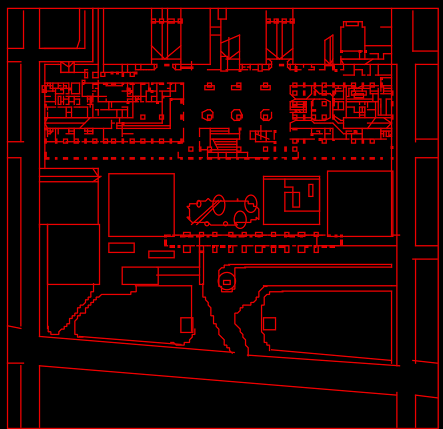
Figure 3.8: LONDON EUSTON STATION - All line axial analysis / integration-N

high integration

low integration

a: Internal space only





b: Internal and adjacent street spaces

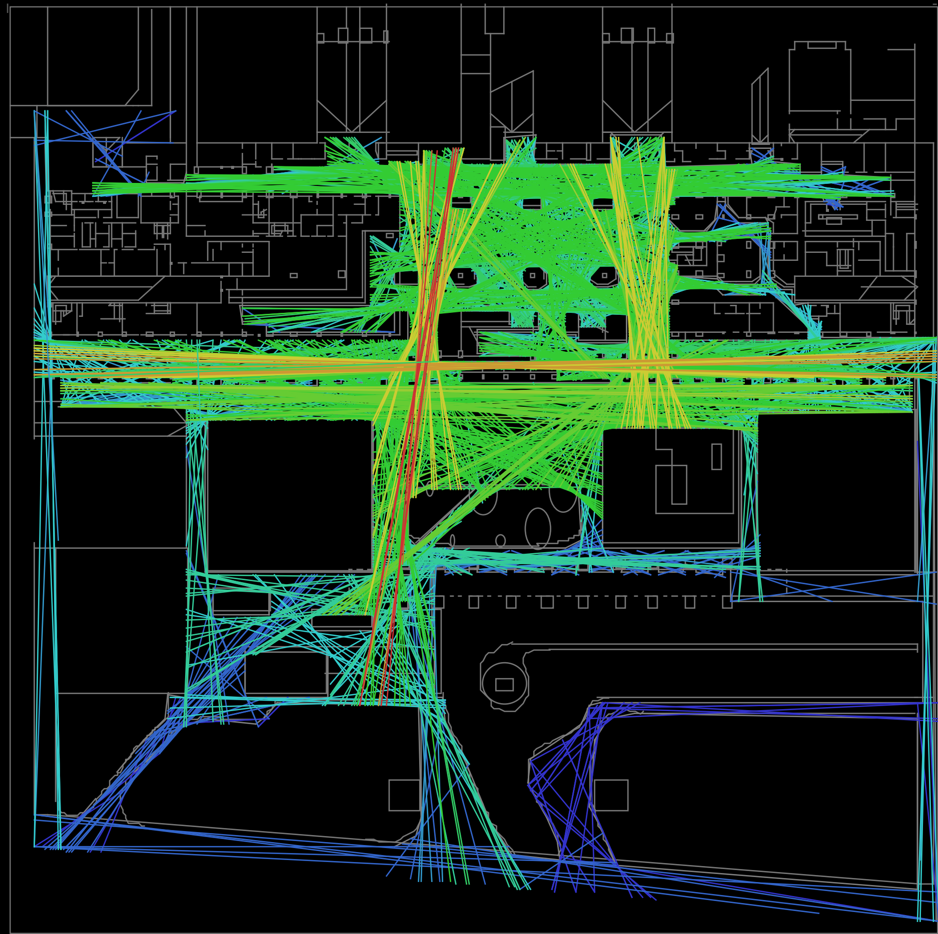
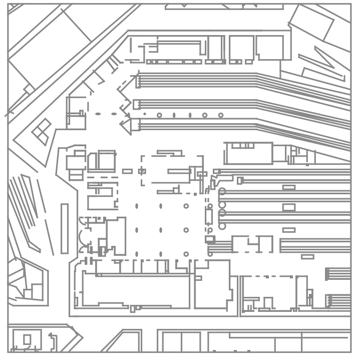
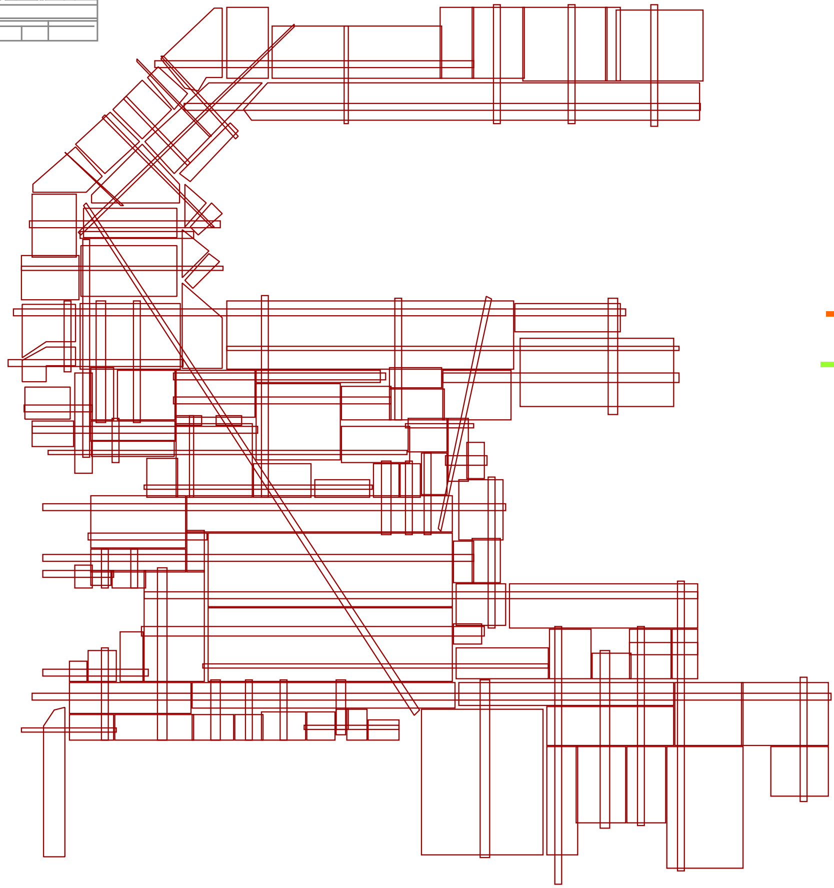


Figure 3.9 : LONDON VICTORIA STATION - convex shape analysis or 'Pesh'



a: Convex shape break up of Victoria Station's internal spaces



b: Convex shape integration analysis

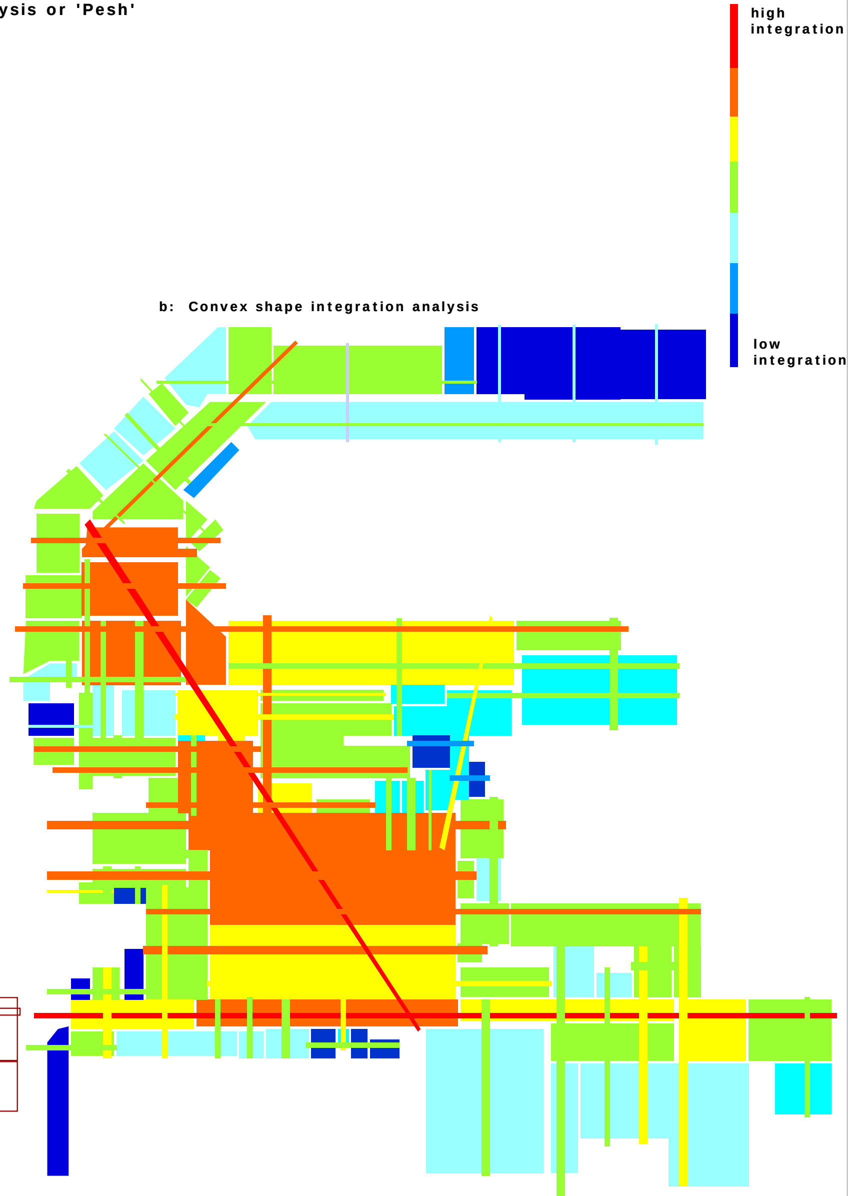
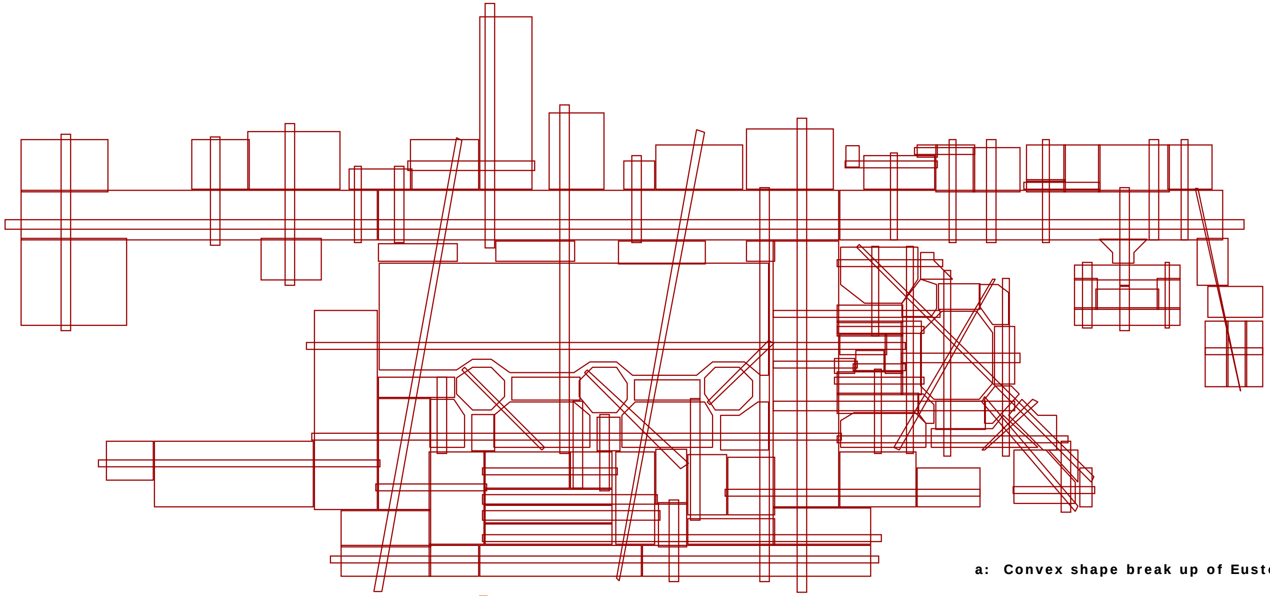
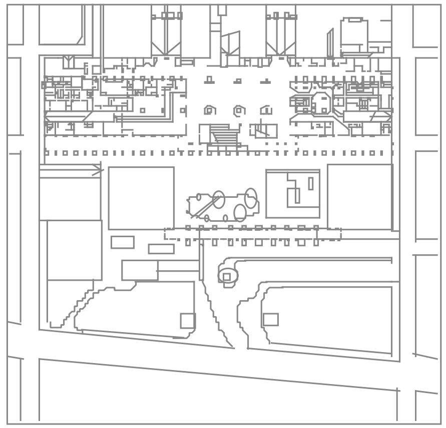
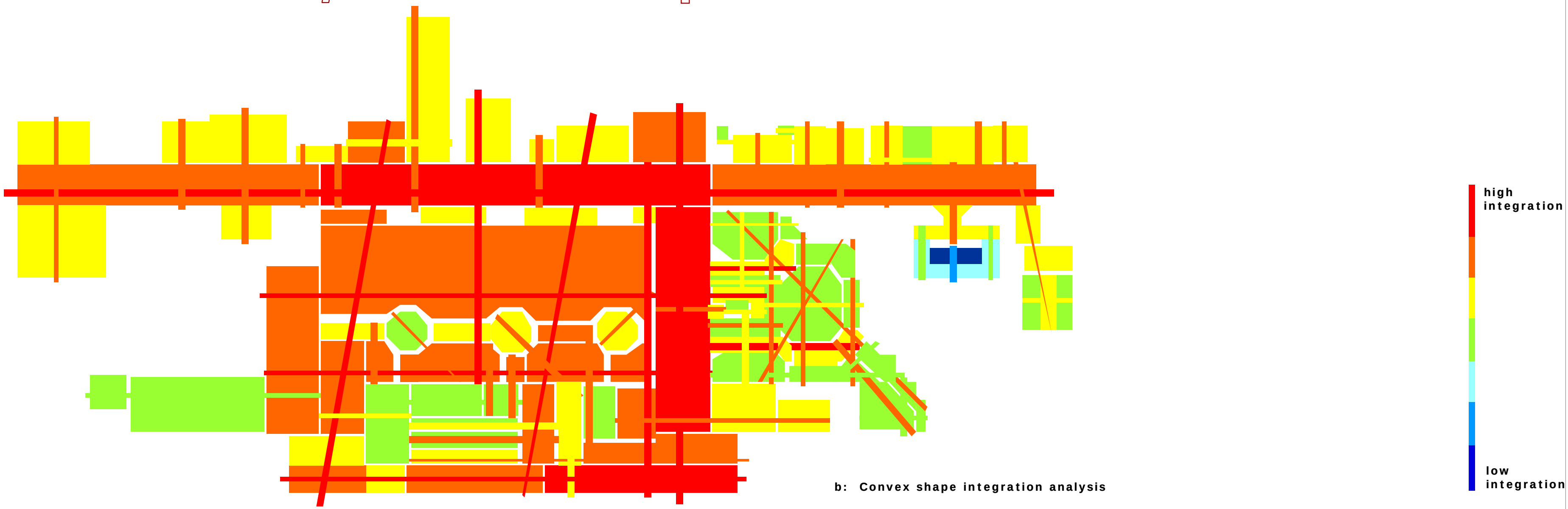


Figure 3.10: LONDON EUSTON STATION - convex shape analysis or 'Pesh'

