International Journal of Business and Management, 2 (1): 58-66, 2018
e-ISSN: 2590-3721

DOI: 10.26666/rmp.ijbm.2018.1.10

The Implementation of Signage as the Tool Guide in Intelligent Transportation System for Disaster Relief Centers during Flood Disaster in Malaysia

Vikneswaran Munikanan[1], Ananthan. S[2,] W. L. Wong[2], Muhamad Azani Yahya[1], Mohammed Alias Yusof[1] and Rabiatul Adawiyah Ahamad Raffiee[1]
[1]Faculty of Engineering, National Defence University of Malaysia Malaysia,
[2]Faculty of Defence Studies and Management, National Defence University of Malaysia Malaysia,

Abstract: Floods, especially the devastating floods in Malaysia in the year 2014 caused huge losses, both to individuals and to the nation. This is mainly due to lack of awareness and understanding of how the intelligent transportation planning and short of proper signage implementation as tool guide for Intelligent Transport System (ITS) in disaster prone area. The main objective of this study is to study the requirement of smart signage system in Intelligent Transportation System (ITS) to improve the disaster management in Malaysia. The signage is one of the tool or medium of a direct guide that give an information toward the driver of transportation. The design and location of signage is necessary to attract the user where it can be useful to transport user find or detect the location when in emergency situation. Both the quantitative and qualitative approach have been used to accomplish the method of the study. This paper presents the aspects that is required for relief and rescue of evacuees by implementing signage to building that is designated as relief centers to facilitate evacuation during flood disaster via helicopter. A set of questionnaire was developed to have input from locals experiencing the flood in 2014 to access the understanding, preferences and reaction from signage implementation to facilitate in evacuation process from relief centres. Based on data analysed, the relief centers need to be implemented with proper singnage system. But there are few aspect of signage based on colour, shape, text and symbols (pictorial) that need further research to facilitate the evacuation and detection planning and management. The research is also expected to provide new design of smart signage as a medium to ease the Intelligent Transport System (ITS) during disaster.

Key words: *Intelligent Transportation System (ITS), Smart Signage, Disaster*

BACKGROUND

Malaysia as developing country in South East Asian in the last 50 years has developed drastically and transformed its economy from an agricultural to industrial based nation. These vast development has contributed to urbanisation of many small towns into cities thus increasing human activities which included unplanned rapid settlement development, uncontrolled construction of buildings in general and major land-use changes that can influence the spatial and temporal pattern of hazards. Besides that, there are several factors contributing toward the rising flooding issues ranging from topography, geomorphology, drainage, engineering structures and climate change. The intensity and duration of the rainfall are the main influencing factors for flood hazards.

In Malaysia results are recorded in damage to human life, property and deterioration of environment. Recently, in the year 2006, 2007 and 2008 heavy monsoons rainfall have triggered floods along Malaysia's east coast as well as in different parts of the country. Peninsular Malaysia suffered from one of the worst floods in recent history during the last two weeks of 2014. A record number of 232,913 evacuees were registered in various evacuation centres across Peninsular Malaysia. However, the actual number of those affected is believed to be higher as numerous people were unable to reach evacuation centres and several evacuation centres

Corresponding Author: Vikneswaran Munikanan, Senior Lecturer, National Defence University of Malaysia. Email: vikneswaran@upnm.edu.my, H/P: +60193004742

were unregistered. The worst hit states were Kelantan, Pahang and Terengganu, followed by Perak and Johor. As of 29th December 2014, Kelantan recorded 160,000 registered evacuees, followed by Pahang with 33,225, Terengganu with 31,820, Perak with 7,540 and Johor with 328 evacuees. The flood cost nearly millions of dollars of property and many lives. During the recent flood that happened in the Malaysia east coast, many evacuees were found trapped in government building such as multi-storied school designated as a relieve centres. The flood effected area covered vast ground and rapid inundation has restricted the deployment of rescue boats to reach people in distress.

