

## Evacuation System as a Route Guide on Signage at Jakarta International Stadium

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### Abstract

Stadiums with large capacity and high-rise buildings must be supported by architecture and information systems that can be presented in the form of signage. This study aims to describe the meaning of signage so that the path of movement has a sequence of evacuation routes in a fast, precise, and safe direction. Environment Graphics Design (EGD) is a solution for signage as a route guide for football spectators when disasters and emergencies occur. The analysis carried out is an evaluation of data and fact findings with literature on EGD theory, then conclusions are drawn. The evacuation system on signage, namely evacuation maps, exit signs, and assembly point signs, has a signage category as regulatory. The regulation follows the standard concerning Building Amenity Requirements and refers to OSH signage. Evacuation maps have signage categories as identification and directional, exit signs have signage categories as directional and warning, and assembly point signs have signage categories as identification and warning. The dominant visual and placement on signage are the exit signs, while the placement on the assembly point signs refers to the regulations as a refuge area. There are no evacuation maps around the emergency exit so football spectators who are not familiar with the stadium.

**Keywords:** emergency, evacuation, regulatory, signage

### INTRODUCTION

Path of movement as a route guide for users of the stadium to make it easier and faster in accessibility. The function of the building as a football stadium with a capacity of 82,000 spectators must have an evacuation system by laws and regulations. Regulation of the Minister of the Republic of Indonesia of 2017 number 14 section 24 concerning Building Amenity Requirements state that every building must provide evacuation facilities, including exit access, exit, exit discharge, and other means of evacuation support. The relationship between evacuation facilities and signage in this study is the exit signs on the path of movement directing to the emergency exit to the assembly point signs. The evacuation route shows the direction out of the building or the direction to a refuge area to help to build users save themselves, located outside the building with minimum distance provisions.

The importance of technical requirements of each building is part of disaster mitigation to prevent or minimize the consequences of disasters including fire hazards. At certain times apart from disasters caused by stadium buildings are riots of supporter football, the spectators of booming who will come out of the spectator seats (tribune), especially in stadiums with large capacity and high-rise buildings. Thus, buildings need to be supported by facilities and information systems in each direction of evacuation in anticipation of an emergency. In such a situation one of the essential parts of the field of architecture is "Environment Graphics Design" (EGD). EGD, in general, has an interest in communication, either conveying information or messages or limited to communicating impressions (Calori & Eynden, 2015). Visual information or messages and non-visual impressions can be presented in the form of signage.

Signage is a set of individual signs that have been designed to identify or direct (Boines, 2008). Signage used to be known in the form of an information board that delivered directions to

a place, the name of a place, and so on. Directory boards are used to obtain location information; Directional signs for information routes, while identification marks are used to confirm the identity of a place (Mustikawati et al., 2018). The signage point must be placed in a strategic position. Craig (2005) states that the location of the signage placement is determined by the results of the analysis of circulation routes and where there is a visitor's decision point at a place. Signage has a role as a conveyor of information about the direction or route that can be passed by the supporter through the surrounding environment so that clarity of movement/route is needed.

This research aims to provide solutions to evacuation routes on interconnected signage to help direct spectators to exit the stadium quickly, precisely, and safely. Connectivity from diverse signage can accelerate the pace of escape to the assembly point. Especially during emergencies, signage must be able to direct spectators to leave the stadium or evacuate by following integrated signage to a safe place. A natural intelligent evacuation route interface in facility management to efficiently guide people to the safe exit under emergency conditions (Dongwoo Lee et al., 2017). This study refers to a literature review or literature on signage in the paper of Chris Calori & David Vanden-Eynden (2015) and adjusted to the evacuation system as a guide route, the types of signage that will be used for discussion, are: (1). Identification sign, (2). Directional sign, (3). Warning sign, and (4) Regulatory & Prohibitory signs.

