 

# Construction Workers' Health and Safety at Post-Disaster Reconstruction (PDR) Phase: A Knowledge Gap Analysis

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Despite having an increasing trend of research on post-disaster reconstruction, the understanding of the concept of construction workers' health and safety at the post-disaster reconstruction phase is still unexplored. The objective of this paper is to explore the scope of research within the area of post-disaster reconstruction and to identify a knowledge gap in the context of construction workers' health and safety. This literature study also identifies the importance of establishing a difference between regular construction and post-disaster reconstruction within the context of construction workers' health and safety. This literature review shows that no distinct study has been done on this area of interest while scholars have been noting significant points about this issue from different aspects. Following the literature review, a few major factors are found that contribute to the construction workers' health and safety within the context of PDR such as debris management, participation of community people, use of unskilled workers and importing workers. This study also found that there is a lack of understanding of the differences between regular construction and post-disaster reconstruction. This study points out the knowledge gap in post-disaster reconstruction literatures thus opening a door for further research on this area.

**Key words:** Construction workers' health and safety, post-disaster reconstruction, PDR, disaster recovery, literature review.

## Introduction

It is reported that at least 250 natural disasters occur every year around the world and the number of natural disasters is increasing every year (UNISDR, 2015). In the coming years, the frequency and magnitude of disasters are expected to be increased due to climate change and the impact on physical properties is going to be extreme nevertheless (Blanchi, 2018). Post-Disaster Reconstruction (PDR) is one of the phases of recovery after a disaster. However, concrete definition, scope, and activities are yet to be defined for Post-disaster Reconstruction (PDR) phase. Many scholars agree that PDR is a complex issue to be addressed and one of the most challenging phases to pass since they come along with uncertainties and complexities. Despite having more uncertainties and complexities than regular construction, no significant study has been conducted to find out the differences between regular construction and PDR. Due to lack of study, it is assumed that PDR projects are not different from regular construction projects, while (Masurier, Rotimi, & Wilkinson, 2006) pointed out the differences between these two in terms of legislation. However, no study so far has defined how the PDR phase is different from regular construction in terms of construction workers' health and safety.

A 2008 study stated that most of the disaster-related injuries happen to construction workers during the PDR process and they are prone to all the construction hazards similar to regular construction hazards but with greater exposure (Grosskopf & Hinze, 2008). Centers for Disease Control and Prevention reports that an increasing injury trends, identified illness cluster, and unconfirmed illnesses have been observed among the workers involved in PDR (CDC, 2006) which proves that construction workers at PDR sites are not only vulnerable to construction hazards but they are also exposed to illnesses, both identified and unidentified. In addition, many other articles noted how dangerous and risky PDR projects could prove to be for construction workers in terms of health and safety. This paper intends to identify a gap in literature in the area of PDR through literature review thus revealing how PDR is different from regular construction projects in terms of construction workers health and safety.

 

## Objective and Scope

The main objective of this study is to reveal the knowledge gap in the area of construction workers' health and safety in PDR phase through literature review. Authors have focused on the reconstruction projects; both housing and infrastructure, taking place only after natural disasters and within the affected geographical area. This paper presents the preliminary outcome of the literature review.

## Methodology

This paper is based on the findings from the review of existing literature on PDR. The paper explores how the literature on PDR has a knowledge gap in terms of construction workers' health and safety. To pursue this objective, the systematic literature review (SLR) methodology has been adopted. A systematic literature review gives a good understanding of the background of the study and researches that have been carried out so far within the boundary of the objective of the study. Many scholars such as Yi & Yang, (2014) and Shafique & Warren, (2016) and many more have been identified using the methodology to carry out extensive literature reviews and spotting knowledge gaps in the past as well.

To conduct this systematic literature review study, a three level of literature review has been done. Figure 1 shows the flowchart of the methodology adopted for this literature study. In the first level of the search procedure, some specific keywords are chosen within the area of PDR. The keywords are "*post-disaster reconstruction", "reconstruction after disaster", "post-disaster recovery", "recovery after reconstruction", "post-disaster rebuilding", "construction workers' safety", "safety at post-disaster reconstruction", "workers' safety issues of post-disaster reconstruction", "and occupational risks at post-disaster reconstruction"*. Google scholar has been used as the literature-searching platform for this study. Each keyword has been used once in the search bar to initiate the literature search and for each keyword, the first 50 search results were targeted for visual examination. To increase the possibility of covering all the materials regarding the topic of this study, technical reports, governmental and non-governmental reports, thesis works and newspaper articles are also taken into consideration as existing literature.