The only best alternative to cope with the difficulties and relief the logistics supplies and evacuation of the sick or injured to/from the evacuation centres is through usage of helicopters. Unfortunately, the helicopters assigned for the tasks were not able to rescue evacuees in large numbers because they were only able to apply the winching method due to difficulties in identifying a suitable landing point. The pilots involved was unable to locate landing points due to unavailability of suitable landing point and low visibility of the area surrounding from aerial. The worst hit and effected by the recent flood in Malaysia was experienced by Kelantan state. Therefore, there is a need to identify pre designated evacuation centres in this state that is installed with visible signage for occupants and rescue efforts from aerial and designated buildings that has structural design flat roof top to facilitate with the logistics and rescue process during flood disaster occurrences. The scope of this study is to analyse the signage implementation and structure of rooftop in facilitating relief effort using helicopter to/from flood disaster centres in flood prone areas. This is aimed to introduce proper signage and structural improvement for disaster relief centres.

Signage System for Evacuation Centre

Evacuation is usually conducted according to trained or predefined plans and procedures when specific requirements are fulfilled [1]. Signage system is an important part of the completeness of the information and guidance needs in the space-building, especially in public space-building and the surrounding area adjacent to it. A signage system is an information system focusing on visual instructions. These visual instructions are generally in the form of typographical elements which are signs consisting of pictures, maps, arrows, codes, colours, pictograms and others. The signage system is used to guide a user's journey inside or outside the building. Following the signage system is generally termed as way-finding, way-signing or sign-posting. Signage system usually consists of several applied signs designed in accordance with the characteristic of unity with the space-building characteristic and its purposes. Applied signs can be texts and symbols with elements of form, colour, texture, and light those are diverse. Signs can also be applied to two dimensional, three-dimensional and digital form. In public space-building such as government buildings, signage system is used to provide clear information and guidance or direction to find the location of intended activity to visitors (users) independently.

MATERIAL AND METHODOLOGY

Data Assessment

In this research the Kelantan state was selected as it is recorded as a flood prone area in recent years. The Figure 1 below listed all the evacuation centres that was activated in the wake of the recent 2014 flood disaster in Kelantan. The worst effected province in Kelantan was *Pasir Mas*, *Kuala Krai* and *Kota Bharu* with the most recorded evacuation centres as temporary settlement for evacuees. The evacuation centres included the local schools in the vicinity, government buildings, mosques, community hall and madrasah.

Table 1 depicted the numbers of the landing point that is available for helicopter throughout the state of Kelantan. The information provided by this portal on the venues of the landing points indicate that most of landing point are field at school vicinity or flat ground surface areas. In the recent wake of the flood disaster in Kelantan most of the ground areas were submerged by yellow muddy water that went up as high as 3 story building. As most of the designated landing points was ground surface areas and submerged in the flood water this has made rescue and relief operation using helicopter difficult. This was the only option as the rescue boat was deemed not deployable as the currents were strong and areas distressed flood victims that needed rescuing was not accessible via boat. Therefore, as mentioned earlier in this research the only option to execute the rescue and relief operation using helicopter was through winching. Even so, this method is not very effective as it cannot carry large number of casualties and logistic and also time consuming. Thus the data obtained in research has helped to identify the most suitable building closest to highly prone flood areas to be equipped with signage to assist in safe helicopter landing on improved flat roof top structure and evacuation of flood victims from evacuation centres.

