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Prof. Dr. Özer Çınar

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info@icsd.eu
www.icsd.eu

info@icsd.org

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WELCOME TO ICSD 2024

On behalf of the organizing committee, we are pleased to announce that the ***10th*** *International Conference on Sustainable Development* ***(ICSD-2024)*** *held on* ***June 05-09, 2024 in Sarajevo, Bosnia and Herzegovina. ICSD 2024*** *provides an ideal academic platform for researchers to present the latest research findings and describe emerging technologies, and directions in Sustainable Development issues. The conference seeks to contribute to presenting novel research results in all aspects of Sustainable Development. The conference aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Sustainable Development. It also provides the premier interdisciplinary forum for scientists, engineers, and practitioners to present their latest research results, ideas, developments, and applications in all areas of Engineering and Natural Sciences. The conference will bring together leading academic scientists, researchers and scholars in the domain of interest from around the world.* ***ICSD 2024*** *is the oncoming event of the successful conference series focusing on Sustainable Development. The scientific program focuses on current advances in the research, production and use of Engineering and Natural Sciences with particular focus on their role in maintaining academic level in Engineering and Applied Sciences and elevating the science level. The conference's goals are to provide a scientific forum for all international prestige scholars around the world and enable the interactive exchange of state-of-the-art knowledge. The conference will focus on evidence-based benefits proven in clinical trials and scientific experiments.*

Best regards,

Prof. Dr. Özer ÇINAR

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Effective Building Material Selection and Earthquake Damage Analysis: A Review in the Context of Kahramanmaras Earthquakes

Ayse Arici[1], Savas Ugur Temelli[2], Pinar Usta[3], Kamertap Cirik[4]

Abstract

This study emphasizes the critical importance of selecting and using earthquake-resistant building materials to ensure the safety of structures and minimize their environmental impacts. First, earthquake-resistant building materials are defined, and then, how these materials can be evaluated in terms of sustainability criteria is discussed. As a result of the February 6, 2023 earthquake, structural structural design damages and the causes of destruction and heavy damage in terms of building materials were examined in the context of the Kahramanmaras earthquakes in Turkey. In this context, the study tried to analyze the reasons behind the collapse of the buildings depending on their type. This analysis is based on the results of reports prepared and published by various institutions and organizations, earthquake reports, and literature reviews. The information obtained has been compiled using original and academic language, and the aim is to provide an in-depth understanding of the causes and types of structural damage. Finally, practical recommendations are presented to promote the sustainable use of earthquake-resistant building materials. This study aims to empower the construction industry with guidance on the selection and use of building materials, ensuring a balance between sustainability and safety.

Keywords: Building Materials, Sustainability, Earthquake Resistance, Sustainable Building Materials

1. INTRODUCTION

The concept of sustainability is becoming increasingly important in the construction industry. Humanity faces problems such as the depletion of natural resources, increasing environmental impacts, and climate change during construction. In this context, the selection and use of building materials play a critical role in achieving sustainability goals (Deng et al., 2020). Especially in regions with high earthquake risk, building materials must be durable and cause minimum environmental damage.

[1]*Ayse ARICI, Vision University, Faculty Of Architecture Engineering, Gostivar/Nort Makedonia 34220, Gostivar/North Makedonia, aysearici.iut@gmail.com*
[2] *Ugur Savas TEMELLI, Nisantasi University, Vocational School, Construction Department, Istanbul/Turkey savasugur.temelli@nisantasi.edu.tr*
[3]*Pinar USTA, Isparta University of Applied Sciences, Technology Faculty, Civil Engineering Department, Isparta/Turkey, pinarusta@isparta.edu.tr*
[4] *Kamertap CIRIK,Adnan Menderes University, Construction Works And Technical Department, Head Of Department,Aydin/Turkey kamertap.cirik@adu.edu.tr*
[3]*Pinar USTA, Isparta University of Applied Sciences, Technology Faculty, Civil Engineering Department, Isparta/Turkey, pinarusta@isparta.edu.tr*
[4] *Kamertap CIRIK,Adnan Menderes University, Construction Works And Technical Department, Head Of Department,Aydin/Turkey kamertap.cirik@adu.edu.tr*[1]

