A Study on Disaster Classification-Based Disaster Prevention Design Frameworks

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Abstract

As society becomes more advanced, the damages humans suffer during disasters have become diverse. These damages vary based on the characteristics of natural and social disasters, necessitating tailored disaster prevention design approaches. This paper proposes differentiated disaster prevention design directions based on the disaster classification system (natural disasters and social disasters). Additionally, the study examines how disaster prevention design is utilized in the four stages of disaster management: mitigation, preparedness, response, and recovery. By analyzing examples in each stage, the necessity for differentiated approaches by disaster type is identified. This study proposes a theoretical framework for disaster classification-based disaster prevention design, providing a theoretical basis for the future creation, application, and verification of practical disaster prevention designs. This framework is expected to enhance disaster response efficiency and minimize damage, contributing to both academic advancement and practical application in the field of disaster prevention design.
Key words: Disaster Classification, Disaster Prevention Design, Natural Disasters, Social Disasters, Design

I. Introduction

1. Research Background and Necessity

As modern society becomes more advanced, the damage that humans suffer during disasters has become increasingly diverse and complex. Natural disasters (such as earthquakes, floods, and typhoons) and social disasters (such as traffic accidents, fires, and industrial accidents) cause different types of damage depending on their characteristics and causes, and the response methods vary accordingly. To effectively respond to these disaster situations and minimize damage, tailored disaster prevention design approaches specific to each disaster type are required. Disaster prevention design aims to minimize damage during disasters and to efficiently manage responses before and after their occurrence, highlighting its growing importance.

2. Research Purpose

The purpose of this paper is to propose differentiated disaster prevention design approaches based on the disaster classification system (natural disasters and social disasters). By doing so, we aim to provide a foundational framework for applying disaster prevention design according to the type of disaster, enhancing the efficiency of disaster response and minimizing damage. The study analyzes the characteristics and cases of various disasters to derive suitable disaster prevention des

ign strategies for each type, thereby presenting an effective disaster prevention design framework.

3. Research Scope and Methodology

This study involves literature reviews and case studies to examine the definitions and characteristics of natural and social disasters. Representative cases for each disaster type are investigated to deeply analyze the causes and effects of disasters, as well as the elements of disaster prevention design in the response processes. Additionally, the study explores how disaster prevention design is utilized in disaster management processes, analyzing examples from each stage to identify the need for differentiated approaches by disaster type.

4. Structure of the Paper

This paper is structured as follows. Chapter 2 reviews the literature and research methods. Chapter 3 presents an analysis of previous research and case studies, examining the characteristics and examples of natural and social disasters. Chapter 4 discusses disaster prevention design case studies. Chapter 5 proposes a disaster classification-based disaster prevention design framework based on the findings. Finally, Chapter 6 provides the conclusion.

This study aims to present a new paradigm for disaster response, offering important insights for seeking more effective response measures in various disaster situations. By emphasizing the importance of disaster prevention design, this research seeks to explore new possibilities in disaster management from a design perspective.

II. Review of Literature and Research Methods

1. Review of Literature

1.1 Concept of Disaster Prevention Design

‘Disaster Prevention Design’ as follows; DPD is a kind of design activity that protects life and property of human beings, minimizes damages, and makes the recovering process rapid and easy, against any kind of disasters. (Noh , *et. al*., 2014: 57).

1.2 Disaster Classification System

In the Republic of Korea, disasters are classified into natural and social disasters. Natural disasters include events such as earthquakes, floods, and typhoons, which are caused by natural phenomena. Social disasters encompass incidents resulting from human activities, such as traffic accidents, fires, and industrial accidents. Each type of disaster has distinct characteristics and causes, requiring tailored disaster prevention design approaches.

1.3 Literature Review

Existing studies on disaster prevention design have primarily focused on specific types of disasters and their respective design approaches. For instance, Youngjun Kim conducted a study titled " Disaster Prevention Design Study for Pedestrian Safety in Pedestrian Shared Roads," which concentrated on disaster prevention design for pedestrian safety in shared road spaces (Kim, 2023).

Building on these existing studies, this research aims to propose new disaster classification-based disaster prevention design frameworks. These frameworks will differentiate disaster prevention design approaches based on the type of disaster, thereby providing tailored and effective design solutions for various disaster scenarios.

2. Research Methods

This study aims to clarify the concept of disaster prevention design and explore various approaches to natural and social disasters through literature review and case analysis. The research methodology is as follows:

1. Literature Review: Review major literature and existing studies related to disaster prevention design to establish a theoretical background. This involves understanding the definition, importance, and scope of disaster prevention design and analyzing the necessity of DPD for different types of disasters. Additionally, investigate various disaster cases to examine how DPD has been practically applied.