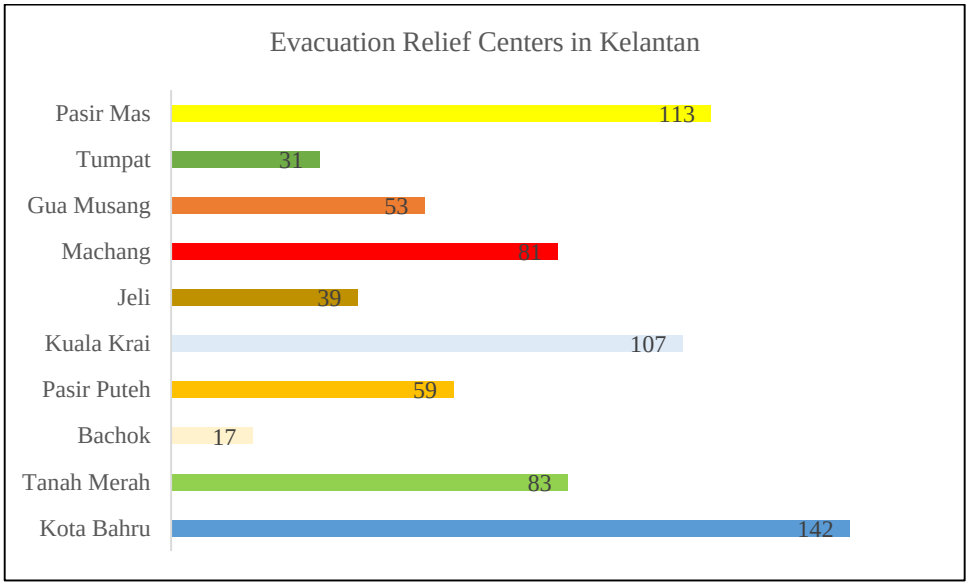

Figure 1 : The Evacuation Relief Centers in Kelantan 2014 Flood Disaster
Source: Shafiaia and Khalid [2]

Service Area	Province	Numbers of Landing Point
1	Bachok	13
2	Gua Musang	23
3	Jeli	8
4	Kota Bharu	16
5	Kuala Krai	5
6	Machang	7
7	Pasir Mas	11
8	Pasir Puteh	6
9	Tanah Merah	11
10	Tumpat	5
TOTAL		**105**

Table 1: The Numbers of Helicopter Landing Points in Kelantan
Source: AIP Supplement Malaysia [3]

Questionnaires
Two different set of questionnaire was developed to investigate the signage application during flood disaster in Kelantan. The first set is to investigate the difficulties that was faced by the helicopter pilots involved in the evacuation effort during the flood disaster due to lack of signage. Interviews were conducted on three Royal Malaysian Air Force (RMAF) helicopter pilots that was tasked to execute relief and rescue operation in Kelantan. The questionnaires focused on problems encountered by the pilots involved from the technicality aspects and the safety hazards of flying and executing operation in such limited visibility and access to plain ground. The second set of questionnaires was given to the locals in three areas which are *Pasir Mas*, *Kuala Krai* and *Kota Bharu* that experienced the flood. The survey will help to facilitate this research in determining the features of signage that is suitable in assisting the pilots and the locals to react effectively in flood disaster area in future.

Ground and Building Structural Survey: A ground reconnaissance was done to identify the most suitable building to conduct the research for the purpose of equipping the building with proper signage for flood relief and rescue via air using helicopter. The signage that is determined has to have the effectiveness of assisting the evacuees in the designated building to undergo the procedure of relief and rescue operation via helicopter in an orderly and organized manner. Other than that the signage that is installed in the designated building is

also intended to facilitate the helicopter pilot involved in operation during day or night.

DISCUSSION

In understanding the requirements for signage in flood rescue and relief operation using helicopter from flat roof top of a building, the understanding from the aspect of the helicopter and the building and its standards are vital points. This research has adapted the standards for elevated helicopter endorsed by the department of Civil Aviation of Malaysia (DCA) as its guidelines in suggesting the proper signage to be installed in the buildings and helicopter landing points on flat roof top of a designated evacuation centres. The DCA has classified elevated helicopter as enlisted in Table 2 into three different types of categories based on the helicopter length.