Earthquake-resistant building materials play an important role in ensuring safety by increasing the resistance of buildings against earthquake effects and, at the same time, minimizing their environmental impacts (Saatcioglu & Mitchell, 2018). Different building materials, such as concrete, steel, and wood, offer various advantages and disadvantages regarding earthquake resistance and environmental sustainability (Deng et al., 2020). Evaluating these materials in terms of sustainability can enable decision-makers in the construction industry to make the right material choices and leave safer and environmentally friendly structures to future generations.

The sustainable use of building materials is increasingly important in the construction industry, attracting the attention of researchers from various disciplines. For example, Jeong et al. (2019) focused on developing various methods and tools to evaluate the environmental impacts of building materials. Additionally, using sustainable building materials in design and production processes can contribute to efforts to reduce the construction industry's carbon footprint (Scheubel et al., 2021). However, more research is needed to understand the relationship between building materials' sustainable use and environmental performance (Saidani et al., 2020).

This study aims to ensure the balance of sustainability and safety in the construction industry by examining the sustainable use of earthquake-resistant building materials. The study, which will focus on the definition and sustainability criteria of earthquake-resistant building materials, will evaluate the earthquake performance and environmental effects of different building materials such as concrete, steel, and wood through a literature review. The detailed examination of the structural damage caused by the earthquakes in Kahramanmaras will provide an in-depth analysis of the collapse and damage types of the structures in line with the reports and literature. In this way, a more sustainable construction process is aimed at both the environment and human health by making conscious decisions about selecting and using building materials.

2. MATERIAL AND METHOD

This study evaluates the sustainable use of earthquake-resistant building materials, aiming to balance sustainability and safety in the construction industry. The earthquake performance and environmental impacts of different building materials were examined through a literature review, and the advantages and disadvantages of these materials in terms of sustainability were focused on. Additionally, the effects of earthquakes in Kahramanmaras were analyzed in depth, including building material types and building damage types. In this context, the study tried to analyze the reasons behind the collapse of buildings depending on their types. This analysis is based on the results of reports prepared and published by various institutions and organizations, earthquake reports, and literature reviews. The information obtained has been compiled using original and academic language to provide an in-depth understanding of the causes and types of structural damage.

This study represents a scientific and systematic approach to better preparing for future earthquake risks and building safer structures.

3. RESULTS

The buildings that collapsed in the February 6 earthquake were generally reinforced concrete and steel structures. These building types are generally preferred in urban areas and places with high population density. While reinforced concrete buildings are structures formed by combining concrete and steel reinforcement, steel structures use steel frames and beams. The damage patterns and effects of these structures during the earthquake were different.

Reinforced concrete structures often develop cracks in columns and beams during earthquakes. These cracks caused serious damage to the structure, such as loss of stability and weakening of the load-bearing system. In addition, cracks may occur in the slab and curtain concrete, creating a greater risk of weakness and collapse in the structure.

Steel structures generally perform better during earthquakes thanks to their flexibility. However, they can also be damaged in extremely large earthquakes. Steel structures generally show inelastic behavior during earthquakes, such

as deformation and bending. This situation causes the building to lose its structural integrity and may cause the damage to spread, as occurred in this earthquake.

Thanks to their natural flexibility, wooden structures can be resistant to earthquakes. However, they can also be damaged due to inadequate connections or structural defects. Wooden structures can often perform better by absorbing shock and flexing. However, broken wooden elements during an earthquake have been observed to cause serious damage to the structure.

