# ENHANCING CONSTRUCTION WORKERS' CAPACITY IN THE IMPLEMENTATION OF CEMENT CONCRETE ROAD WORKS IN THE ASPECTS OF PLANNING, EXECUTION, AND OCCUPATIONAL HEALTH AND SAFETY

**NABILA[1*], Sylvia INDRIANY[2], Widodo Budi DERMAWAN[3], Erlangga Rizki FITRIANSYAH[4], Agus SUPIYAT[5]**
[1,2,3,4] ***Universitas Mercu Buana, Jakarta, INDONESIA***
[5]***Tunas Engineering, INDONESIA***
[*]***nabila@mercubuana.ac.id***

## ABSTRACT

This *community service* initiative aimed to enhance the capacity of construction workers in performing cement concrete road projects by strengthening three essential domains: technical planning, construction execution, and occupational health and safety (OHS). The methodology consisted of training sessions and interactive discussions held with a group of construction workers in Menes District, Pandeglang Regency. Evaluation of the program revealed improvements in participants' understanding of standard operating procedures, the importance of technical preparations, and the application of OHS principles in cement concrete road construction. It is anticipated that this initiative will contribute to the enhancement of the quality of concrete road infrastructure delivered by the local construction workforce.

**Keywords:** Cement Concrete Road, Capacity Building, Construction Workers, Occupational Health and Safety, Training

## 1. INTRODUCTION

Pandeglang Regency is located in Banten Province, at the westernmost tip of Java Island. The region borders Serang Regency to the north, Lebak Regency to the east, and the Indian Ocean to the west and south. Geologically, Pandeglang is an earthquake-prone area due to the presence of two active faults—the Cimandiri Fault and the Lembang Fault—and is also influenced by volcanic activity from Mount Anak Krakatau.

Indonesia itself lies at the convergence of four active tectonic plates: the Pacific Plate, the Indo-Australian Plate, the Eurasian Plate, and the Philippine Sea Plate. It is part of the Pacific Ring of Fire, a region containing hundreds of active faults both on land and beneath the sea. This tectonic setting allows for the discovery of new faults in various areas, including in Banten Province, such as the Baribis Fault (see Figure 1).


Figure 1. Cimandiri Fault, Lembang Fault, and Baribis Fault location

In Pandeglang Regency, there are extensive Quaternary deposits, including coastal, fluvial, and swamp alluvium that are loose, soft, and unconsolidated, which further increases the region's vulnerability to earthquakes. Seismic

shaking tends to be more intense in areas with soft soil, ultimately heightening the risk of building damage and casualties.

According to data from the Ministry of Public Works and Housing (see Figure 2), during earthquakes, non-engineered buildings are the most frequently damaged structure type. The Meteorology, Climatology, and Geophysics Agency (BMKG) attributes the primary causes of such damage to the proximity of structures to the earthquake epicenter, the presence of soft soil conditions, and the limited application of earthquake-resistant building standards. Most injuries and fatalities are not caused directly by seismic shaking, but rather by falling objects or collapsing buildings.


Figure 2. Impact of the 2018 Earhquake on Building Damage(4)

This fact indicates that public understanding—particularly among construction workers in Pandeglang—of earthquake-resistant construction principles remains very limited. Yet, these workers play a critical role in building homes and public facilities such as schools, community health centers, and other basic infrastructure, including roadworks in Pandeglang and its surrounding areas.

Figure 3 shows building damage caused by foundation failure during the Pandeglang earthquake of 24 February 2024, while Figure 4 illustrates road damage resulting from the earthquake of 14 January 2022. Although specific data on the impact of earthquakes on road damage are not explicitly reported, the condition of road infrastructure in Pandeglang had already been a matter of concern even prior to these seismic events

Figure 3. Building Damage Due to Foundation Failure During the Pandeglang Earthquake, 24 February 2024

Figure 4. Example of Road Damage Caused by the Pandeglang Earthquake, 14 January 2022

Based on data from Pandeglang Open Data 2024, the condition of roads in Pandeglang Regency for the years 2021–2024 is presented in Table 1. The table indicates a decline in the proportion of roads classified as being in "good condition" (*jalan mantap*) in 2023 compared to the previous year. This decline reflects an increase in the number of severely damaged roads, which may be attributed to earthquakes, unstable soil conditions, and limited budgets for road maintenance and repair. Road damage has a direct impact on various aspects of community life, including road user safety and access to educational and economic facilities.

Table 1. Road Condition Statistics for Pandeglang Regency, 2021–2024

| Year | Total Road Length (km) | Good Condition Road Length (km) | % Good Condition |
|---|---|---|---|
| 2021 | 723,03 | 449,03 | 62,10 |
| 2022 | 723,03 | 511,72 | 70,80 |
| 2023 | 723,03 | 495,33 | 68,50 |
| 2024 | 723,03 | N/A | |

Source : Pandeglang Open Data, 2024

As part of its improvement efforts, the Government of Pandeglang Regency has launched the JAKAMANTUL (*Jalan Kabupaten Mantap Betul*) program, one of which includes road concreting projects. Concrete pavement is considered more resilient to unstable soil conditions and can improve community accessibility more rapidly. The program also generates employment opportunities for local construction workers. Consequently, capacity building for these workers is essential to enable their optimal participation in infrastructure development.