Category	Helicopter Over-all Length
H1	up to but not including 15 meters
H2	from 15 metres up to but not including 24 meters
H3	from 24 metres up to but not including 35 meters

* Helicopter length including the tail boom and rotors

Table 2: Helicopter Categories based on the Standards by Department of Civil Source: Aviation of Malaysia (DCA), ASD 903 (2006)

The required signage for helicopter landing point on a flat roof top will be more or less similar to the signage that can be found on ground surface. However there are certain features that was enhanced prior to feedbacks from interview session conducted onto helicopters pilot that was involved in the 2014 flood in Kelantan. These enhanced features will be further explained later in the literature. The aspects that are considered in a helicopter landing point included the physical characteristics, obstacle limitation, visual aids; wind direction indicator, markings, lights, visual alignment guidance system and approach path indicator. For the purpose of this research, the emphasis is on the visual aid as means of physical signage in assisting the helicopter pilot to land the helicopter as lack of such signage as one of the difficulties faced during the flood rescue and relief efforts. The visual aid should be visible in day time and at night as a guide for helicopter pilots when approaching a helicopter landing point. The visual aid that are required on the helicopter landing point are:

Wind Direction Indicator.

There should be at least one wind direction indicator on a landing point to give clear indication of the direction of the wind and a general indication of the wind speed over the FATO/TLOF area and in such a way as to be free from the effects of airflow disturbances caused by nearby objects or rotor downwash. It shall be visible from a helicopter in flight. A wind direction indicator shall be a truncated cone made of lightweight fabric and shall have minimum dimensions of 2.4 m in length, 0.6 m diameter at larger end and 0.3 m diameter at smaller end. The colour of the wind direction indicator should be so selected so as to make it clearly visible and understandable, having regard to background. Where practicable, a single colour, orange should be used. Where a combination of two colours is required to give adequate conspicuity against changing backgrounds. A wind direction indicator shall at a heliport intended for use at night shall be illuminated.