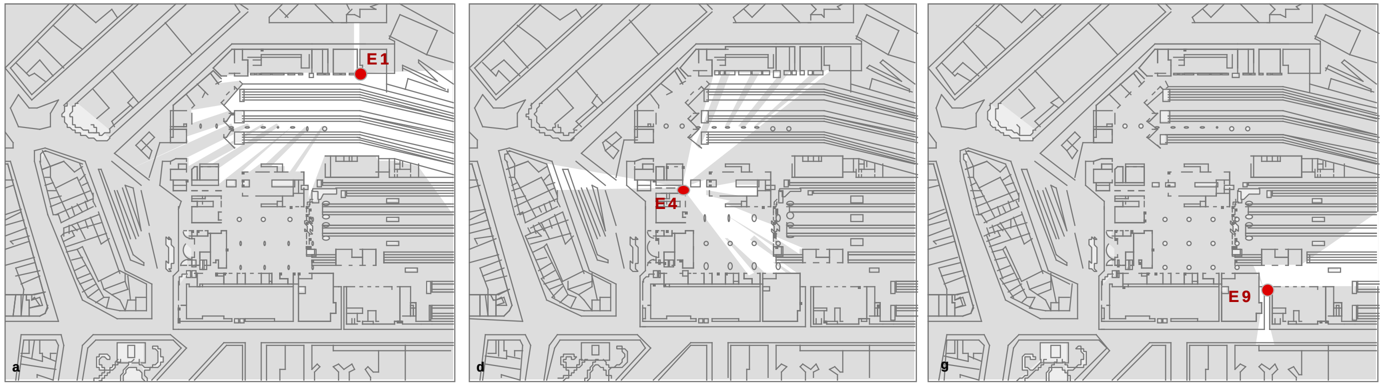




a: Convex shape break up of Euston Station's internal spaces



b: Convex shape integration analysis



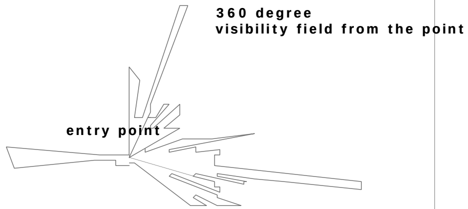
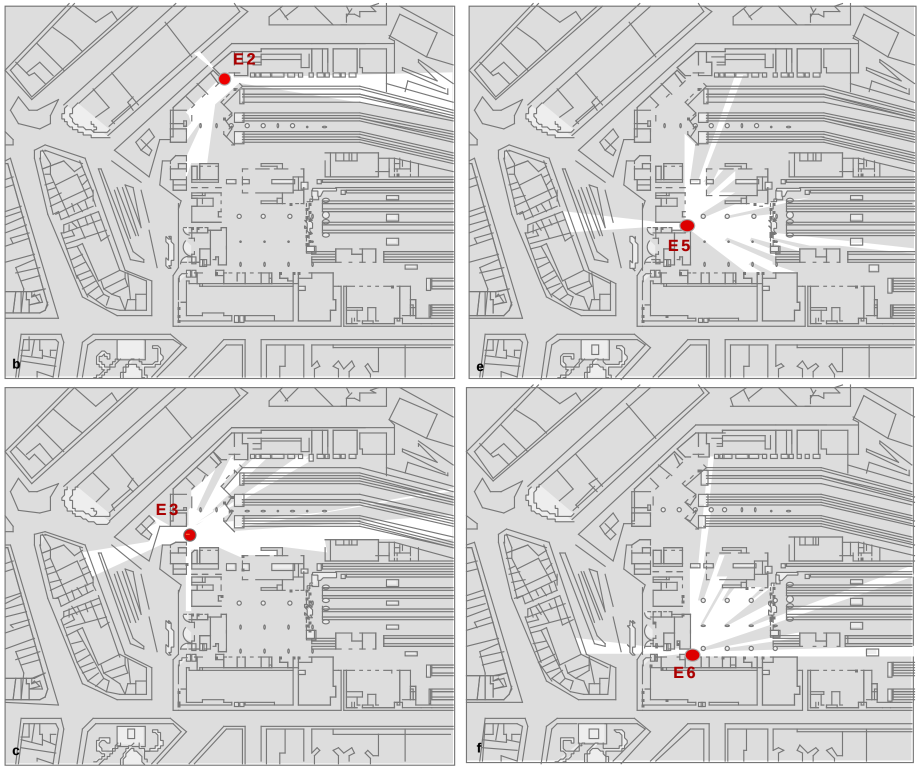


Figure 3.11: VICTORIA STATION - point isovists from all station entrances



h: Combined point isovists from all Victoria Station's entrances

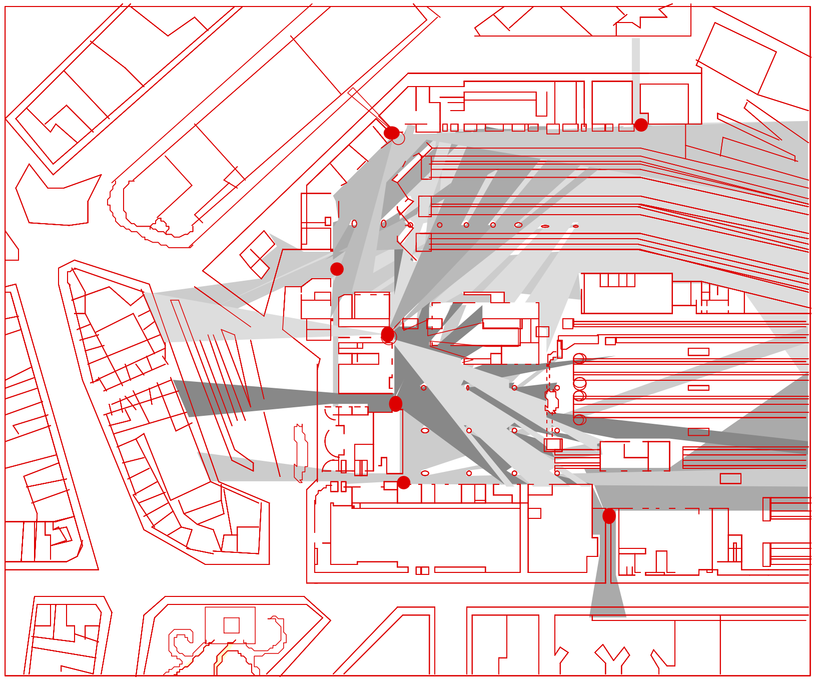
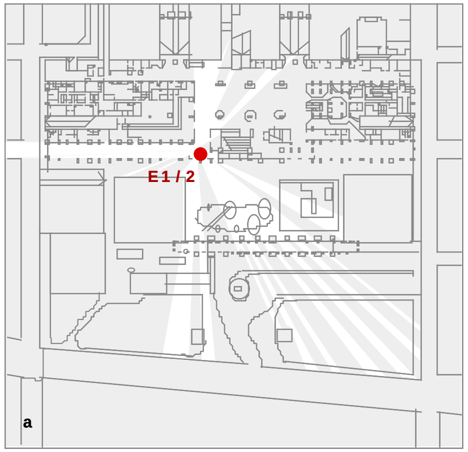
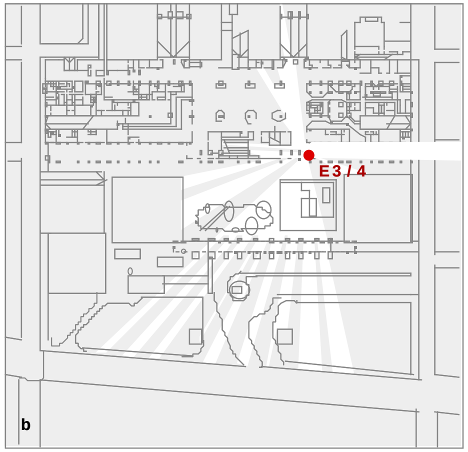
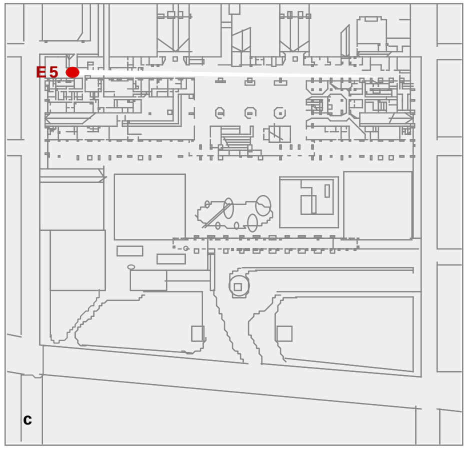
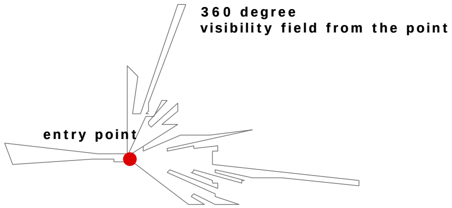


Figure 3.12: EUSTON STATION - point isovists from all station entrances









d: Combined point isovists from all Victoria Station's entrances

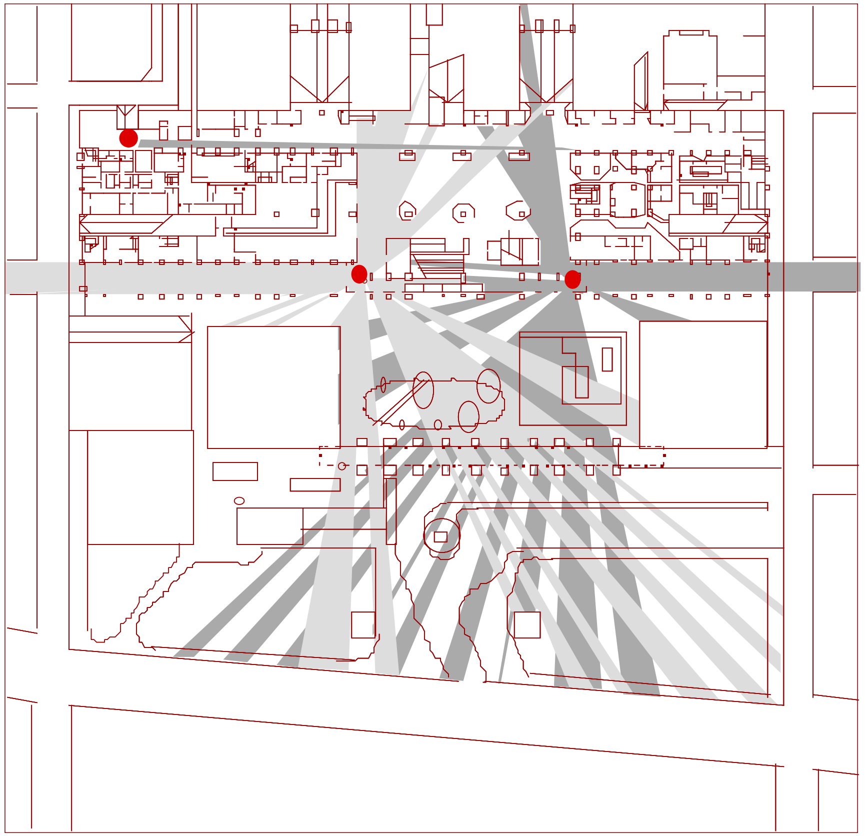


Figure 3.13: VICTORIA STATION - Moving Isovists along an inbound route from Wilton Road into the Eastern concourse hall

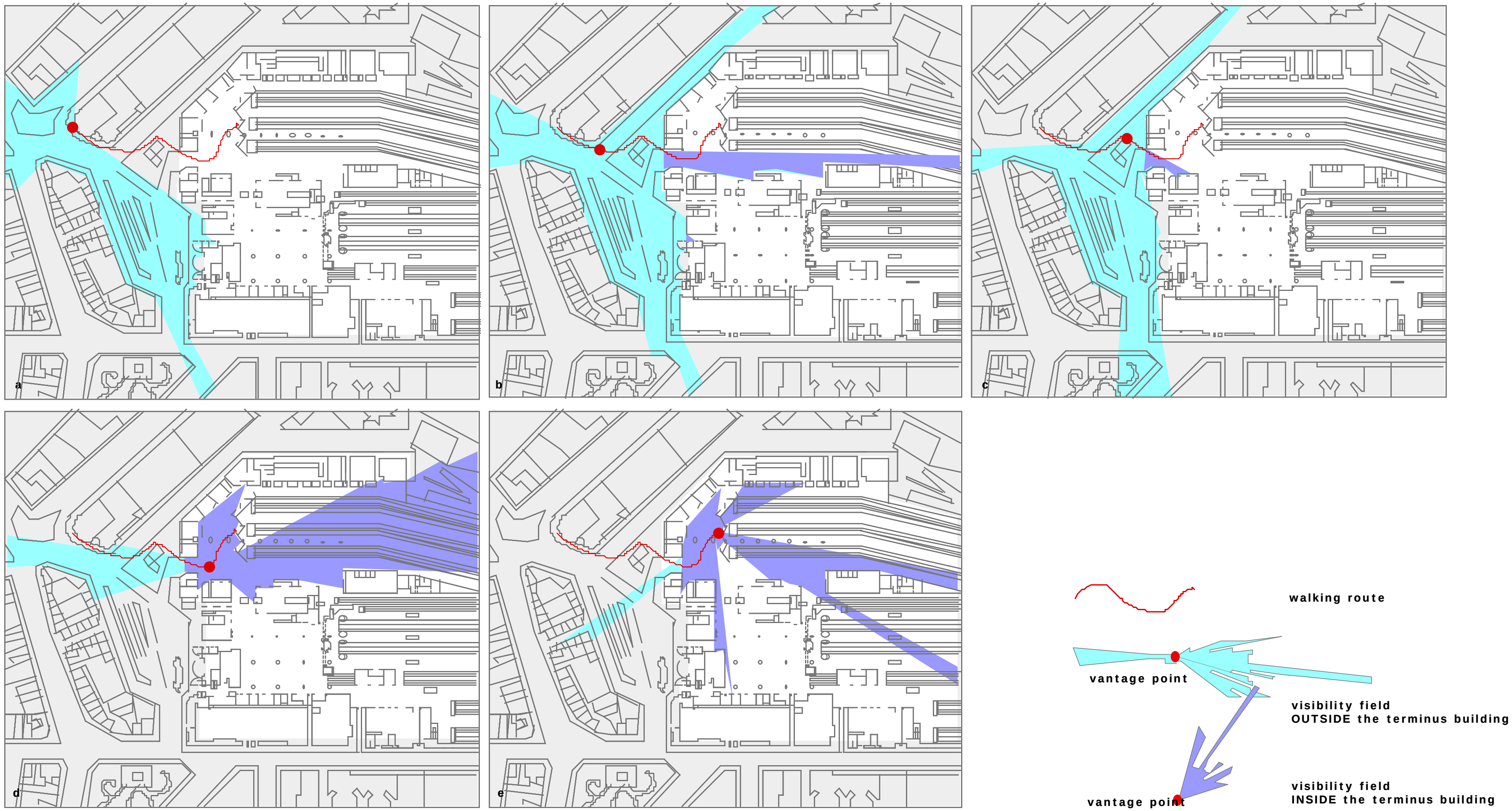


Figure 3.14: VICTORIA STATION - Moving Isovists along an outbound route from Platform 15 to the Underground entrance

