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A literature review of dual disaster challenges for resilient office building toward reducing disaster risks

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Abstract. Flood is acknowledged as the most common natural disaster in several parts of the globe. For Malaysia, flood is considered as the most frequent natural disaster, with the frequency of at least once a year. The risks of flood can be seen through property loss and damages, infrastructure casualties, and disruption to socio-economic activities. Adding to that, Malaysia also faced the flood during the pandemic when it hit several states, namely Pahang, Johor, and Kelantan, during the monsoon season in 2020 and 2021, amid the rising cases of Covid-19. The ongoing COVID-19 pandemic has posed significant challenges for disaster response, calling for the “new norms” to be quickly established for better disaster risk reduction. Several mitigation strategies have been taken by the government to reduce the risks of floods in Malaysia. As office buildings possess important roles in delivering effective services to the public while maintaining their critical documents, this paper focuses on providing related literature on building resilience. Having an early understanding of the core elements of office building resilience in dual disaster challenges will provide the basis for further investigation in the later stage of data collection.

Keywords: covid-19, disaster risks, monsoon flood, office building resilience

1. Introduction

In recent years, the occurrence of floods around the world has been on the rise and predicted to become more frequent as an effect of climate change which has brought intense rainfalls throughout the globe [1] [2]. It has brought a great loss to humans and extensive damage to the properties, apart from affecting the socioeconomic activities [3]. Kuala Lumpur, Penang, and Johor were among the large and emerging cities that often experienced the flood phenomenon. It was due to the unrestrained human activities such as the development of infrastructures and the cluttering of debris and waste nearby the river that could clog drains and waterways. Meanwhile, the monsoon floods also occur yearly during the rainy season in the East Coast states of Peninsular Malaysia, such as Pahang, Kelantan, and Terengganu.

Almost every year, floods hit several states in Malaysia, specifically in the monsoon season. The disaster is expected to occur from October to March, during the northeast monsoon season on the east coast of peninsular Malaysia, which is extremely vulnerable to floods. Therefore, it is vital for Malaysia to have a coping mechanism to face the disaster situation. It should not be applied only to the people and community, but we must also look from the context of office building resilience towards disaster,



as the office buildings were also affected during a flood, and the impacts were also severe as these buildings hold important records and confidential files. Thus, it is crucial to view the disaster risk mitigation methods adopted by the building operators and other related agencies as all these stakeholders are related to one another. The decision made by the government agencies may affect the building later regarding the external infrastructure surrounding the office building, such as deepening the drainage system to avoid floods.

As the world has been facing the Covid-19 pandemic these few years, the approaches to dealing with floods have significantly changed as the world needs to adapt to this dual disaster situation. Among the challenges is how to develop appropriate mitigation measures whilst maintaining the Standard Operation Procedures in controlling the spread of the virus. Thus, every government should come out with its own SOPs based on the current situation of the Covid-19 cases in the countries. For the office buildings, the SOPs will be the baseline in maintaining the service given by the respective agencies or organizations operated in the building.

2. Overview of Disaster

The International Federation of Red Crescent has defined disaster as an unforeseen, catastrophic incident that severely disturbs the operation of a society, leading to mankind, properties, and economic or environmental losses. It goes beyond the capability of the community to cope with the disaster by using its own resources. Although it is frequently triggered by nature, disaster can also be originated from human factors.

In Malaysia, disaster is put under NSC D20, as defined by the National Security Council (NSC), [4] “An incident that occurs in a sudden manner, complex in nature, resulting in the loss of lives, damages to property or the environment as well as affecting the daily activities of the local community. Such incident requires the handling of resources, equipment, frequency, and extensive manpower from various agencies as well as effective coordination and the possibility of demanding complex actions over a long period of time.”

2.1. Disaster in Malaysia

The types of disasters that occur in Malaysia are floods, landslides, coastal erosion, tsunami, earthquake, and sea-level rise [5]. Among the disasters listed, the most common and frequent disaster floods will occur once or twice a year.