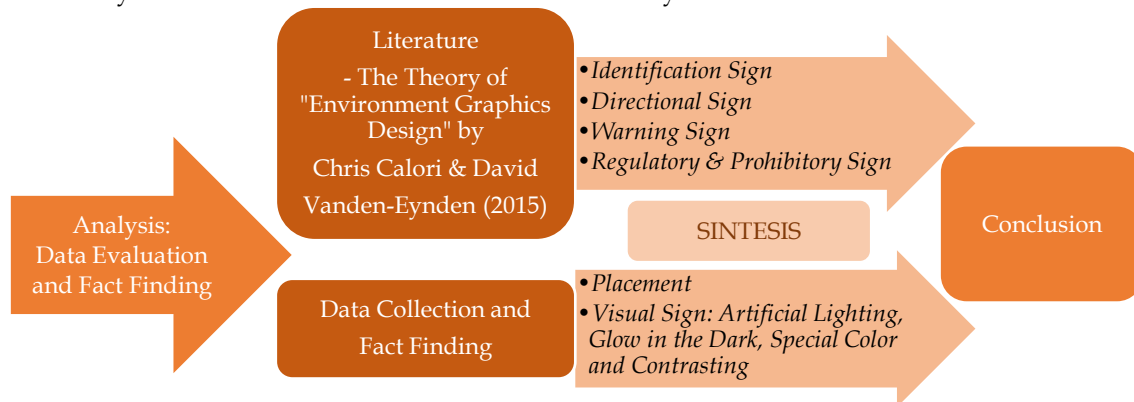
The evacuation system in a building must function based on procedures by providing convenience for people who use it. In this case, football spectators should be able to save themselves as quickly as possible when in an emergency. In the evacuation process, a path of movement is needed that can guide the supporter in search of a way out briefly. Paths in the form of circulation and turns have clarity with a big purpose (Febriarto & Fidali, 2022). Another purpose of this study is to add references as part of architectural science regarding signage and also other fields such as information systems. This study also aims to describe the meaning of signage and use an evacuation system quickly, precisely, and safely as a guide for the supporter route so that the path of movement must have a sequence and be informative. Of course, this refers to regulations regarding buildings, especially case studies of stadiums with large capacity and high-rise buildings.

## RESEARCH METHOD

The evacuation system used is based on circulation as the path of movement of the football spectators, especially during emergencies. The installation of signage avoids cross circulation in buildings so that access and processes of evacuation become fast, precise, and safe or in other words not confusing. In the graphic aspect, three main causes can cause difficulty finding a way in signage, namely confusing the naming/numbering of rooms, because the signage (direction) is not clear (poor clarity), and because of the improper position of the signage (Hariyanto et al., 2012). Therefore, accuracy, clarity, and legibility are needed in signage. Following laws and regulations, signage must have good artificial lighting, be visible in the dark (glow in the dark), must have a special color and contrast with the decoration, and other markers are universal design, as well as the accuracy of the direction of the arrow.

The method chosen in this study is the Post Occupancy Evaluation (POE) method (Friedman, Zimring, & Zube, 1978) as well as qualitative methods that are analyzed descriptively, the Post Occupancy Evaluation (POE) method is one of the most commonly used design evaluation methods and is carried out after the completion of construction. The application of the POE method is to clarify the route of the evacuation systems that are interconnected to the assembly point. The analysis carried out is an evaluation of data and fact findings with a literature review or literature referring to the theory of EGD, then conclusions are

drawn (Figure 1). Actual conditions as primary data sources that have been collected, clarified, and interpreted in the form of field observations and documentation, while literature is a secondary data source which then all data sources are synthesized.



**Figure 1.** Research Method Scheme (Source: Processing Personal Data)

## RESULTS AND DISCUSSIONS

This research raised Jakarta International Stadium (JIS) as a case study discussion. JIS is a high-rise building that functions as a sports facility has a capacity of 82,000 spectator seats (tribune) and is equipped with the management of the building. This existence makes JIS have building facility requirements, so this study takes the topic of signage with an evacuation system as a guide for football spectator routes, namely supporters to save themselves during emergencies. Based on the Regulation of the Minister of the Republic of Indonesia of 2014 number 13 concerning Transportation states that signage or also called traffic signs are parts of road equipment in the form of symbols, letters, numbers, sentences, and/or combinations that function as warnings, prohibitions, orders, or instructions for road users. Signage that will be discussed regarding the requirements of building facilities, especially evacuation systems, are (1). Evacuation maps; (2). Exit signs; and (3). Assembly point signs. The signage was analyzed based on the theory of EGD by Chris Calori & David Vanden-Eynden (2015) as a reference in categorizing signage (Table 1).