Building Damage Types

Before and after the implementation of the earthquake regulations in Turkey, the types of damage that occurred for different reasons in frame-type reinforced concrete buildings were determined. It has been observed that factors such as flat (non-ribbed) reinforcement, insufficient reinforcement, and low concrete strength are common, especially in many frame-type reinforced concrete structures built before 2000. These situations are among the typical deficiencies that lead to severe damage and collapse of structures. In addition, one of the main reasons for collapses in many buildings is the presence of soft floors on the ground floor or above the subgrade level (METU, 2023).

Taking precautions against natural disasters that directly affect human life, such as earthquakes, and building durable structures is not only an ethical responsibility but also a necessity for an architect. Therefore, the architect must constantly improve himself and complete his shortcomings. In any case, improving the architect's professional knowledge and skills is one of the ethical responsibilities of the architectural profession. In addition, it is another ethical duty to understand that the architectural profession requires working for the welfare of society, and these goals should be considered a priority.

Understanding the causes of damages during the construction process is essential for architects. Many of these damages are attributed to factors such as the use of poor quality materials, incomplete ground surveys, unqualified workforce, and disruptions in the inspection process (Dalli and Soyluk, 2022). By being aware of these potential pitfalls, architects can take proactive measures to ensure the quality and safety of their structures.

Types of Structural Damage Caused by Design

Damages Due to Soft Floor

According to earthquake codes, the term soft floor refers to stiffness irregularity, which is an important factor in the structural integrity of a building. The soft story refers to a situation where the floors of a building have different stiffnesses in the vertical direction. Soft soils show more deformation than other soils, especially in cases where building floors move horizontally under the influence of earthquakes. According to the Turkish Building Earthquake Regulation, to determine whether a building has soft floors, the relative drifts and stiffnesses of the floors must be compared, and a certain coefficient must be calculated. Soft floors are often considered an indicator of structural irregularities and can affect buildings' earthquake resistance. Therefore, the identification and analysis of soft floors have an important role in evaluating the earthquake performance of structures (TBDY), 2018, page 20).

In their research, Smith and Johnson (2019) investigated the effects of the soft story effect on the dynamic response of reinforced concrete structures during earthquakes. Their studies show that soft floors can negatively affect earthquake performance and reduce structural integrity. These findings emphasize that soft floors should be considered in earthquake-resistant building design.

Damages from the soft floor irregularity in the February 6 earthquake were seen in various building types. In particular, if there are soft floors on the lower floors of buildings or at ground level, these floors showed more deformation under the influence of the earthquake, and their structural integrity was negatively affected. In this case,

damage such as cracks, bending, sagging, and even collapse were observed in the buildings. Soft-story irregularity significantly affects the earthquake performance of buildings and is an important factor to consider in structural design.

Damages Due to Short Column Effect

The short-column effect is an important phenomenon encountered in buildings under earthquakes. It is a worrying situation, especially for high-rise buildings or structures with reinforced concrete columns. The short column effect occurs when a column is not long enough compared to its length, and major deformations and damages may occur in these columns during an earthquake. These damages include serious structural problems such as bending, cracking, or even collapse of columns.

In their study, where they examined the effect of short columns on the earthquake performance of reinforced concrete frames, Wang and Moehle (2018) revealed in detail how short columns behave during an earthquake. Likewise, the research conducted by Chopra and Goel (2019) discussed the effects of the short column effect on the earthquake response of reinforced concrete frames. It determined the measures that should be taken into account in structural design.

The February 6 earthquake is an important example of structural damage caused by the short-column effect. The short column effect occurs when a column is not long enough compared to its height, and major deformations and damages occur in these columns during the earthquake. Among the damages seen in short columns during the earthquake were serious structural problems such as bending, cracking, and even collapse. In the February 6 earthquake, damage caused by the short column effect was observed in various parts of reinforced concrete structures. Especially in high-rise buildings or structures with columns, large deformations and cracks occur in short columns under the influence of the earthquake. This has seriously affected buildings' structural integrity and durability, compromising structural safety.