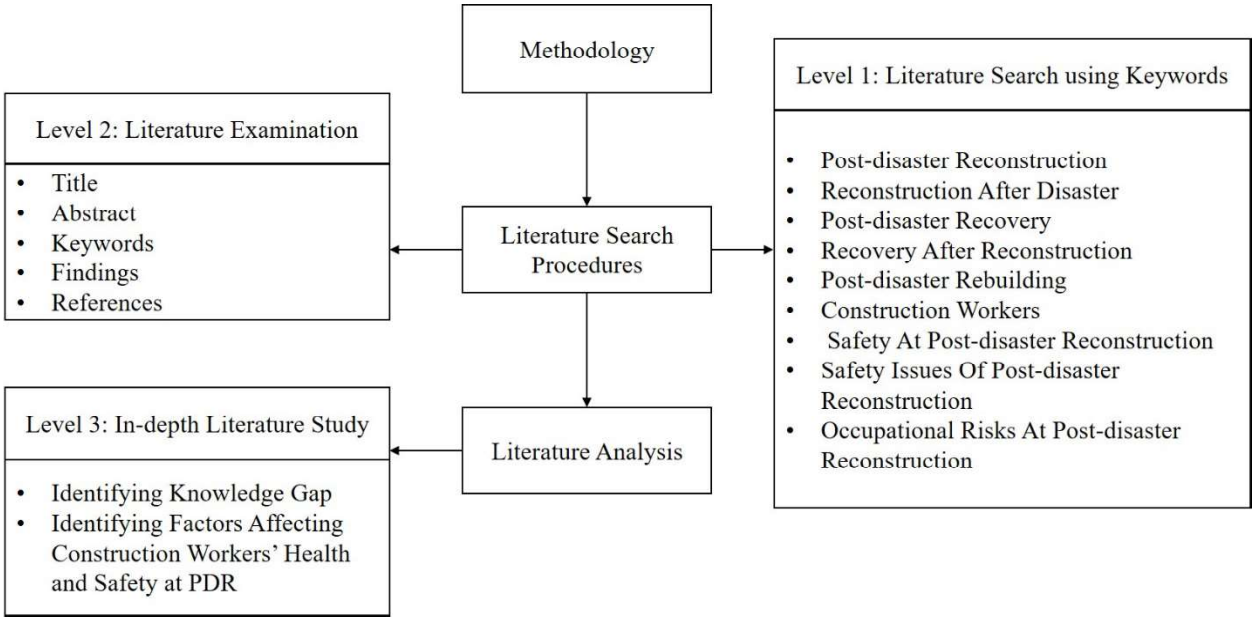


Figure 1: Flowchart of the Methodology

In the second level of the literature review, the targeted literature are narrowed down by examining the Title, Abstract, Keywords, Findings, and References of the research papers to identify if any paper is directly related to "Construction Workers' Health and Safety at PDR Phase". The third level of review is done followed by the

previous one where all the target papers were studied thoroughly to achieve the objective of this study by finding out the knowledge gap in PDR literature and identifying the factors affecting workers' health and safety.

## Understanding Post-disaster Reconstruction (PDR) Phase

According to Mannakkara & Wilkinson (2015), complete recovery after a disaster is to reach a state equal to or better than the pre-disaster state. Complete recovery from the impact of disasters has several phases and stages comprising of multiple activities to be done within the phases. Response and Recovery are the two main stages that take place after a disaster consisting of several other phases and activities (Masurier et al., 2006). According to Lindell (2013), disaster recovery has four phases e.g. Disaster Assessment, Short Term Recovery, Long-term Reconstruction and Recovery Management.

Considering the definitions and information extracted from the literature, authors believe that PDR is a phase that comprises of activities involving and including debris management, construction, and repairing of structures and demolition, restoration, and retrofitting of damaged structures that are performed after the disaster until the complete recovery is achieved within the affected geographical area. Figure 2 shows the breakdown of the recovery process after a disaster.