**Table 1.** Signage Category based on the Theory of EGD (Source: Processing Personal Data)

Number	Type/Model Signage	Signage Category			
		Identification	Directional	Warning	Regulatory & Prohibitory
1	Evacuation maps	√	√		√
2	Exit signs		√	√	√
3	Assembly point signs	√		√	√

The path of movement is the first step in how football spectators follow the evacuation system. The evacuation system through signage is a route guide for supporters from the spectator seats (tribune) to a safe place, namely the assembly point that must be fulfilled by JIS. The three signages, namely the evacuation route sign, emergency assembly point sign, and exit sign are controllers (Sari & Bomo, 2022). Route control, i.e., constant control and confirmation that the individual is following the chosen route (Downs & Stea, 1973). Clarity of routes in a movement is needed by using practical signage and efforts to improve access quickly, precisely, and safely. The existence of a communicative and informative sign system will help visitors access each facility (Repi et al., 2020).

Evacuation maps are signage that has identification, directional, and regulatory categories. In general, the type of sign in identification sign is used to inform or clarify a place (Calori & Eynden, 2015). All participants were able to express how they felt they had learned the route (after successfully demonstrating that they could repeat the route after being guided along the route) and identify the strategies and environmental cues they felt they had used (O'Malley et al., 2020). Identification signs by providing a small map for visitors, which can make visitors know the routes when they want to enter the area (Repi et al., 2020). At JIS, identification shows evacuation maps that provide information on the current existence of the place in the form of a floor plan (per floor) and parts or pieces of the floor plan that is more pursed or enlarged or detailed so that they are legible and easy to understand (Figure 2).

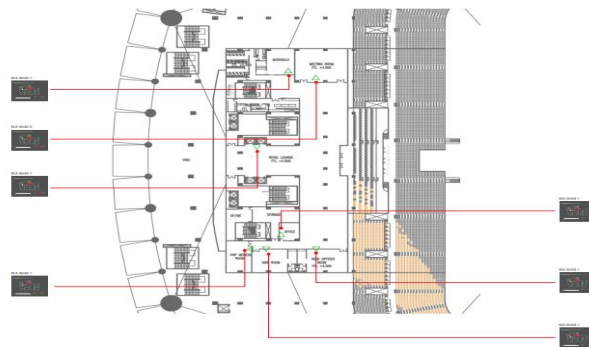


Figure 2. Detail engineering drawing of evacuation signs placement (Source: Project Document)

Evacuation maps are located around lift directory signs and room name signs (Figure 3). No evacuation maps were found in JIS because they were not on the wall or around the emergency exit (door evacuation) so football spectators did not know where they were. Importance of navigation aids in environmental design such as maps, signage, color-coded areas, and separated “wings” to help identify (O'Malley et al., 2020). Captions that read “you are here” as well as directions, symbols, floor plans, and other texts are right to direct the destination (Sari & Bomo, 2022) and are appropriate as directional signs. The directional sign is a sign used to indicate direction and one of the main indicators is the presence of arrows (Calori & Eynden, 2015). Although the directions and symbols are not depicted visually, the floor plan and other text make it easier for the football spectator to evacuate.



Figure 3. Evacuation maps (Source: Processing Personal Data)

Evacuation maps are also regulatory because they show the presence or accuracy of the position being located. Regulatory signs that are used to regulate a person's behaviors in an environment with the main indicator of red are often found framing a white field. Although evacuation maps are not so, they follow evacuation procedures and planning routes out of a building based on the Occupational Safety and Health (OSH). Maps are two-dimensional representations of the environment that showroom layout, and function, from other building elements (Farr et al., 2012). If the evacuation of the building is required, stress and confusion levels can escalate and users must rely on the correct placement and accuracy of signs and maps to be able to evacuate as quickly as possible (Farr et al., 2012).