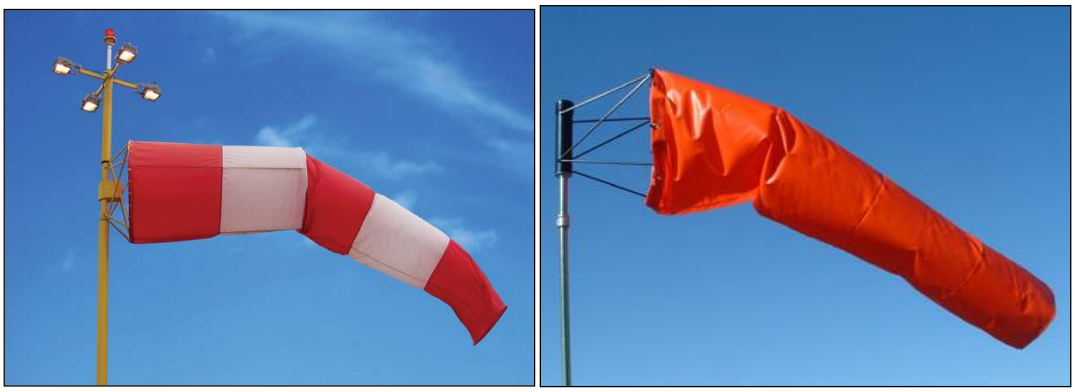

Figure 2: Types of Wind Direction Cone Installed for Helicopter Landing Point

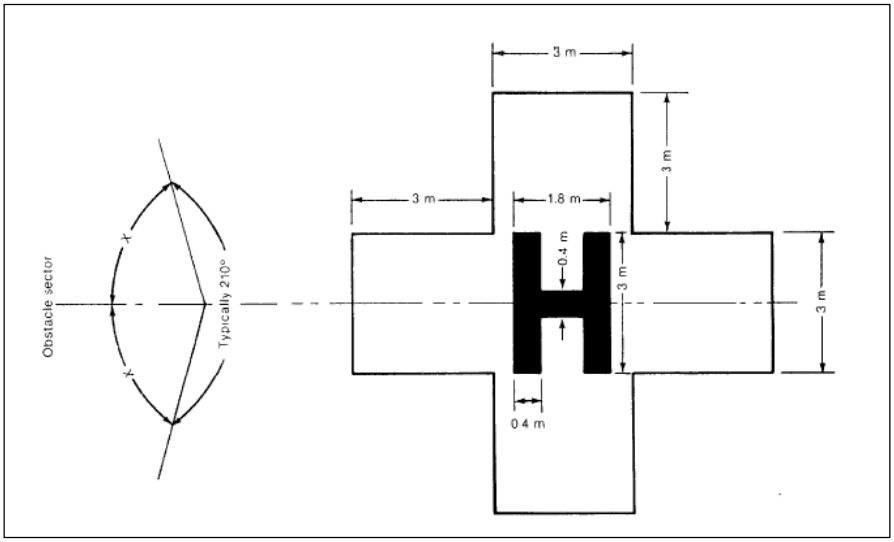

Figure 3: Example of Helicopter Landing Point Marking on a Hospital Building

Markings.
The marking that is required for helicopter landing point are heliport identification marking, Touchdown and Lift-off Area (TLOF) area marking, touchdown marking, maximum allowable mass marking and under some operational circumstances included Final Approach and Take-off Area (FATO)/ Touchdown and Lift-off Area (TLOF) area designation marking.

Lights.
It is provided for heliport use by night or in restricted visibility condition by day or night such as obstacle lights, TLOF area lights and visual alignment guidance system.

As working with any helicopter is inherently dangerous, no responsibility can be accepted for any divergence from technical and safety procedures. Helicopters can be an extremely valuable and versatile asset in any relief and rescue for flood operation. However, like any mechanical device and specifically one that flies in generally poor weather it has its limits and as such must be managed and used with this in mind. The RMAF pilots involved in the Kelantan badly flood hit areas had to encounter many obstacles in executing their task such as air to ground low visibility during day and night, non-existence of guidance system to assist pilots to land and no suitable helicopter landing point as existing points were submerged in flood water. This research tried to determine the proper signage to aid the helicopter pilot via information obtained from validated survey questionnaires that could assist in the relief and rescue operations. The questionnaires as mentioned earlier in this literature encompasses technicality aspects and the safety hazards of flying and executing operation. The questionnaires were asked to the pilots involved in an interview and all the information were recorded and analysis. The questionnaires that was asked includes factors such as requirements of visibility, requirements of technicality; wind direction, size and shape of landing points, the surrounding of the flood area, the surface and the slope of the landing point, safety hazard; near misses, incident and accidents and operations requirements.

The building signage aspect is also considered in this research whereby through the reliable data collected, three areas around Kelantan that are *Pasir Mas*, *Kuala Krai* and *Kota Bharu* was chosen for ground reconnaissance. These areas are taken into consideration as is has the highest evacuation centres set up during the flood disaster. Each of this area as enlisted in Table 2.1 has its own designated helicopter landing point that are mostly situated near school or vicinity halls. Lesson learnt form the recent flood scenario, is that these landing points were not available as flood submerged all of them. On the logistical aspect most of the designated landing points were accessible through secondary road. The annual meteorological report for rain fall in Kelantan has shown a significant increase from year to year. Therefore, the flood water level is forecast only to increase and the most viable option to resolve submerged landing point is to find points at higher ground such as multi-storied buildings. The selection is focused on existing governmental buildings that are in close vicinity with the existing helicopter landing points in *Pasir Mas*, *Kuala Krai* and *Kota Bharu*. Managing a large group of people in flood crisis that is occupied a multi-storied building can be very challenging task for the authorities. During a relief and rescue operation from a building, the absence of facility management

and inappropriate guidance poses a threat to the evacuees. Though the design of the building might meet the regulations of safety the problem arises with the behaviour of the people during emergency. Past studies reveal that it is more difficult to find a proper evacuation path under emergency, due to mental stress and time limitation. Humans often tend to panic and create a chaotic situation during emergency situations. Under such a situation, evacuation is one of the most important aspects to save lives and proper signage installation on facilities is essential for evacuation and tackling relief and rescue operation during flood situation. There is many international signage applied in many countries aimed to alarm and warn people of disaster or means to evacuate.