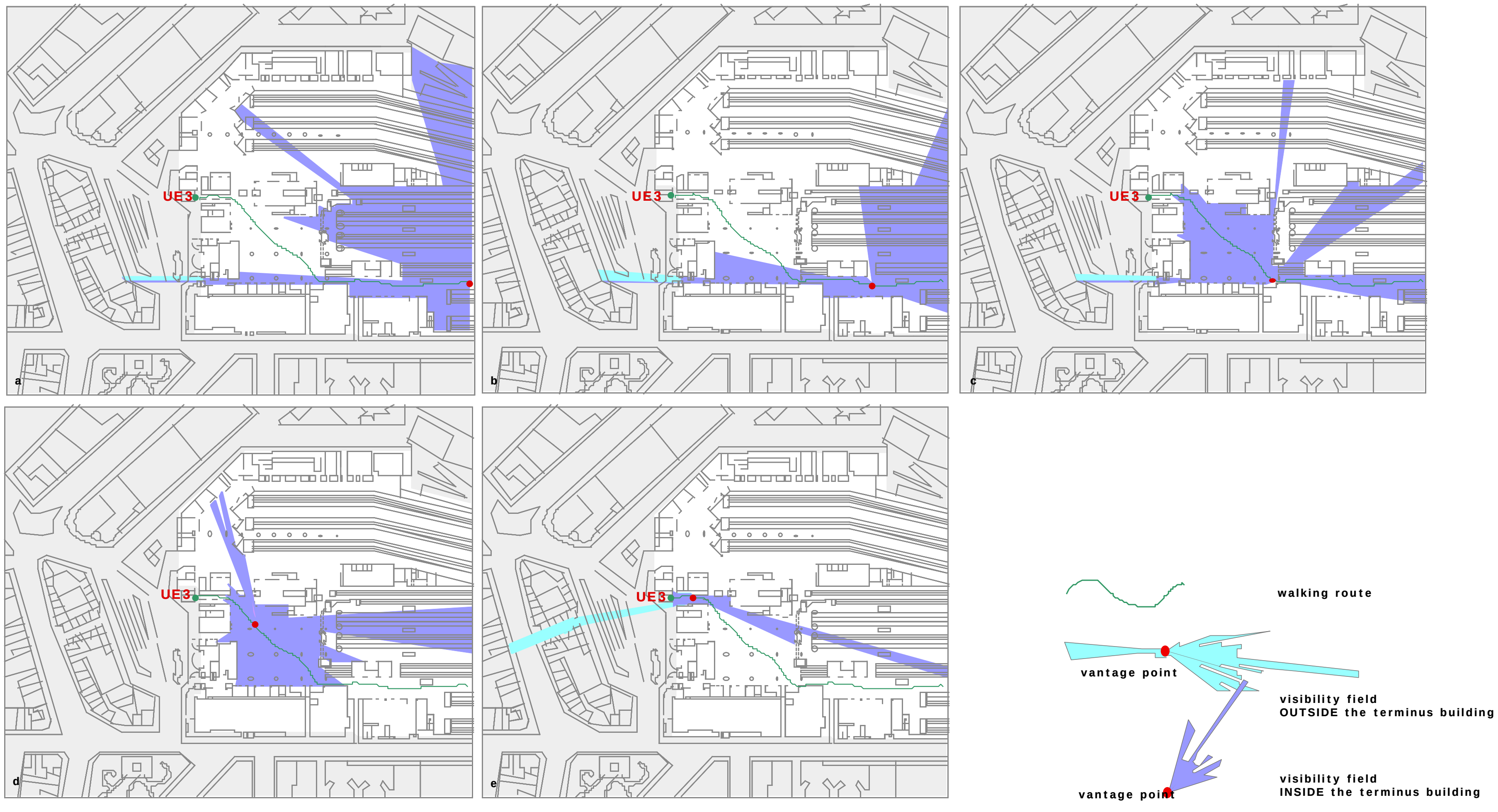
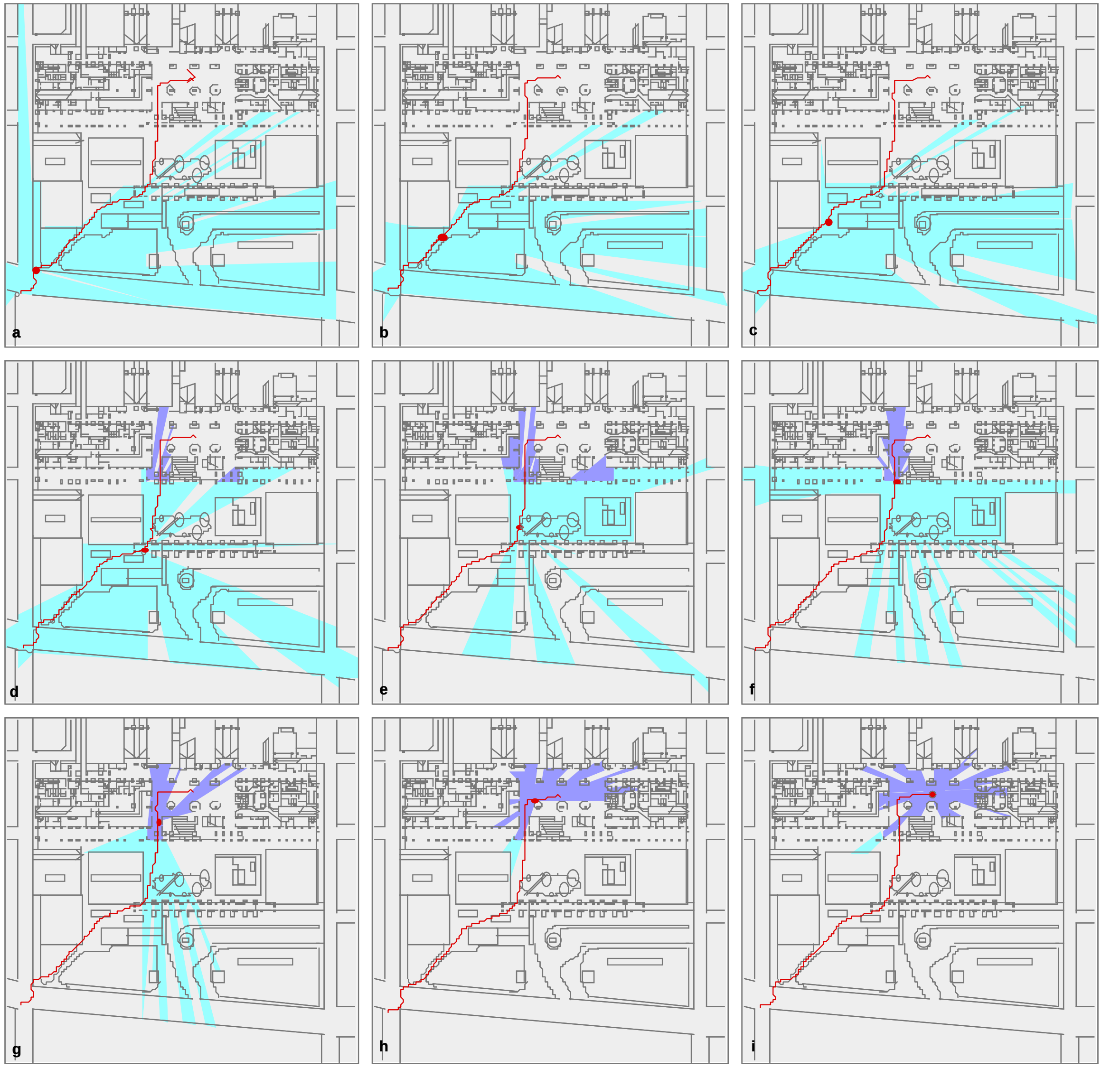


Figure 3.15: EUSTON STATION - Moving Isovists along an inbound route from Euston Road into the main concourse hall



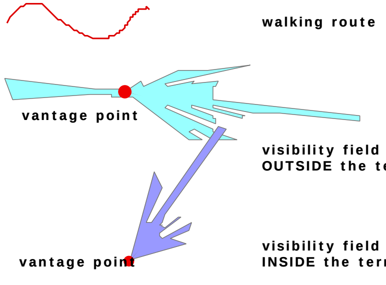


Figure 3.16: EUSTON STATION - Moving Isovists along an outbound route from Platform One to the Underground entrance