2. Case Analysis: Investigate and analyze representative cases of DPD application for both natural and social disasters. This helps evaluate the effectiveness and limitations of actual DPD implementations and will be used to derive the disaster classification-based disaster prevention design frameworks.

3. Conclusion Derivation: Synthesize data collected from the literature review and case analysis to derive the effectiveness and limitations of DPD. Based on this, propose application frameworks for DPD for both natural and social disasters.

Through these research methods, this study systematically explores the concept and application of disaster prevention design, aiming to clarify its role in disaster management.

III. Case Analysis

1. Characteristics and Cases of Natural Disasters

Natural disasters such as earthquakes, floods, and typhoons each have distinct characteristics and impacts. For example, earthquakes can cause building collapses and loss of life, while floods can lead to widespread inundation and property damage. This section analyzes representative cases

of natural disasters, examining the damage and response strategies for each type.

2. Characteristics and Cases of Social Disasters

Social disasters, including traffic accidents, fires, and industrial accidents, are closely related to human activities. The causes and impacts of social disasters vary, necessitating effective preventio n and rapid response measures. This section analyzes representative cases of social disasters, exa mining the damage and response strategies for each type.

IV. Disaster Prevention Design Case Studies

1. Case Studies on Disaster Prevention Design Based on Natural Disasters

[image 1] Development of Variable Air Mattresses for Shelter based on Disaster Prevention Design

In this study (Noh & Chung, 2022: 80-87), we analyzed the issues related to the usage environment of shelter mattresses among disaster relief supplies and developed a variable air mattress based on disaster prevention design to address user requirements. The aim was to overcome the difficulties in mass distribution of traditional fiber mattresses and the functional limitations of foam plastic mattresses.

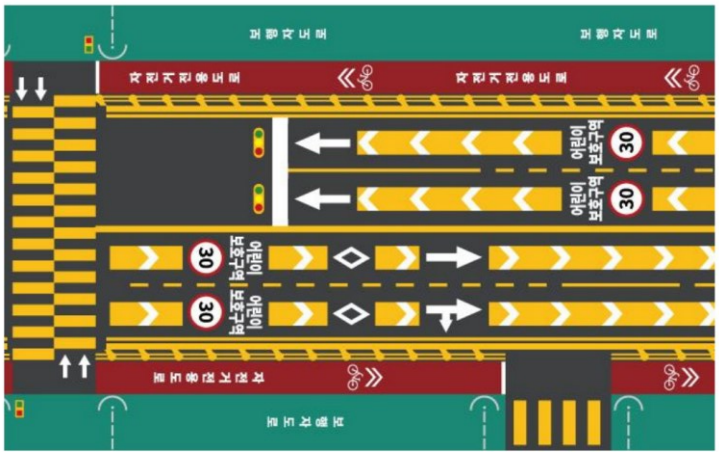
The developed variable air mattress is designed to minimize volume and can be stored in a bag form. When needed, it can be easily unfolded and inflated for use as a mattress. As a disaster r elief item, it provides stable rest and sleep in temporary shelters at earthquake or flood sites. Its lightweight and compact design makes it easy to store and transport in bulk, while its multifuncti onal storage and transport features maximize usability.

Additionally, the mattress includes superior features for maritime or river rescues compared to tr aditional rescue equipment, effectively minimizing water contact. As a medical air mattress, it dist ributes body pressure to prevent pressure ulcers. The design also considers recreational application s, making the bag lightweight and shock-resistant, with the ability to function as an insulated coo ler when not in use as an air mattress.

The disaster prevention design-based variable air mattress developed in this study is expected to alleviate physical fatigue, prevent disease exacerbation, and reduce sleep deprivation for evacuees

and temporary shelter residents during extended shelter stays. It is anticipated to be highly useful in disaster sites worldwide, contributing to improved living stability and rehabilitation motivation. The expected benefits include minimizing volume and enhancing portability through a customer-oriented variable design, maximizing user convenience through diverse applications as disaster relief, rescue, medical, and recreational items, and effectively utilizing it in disaster response and relief systems.

2. Case Studies on Disaster Prevention Design Based on Social Disasters



[image 2] A Model for Improving School Zones Based on Disaster Prevention Design

This study analyzes the current state and issues of school zones to propose a standard model for improving these zones, focusing on enhancing driver awareness and pedestrian protection. The research aims to provide fundamental guidelines for future school zone design. Researchers conducted a perception survey of school zone users to identify issues and present an improved design model.