Occupational safety in construction plays a critical role in ensuring worker well-being, project continuity, and the sustainability of development outcomes. Effective implementation of safety measures can prevent accidents, ensure compliance with regulations, and foster trust among stakeholders. In road construction projects, workplace safety also ensures efficiency, timely completion, and adherence to technical standards.

Unfortunately, most construction workers in Pandeglang have only completed elementary or junior high school education, have never received training on construction in accordance with the Indonesian National Standards (SNI), and are unfamiliar with the importance of accounting for seismic risks. Typically, the construction of simple houses does not involve technical planners or civil engineers but is carried out by workers coordinated by a foreman.

Similarly, in road projects, many workers remain unfamiliar with the criteria and techniques for constructing cement concrete roads in accordance with PdT 05-2004: Guidelines for the Implementation of Cement Concrete Pavement and other relevant standards. Therefore, enhancing workers' technical capacity in earthquake-resistant building practices and cement concrete road construction is crucial.

Given the growing predominance of concrete roads over asphalt roads in Pandeglang, this training and outreach program will focus on improving the ability of construction workers to build cement concrete roads that meet established standards and are resilient to seismic risks.

## 2. METHOD

Based on the identified situation, the main challenges faced by the partner community are as follows:

1. **Limited Knowledge of Road Construction in Earthquake-Prone Areas**
   Most construction workers lack access to information and training on construction techniques suitable for earthquake-prone regions. This lack of knowledge leads them to continue using conventional methods that may not meet safety standards for such areas.
2. **Insufficient Training and Support from the Government**
   To date, no specialized training has been provided to the community of construction workers to improve their skills in building stronger, disaster-resilient structures. Without adequate training, it is difficult for them to adopt safer, modern construction techniques.
3. **Location in a Seismically Hazardous Region**
   Pandeglang Regency is frequently affected by earthquakes due to the presence of two active faults. Structures that do not take seismic risks into account are highly vulnerable to severe damage and economic losses.
4. **Limited Access to Comprehensible Learning Resources**
   With most workers having only completed elementary or junior high school education, they often struggle to

understand technical information presented in theoretical form. A more practical and hands-on educational approach is needed.

5. **Low Awareness of Construction Safety Standards**
   Many workers are still unaware of the importance of occupational safety and continue to use construction practices that do not comply with Occupational Health and Safety (OHS) standards.

**Implementation Methodology**

The activity began with coordination involving local stakeholders, such as village officials and the head of the construction workers' community, to identify specific needs. Since the target participants were construction workers from Pandeglang, the implementation was carried out at the campus of Mathla'ul Anwar University of Banten (UNMA), serving as the local higher education partner.

| No | Stages | Description |
|---|---|---|
| 1 | **Preparation and Coordination** | ➢ Conduct an initial meeting with partner stakeholders to determine specific training needs related to cement concrete road construction and Occupational Health and Safety (OHS).<br>➢ Prepare the training materials. |
| 2 | **Training on Basic Principles of Safe Road Construction in Earthquake-Prone Areas** | ➢ Use a theoretical module on the basic principles of safe cement concrete road construction in earthquake-prone areas, supplemented with real-world case studies. |
| 3 | **Training on Construction Safety Procedures and Standards** | ➢ Apply safety, health, sustainability, and security standards, accompanied by practical examples of their field implementation. |
| 4 | **Training on Construction Safety Procedures and Standards** | ➢ Provide direct training to participants on how to identify and mitigate potential hazards at cement concrete road construction sites.<br>➢ Conduct hands-on training in the use of personal protective equipment (PPE) through simulations to help participants understand the importance of personal protection in construction projects. |
| 5 | **Training on the Use of Materials and Construction Techniques Suited to the Geological Conditions of Pandeglang** | ➢ Deliver practical training on selecting and applying materials and construction techniques suitable for the geological conditions of Pandeglang.<br>➢ Provide reinforcement bar (rebar) installation training. |
| 6 | **Monitoring and Evaluation** | ➢ Evaluate the program's effectiveness through surveys, interviews, and on-site monitoring. |

Figure 5. Implementation of the Construction Worker Training Program

**Partner Participation**

**PT Tunas Engineering, as the main partner**, played the following roles:

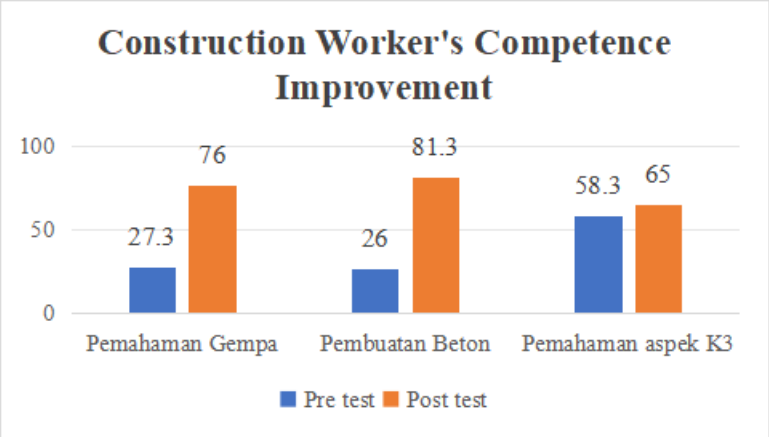
1. Preparing the statement of willingness to collaborate as a partner and fulfilling administrative requirements.
2. Providing training equipment related to the application of technology.