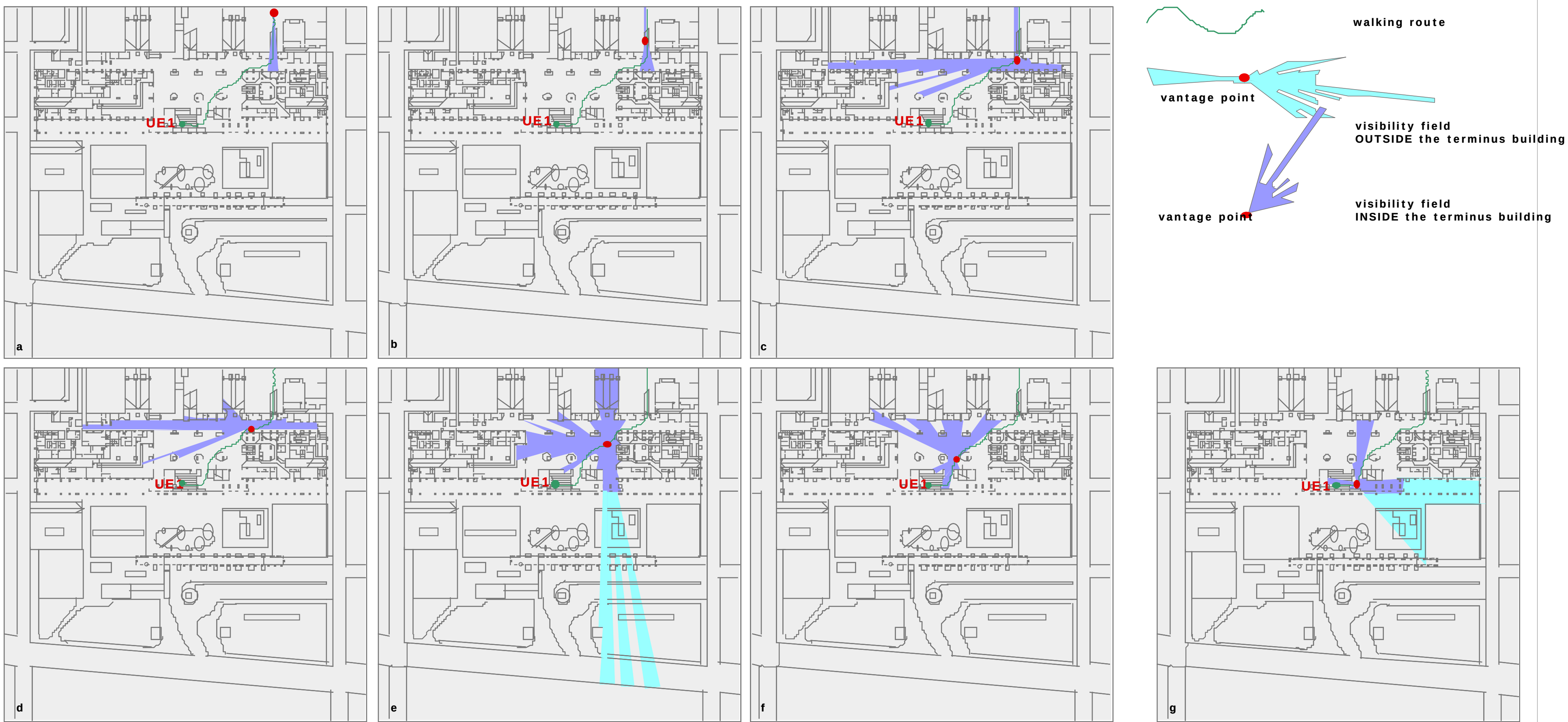


Figure 3.17: VICTORIA STATION - Serial photographic view

a: The inbound route from Wilton Road into the eastern concourse hall


cf. isovist: 3.13a


cf. isovist: 3.13b


cf. isovist: 3.13c

b: The outbound route from Platform Fifteen to the Underground entrance


cf. isovist: 3.14b


cf. isovist: 3.14c


cf. isovist: 3.14d


cf. isovist: 3.14e

cf. isovist: 3.14e

Figure 3.18: EUSTON STATION - Serial photographic view

a: The inbound route from Euston Road into the main concourse hall


cf. isovist: 3.15a


cf. isovist: 3.15d


cf. isovist: 3.15e


cf. isovist: 3.15f


cf. isovist: 3.15g


cf. isovist: 3.15h

b: The outbound route from Platform One to the Underground entrance


cf. isovist: 3.16b


cf. isovist: 3.16c

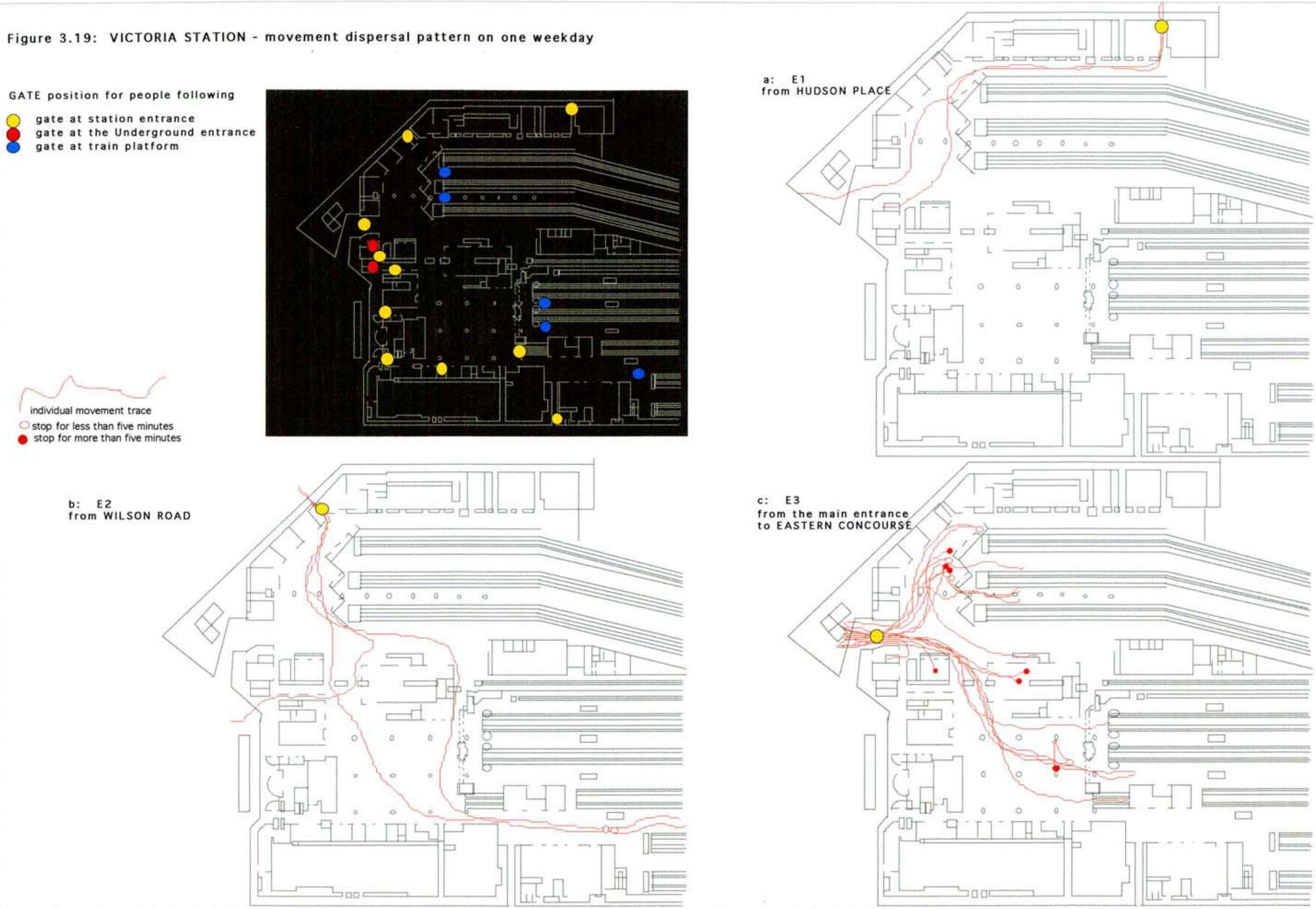

cf. isovist: 3.16e

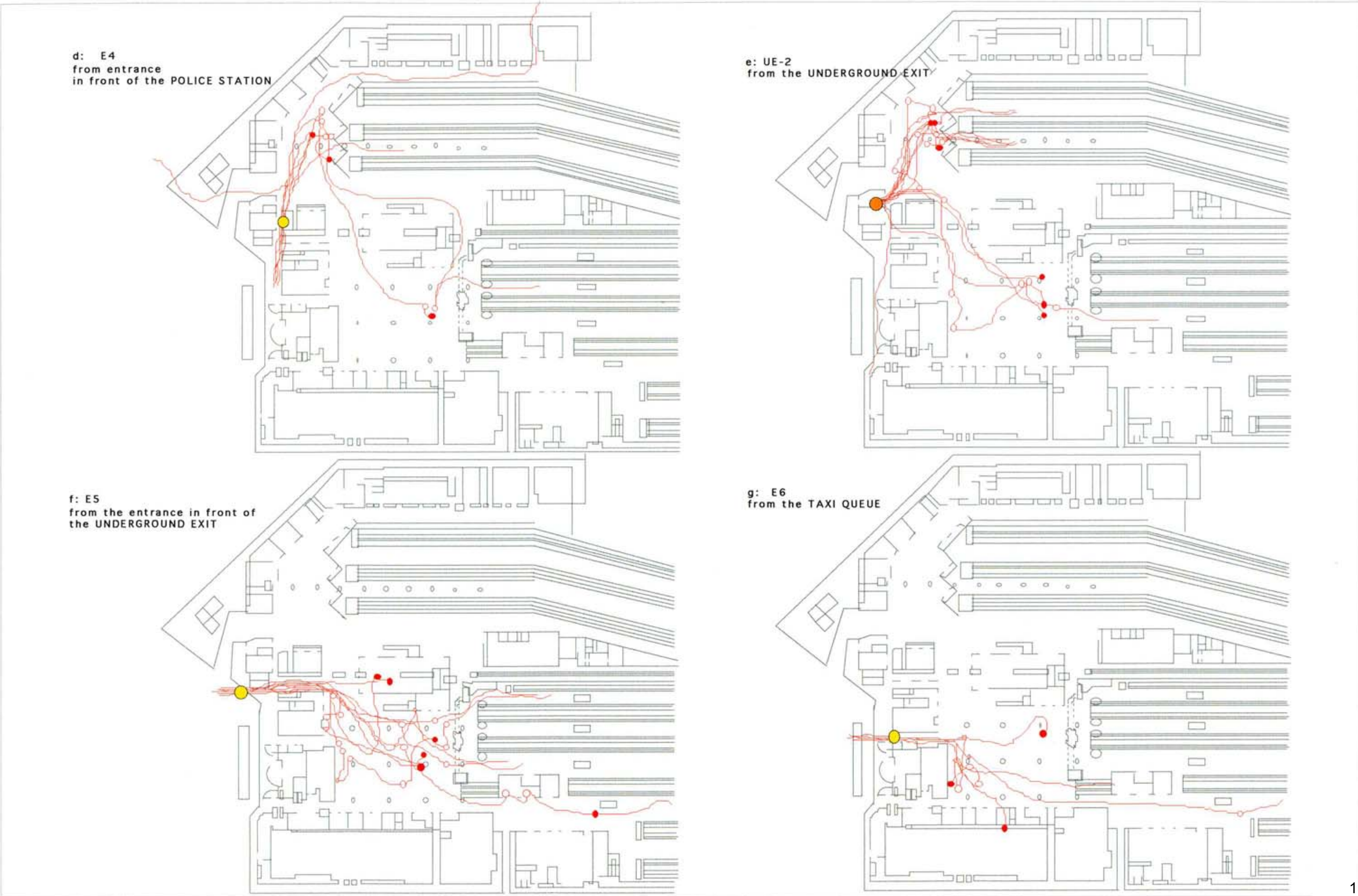

cf. isovist: 3.16f

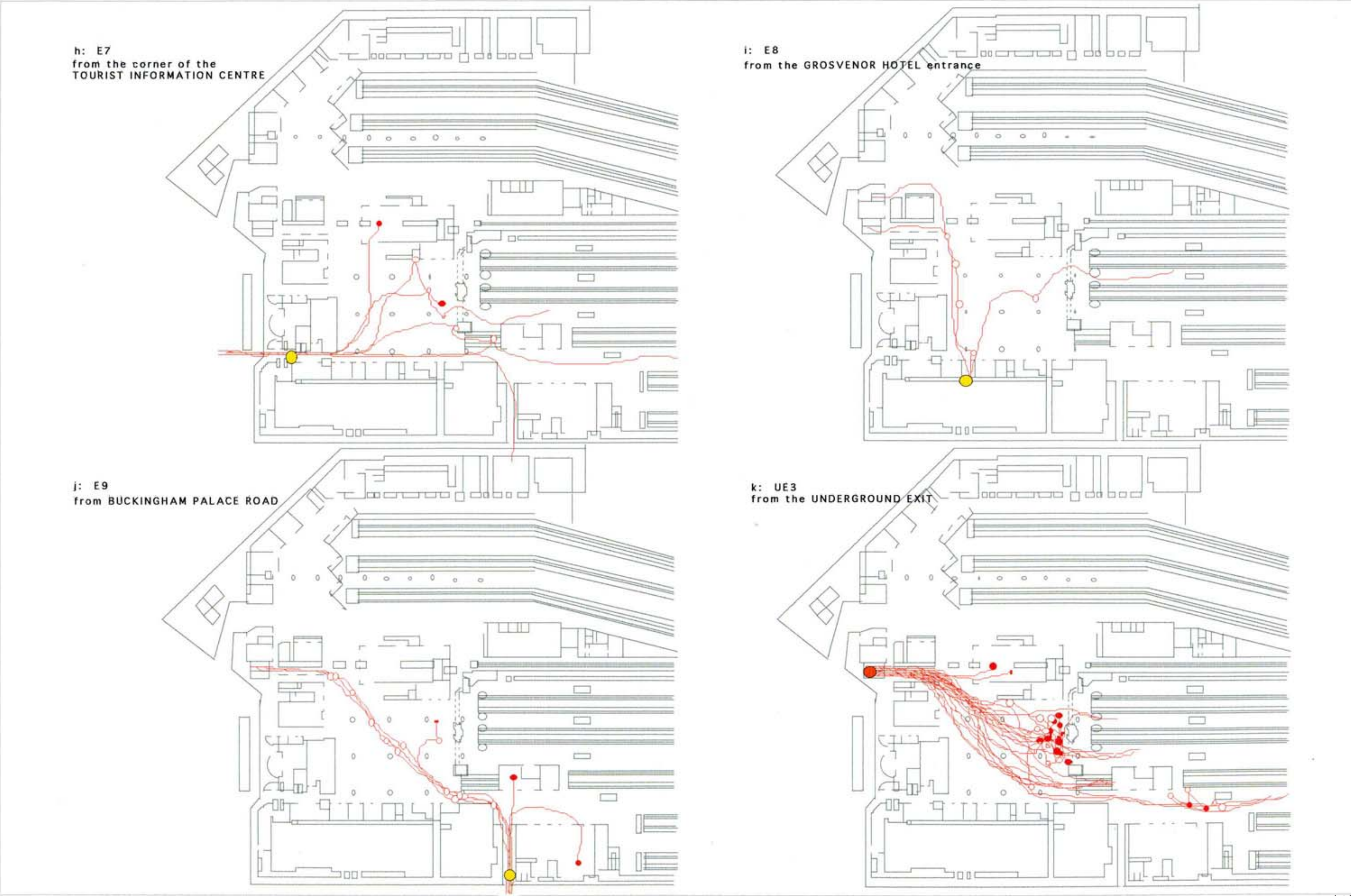

cf. isovist: 3.16f-g


cf. isovist: 3.16f-g

Figure 3.19: VICTORIA STATION - movement dispersal pattern on one weekday

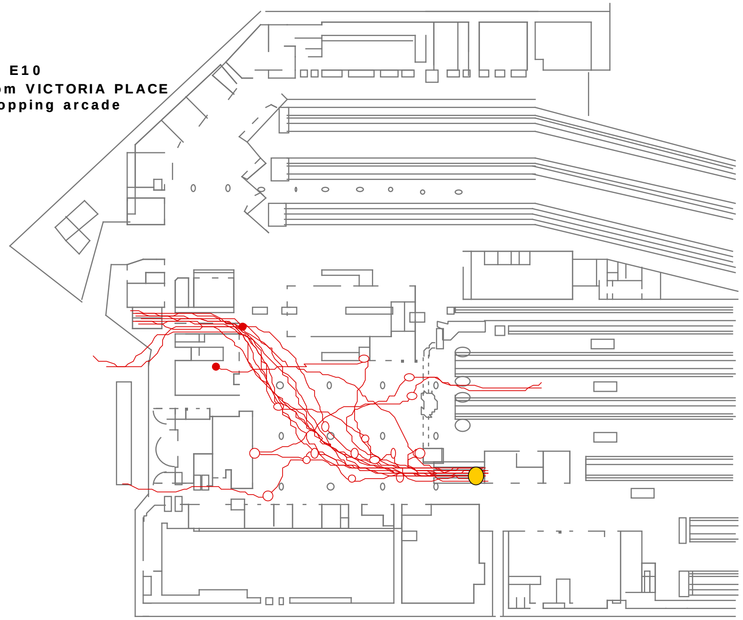



d: E4
from entrance
in front of the POLICE STATION
e: UE-2
from the UNDERGROUND EXIT
f: E5
from the entrance in front of
the UNDERGROUND EXIT
g: E6
from the TAXI QUEUE

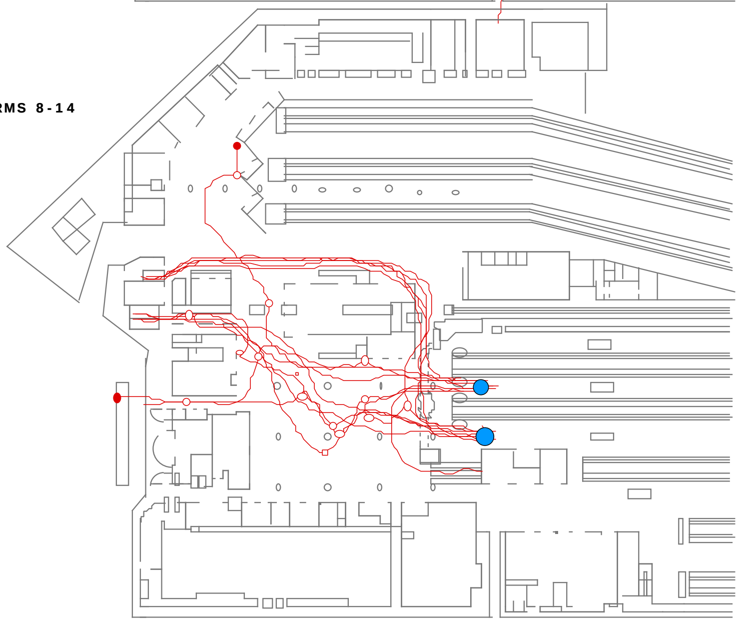

h: E7
from the corner of the
TOURIST INFORMATION CENTRE
i: E8
from the GROSVENOR HOTEL entrance
j: E9
from BUCKINGHAM PALACE ROAD
k: UE3
from the UNDERGROUND EXIT

l: PE6
from PLATFORMS 14-17

m: E10
from VICTORIA PLACE
shopping arcade



n: PE4-PE5
from PLATFORMS 8-14



o: PE2-PE3
from PLATFORMS 3-6

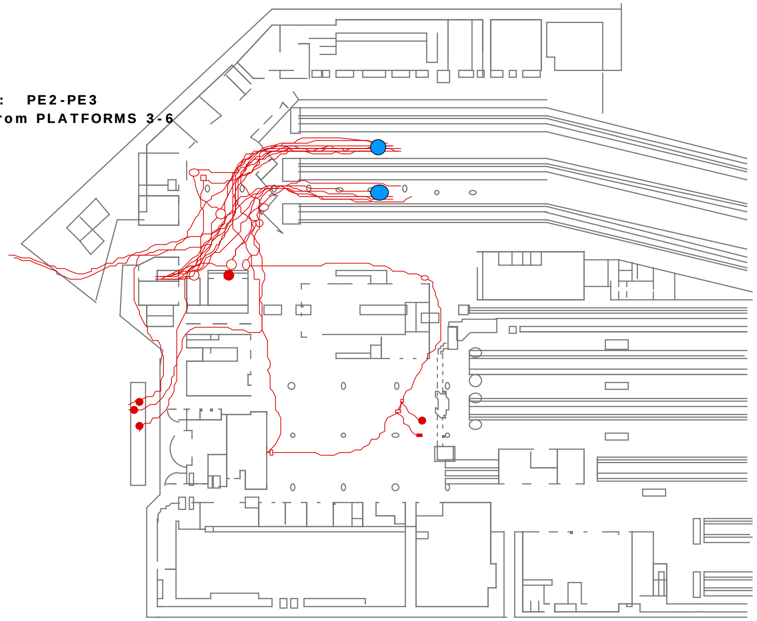


Figure 3.20: EUSTON STATION - movement dispersal pattern on one weekday

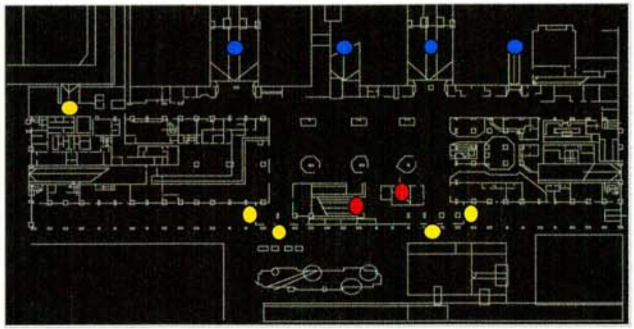
GATE position for people following

- gate at station entrance
- gate at underground entrance
- gate at train platform