The exit signs are signage that has directional, warning, and regulatory categories. The directional sign indicates that the exit signs confirm the movement that should be selected. Although exit signs do not have arrows, indicators that support directional signs are signs that notify and guide by showing where the exit to the assembly point is located. At JIS, exit signs have high contrast specifications and can glow in the dark (Sari & Bomo, 2022). However, the suggestion contrasts with other reports highlighting the importance of creating a less institutional environment (particularly when considering it as an ideal environment to live in) (O'Malley et al., 2020). The connection shows that the exit signs are also a warning for football spectators in the evacuation process.

The warning sign category refers to EGD theory where the term is more attached to the use of notice. A notice is an announcement that is neutral and harmless because its purpose is to provide information, for example, notification of the direction of the exit of stairs. Thus, the exit signs function as an access notification leading to the exit or to the emergency stairs which is explained in the text briefly. At JIS, exit signs are communicated visually briefly in the form of letters or words in white and framed in green (Figure 4). The color makes a special meaning and contrasts with decorations (the walls, floor, and ceiling are white) that comply with laws and regulations. Visual landmarks that contrast with the environment, therefore, become memorable (Yesiltepe et al., 2021).

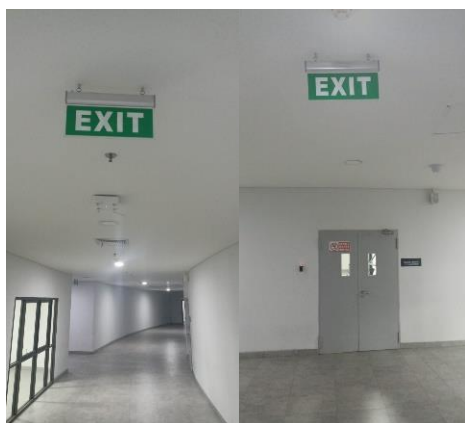


Figure 4. Exit maps visually contrast with decorations (Source: Processing Personal Data)

The installation of exit signs is hung from the ceiling and is located in circulation at the decision point so that the existence of exit signs leads the audience (Sari & Bomo, 2022) to guide the route in the evacuation system of the building, namely the stadium. Circulation on evacuation routes is found in many decision points or nodes. The decision point directs spectators to the stadium exits (emergency doors and stairs). Nodes are circulation decision points, strategic spots in a city where the observer can enter, and which are the focus of where he walks from (Lynch, 1960). Porteous (1977) argues that nodes are points where there are decisions such as



intersections. Although there are many exit signs at nodes, accessibility is a route that guides football supporters to the refuge area.

At JIS, exit signs number up to hundreds to support stadium performance, namely the number of turns, and intersections (Sari & Bomo, 2022). To minimize the occurrence of perverted paths for football spectators, one solution is an exit sign (Sari & Bomo, 2022) to the assembly point. The installation of exit signs avoids cross circulation because it guides the route in the evacuation system during emergencies to the exit from the stadium. The application of the following exit signs with the use of colors follows the standard of Regulation of the Minister of the Republic of Indonesia of 2017 number 14 concerning Building Amenity Requirements. Thus, it also functions as a regulatory supported by artificial lighting performance (Figure 5). A good signage system within an environment must use consistent design elements when combined with correct lighting, it is more likely to be noticed by users (Fewings, 2001).