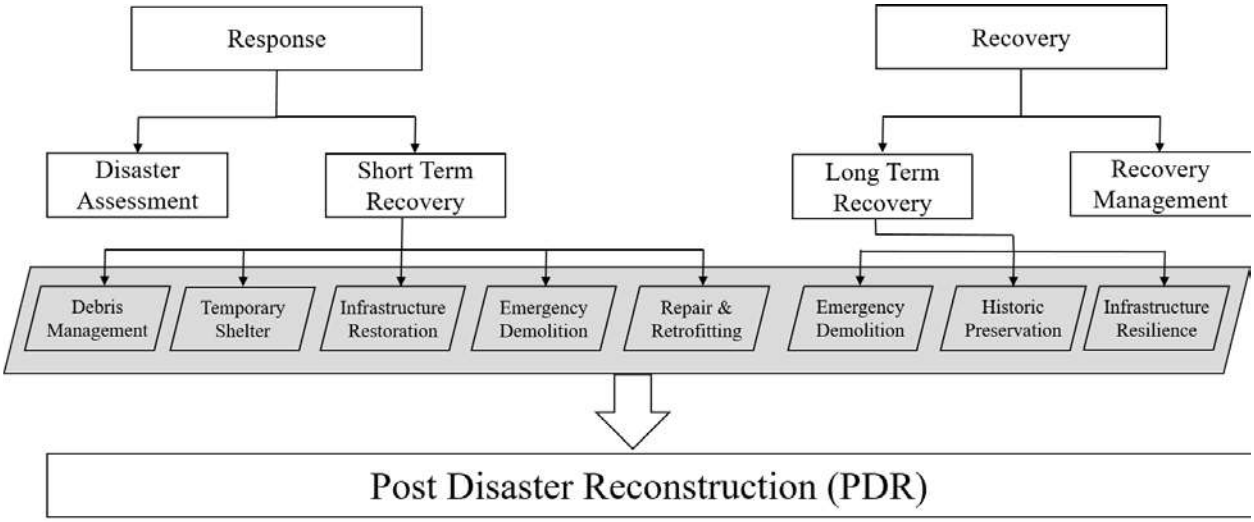


Figure 2: Activities of Post-disaster Reconstruction (PDR) Phase

Following the diagram, Disaster Assessment, and Short Term Recovery phase fall under the Response stage while Long Term Recovery and Recovery Management phase fall under the Recovery stage. There are several activities within these four PDR phases but in this study, authors have identified eight activities from short-term recovery and long-term recovery phases that also belong to PDR thus defining the definition of PDR phase. It is worthwhile to note that the PDR phase may exist separately or simultaneously with other phases after a disaster; however, no concrete demarcation exists among them in terms of sequential implementation.

## Discussion and Findings

Construction Industry is one of the most dangerous industries in terms of health and safety due to its own dynamic nature. Construction activities pose a great challenge to health and safety of the workers. Among the other industries, construction ranks one of the tops in terms of fatality. Many literatures have already stated and agreed that the construction industry has one of the highest fatality rates in the world. From 2003 to 2016 more than 13,500 workers have died on the construction industry averaging more than 960 deaths per year and 5190 fatal work injuries occurred in the US (US Bureau of Labor Statistics, 2016). There are various causes of construction accidents

that affect the health and safety of construction workers and scholars have been addressing them in an extensive way over the past decades. Nevertheless, when it comes to PDR projects, workers' health and safety has not been a popular topic of research among the scholars while reconstruction during post-disaster period makes it more vulnerable and prone to construction hazards (Grosskopf, 2010). Following the review study conducted by (Yi & Yang, 2014), it has been observed that construction workers health and safety is not a theme of research that scholars of PDR have been addressing distinctly where PDR projects can have significant effects on construction workers health and safety. Many scholars noted several factors of PDR, different to regular construction projects, that has a direct effect on construction workers health and safety but have not been distinctly studied. Following sections describe the factors pertaining to the health and safety of construction workers in PDR phase.