2.2. Disaster Management in Malaysia

The available kinds of literature on disaster administration in Malaysia is mainly dependent on the reviews of the government reports from organizations involved in managing disasters, such as the National Security Council (NSC), National Disaster Management Agency (NADMA), the Welfare Department (WD), the Public Drainage and Irrigation Department (DID), the Public Work Department (PWD), the Statistics Department (SD), the Malaysian Medical Relief Society (MERCY), Red Crescent Society (RCS), Red Cross Society (RCS) and other NGOs, or organizations, along with the State Departments and Local Councils. It also covered the research transcripts, academic dissertations, journals, news articles, and websites of well-known organizations [6].

In Malaysia, the agency responsible for disaster management is called NADMA, which stands for the National Disaster Management Agency. Until 2015, the function of disaster management in Malaysia had been issued by the Malaysian National Security Council (NSC). In response to the major flood events in 2014, the government felt the urge to establish a specific agency to manage disasters and crises. Thus, in 2015, the disaster management unit was released and expanded with the establishment of the JPAM Post-Flood Recovery Unit and Special Malaysia Disaster Assistance and Rescue Team (SMART), consisting of members from the Royal Malaysian Police, Fire and Rescue Department of Malaysia, and Malaysian Armed Force, leading to the constitution of National Disaster Management Agency or NADMA. During the establishment, MKN had handed over Directive No.20 to be fully managed by NADMA at the district, state, and national levels.

On the 1st of October 2015, NADMA was established and fully operated as the National Disaster Management Agency. The authorities and duties of NADMA involved the roles of the Head of Humanitarian Assistance Disaster Relief delegation, the Secretariat of National Disaster Management Committee, the establishment of the National Disaster Management Policy, the directive of policies application, synchronization of Disaster Risk Reduction strategies, execution of Public Outreach Programmes, administration of trust funds for disaster relief, and position of SMART Team.

2.3. The National Disaster Management Strategy

The 2016-2020 Eleventh Economic Development Plan was published on 21st May 2015 by the Malaysian Government targeted to implement the framework towards assuring that Malaysia can attain its higher-earning economy by 2020. The Plan recognized six 'Strategic Thrusts' towards changing the route of the country's economic development and enhancing the nation's earnings per capita to be more than USD 15,000 [7].

The Plan sets forth its disaster management strategies in Chapter 6, under Focus Area D: Building Up Resilience Towards Natural Disasters and Climate Change. Since Malaysia is developing socio-economically, the country emphasizes resilient development in assuring that the growth obtained will not be driven backward by natural disasters. Thus, the fundamental approaches to managing and overcoming natural disasters, determining susceptible regions societies, and arranging the appropriate instrument in the event of an emergency are some of the essential plans of action emphasized in the Plan with respect to developing an extensive Disaster Risk Management (DRM) framework whilst securing the country's resilience and its future. These approaches were listed to achieve these goals:

1. Essential D1: Enhancing Disaster Risk Management through the establishment of DRM policies and governmental groundwork, upgrading disaster sensing and reaction capacity, incorporating DRM into enhancement plans, and spreading awareness to the community
2. Essential D2: Upgrading flood alleviation through the formation of new investments in flood mitigation projects, improving long-run planning, and empowering flood prediction and warning systems
3. Essential D3: Establishing adaptation of climate change through the National Transformation Plan and enhancing resilient infrastructures and natural buffers, as well as developing awareness of the health impact.

Under this strategy, the emphasis is also put on building resilient infrastructures as it is crucial in overcoming the impacts of climate change. More emphasis will be considered on environmental and climate change during the preparation, assessment, and execution phases for the energy-related infrastructures. Reliance on the resources, specific pollution from the non-renewable sources, will be put in order by introducing renewable resources. Other substitutes of water resources such as recycled groundwater, lakes, and reservoirs will be observed to enhance the variety of funds and resilience towards the possible effects of climate change.

The National Disaster Management Strategy (NDMS) of Malaysia is the foundation plan of action to advocate efficient coordination and as a joined way to cultivate a civilization of prevention, security, and general security within the society. It is aimed to build a secure environment for society by effectively managing disasters and practicing sustainable advancement in the 21st century. Disaster readiness is an eminent approach to increasing the readiness and knowledge in association with different stakeholders concerning the risks, agencies involved, preventive measures, and other information associated with disaster. Distinguished provincial training and education programs can help improve the preparation to face a disaster in any specific region. Nonetheless, insufficient fund allocation for the training can be a real challenge [8].