The findings reveal that merely strengthening laws is insufficient to significantly reduce the actual risk and anxiety levels in school zones. Children feel highly threatened by motorcycles crossing pedestrian paths, and drivers find it difficult to visually recognize school zones. Consequently, the researchers proposed improvements for key elements of school zones, including crosswalks, roads, pedestrian paths, and traffic lights, to enhance driver visual recognition.

The limitations of this study include the lack of testing in actual use environments, which means the practicality and durability of the proposed improvements have not been verified. Additionally, a standardized model applicable to all school zone environments was not provided. Future research should focus on testing the proposed standard model in real environments to verify its visibi

lity and durability, and on categorizing local conditions and traffic environments to enhance the ef ficiency of applying the standard model.

V. Proposed Framework for Disaster Prevention Design by Disaster Classification

1. Framework for Disaster Prevention Design for Natural Disasters

The framework for disaster prevention design for natural disasters involves a tailored approach t hat reflects the characteristics and damage types of natural disasters. It focuses on reducing the li kelihood of disaster occurrence and minimizing damage. This section outlines the framework divid ed into prevention, preparedness, response, and recovery designs based on visual design principles.

Type	Description	Examples
Prevention Design	Measures to reduce the occurrence of natural disasters using visual elements.	- Awareness Posters: Visually conveying safety measures for typhoon preparedness and flood prevention. - Educational Materials: Creating visual materials, infographics, and animations for disaster prevention education.
Preparedness Design	Maintaining readiness and ensuring quick response to natural disasters through visual elements.	- Warning Systems: Utilizing visual elements such as warning lights, electronic billboards, and mobile app notifications. - Evacuation Maps: Creating visual evacuation maps for easy understanding of evacuation routes.
Response Design	Immediate visual actions during and after a natural disaster to minimize damage and ensure safety.	- Emergency Signage: Designing signs to guide people to safety zones during disasters like earthquakes. - Crisis Information Delivery: Quickly conveying critical information through visual graphics on broadcast screens.
Recovery Design	Using visual tools to rebuild and restore communities after a natural disaster.	- Recovery Process Infographics: Visualizing recovery steps and necessary actions. - Damage Recovery Maps: Creating visual maps to illustrate the recovery status of affected areas.

[table 1] Framework for Disaster Prevention Design for Natural Disasters

2. Framework for Disaster Prevention Design for Social Disasters

The framework for disaster prevention design for social disasters considers social risk factors an d aims to minimize social disruption. This section outlines the framework divided into prevention, preparedness, response, and recovery designs based on visual design principles.

Type	Description	Examples
Preventi on Design	Proactive measures using visual elements to reduce the occurrenc e of social disasters.	- Safety Campaign Posters: Visual posters for crime prevention, tr affic accident prevention, and other social safety measures. - Educational Program Materials: Creating infographics to convey fire prevention rules and other safety information.
Prepared ness Desig	Maintaining readiness and ensu ring quick response to social disa	Emergency Evacuation Guides: Designing visual guides and digita l displays to show emergency evacuation routes and procedures.

n	sters through visual elements.	- Warning and Alert Systems: Implementing visual warning and alert systems, such as fire alarm signals.
Response Design	Immediate visual actions during and after a social disaster to minimize damage and ensure safety.	- Emergency Situation Signage: Designing clear and effective emergency signage to assist in quick and safe responses. - Relief Information Delivery: Utilizing visual displays to quickly disseminate crucial information, such as locations for relief supplies distribution.
Recovery Design	Using visual tools to rebuild and restore communities after a social disaster.	- Recovery Progress Visualization: Developing graphics and maps to visually represent the progress of recovery efforts. - Support Information Infographics: Creating infographics to visually explain the support available for disaster victims.

[table 2] Framework for Disaster Prevention Design for Social Disasters

VI. Conclusions

This study proposes differentiated disaster prevention design approaches based on the disaster classification system (natural disasters and social disasters). By doing so, it aims to provide a foundational framework for applying disaster prevention design according to the type of disaster, enhancing the efficiency of disaster response, and minimizing damage. Through literature reviews and case analyses, the characteristics and response strategies for various disaster types were deeply examined, resulting in a specialized disaster prevention design framework for both natural and social disasters.

The results of this study present a new paradigm for disaster response and provide significant insights for seeking more effective response measures in various disaster situations. Particularly, the study emphasizes the role and importance of disaster prevention design, which comprises prevention design, preparedness design, response design, and recovery design, highlighting the necessity for tailored design strategies for different disaster types.

Future research should further refine the proposed framework through the actual creation, application, and validation of disaster prevention designs. By doing so, the practical effectiveness of disaster prevention designs can be verified in various disaster scenarios, contributing to the establishment of a more efficient disaster response system. Additionally, continued research is expected to explore new possibilities in disaster management from a design perspective, emphasizing the critical importance of disaster prevention design.

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