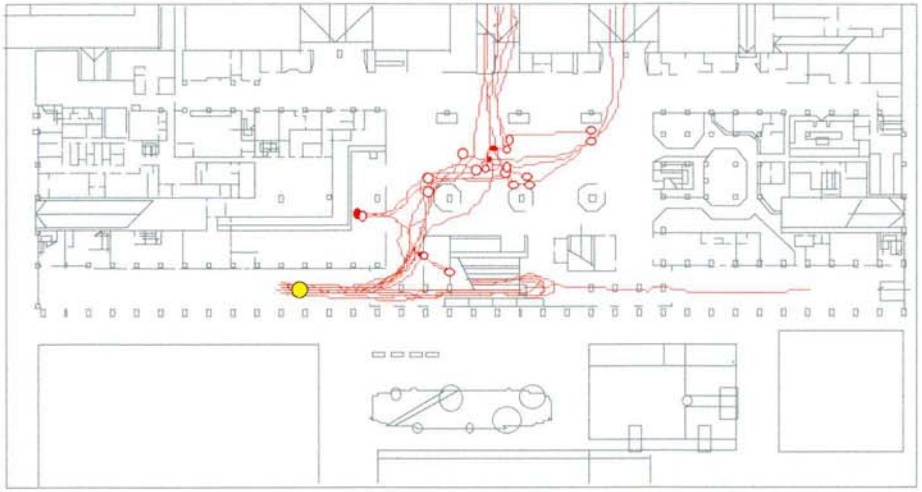
individual movement trace

stop for less than five minutes

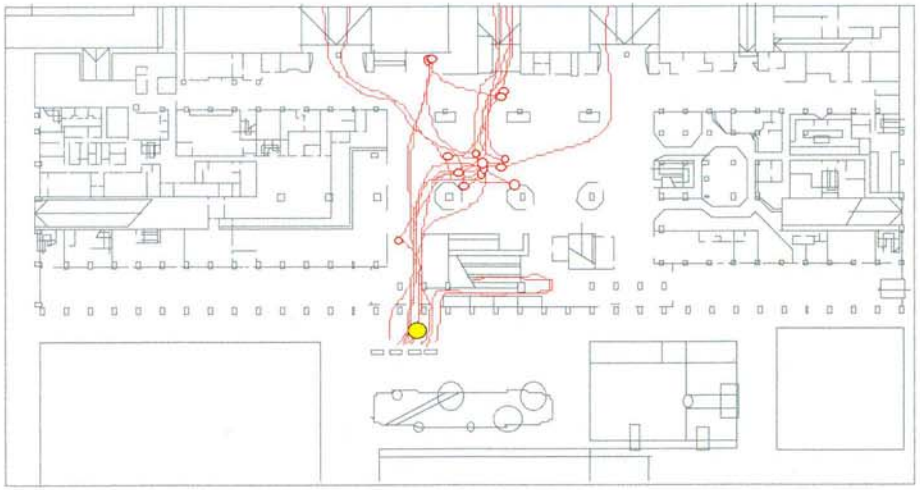
stop for more than five minutes



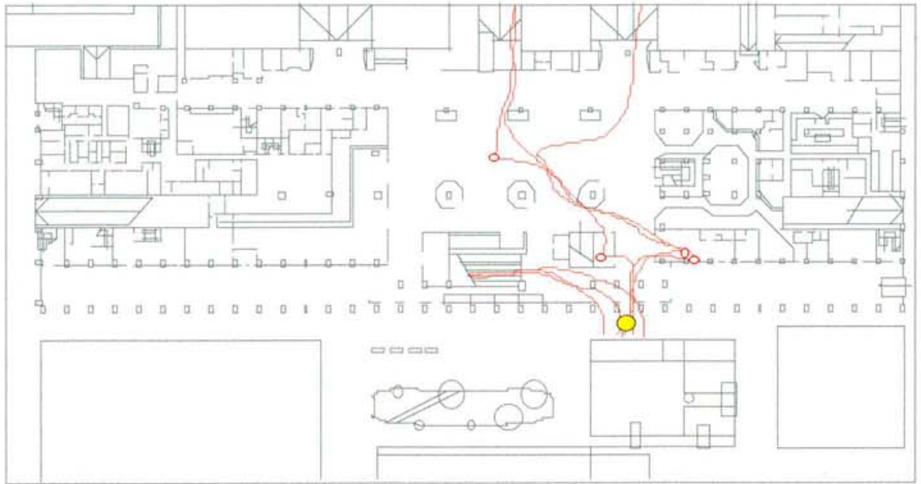
a: E1
from WESTERN ENTRANCE



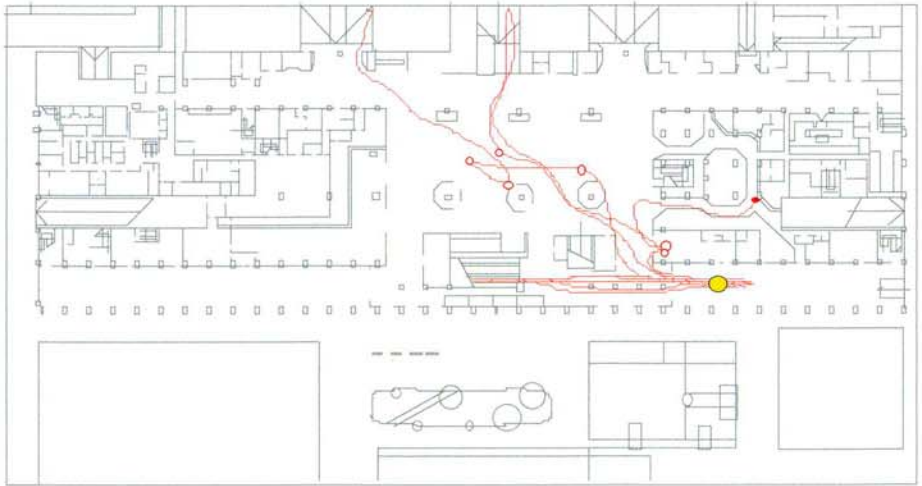
b: E2
from SOUTH-WESTERN ENTRANCE



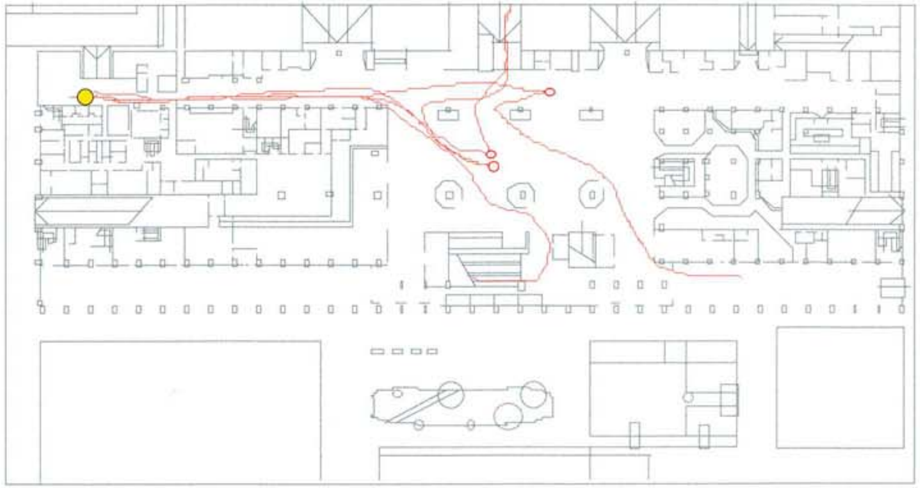
c: E3
from SOUTH-EASTERN ENTRANCE



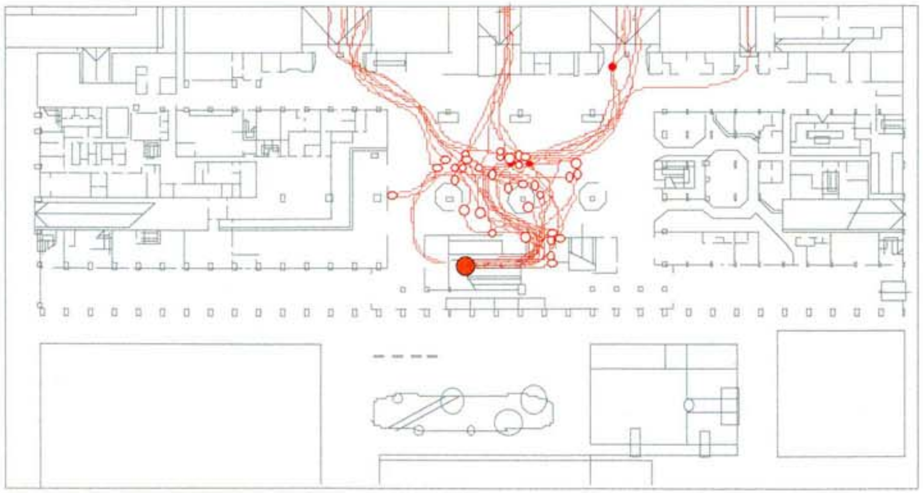
d: E4
from SOUTH-EASTERN ENTRANCE



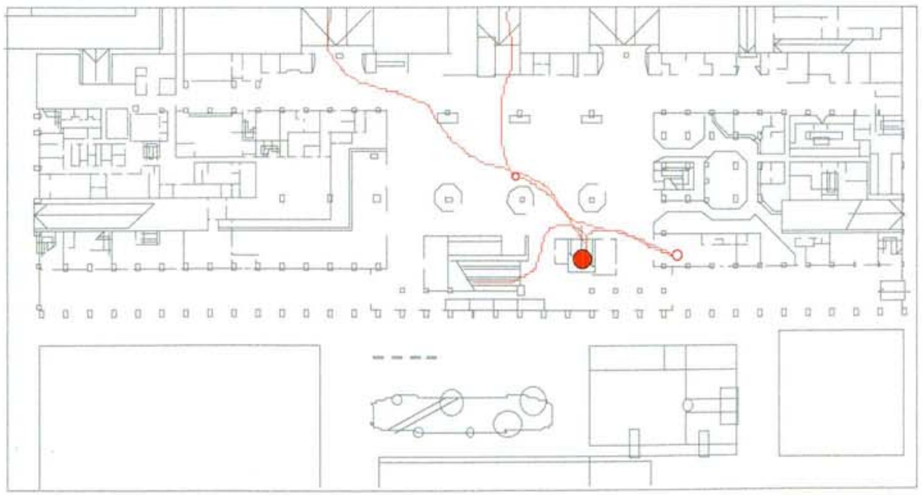
e: E5
from MELTON STREET



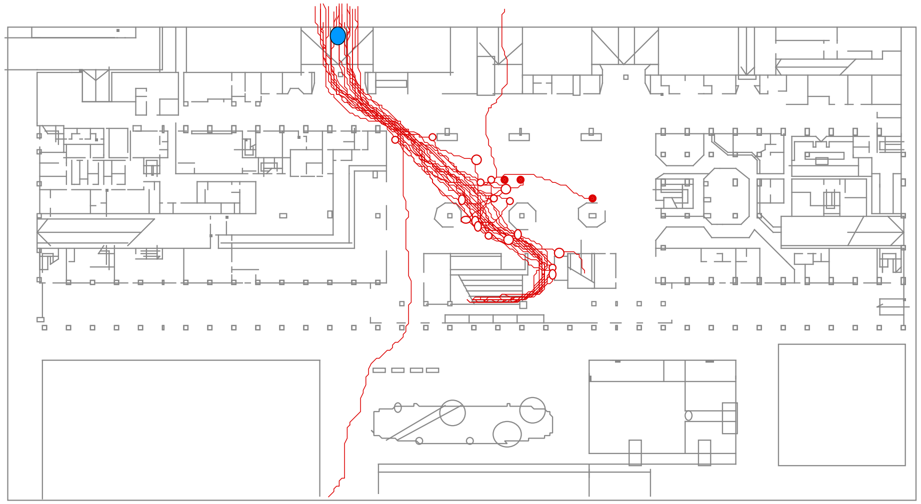
f: UE1
from the UNDERGROUND EXIT



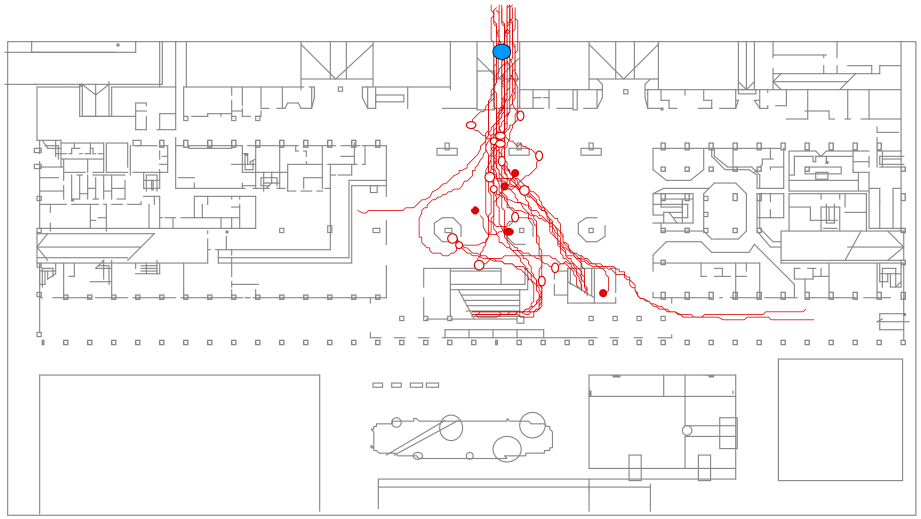
g: UE2
from the UNDERGROUND PARKING and TAXI QUEUE



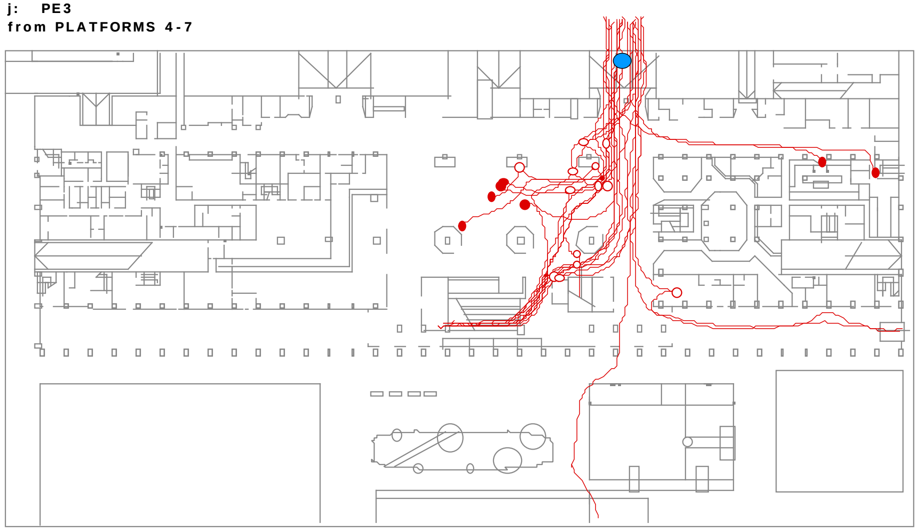
h: PE1
from PLATFORMS 12-15



i: PE2
from PLATFORMS 8-11



j: PE3
from PLATFORMS 4-7



k: PE4
from PLATFORMS 1-3

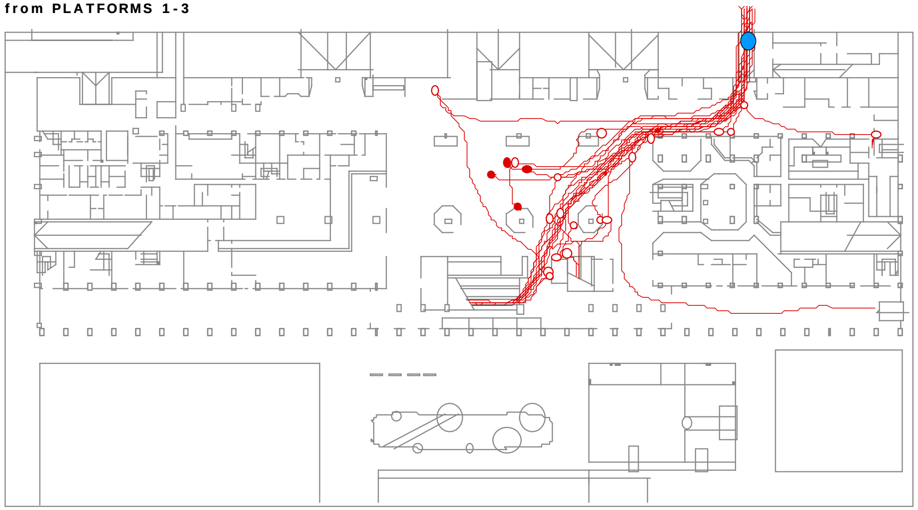
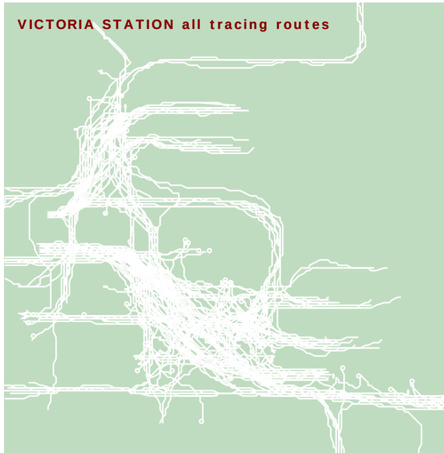


Figure 3.21: VICTORIA STATION
Combined movement dispersal pattern for all gates



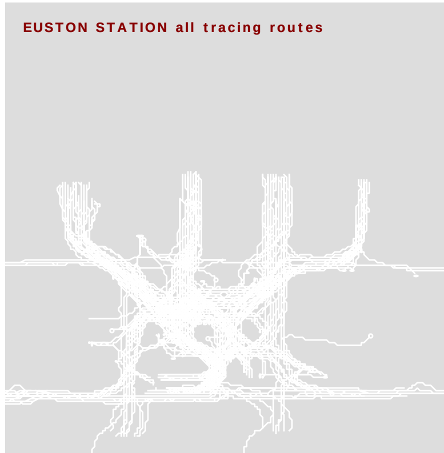


Figure 3.22: EUSTON STATION
Combined movement dispersal pattern for all gates

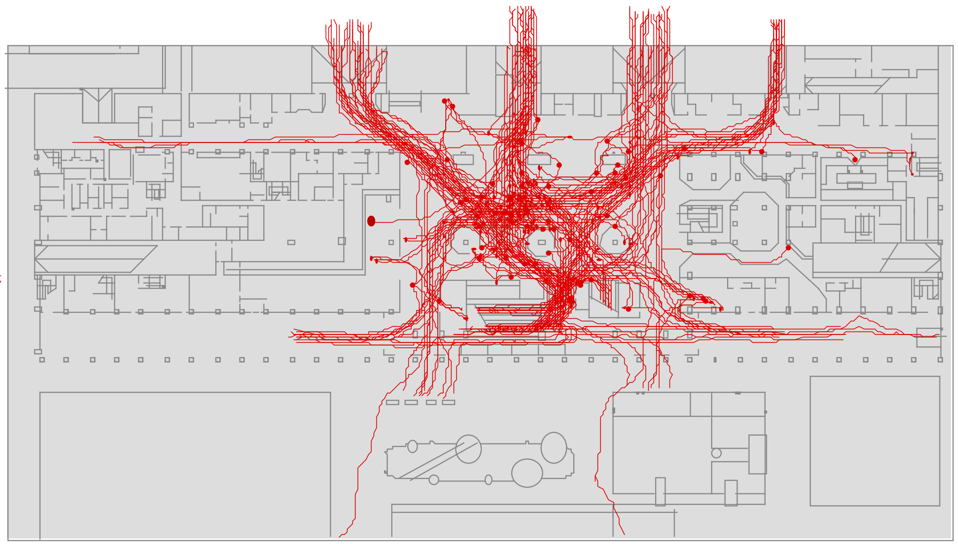
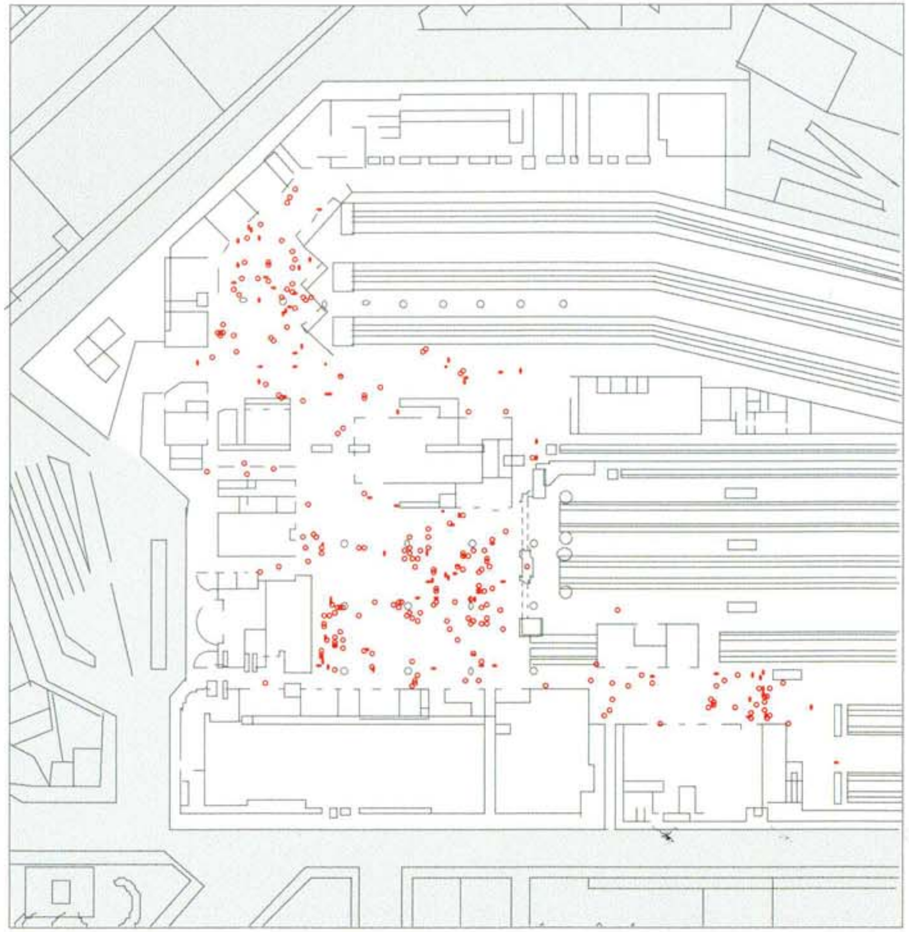