### *1) Health and Safety with Debris Management*

PDR process starts with the removal and management of debris that occurs due to the natural disasters. Proper and early removal of debris is important after the disaster but at the same time, it is a risky job. Different types of disasters bring different types of debris along with it. In one of their reports, FEMA categorized disasters in seven types based on their debris producing nature and these seven types of debris producing disasters are Hurricanes, Tsunami, Tornadoes, Floods, Earthquakes, Wildfires and Ice Storms. They also highlighted nine types of debris that are produced during these different types disaster namely Vegetative, Constuction & Demolotion, Hazardous Waste, White Goods, Soil, Mud & Sand, Vehicles and Vessels, Putrescent Debris, Infectious Waste and Chechimal Debris and each of them carries their own risks and potentiality of hazards to human health. The presence of hazardous and contagious debris makes the PDR sites more vulnerable in terms of health and safety (Grosskopf, 2010). Centers for Disease Control and Prevention reports that an increasing injury trends due to identified illness cluster and unconfirmed illnesses have been observed among the workers involved in PDR (CDC, 2006) which proves that Construction Workers at PDR sites are exposed to illnesses, both identified and unidentified.

### *2) Participation of Community People*

It has been observed in many cases that after natural disasters, there is a huge lack of construction workers to initiate the reconstruction process. This deficiency is usually met in three ways in a disaster-affected area e.g. participation of community people in PDR, use of unskilled workers and importing workers from nearby countries. Though participation of community people in PDR has always been encouraged by the governments, NGOs and scholars, it has its own risks and challenges. (Davidson, Johnson, Lizarralde, Dikmen, & Sliwinski, 2007) expressed their concern regarding the little knowledge and applicability of this solution to the shortage of workers during the PDR phase. Community people without the required knowledge or skill of construction are always vulnerable and exposed to hazards. It is also worthwhile to mention that most of these community people who participate in reconstruction works are also disaster survivors as well. Working at the PDR sites, confronting their own devastated homes and the dead bodies of their own people, often lead them to Post-Traumatic Stress Disorder (PTSD) and Depression. It has also been observed that PTSD often leads the sufferer to suicidal attempts (Wang, Chan, Shi, & Wang, 2013). Moreover, construction work has been identified to be one of the most stressful work both physically and mentally. The stress and trauma increase the possibility and probability of accidents for construction workers at workplaces and when it comes to PDR works, it becomes more significant.

### *3) Use of Unskilled Workers*

While we are talking about the risks associated with the participation of community people in reconstruction projects, the hired/appointed construction workers are also prone to hazards/fatalities no less than the community people due to lack of skill, experience or knowledge of working at PDR projects. Construction workers can be divided into three categories based on their required skill set e.g. Unskilled Workers, Semi-skilled Workers and Skilled Workers. Generally, skilled workers are involved in specific works that require skill or decision making the ability to some extent whereas semi or unskilled workers are involved in works that do not require skill or decision-making ability. Following a study where 100 construction accidents were analyzed, it is seen that even semi-skilled and skilled workers were involved in 60% of the accidents due to the nature and complexity of the construction work (Haslam et al., 2005). During the PDR phase, shortage of skilled workers and the use of unskilled have been identified in the media and in scholarly articles as well. Moreover, after a major natural disaster and heavy loss of structures, the main focus moves to the faster restoration of structure and temporary shelters and shifting the affected people to their shelters. To accelerate the restoration process, a high inflow of financial aid for the reconstruction

projects get in from ally nations, NGOs, INGOs. In response to the disasters and loss of homes, many international organizations e.g. Red Cross and World Bank come forward with funds to help the nations to overcome. Majority of the World Bank's PDR loans are used for housing reconstruction in affected areas. As a result, the government and construction companies urges to build as many structures as early as possible (United Nations, 2015) resulting in 'Building Back Faster' syndrome. Because of that, they compromise with the construction workers' skills and expertise thus overall health and safety. With less skilled work force, they became more exposed to construction hazards. This scenario of using less or unskilled workforce due to lack of skilled workers has been observed after the tsunami in Aceh and Sri-Lanka 2004, (Kennedy, Ashmore, Babister, & Kelman, 2008) Nepal Earthquake 2015 (The Himalayan Times, 2017) and Haiti Earthquake 2010 (GFDRR, 2014). It is true that after a disaster, emergency action and attention are required at the affected area and there is usually no time to hire and appoint skilled work force but addressing this issue and preparing the construction workers and even the community people to some extent will definitely help to solve the issue.