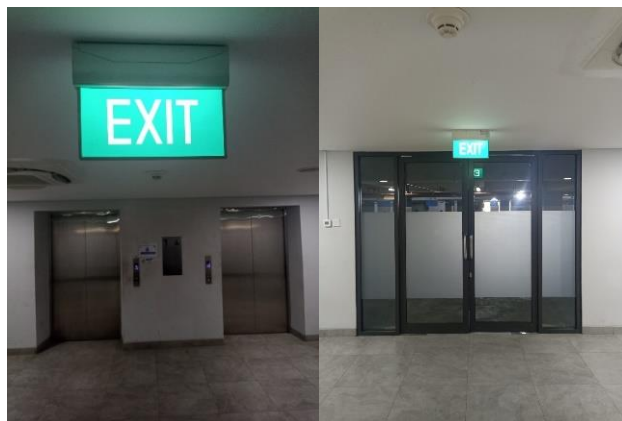


Figure 5. Exit maps with artificial lighting performance (Source: Processing Personal Data)

Architecture, landmarks, lighting, landscapes, and other visual features are one strategy to signal so that people can find their way in complex/unfamiliar environments (Nadhifah, 2021). Exit signs are installed on the path of movement and identity to make navigation easier as directional signs and this is a standard regulation and must be present in buildings. The main purpose of exit signs is to help the audience with readability, especially at night, in dark situations, and in emergencies (Sari & Bomo, 2022). As a step of the process, the exit sign as route selection is choosing a route that leads to the desired destination (Downs & Stea, 1973). So, these exit signs are a route guide in the evacuation system in signage. Signage is a series of graphic visual and symbolic representations that aim as a medium of interaction between humans and public space (Tinarbuko, 2008).

Assembly point signs are signage that has identification, warning, and regulatory categories. An identification sign is a visual marker that displays the name and function of a place or space (Gibson, 2009). At JIS, the assembly point signs contain a refuge area notification from the direction of the exit or originating emergency stairs described in the form of text and images. A marker refers to a sound, image, or word, and a signifier is the concept or meaning of a marker (Vaez et al., 2016). The text of solid, clear, and short, and placement according to location or spatial layout support information on signage (Andrivina, 2019). Assembly point signs are located in the open space of the stadium building that has met the building requirements. Referring to Regulation of the Minister of the Republic of Indonesia of 2017 number 14 concerning Building Amenity Requirements, the minimum distance of the assembly point from the building is 20 meters to protect building users from collapse or other hazards.

The existence of the assembly point signs becomes the endpoint in the evacuation system so that it must be easily seen and identified. In emergencies such as fires or others, such as spectators who are not familiar with the stadium must be able to get out of the building, especially the stands, quickly and safely to the assembly point signs. The number of emergency assembly point signs  $\pm 14$  pieces that can accommodate all football spectators. This refers to the Regulation of the Minister of the Republic of Indonesia of 2017 number 14 concerning Building Amenity Requirements stating that the assembly point signs must meet the capacity of the refuge area. Assembly point signs follow international standard rules, so they are easy for everyone to understand (Figure 6).



Figure 6. Assembly point signs follow international standards (Source: Processing Personal Data)

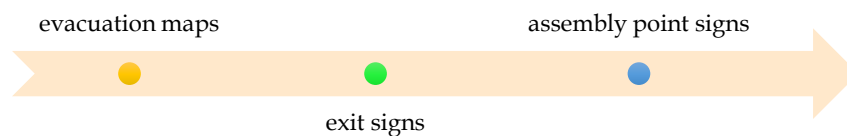
A warning sign or a sign used to warn or sign invite people to be careful because of things that can be dangerous if the person is not alert (Calori & Eynden, 2015). The main indicator of a warning sign is yellow, although the warning sign does not mean but hints that the current existence is a warning. The assembly point signs are green with white text. The placement of the assembly point signs is precisely connected with the exit sign as an evacuation route so that it is integrated appropriately. All assembly point signs have the same specifications for color, text, images/symbols, and signage height. The image/symbol of the assembly point signs refers to the Occupational Safety and Health (OSH) signs. The shapes must contain information about a particular symbol or shape that represents the state of the surrounding environment (Sutantio et al., 2022). These signs also indicate a universal design.

As the final process step in an evacuation system, the assembly point signs are also a recognition of the destination, namely the ability of individuals to realize that they have reached the desired destination (Downs & Stea, 1973). It focuses on cognitive elements to obtain a route from the origin point to the destination that includes the environment, problem-solving strategies, choice of perceptual input from the environment, and choice of adequate movement patterns (Golledge, 1999). Following the Regulation of the Minister of the Republic of Indonesia of 2017 number 14 concerning Building Amenity Requirements state that assembly point signs such as JIS pay attention to suitability as the intended final location in the evacuation route and the possibility to be able to function communally by building users and building visitors.