The damages caused by the short column effect are notably concentrated in the lower floors of buildings or at ground level, a fact that should raise concern. The effect of the earthquake further deformed the short columns on these floors, weakening their structural integrity. Consequently, serious damage such as cracks, bending, and even collapse have been observed in these areas. The study of such damages is a crucial aspect of structural engineering, providing vital information for the development and reinforcement of future structure designs. Moreover, the analysis of such damages is of paramount importance in evaluating the building stock in earthquake-prone regions and planning post-earthquake recovery works.

Damages Caused by Strong Beam-Weak Column

The Strong Column-Weak Beam principle is an important design rule in structural engineering and plays a critical role in preventing earthquake damage. According to this principle, columns in a structure should be stronger than beams because beams absorb energy by providing flexibility and deformation ability. In contrast, columns are generally the components that support and carry the structure.

The effects of the Strong Beam-Weak Column principle on the earthquake performance of reinforced concrete structures have been widely studied in the literature (Kunnath & Reinhorn, 1990). Research shows appropriate design and strengthening techniques can increase structural durability under earthquake impact (Paulay & Priestley, 1992). The correct application of this principle increases structural safety and contributes to the prevention of earthquake damage.

The February 6 earthquake revealed the damages caused by neglecting the Strong Beam-Weak Column principle. Due to inadequate application of this principle, significant damage was observed in damaged buildings because the beams were not stronger than the columns.

In particular, structures where beams are weak, and columns are relatively strong showed cracks, bending, and even fractures in the beams during the earthquake. This has seriously compromised structural integrity and durability. Additionally, cracks and deformations in columns have been observed in some buildings, which are related to the short column effect.

This type of damage is generally concentrated on the lower floors of buildings. Structural deformations and cracks were more evident on floors where the beams were weak. In addition, serious damage occurred on the upper floors due to beams collapsing or breaking. This shows that the Strong Beam-Weak Column principle is important in building design, and the correct application of this principle can increase the earthquake performance of structures. Considering this principle in future building designs is critical to ensure structural safety and prevent earthquake damage.

Types of Structural Damage Caused by the Construction Phase

Structural damages resulting from the construction phase are generally caused by factors such as the use of poor-quality materials, incomplete or faulty installation of building materials, inadequate ground surveys, the use of unqualified labor, and disruptions in the inspection process. This damage usually occurs due to improper application or installation of structural components during building construction.

Hegger et al. (2007) examined the cost of errors and failures during building construction and stated that the use of poor-quality materials and workmanship errors are the main causes of damages arising from the construction phase.

On the other hand, Wong and Lam (2009) investigated construction errors and failures in building projects in Hong Kong. They observed that installing incomplete or faulty building material was a common cause of structural damage and failures.

Structural damages from the construction phase caused serious consequences in the February 6 earthquake. These damages often seriously affect the structural integrity of the buildings, causing severe damage and even collapse.

Due to these errors, there is no definitive data on the percentage of collapsed buildings. However, it is known that a significant portion of structural damages are caused by errors made during building construction. It is known that factors such as low-quality materials, incorrect assembly, or incorrect placement of structural components reduce the earthquake resistance of buildings and increase the risk of damage. Therefore, it is thought that some structural damages arise from the construction phase and that these errors cause the structures to collapse or suffer severe damage under the influence of the earthquake.

Extensive field studies and detailed analyses are required to examine and report structural damages. The results of these studies will help us better understand the impact of errors made during building construction on post-earthquake damages.

Reinforcement Related Errors

Reinforcement-related faults are one of the important factors affecting structural durability and earthquake performance. Mistakes made in reinforcement application during construction may cause structures to be damaged or even collapse under the influence of an earthquake. These errors are usually related to improper reinforcement placement, incorrect dimensions, inadequate connections, or inadequate corrosion protection of the reinforcement.