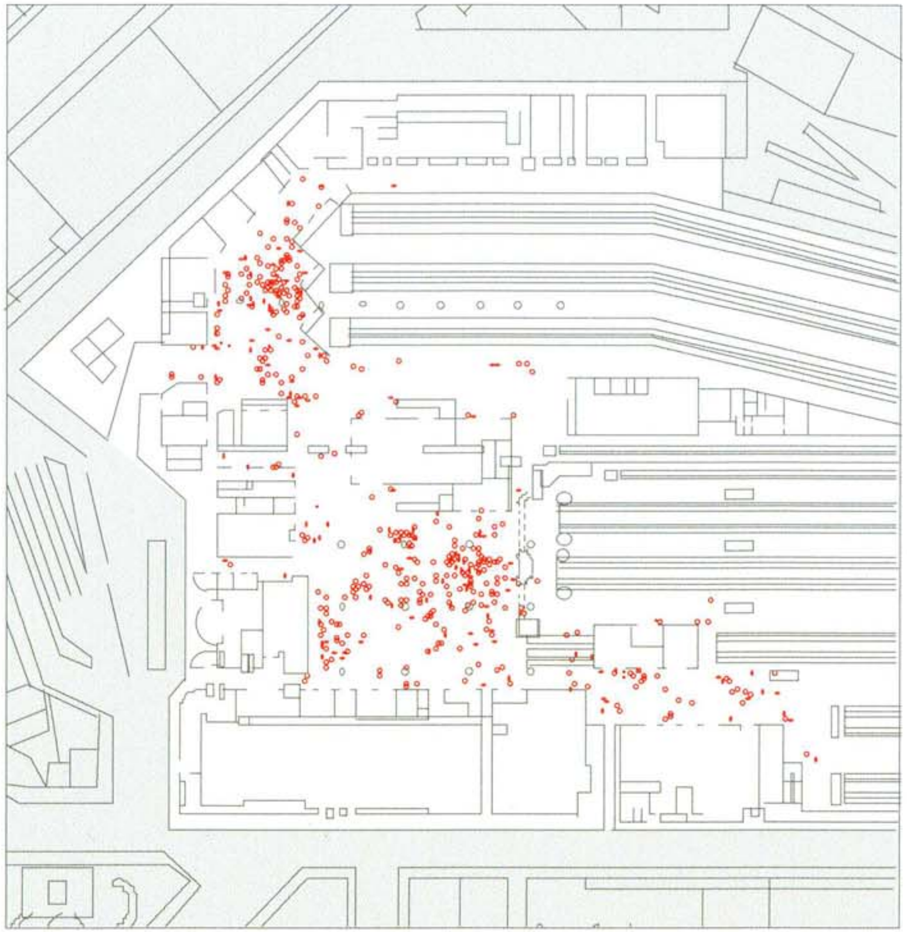
Figure 3.23: VICTORIA STATION - Static snapshots (one weekday)

static station user

a: 08:00 - 10:00 hrs

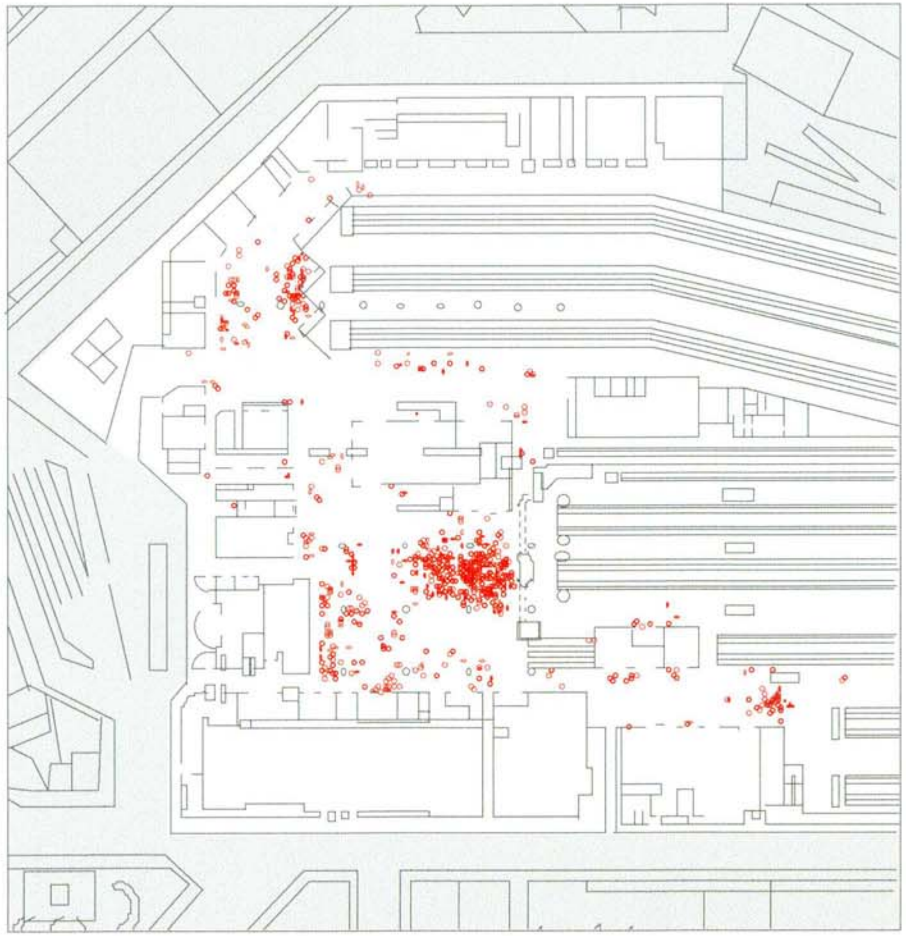


b: 10:00 - 12:00 hrs

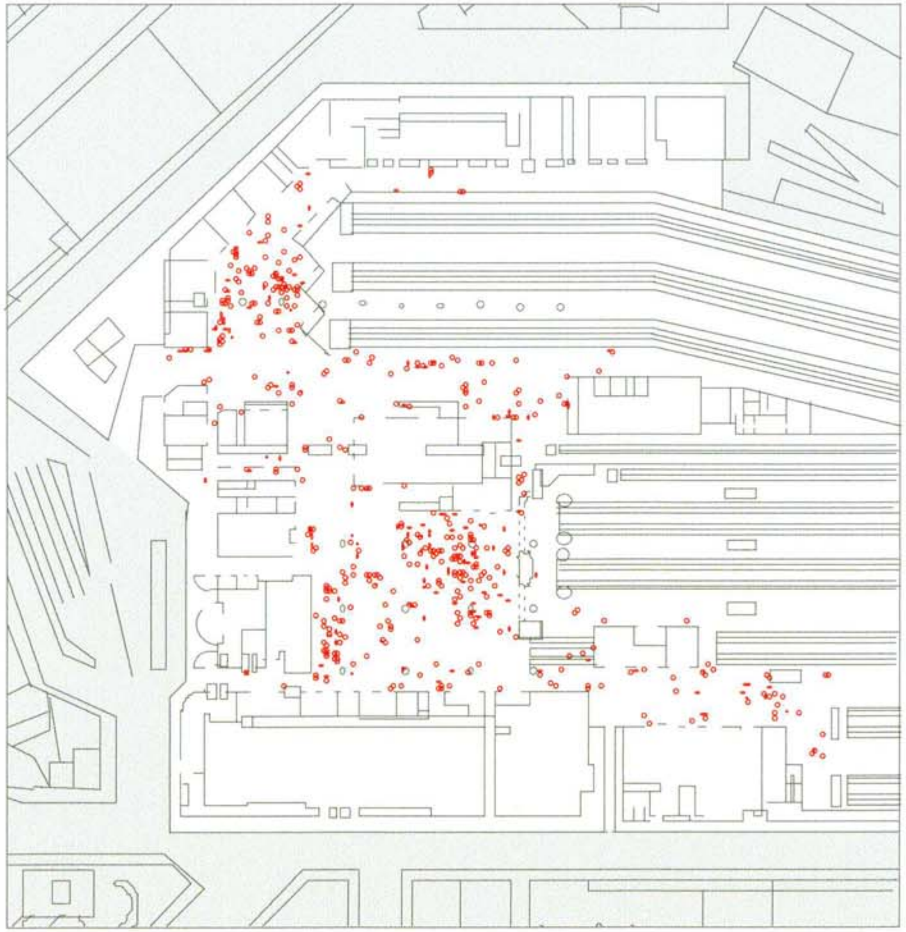


static station user

c: 12:00 - 14:00 hrs



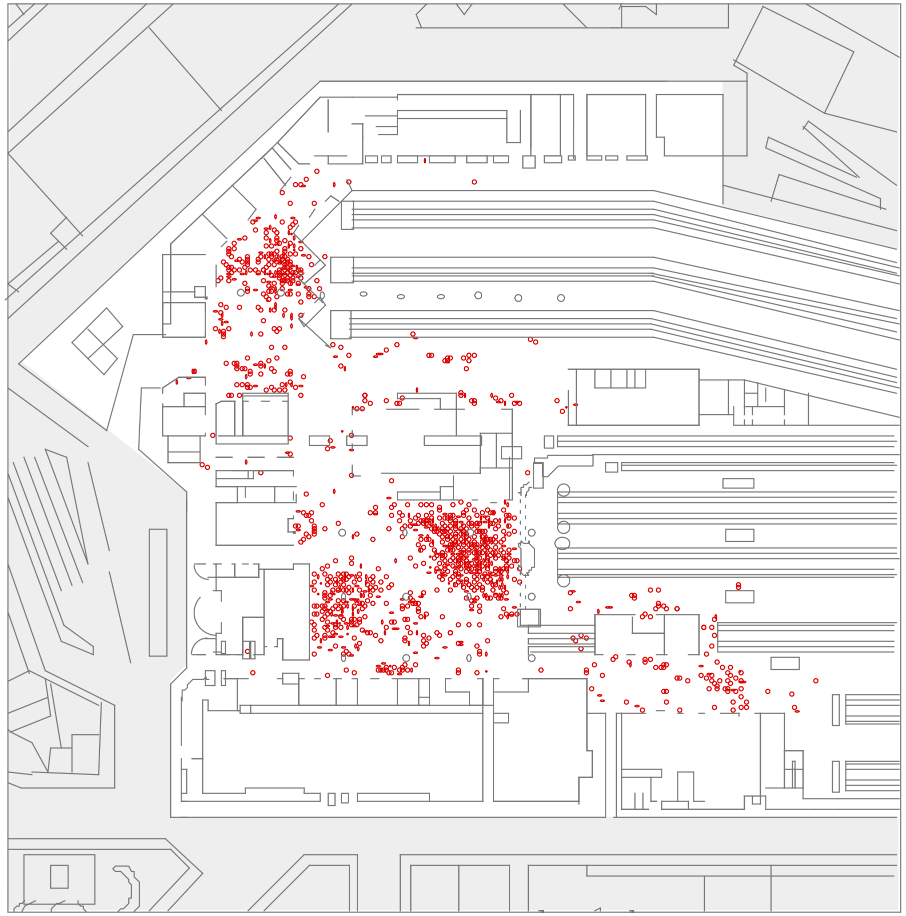
d: 14:00 - 16:00 hrs



static station user

The clustering of stationary people in the central concourse hall

e: 16:00 - 18:00 hrs



f: combined static snapshots - all day
(08:00 - 18:00 hrs)

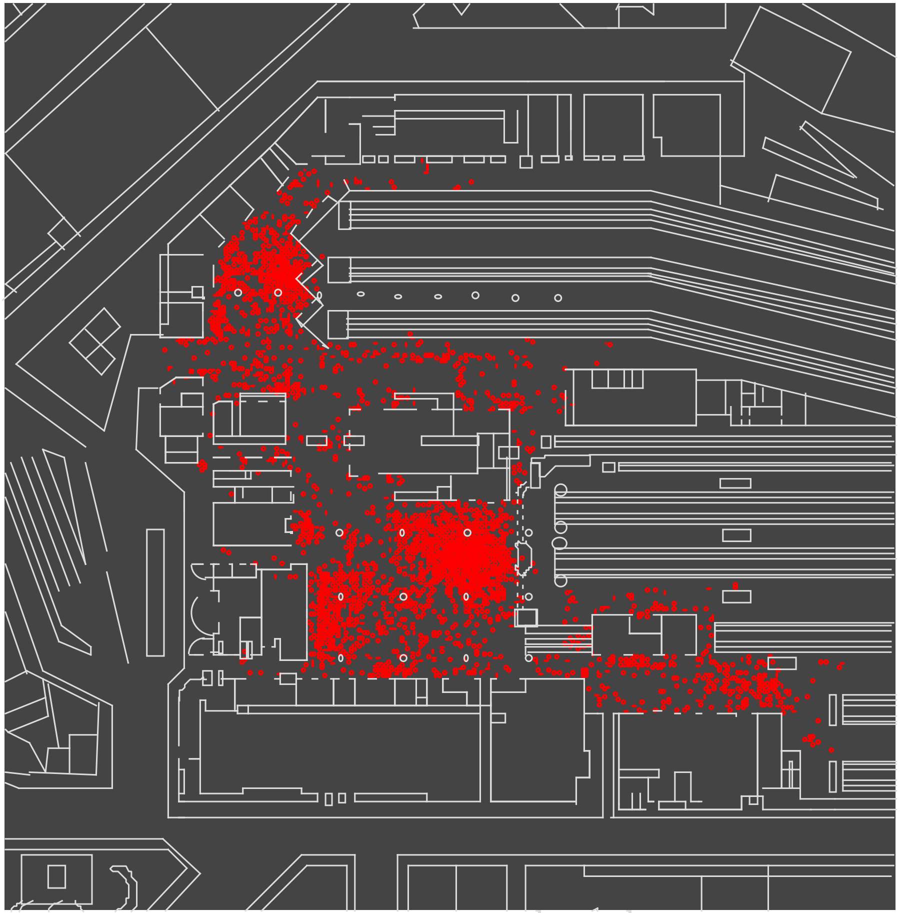


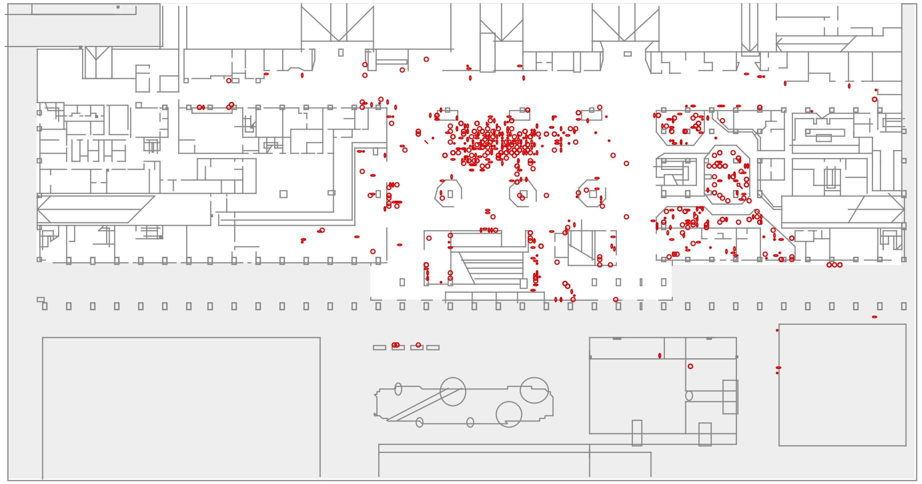
Figure 3.24: EUSTON STATION - Static snapshots (one weekday)

a: 08:00 - 10:00 hrs

b: 10:00 - 12:00 hrs

c: 12:00 - 14:00 hrs

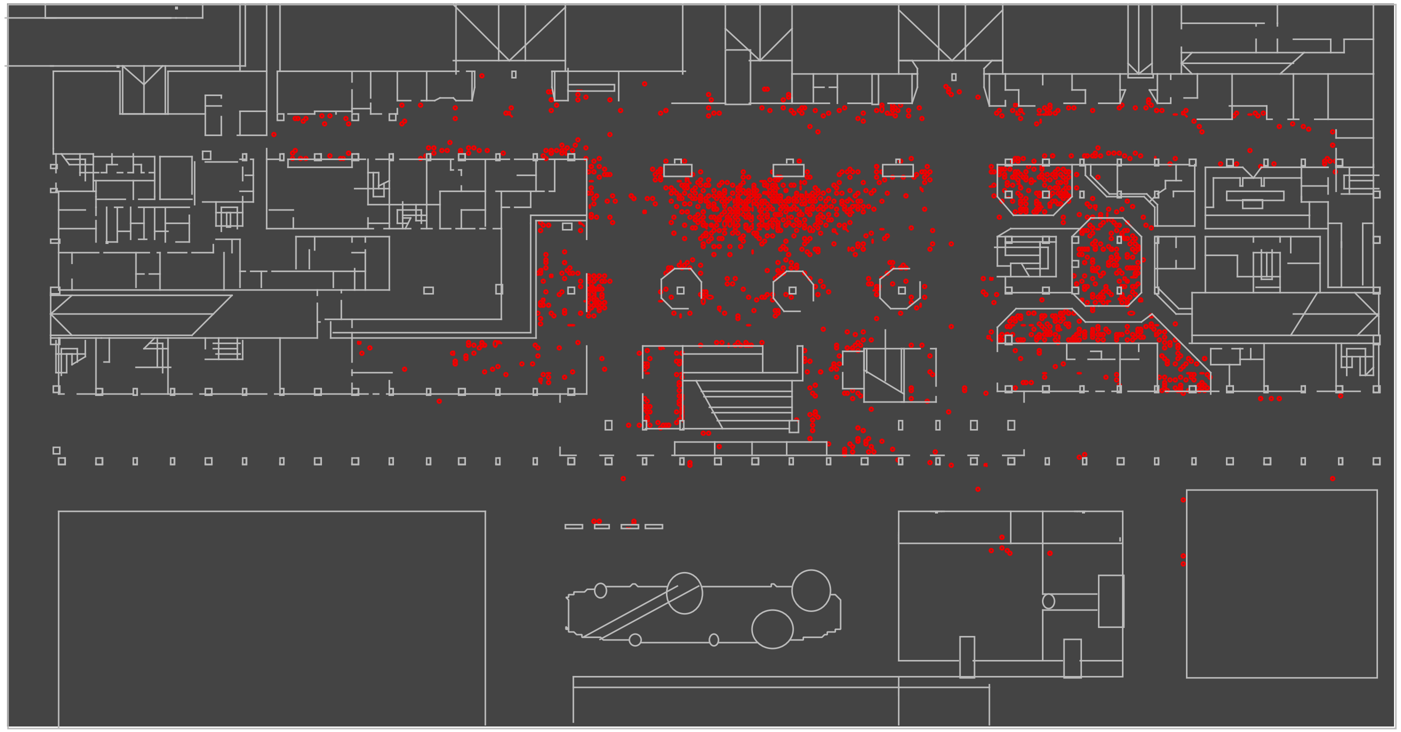
d: 14:00 - 16:00 hrs



e: 16:00 - 18:00 hrs

The clustering of stationary people in the main concourse hall

f: Combined static snapshots - all day (08:00-18:00 hrs)



static station user

Figure 3.25: VICTORIA STATION
Combined movement dispersal and stationary activity pattern