**Civil Engineering Study Program, UNMA, as the higher education/university partner**, played the following roles:

1. Contacting and gathering local construction workers.
2. Providing the training venue.
3. Assisting in the implementation of the training, both as instructors and in managing accommodation arrangements.
4. Involving students in the outreach activities as guest participants to broaden their knowledge.

## 3. RESULTS AND DISCUSSION

The effectiveness of the activity was evaluated through pre-tests and post-tests. The evaluation results indicated a significant improvement across all aspects of the material delivered.




Gambar 7. Hasil Evaluasi Pelatihan Tukang
Figure 7. Evalutaion Result of the Construction Worker Training Program

**Understanding of Earthquakes**
Understanding increased to 76% from 27.3%, particularly in grasping the causes, types of structural damage, and risk mitigation through construction practices.

**Cement Concrete Roadwork**
Understanding increased to 81.3% from 26%. Participants gained knowledge of the stages of road construction, from subgrade preparation to pavement finishing.

**Occupational Health and Safety (OHS)**
Understanding increased to 65% from 58.3%. Prior to the training, most participants were unaware of the importance of personal protective equipment (PPE), safety signage, and safe work procedures. After the training, participants were able to identify potential hazards and apply basic OHS principles.

Overall, the practice-oriented training approach proved effective in enhancing both the technical understanding and safety awareness of construction workers. This activity has had a positive impact on the quality of local human resources engaged in road construction within disaster-prone areas.

## 4. CONCLUSION

This training program successfully enhanced the capacity of construction workers in implementing cement concrete road projects, particularly in the areas of planning, technical execution, and the application of Occupational Health and Safety (OHS) principles. The significant improvement in participants' understanding demonstrates that practice-based, collaborative, and context-specific training methods are highly effective when applied within construction worker communities. It is hoped that similar initiatives can be expanded to other regions with comparable geological characteristics and high disaster exposure, as part of broader efforts to improve national infrastructure quality and construction safety.

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## 5. REFERENCES


Setyaningrum P. Mengenal 10 Sesar Aktif di Indonesia, dari Sumatera hingga Papua. kompas.com. 2022.

Wirachmi A. Fakta Sesar Cimandiri Pemicu Gempa di Jawa Barat yang Terbentuk Sejak Jutaan Tahun Lalu. inews.id. 2022.

Antaranews. Badan Geologi: Gempa Banten akibat aktivitas sesar aktif [Internet]. antaranews.com. 2022. Available from: https://www.antaranews.com/berita/3169041/badan-geologi-gempa-bantenakibat-aktivitas-sesar-aktif

Desiana V, Nabila. Penyuluhan Membangun Rumah Tahan Gempa Untuk Elemen Masyarakat Kecamatan Kembangan, Jakarta Barat. 2021.

Aini N, Febriyan A. BMKG Ungkap 3 Faktor Penyebab Kabupaten Pandeglang Terdampak Gempa Terparah. https://news.republika.co.id/. 2022.

Update Gempa Banten: 200 Bangunan Rusak di Seluruh Wilayah Terdampak [Internet]. Available from: https://regional.kompas.com/read/2019/08/03/12171241/update-gempa-banten-200-bangunan rusak-di-seluruh-wilayah-terdampak

https://tirto.id/wagub-banten-bangunan-dan-jalan-rusak-akibat-gempa-64-sr-cDFf13

PdT 05-2004 tentang Pelaksanaan Pekerjaan Perkerasan Beton Semen.Pustrans Balitbang PU, 2004.

Drajad, K, " Sistem Manajemen Keselamatan Konstruksi (SMKK)", Pembekalan Kompetensi Tambahan Pergururuan Tinggi Bidang Konstruksi, 12 September 2024

Departemen Pekerjaan Umum Direktorat Jendral Bina Marga, "Pedoman Pelaksanaan Keselamatan dan Kesehatan Kerja (K3) Untuk Konstruksi Jalan dan Jembatan", Bina Marga 2006

Herlambang FS, Purnawirati IN, Ardika IN, Intara IW, Suasira W, Jaya IM. Peningkatan Pengetahuan Serta Keterampilan Penulangan dan Pengecoran Pada Masyarakat Candi Kuning, Tabanan, Bali. Mitra Akademia: Jurnal Pengabdian Masyarakat. 2023 Dec 16;6(3):401-7.