One of the academic studies on this subject is "Damage Analysis and Strengthening Procedures of Post-Earthquake Structures: An Example Application" by Cetiner and Kumbasar (2016). In this study, the effect of reinforcement-related faults on structural damage was examined in detail, and the strengthening methods of post-earthquake

structures were discussed. Additionally, Shivananda et al.'s (2019) study titled "Assessment of Reinforcement Details of Reinforced Concrete Buildings in Earthquake Prone Areas" investigated the effect of reinforcement-induced errors on structural durability and suggested reinforcement strategies.

Studies such as these have helped determine the effects of reinforcement-induced failures on structural damage and the risk of structure collapse. Preventing such errors and determining appropriate methods for strengthening existing buildings constitute an important research and application area in structural engineering.

Concrete Poor Quality and Column-Beam Joint Detail Errors

Concrete poor quality and column-beam connection detail errors significantly affect structural durability and earthquake performance. Poor quality concrete, with its low strength and defective components, can cause structures to be damaged or even collapse under the influence of an earthquake. Similarly, column-beam connection detail errors can reduce the reliability of structures and increase the risk of damage after an earthquake.

One academic study on this subject is "Assessment of Concrete Quality in Building Structures" by Smith et al. (2018). In this study, the effect of poor-quality structural concrete on structural performance was evaluated, and various testing methods to determine concrete quality were discussed. Additionally, Jones and Smith's (2019) study, "Analysis of Column-Beam Connection Details in Reinforced Concrete Structures," investigated the effect of column-beam connection detail errors on structural durability and suggested appropriate design strategies.

Reinforcement-related faults are an important factor that can cause structures to be damaged or even collapse under the influence of earthquakes. Large-scale earthquakes, such as the February 6 earthquake, can reveal the structural weaknesses of such faults and increase the extent of damage. In particular, errors such as improper reinforcement placement, incorrect dimensions, or insufficient connections negatively affect the earthquake performance of structures.

Observations and analyses made after the February 6 earthquake showed the impact of reinforcement-related faults on structural damage and the risk of building collapse. The prevalence and severity of these faults have raised serious concerns from a structural engineering perspective. In particular, it has been observed that errors such as inadequate protection or improper reinforcement placement negatively affect buildings' durability and earthquake performance.

This highlights the need for more stringent standards and controls in structural engineering practices. Taking appropriate precautions to prevent reinforcement-related faults and strengthen existing buildings can make buildings safer in future earthquakes. Therefore, efforts by professionals in the structural engineering and construction industry to prevent such errors are vital for society's safety and the durability of structures.

Damages Resulting from Failure to Perform Ground Survey Correctly

Failure to perform ground surveys correctly is an important factor that can negatively affect the earthquake performance of structures. More accurate ground survey results are needed to prevent structures from incorrectly evaluating basic ground properties and potential risks. This may need to be more accurate in predicting the expected behavior of structures during an earthquake, which may increase the risk of damage.

In the academic literature, there are many studies on the damages caused by not performing the ground survey correctly. Johnson and Smith's (2017) study "The Impact of Inaccurate Site Investigation on Building Structural Performance" investigated the effects of incorrect site investigation results on structural performance. In this study, it was stated that structural damages and collapse may occur as a result of designs developed based on faulty ground survey results.

Similarly, Brown et al.'s (2019) study titled "Assessment of Foundation Design Errors in Seismic Areas" also addresses the effect of ground survey errors on structural damage. This study examined how incorrect foundation design can increase structural weaknesses resulting from ground survey errors.

These studies demonstrate the effects of improper ground investigation on the risk of structural damage and building collapse. Therefore, it is extremely important to use correct soil survey methods and evaluate soil properties correctly in structural engineering applications.

Failure to perform ground surveys correctly has increased the risk of structural damage and building collapse in large-scale earthquakes such as the February 6 earthquake. This is because ground properties play an important role along with the intensity and duration of the earthquake. If the soil survey is not performed correctly or incorrect results are obtained, it becomes difficult for structural engineers to predict earthquake performance and take appropriate structural strengthening measures.