2.4. Flood in Malaysia

A flood can be referred to as any inflowing water overtop natural or unnatural banks in the river system components. Thus, once a riverbank is overflowing, the water will extend beyond the alluvial plain and typically become a threat to the community [9] [10]. Floods are a natural phenomenon; however, when

they exceed the coping capacity and damage life and property, then they become a major source of concern.

The estimated locations at risk of being flooded in Malaysia are estimated to be about 29,800 km² or 9% of the total areas, affecting approximately 4.82 million people, comprising around 22% of the total population of the country [10]. Floods in Malaysia have been categorized by the Malaysian Drainage and Irrigation Department into monsoon and flash floods [11]. In terms of hydrological perspectives, these two disasters can be distinguished from one another based on the duration required by the river flow to subside to the natural level. Flash floods require a few hours to turn back to the regular water level, whilst monsoon floods can carry on for up to one month [12].

Flash floods and monsoon floods are the main environmental conditions associated with natural calamities in this country. The annual critical loss comprising fatalities, disease outbreaks, and equity, along with produce catastrophe, had been associated with flood hazards in Malaysia. Furthermore, the loss caused by floods is estimated to be the US \$4.82 million in 2019 annually [13].

A floodplain or flood-prone area is defined as any land area which is vulnerable to being flooded by water from any sources. Malaysia's floodplain areas covered nearly 29,000 km and affected more than 4.82 million people. The areas are shown in figure 1 for Peninsular Malaysia and figure 2 for East Malaysia below:

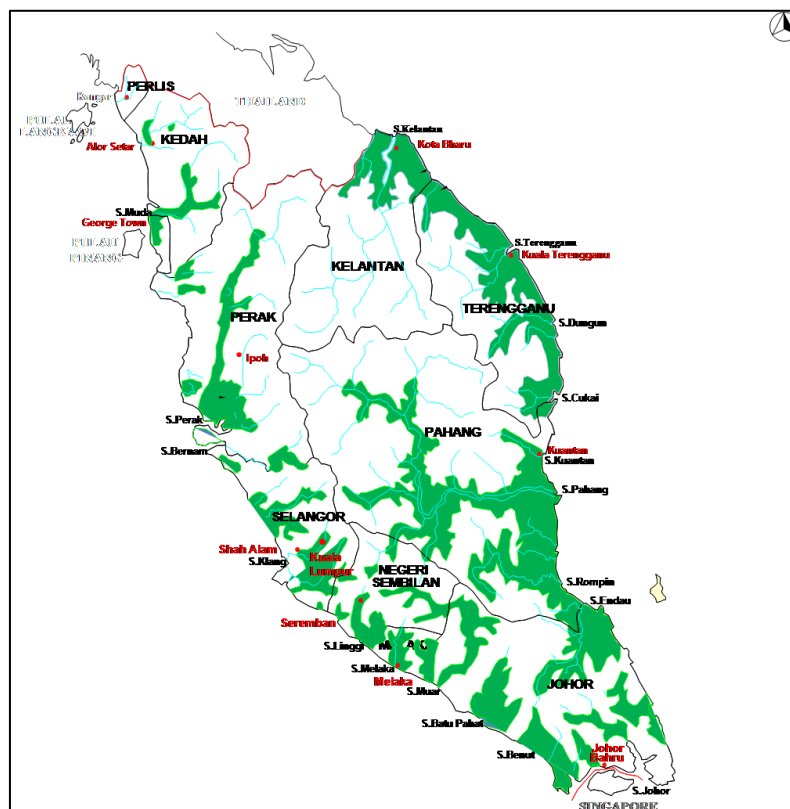


Figure 1: The Floodplain Areas in Peninsular Malaysia

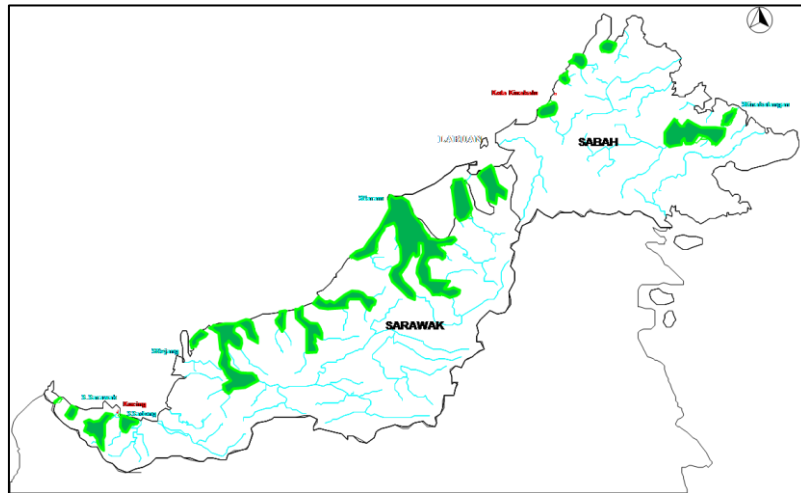


Figure 2: The Floodplain Areas in East Malaysia

2.5. Flood and Covid-19, the Dual Disaster Challenges

The fundamental facts of the COVID-19 pandemic are physical distancing, arising demands for crisis reaction workforce, and momentary closing of government facilities which led the municipalities to alter their normal operations and give more attention to critical functions only. Local leaders can play their roles by bringing together all parties concerned in running crucial government services such as commissions from susceptible populations, public health authorities, emergency administration personnel, and local department leaders to analyze current emergency plans and making a decision on how the crucial administrative services can still be operational if another disaster collides [14].

Some essential suggestions made by the Office of Disaster Risk Reduction (UNDRR) through a briefing on ‘Combating the Dual Challenges of Covid-19 and Climate-Related Disasters’ are to improve multi-hazard risk readiness, to take aggressive actions in reducing susceptibility, to protect the frontliners, and to assist local actions. It also advised that all the nations ‘not turn a blind eye on the importance of protecting the most susceptible from the effects of both’ and ‘to analyze the existing preparation plans to assure that they matched with the COVID-19 efforts’ [15], whilst the policy of managing flood disaster during COVID-19 pandemic as suggested by [16] is illustrated in the figure below:

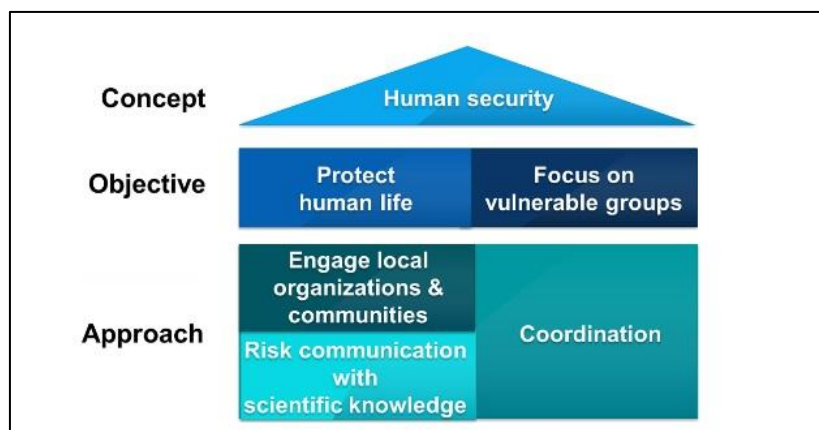


Figure 3. The Managing Policy of Flood Disaster amid Covid-19.

Essential points derived from the double impacts of Covid-19 and climate-related disasters required all countries to emphasize a combined multi-hazard disaster risk management approach which consists

of high-level disaster readiness and increased disaster risk reduction beyond the sectors. The important suggestions are [17]:

- Improving multi-hazard disaster preparedness attempts, as well as revising the SOPs and emergency plans
- Being proactive in lessening vulnerabilities from COVID-19 and other hazards
- Prioritising the combined disaster risk governance
- Protecting the first responders and frontliners
- Aiding local actions in prohibiting, adapting, and responding to disasters
- Shifting the current model of international assistance

The suggested intersections between disaster management and disaster preparedness or DRR and pandemic preparedness are:

- Multi-agency efforts are critical
- The balance between centralized and local approaches, whether it is disaster preparedness and risk reduction approach should be identified
- Flexible and sharp plans are essential in helping the governments to react to different types of emergencies effectively and quickly
- Data and technology are crucial in aiding crisis response effectively
- The key to safeguarding people during any type of crisis is by gaining public trust.