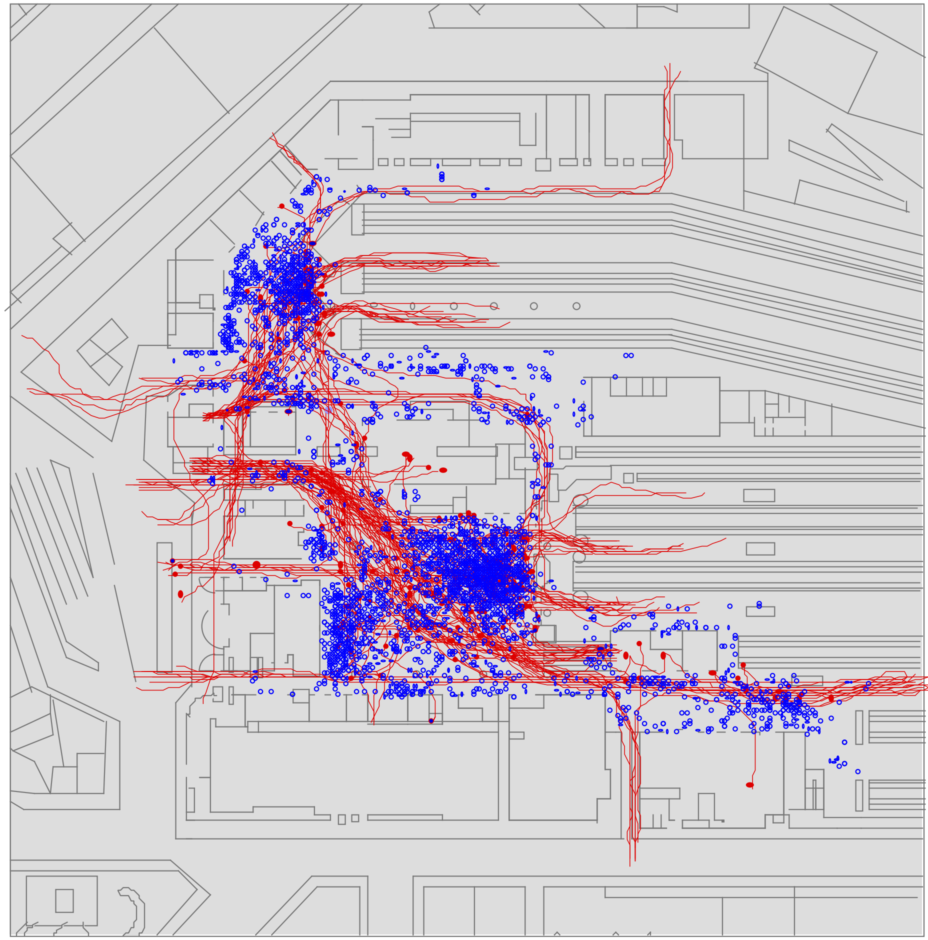


Figure 3.26: EUSTON STATION
Combined movement dispersal and stationary activity pattern

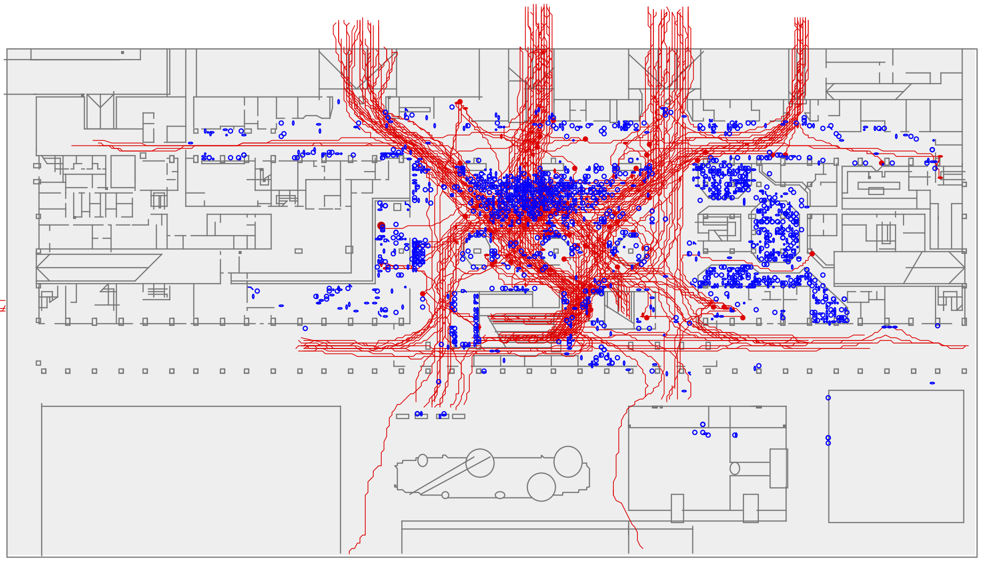
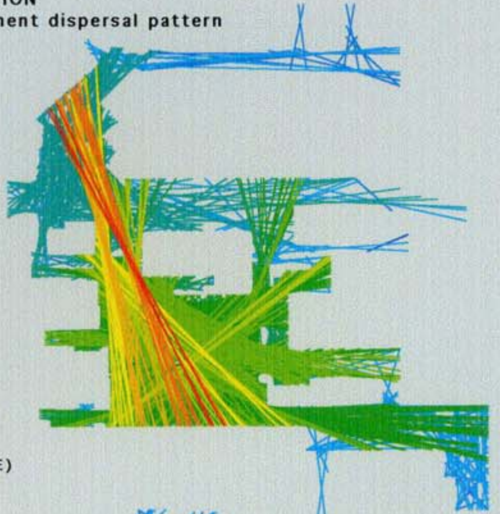
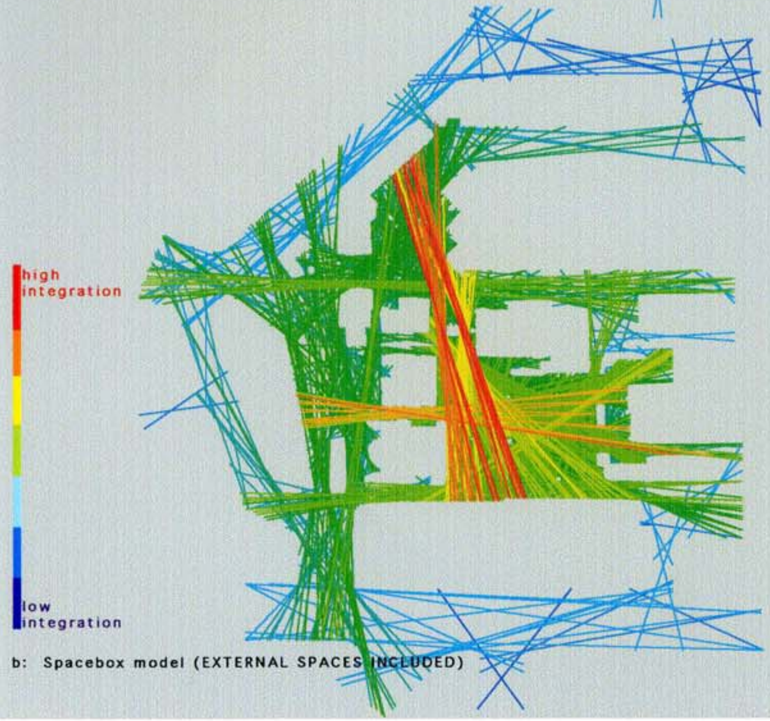


Figure 3.27: VICTORIA STATION
Combined Spacebox and movement dispersal pattern

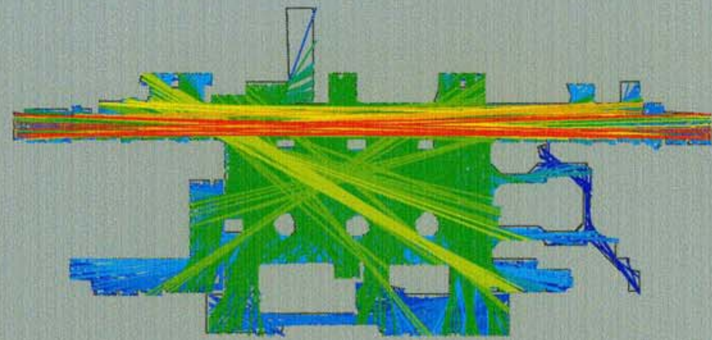


a: Spacebox model (INTERNAL SPACE)

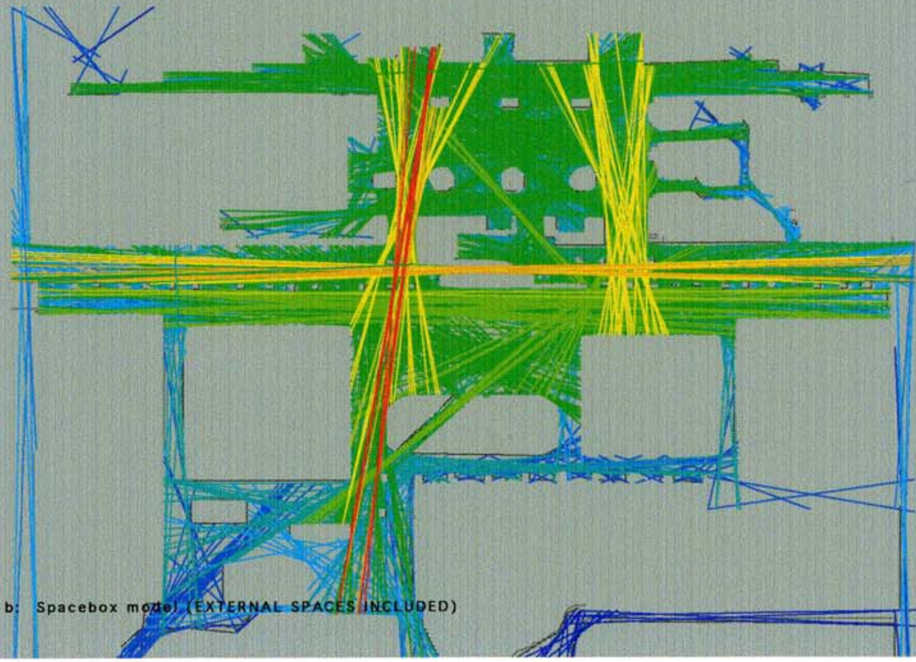


b: Spacebox model (EXTERNAL SPACES INCLUDED)

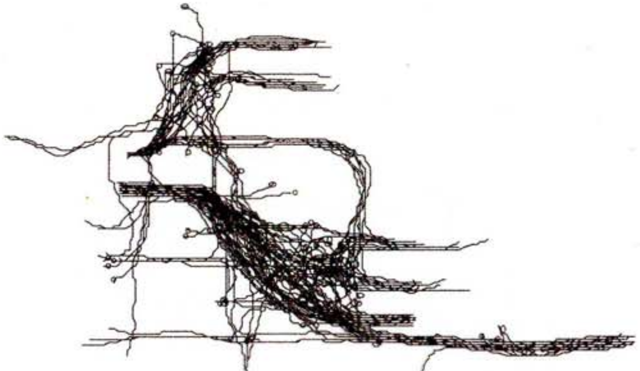
Figure 3.28: EUSTON STATION
Combined Spacebox and movement dispersal pattern



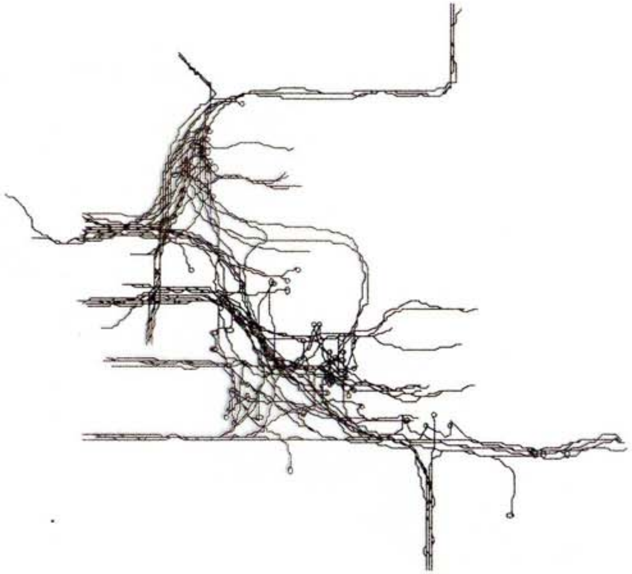
a: Spacebox model (INTERNAL SPACE)



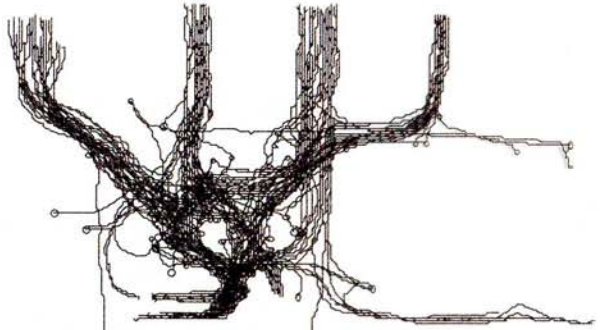
b: Spacebox model (EXTERNAL SPACES INCLUDED)



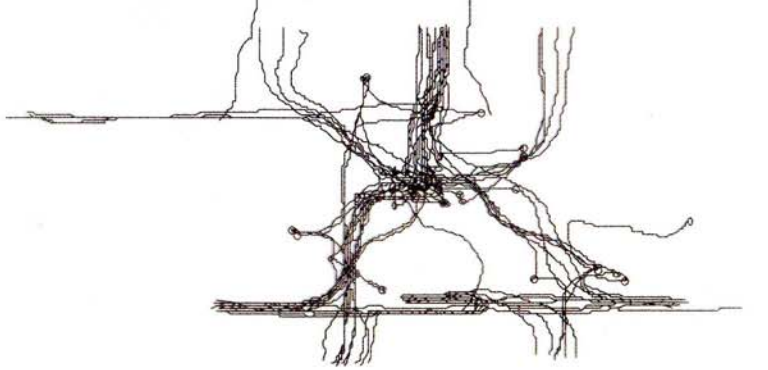
Movement dispersal pattern - FROM THE PLATFORM AND UNDERGROUND ENTRANCE GATES