### *4) Importing Workers*

Importing workers from other countries is an ancient theory, which has been practiced for centuries in this world. One of the main reasons of importing construction workers is cost reduction since workers' cost accounts for 30-60% of the total cost of construction (Hanna, Peterson, & Lee, 2002). However, during the PDR phase, shortage of construction workers is the main reason for importing construction workers from nearby countries (Fletcher, Pham, Stover, & Vinck, 2006). However, it is often observed that imported workers have been subjected to exploitation in terms of wages, facilities and also safety equipment (Lyons, 2009). After the hurricane Katrina, it has been observed that most of the construction workers for reconstruction works were immigrants, both documented and undocumented. It has been reported that those workers were exploited by their employers thus exposing them to more construction hazards by not providing enough safety training and safety equipment. According to OSHA, Personal Protective Equipment (PPE) is one of the most effective ways to deal with many construction hazards and the use of PPE is required by OSHA standard as well. About 2 million workers at risk of work-related injuries each year of which 25% are head, eyes, eyes, hands and feet related which can be protected using PPE (OSHA, 2016). Construction workers are at great risk if they do not use PPE or they use damaged PPE. Absence of PPE or not using PPE has been identified as one of the major factors for Construction accidents in the literature over the years (Williams, Adul Hamid, & Misnan, 2018). Not only PPE, but equipment without safety devices are also a major reason of construction accidents (Abdul Rahim, Muhd Zaimi, & Bachan, 2008). On top of that, because of being foreigners they had difficulty understanding the language of instruction, safety signs on devices and communicating at PDR projects (Fletcher et al., 2006). It has also been noted that imported/migrant workers suffer from febrile illness where febrile illness refers to the known sickness (such as fever) but with unknown or unidentified cause. And they are more prone to occupational hazards and health issues than local workers (Ahonen, Benavides, & Benach, 2007).

This literature study shows there are several factors, both common and unique, that contribute to the health and safety of PDR workers. Among the common, the factors 'use of unskilled workers', 'lack of PPE', and 'lack of training' are the major ones but they have their own background and significance in terms of PDR. Authors believe the traditional way or technique may not be well enough to address the aforementioned issues of PDR projects. Through the literature review, a few factors are also identified that are unique to regular construction and contribute to the health and safety of the construction workers at PDR projects. Among them, 'exposure to hazardous and contaminating debris', 'building back faster syndrome', 'imported workers', 'post-traumatic stress disorder' are a few of the major contributing factors that are not usually seen in the regular construction projects.

## Conclusion and Future Works

Natural Disasters affect human life in many ways and one of the major aspects of them is health and safety. Workers involved with PDR projects are the most exposed to fatal hazards in a substantial way. Unfortunately, no distinct study has been done so far on this topic neither any specific data is available for PDR projects regarding fatality of construction workers. Although many aspects of PDR have been moderately studied and analyzed over the past years (Yi & Yang, 2014), the construction workers' safety has been untended to be considered as a distinct theme of research. No major articles or studies have evaluated the health and safety of construction workers' at PDR projects whereas the safety of construction workers' at regular construction projects has been extensively studied. On top of

that, no significant research has been done so far on the differences or similarities between regular construction projects and PDR projects. However, this literature paper shows that many researchers have noted the significance of PDR in terms of health and safety of construction workers. Studying PDR on the context of construction workers' health and safety can lead to some effective measures that will contribute to reducing the fatality rate in PDR projects and in the construction industry overall. This literature review paper signifies the need for attention and research in this area of interest.

Authors intend to continue studying the differences between regular construction and PDR in terms of health and safety to establish the lines of demarcation. A further study is also required to identify factors affecting the health and safety of construction workers at PDR projects through factor analysis. After identifying specific factors affecting the health and safety of construction workers, qualitative analysis of the factors will be done to find out the significance of each contributing factors. Authors also intend to conduct interviews with different stakeholders of PDR projects to acquire different perspectives on the issue. After recording the semi-structured interviews, data will be coded, condensed and analyzed to understand the concept of constructing knowledge about the interrelated issues and deep structure of the data. This analysis will also facilitate the construction of relational networks by identifying the content and structure of respondents' opinions.

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