Figure 4: Example of International Warning Signage

This research tried to examines the use of colour, shapes, symbol (pictorial) and text of natural disasters signage to facilitate in the relief and rescue operation for evacuees in relief centres. In this research 50 local Malaysian that were among the flood victims in relief centres in *Pasir Mas*, *Kuala Krai* and *Kota Bharu* were interviewed to excess their preference and understanding of signage. Aucote, Miner and Dahlhaus [4] in their research stated that warning signage has common usage in many culture as means to inform the public of danger presence and ways to avoid it. Understanding the factors related to behavior promoted from warning signage will avoid injury or death and protect the general public [4]. The symbol (pictorial) was examined by Blees and Mak [5] suggested that symbol developed in one culture may not have the same meaning for people from other cultures. From aspect of colour, Von Goethe and Eastlake [6], published the 'Theory of Colors' that explained that different colour has different effects on ones' mood and emotion based of four different colours; red, blue, green and yellow (Table 3).

Colour	Effects on Ones' Mood and Emotions
Red	Impression of gravity and dignity and at the same time of grace and attractiveness
Blue	Stimulating negation and a contradiction between excitement and repose
Green	The beholder has neither the wish nor the power to image a state beyond it.
Yellow	Serene, gay and softly exciting character

Table 3: The Effects of Colours on Ones' Mood and Emotions [6]

Burgess [7] stated that warning and prohibition signage is a basic safety system that works as visible communication and useful as first aid for people whom are faced with dangerous and emergency situation. The signage can be combination of visible shapes, colours, symbols and text that can be divided into different types depending on the messages conveyed and communicated under specific controlled form [7]. The research on Thais and Japanese people that has experienced flood disasters has suggested specific understandings of signage as depicted in Table 4 with combination of shapes, colours, symbols and text.

Colour	Meaning and Objectives	Command and Information	Shapes and Description of Sign
Red	Prohibiting and warning	**To stop dangerous** behavior or stop immediately. To tell when faced unsafe, machine. To escape	**A red circle** with a line from the upper-left to lower right, approximately 35% of the total area. There are black picture on a white background.
Blue	Command	**To indicate specific behavior** such as telling to wear protecting equipment	**A circle** with a white face on blue background which is at least 50% of total area.
Green	Emergency escape, first aid without danger	**To show exit way**	**A rectangle or square** with a white person running on green background which is at least 50% of total area.
Yellow	Warning	**To be careful** and safe, keep an eye on it.	**A triangle** with a black exclamation on a yellow background which is at least 50% of the area.

Table 4: International natural disaster communications: an exploratory study of signage for tsunami, earth quake and flood in Japan and Thailand
Source: Ongkrutraksa [8]

The consideration of suitable signage to be implemented in an existing building for flood relief and rescue purposes not only depends on the physical design of the existing building but also the evacuation plan itself. Previous studies on signage system has been done in coming with solution to increase efficiency and decrease fatality rate in emergency [9]. Deshpande and Faltesek [10] stated in fire rescue efforts, signage system helps to indicate ingress route and egress route for evacuees and the fire fighters to find their respective routes. The egress route guides evacuees to exit a building whilst ingress facilitate the fire fighters to enter into fire hazard building and contain fire [10]. The designed or predefined route are installed with smoke detectors to give path during fire breakouts [10]. Most of the building in Malaysia are equipped with static evacuation plan that may have many disadvantages especially when situation tends to change during evacuation [1]. A dynamics signage system offers a solution that takes into consideration the hazard source and people distribution in a building [1]. The combination of this two set of information will help in assessment of evacuation route and optimize the evacuation process from a building [1]. Evacuation planning in flood disaster areas can range from a small scale and even developed into a large scale for building evacuation. Wang and Sun [11] mentioned that evacuation of large crowds from disaster are has been main focus of many scholars at home and abroad. The principal aspects to be considered in terms of the crowd scale differ from one size to the other as enlisted in Table 5 below:

Scale of Evacuees		
Small (Localized area of flooding, i.e.; town)	**Medium (Medium size area, i.e.; a few town or city)**	**Large (Huge area flooded, i.e.; a whole state)**
		Evacuation theory • Correlations of evacuation parameters
		Evacuation modeling • Laws of human evacuation behavior • Mathematical models • Simulation model
Evacuation decision-making • Evacuation route selection • Evacuation population assignment • Evacuation resource allocation		Evacuation decision-making • Evacuation route selection • Evacuation population assignment • Evacuation resource allocation
		Evacuation risk evaluation • Gathering risk • Traffic risk

Table 5: Principal Aspects to be considered in Term of Crowd Scale
Source: Wang and Sun [11]

CONCLUSION

We have learned that we are seriously at risk from events for which we are unprepared, not because we fail to remember what happened before, but because we will encounter newly emerging risks that differ completely from what we faced before. The implementation of proper signage are crucial, as the disaster become a frequent event in this country. All the relevant agency need to align to focus on this issue to counter the problem immediately. All the counter measures have to be implemented according to the need.

The study found that the need for the signage could be decided as this is still in an infant level. This approach will help to give input in answering questions regarding what is the suitable building in determined areas to be applied as relief centers during flood disaster. The signage requirements to aid helicopter pilot during relief and rescue operation via air is crucial as it is the alternative way to reach the flood victims during the disaster. Understanding and reaction based on signage colour, shape, text and symbols (pictorial) is another area that the study will look into to improve the current situation. The proper signage design based on the evacuation plan will be designed to counter the current problems.

ACKNOWLEDGMENT

All the researchers would like to convey the gratitude to Centre for Research Management and Innovation, University Pertahanan Nasional Malaysia for the support and encouragement.

REFERENCES

[1] Cisek, M., & Kapalka, M. (2014). Evacuation Route Assessment Model for Optimization of Evacuation in Buildings with Active Dynamic Signage System. *Transportation Research Procedia*, Vol *2*, Pages 541-549.

[2] Shafiaia, S. and Khalid, M. S. (2016). Flood Disaster Management in Malaysia: A Review of Issues of Flood Disaster Relief during and Post-Disaster. *ISSC 2016: International Soft Science Conference*.

[3] AIP Supplement Malaysia (2011). Aeronautical Information Services Department Of Civil Aviation, Putrajaya, Malaysia.

[4] Aucote, H. M., Miner, A., & Dahlhaus, P. (2012). Interpretation and misinterpretation of warning signage: Perceptions of rockfalls in a naturalistic setting. *Psychology, health & medicine*, *17*(5), 522-529.

[5] Blees, G. J., & Mak, W. M. (2012). Comprehension of disaster pictorials across cultures. *Journal of Multilingual and Multicultural Development, Vol 33*(7), pages 699-716.

[6] Von Goethe, J. W., & Eastlake, C. L. (1970). *Theory of Colours* (No. 3). Mit Press.

[7] Burgess, L. (2010). Learning as a social practice in art and design. *Understanding art education: engaging reflexivity with practice*, pages 67-92.

[8] Ongkrutraksa, W. (2015). International natural disaster communications: an exploratory study of signage for tsunami, earth quake and flood in Japan and Thailand. *ジャーナリズム & メディア: 新聞学研究所紀要*, Vol 8, Pages 7-19.

[9] Yenumula, K., Kolmer, C., Pan, J., & Su, X. (2015). BIM-Controlled Signage System for Building Evacuation. *Procedia Engineering*, *118*, 284-289.

[10] Deshpande, R. G., and Faltesek, A. E. (2006). Building emergency path finding systems and method. US Patent 7026947.

[11] Wang, J. H., & Sun, J. H. (2014). Principal aspects regarding to the emergency evacuation of large-scale crowds: a brief review of literatures until 2010. *Procedia engineering*, *71*, 1-6.