3. Office Building during Flood

3.1. The Affected Office Building during Flood

The flood is a natural calamity that possesses a destructive impact on the economy, community, and the environment [18]. It is also regarded to be one of the frequent natural disasters that caused ample losses of humans, livestock, and assets. In terms of property loss, a flood can damage infrastructures and buildings such as houses. The impacts of floods on properties are diverse, based on natural factors such as recurrence, depth, momentum, and the length of the event.

In a major flood that recently hit Malaysia, the Department of Statistics of Malaysia (DoSM) had announced a total loss of RM6.1 billion, in which Selangor had been the most badly affected state, with a total loss of RM3.1 billion, succeeded by Pahang (RM593.2 million), Malacca (RM85.2 million), Negeri Sembilan (RM77.1 million) and Johor (RM50.1 million). The losses include living accommodation, transport, business buildings, production, and agriculture field, as well as public properties and infrastructure. Among those public assets were the office buildings that were hit by the massive flood [19].

For a country that frequently experiences major floods, the restoration of properties would require a long time and incur high repair costs, which might lead to the depreciation of property value, whilst minor floods usually involve quick damage recovery [20]. The actual impacts of flooding comprise fatalities, property and infrastructure damages, along with crops and livestock devastation. For instance, the destruction of communication networks and crucial infrastructure (such as power plants, roads, hospitals, etc.) are the long-term effects of the flood event, which significantly affected social and economic activities.

Throughout the years, flood construction of resilient infrastructures has been a fundamental element in the combined approaches of flood risk management, and it has been broadly acknowledged in recent years by the ideas of building areas for water and living with floods. Resilient development has been recognized for centuries, but only in recent years it has been acknowledged as a component of this broader approach to flood risk management. Buildings and the expansive built environment are famous for their essential roles in managing flood risks, thus, when buildings are developed on or nearby the flood plain areas, there will be an apparent reason to conserve them [21].

This study focuses on office building as the main component as it is a crucial element to be given attention to during a disaster, especially in flood events. This is due to the fundamental function of this type of building, where it holds a lot of important documents and serves as the administration place for

the government and private sectors. The Purpose-Built Office (PBO) is used to indicate the buildings which were built with the intention to be used mainly as an office [22]. By dominantly using the building for that purpose, it means that not less than 75% of the net capable area to be rented or leased is utilized as an office. The Uniform Measurement Method of Buildings, according to the Royal Institution of Surveyors Malaysia (RISM) is adopted to measure the net area which is capable of being rented.

The DRR resilience perspective focuses on the forms of vulnerability but mainly focuses on capacity-building and adaptation [23]. It can be regarded as the typical features of an individual or a group that affects their capacity to predict, confront, withstand, and bounce back from the consequences of a natural threat (an extreme genuine occurrence or process) [23], whilst resilience is the capability of an arrangement, community, or people to withstand, assimilate, hold to, and get back better from the effects of a disaster inappropriate timing and effective behaviors, through safeguarding and restoring the fundamental structures and functions [24].

3.2. *The Affected Office Building during Flood*

The National Institute of Building Science in the United States has ascertained that resilience can be characterized by four characteristics [25]:

- **Robustness:** Capability of maintaining crucial operations and functions during a crisis. It covers the building, its infrastructural arrangements (office buildings, power generation, structures allocation, bridges, dams, levees), or in repetition arrangement and replacement (transport, electrical grid, communication networks)
- **Resourcefulness:** The ability to be fully prepared for, responded to, and managed a crisis or interruption as it spreads out, which includes recognizing the flow of operation and business progression planning, coaching, managing the supply chain, arranging operations towards controlling and mitigating damages, and adequately corresponding the decisions
- **Rapid recovery:** Capability of returning to and/or reconstituting regular operations as soon and as effectively as possible after a disturbance. The components of rapid recovery comprise attentively enlisted emergency plans, efficient contingency operations, and getting the appropriate people and resources to their respective places
- **Redundancy:** Suggested as another key feature, in which backup resources are available to complement the initial plans that should be considered in case of failure.