Movement dispersal pattern - FROM THE ENTRANCE GATES

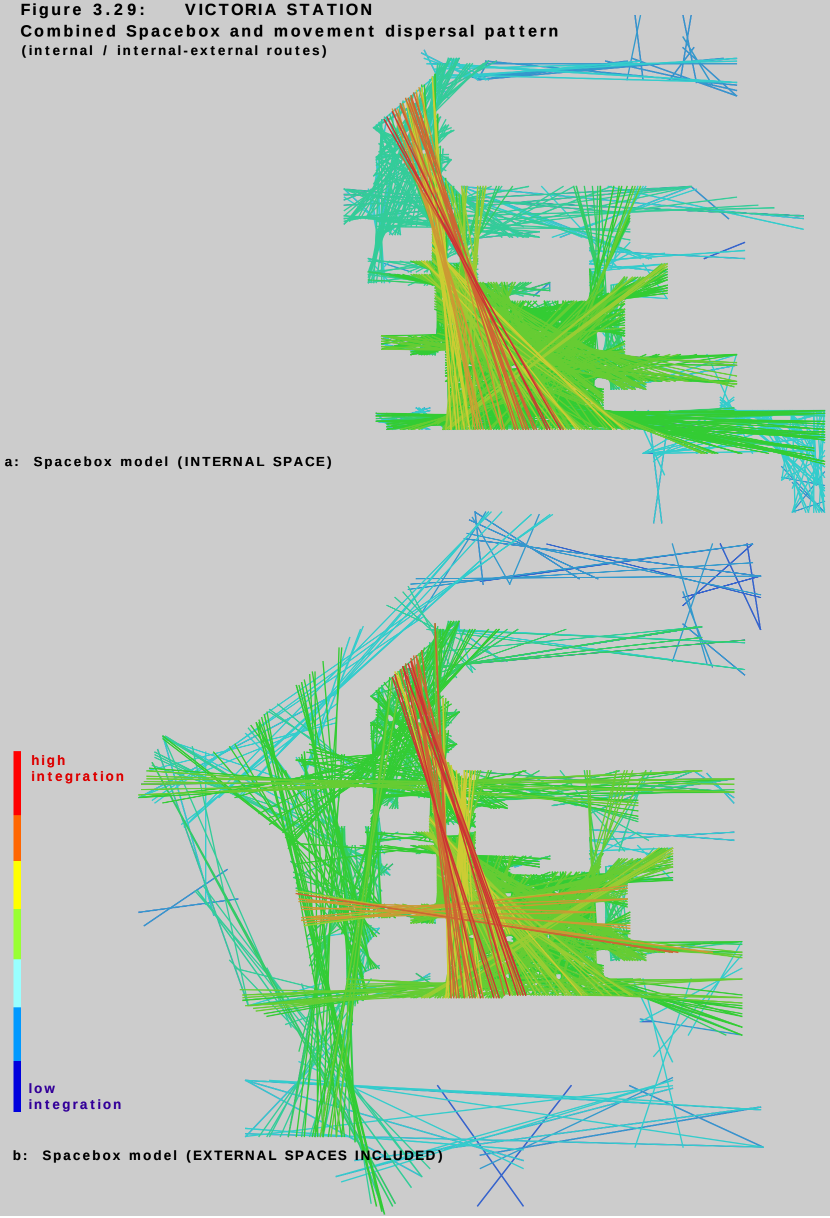


Movement dispersal pattern - FROM THE PLATFORM AND UNDERGROUND ENTRANCE GATES



Movement dispersal pattern - FROM THE ENTRANCE GATES

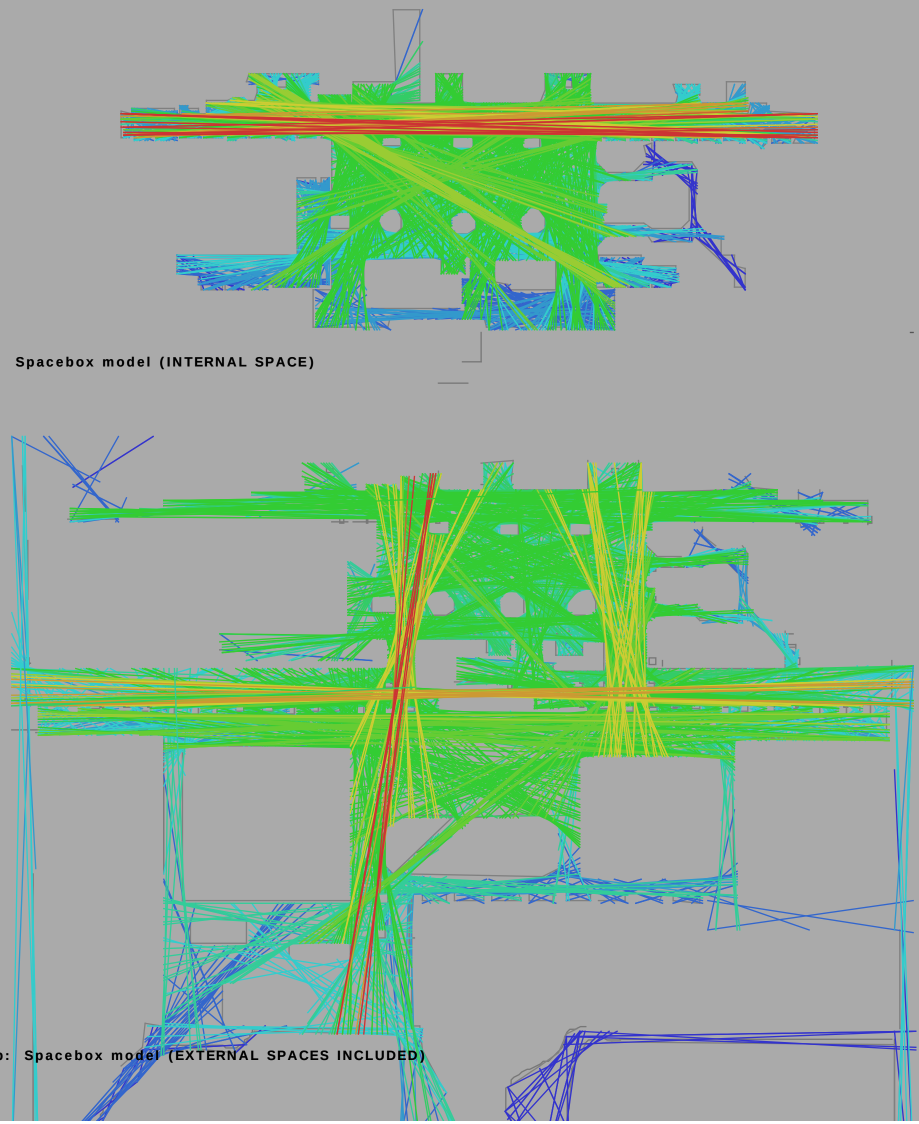
Figure 3.29: VICTORIA STATION
Combined Spacebox and movement dispersal pattern
(internal / internal-external routes)



a: Spacebox model (INTERNAL SPACE)

b: Spacebox model (EXTERNAL SPACES INCLUDED)

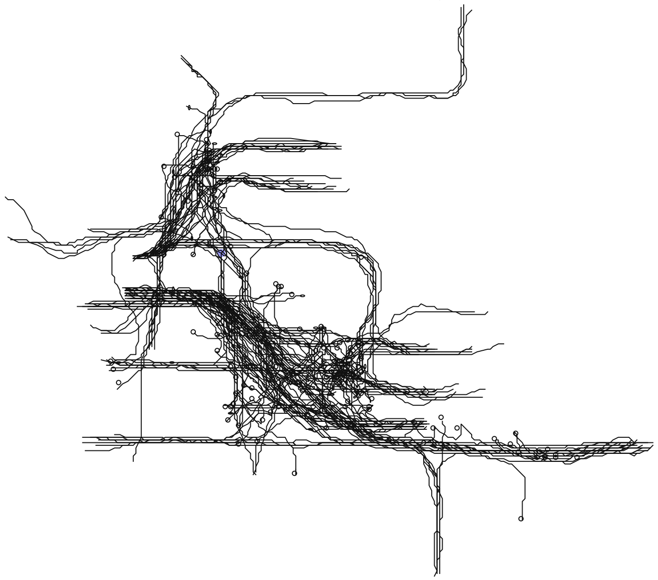
Figure 3.30: EUSTON STATION
Combined Spacebox and movement dispersal pattern
(internal / internal-external routes)



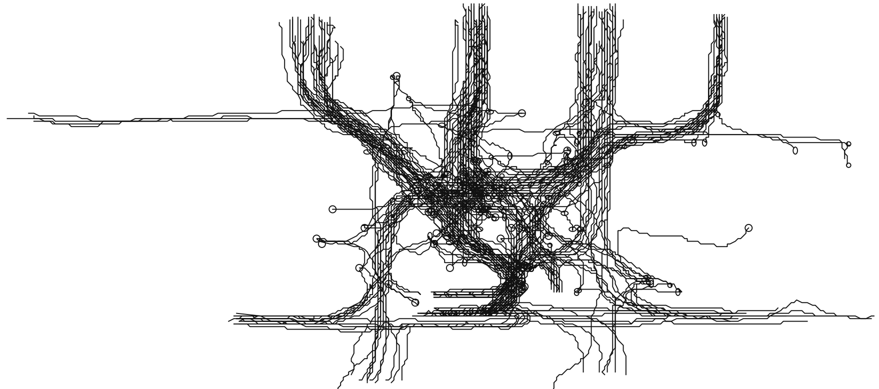
a: Spacebox model (INTERNAL SPACE)

b: Spacebox model (EXTERNAL SPACES INCLUDED)

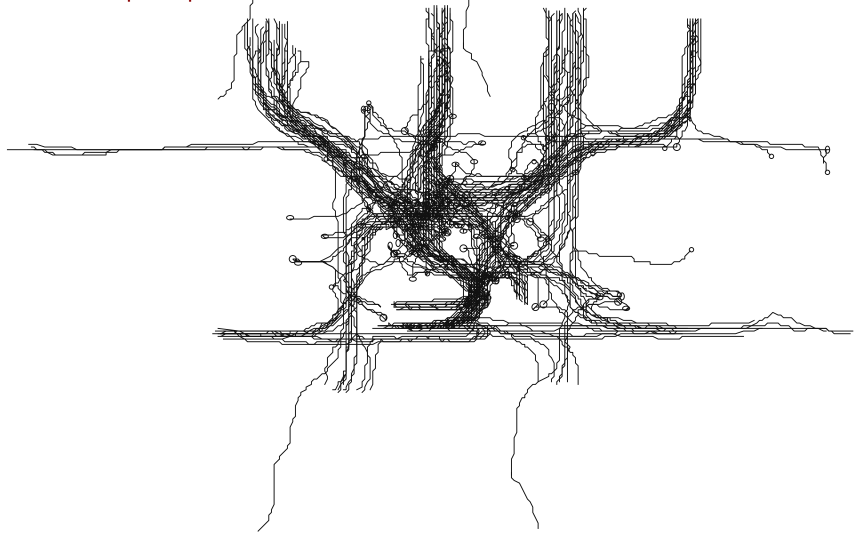
All movement dispersal pattern



All movement dispersal pattern



All movement dispersal pattern



All movement dispersal pattern

Figure 3.31: VICTORIA STATION - Combined Pesh and static activity pattern

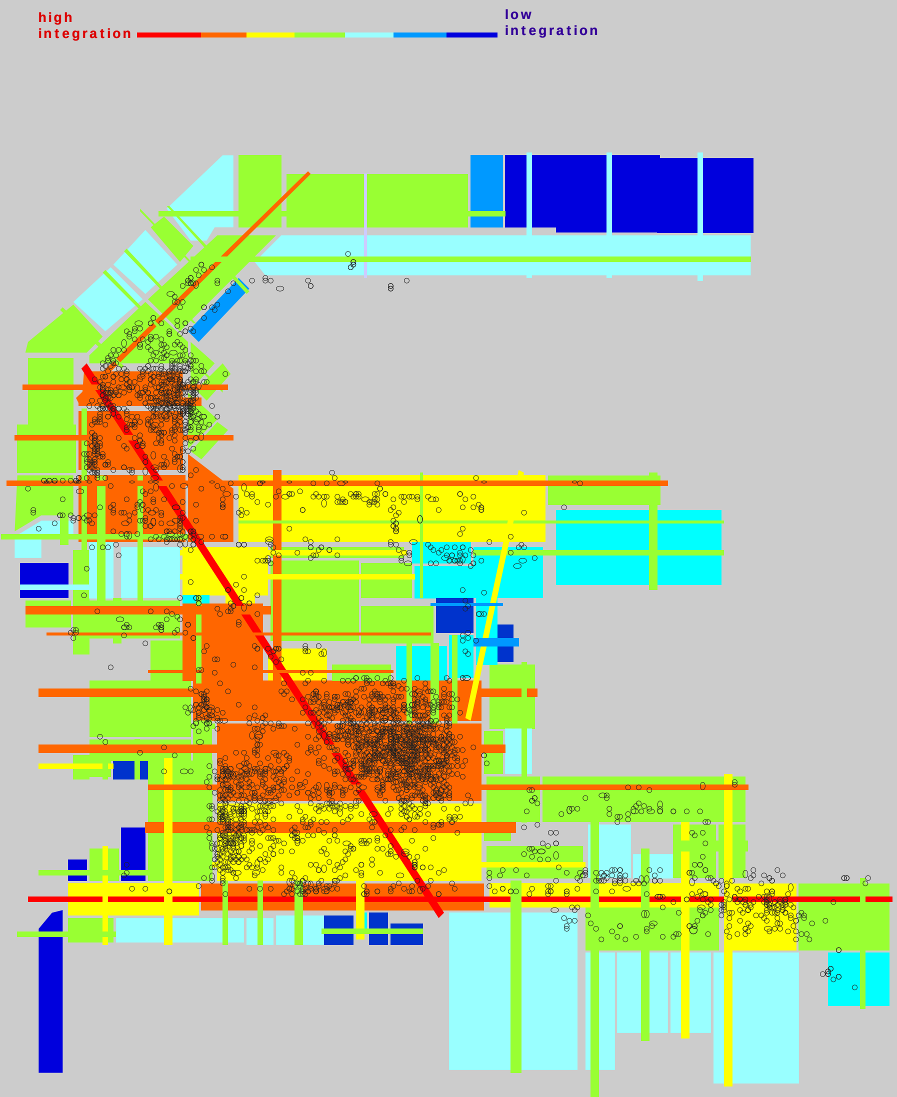
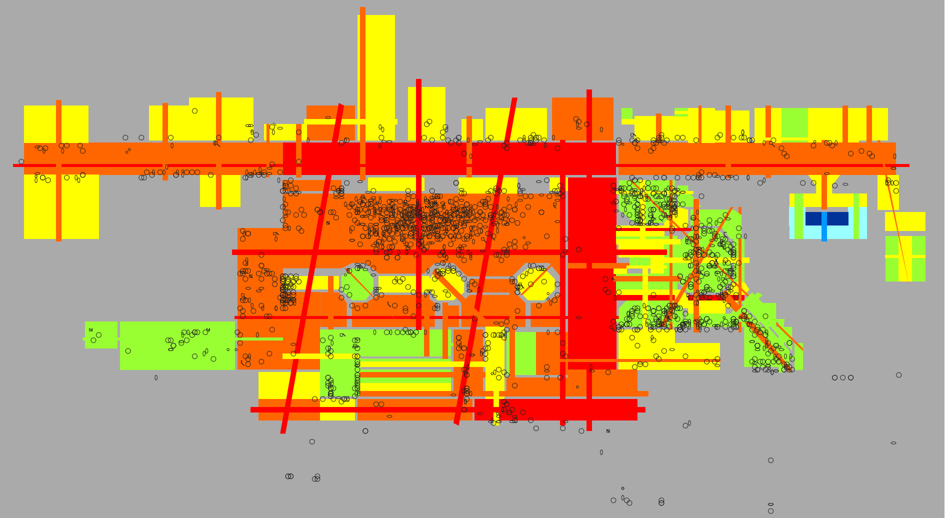
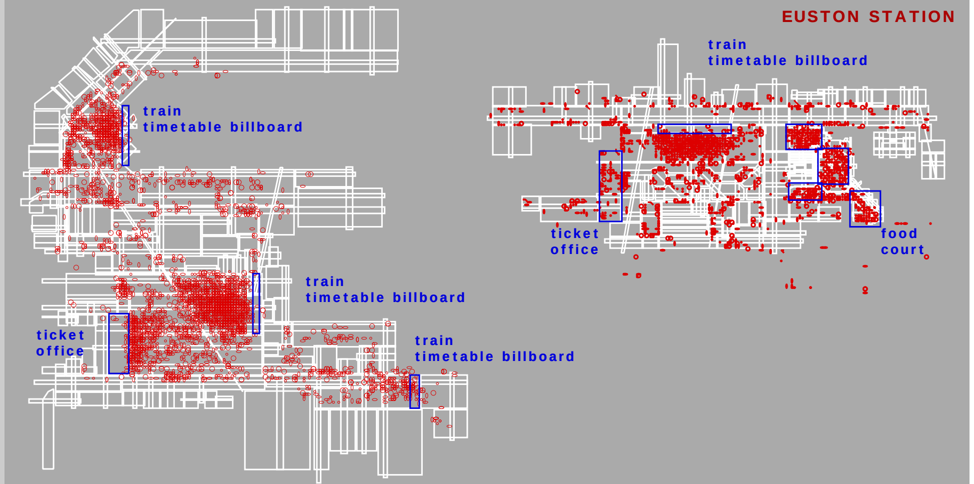


Figure 3.32: EUSTON STATION - Combined Pesh and static activity pattern





VICTORIA STATION

Location of some significant station functions and static activity pattern