Assembly point signs regulations to regulate one's behavior in an environment. The use of markers that are also a means of designing objects is also needed to make it easier for people to move to certain locations in the building (Arthur & Passini, 1992). Following the Regulation of the Minister of the Republic of Indonesia of 2017 number 14 concerning Building Amenity Requirements state that JIS has an assembly point sign that accommodates 82,000 football

spectators. With the capacity of football spectators, in times of emergency, almost most people are easily panicked, unable to think clearly and beyond logic. The regulation states that the design and provision of assembly point signs must be secure and easy to access for building users, namely management and visitors to buildings, namely football spectators (supporters).

In the end, going to an open space must be able to be passed quickly, precisely, and safely. Therefore, someone must achieve the desired goals by using signage. The definition of signage as part of wayfinding is almost the same, according to Golledge (1999), wayfinding is the process of finding and following a path or route between the starting point and the destination. Wayfinding is an activity that is backgrounded by motivation, directed, and purposeful, and can be observed as evidence of sensorimotor actions in an environment. As a route guide in the evacuation system, the signage has a sequence of evacuation maps, exit signs, and assembly point signs moving from one place to another (Figure 7). EGD is a solution in the signage approach as a route guide for football spectators where the path of movement must be sequenced as an evacuation route in a fast, precise, and safe direction.



**Figure 7.** The evacuation system signage has a sequence (Source: Processing Personal Data)

Speed, accuracy, and safety are principles in evacuation systems on signage that refer to regulations. In an emergency, people will need minutes or even seconds to evacuate as quickly as possible. So that in the design and provision of signage has a priority to save lives when disasters, unsafe situations, emergencies and ultimately fatal events can be minimized. Safe evacuation is the most important aspect to save lives under such a critical situation and the knowledge and installed facilities information used for evacuation are essential in tackling emergencies (Dongwoo Lee et al., 2017). People with strong wayfinding abilities tend to memorize the existing basic elements in complex large-scale environments, such as the main routes and important places to solve their wayfinding problems (Lynch, 1960). Götze and Boye (2016) used a methodology that automatically derived salience using route instructions collected from subjects. They asked subjects to walk a specific route and describe the path (Götze & Boye, 2016).

JIS or stadiums in general have similar characters in the floor plan so that the same elements exist in hallways, intersections, and others. This can cause road errors, the way the management solves it is by dividing the zones (west, north, east, and south) with colors on the signage. Color is one of the elements in EGD to obtain precision, clarity, and legibility in signage. With color, it is hoped that football supporters can follow the path of movement from the entrance to the spectator seats (tribune) and return to the exit. At JIS, the installation of signage, especially in the evacuation system, avoids cross circulation so that signage as a route guide does not accumulate at the decision point. All signage in the evacuation system has a signage category as regulatory because it refers to Government Regulation, refers to OSH signs, and other International Standards.



## CONCLUSION

The evacuation system on signage, namely evacuation maps, exit signs, and assembly point signs, has a signage category as regulatory. The regulation is that JIS meets the requirements and complies with the Minister of the Republic of Indonesia of 2017 number 14 concerning Building Amenity Requirements. The regulation refers to OSH signs and other international standards. Evacuation maps have signage categories as identification and directional, exit signs have signage categories as directional and warning, and assembly point signs have signage categories as identification and warning. The dominant visual and placement on signage is the exit signs that can glow in the dark, have special colors and contrast with decorations, and some have artificial lighting. Placement on exit signs is often found on nodes that facilitate the readability of the football spectators in following it. Placement on evacuation maps is not found around emergency exits so spectators who are not familiar with the stadium will be confused and there is no special ability and contrast on evacuation maps. Placement of the assembly point signs following the regulations. Evacuation systems, namely evacuation maps, exit signs, and assembly point signs as a guide for spectator routes to find the way out of the stadium to open space as a refuge area.

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