These four resilience components are also known as the 4Rs. Resilience is a combination of various disciplines that complements one another towards successful outcomes. It cannot be successful or competent resilience if multidisciplinary cooperation and contributions are lacking. There is a fundamental difference between an asset and community resilience in which asset resilience is the individual property resilience whilst community is the resilience of the systems that make up the community. For instance, an asset is regarded as a single property. There are other types of assets that are also doable such as bridges, mass transit stations, transmission towers, or tunnels, which are integrated together into a system.

4. Summary and the way forward

Through comprehensive reviews of available literature, an understanding of dual disaster challenges and how to integrate them into office building resilience can be developed. It can be concluded that the dual disaster, which was a flood amid the Covid-19 pandemic had changed the way of carrying out disaster mitigation approaches. It can be seen through the implementation of specific SOPs that should be followed by all the agencies involved in disaster management, such as wearing a mask during evacuation and throughout the stay at the evacuation centers, as well as maintaining social distancing to reduce the risk of being infected by Covid-19 during that process. Each country will have its own procedures in dealing with floods and Covid-19, but the fundamental framework is mainly similar, as the basic conducts of standard SOP should comply with the ones issued by WHO.

To enhance the resilience of office buildings, the new norms or SOP should be integrated with the core elements of office building resilience. From the literature review, there are four elements of office

building resilience which are robustness, resourcefulness, rapid recovery, and redundancy. These elements should be the baseline in constructing the mitigation approaches during a disaster to improve the resilience of the office building towards reducing the risks of a disaster, which are concluded in figure 4 below:

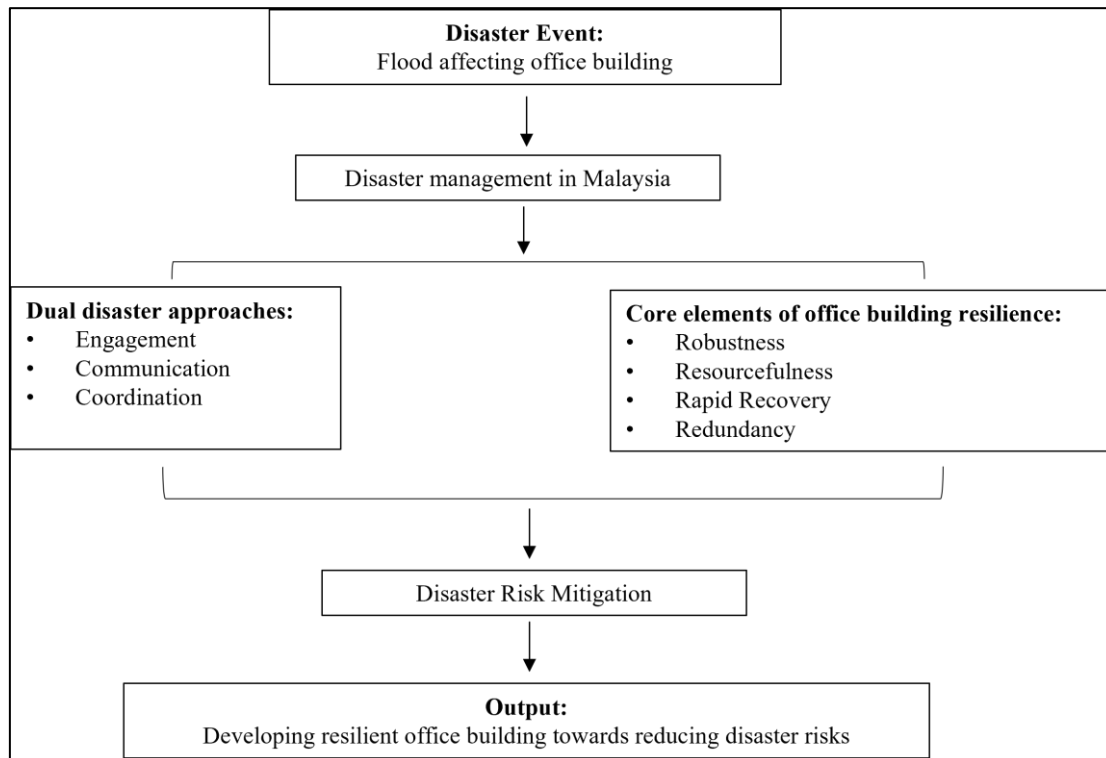


Figure 4. Elements of resilient office building towards reducing disaster risks

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