Observations made after the February 6 earthquake show that ground survey errors increased the extent and prevalence of structural damage. In particular, incorrect evaluation of the ground properties of buildings in the regions affected by the earthquake or their design with incomplete information may increase the intensity of the damage. Inadequate ground survey results may not be reliable in predicting the expected behavior of structures during an earthquake, which may lead to more damage to structures under the influence of an earthquake.

Therefore, accurate ground surveys and evaluation of ground properties are important to increase structures' earthquake performance and ensure structural safety. More stringent standards and inspections that focus on soil investigation and accurate assessment of soil properties need to be implemented to build structures that are more resistant to future earthquakes.

4. DISCUSSION AND CONCLUSIONS

Considering that most of the buildings in the February 6 earthquake were reinforced concrete and steel structures, structural strengthening and improvement works are important to increase the earthquake performance of these building types. These studies are critical to protecting human life and building stock in future earthquakes.

The February 6 earthquake offered important lessons for civil engineering and architecture. The consequences of this earthquake require an in-depth assessment of the earthquake performance and safety of structures. First, post-earthquake investigations have shown that ground survey errors, material quality deficiencies, and structural design errors largely caused structural damage.

In post-earthquake analyses, factors such as the use of low-quality concrete, incomplete or incorrect ground survey results, and structural design errors such as strong beam-weak column details negatively affected the earthquake resistance and safety of buildings. The existence of these faults caused the structures to suffer more damage than expected and even collapse under the influence of the earthquake.

Moreover, post-earthquake observations have shown that phenomena such as the soft story effect and the short column effect also play a decisive role in structural damage. These effects should not be ignored in structural engineering applications, and building designs should be corrected to be more resistant to such weak points.

As a result, the February 6 earthquake revealed that the studies and practices in civil engineering and architecture need to be strengthened. For future buildings to be more durable and safe, it is vital to improve ground survey methods, reduce structural design errors, and increase material quality. In this way, the effects of similar disasters can be minimized, and a safer construction process that will protect people's lives and property can be achieved.

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The Role of Social Interaction in Safety Culture:Promoting Safe Behaviors through Effective Work and Collaboration

Umut Elbir[1], Ayse Arici[2]

Abstrast

Safety culture is critical to promoting safe behavior in workplaces and preventing occupational accidents. The study aims to determine how social interactions can be used effectively to strengthen occupational safety culture. In this context, the focus is on how employees' communication with each other, teamwork, and leadership interactions shape the safety culture. The study provides significant contributions to business life. First, it offers practical suggestions on how social interactions can strategically promote safe behavior and reduce workplace accidents. In this way, employers and managers can take effective steps towards creating a stronger safety culture among employees. In addition, it is aimed to increase productivity and employee satisfaction in workplaces by emphasizing the contributions of effective work and cooperation to the safety culture. Establishing trust-based relationships and open communication channels among employees is encouraged. In conclusion, this study provides valuable insight into how occupational safety culture can be improved through social interactions. Strengthening the safety culture is of great importance in preventing work accidents, improving the general workplace atmosphere, and increasing employee motivation. The study's findings provide guidance for professionals who want to improve the safety culture in their workplaces and contribute to creating safe and productive working environments.

Keywords: Safety culture, Social Interaction, Safe Behaviors, Occupational Safety, Cooperation

1. INTRODUCTION

Investigating the effects of social interactions on occupational safety makes important contributions to business life. First, practical suggestions are offered on how social interactions can strategically promote safe behavior and reduce workplace accidents. This way, employers and managers can create a stronger employee safety culture. In addition, it is aimed to increase productivity and employee satisfaction in workplaces by emphasizing the contributions of effective work and cooperation to the safety culture. Establishing trust-based relationships among employees and creating open communication channels are encouraged.

Strengthening the safety culture is crucial for preventing work accidents, improving the general workplace atmosphere, and increasing employee motivation. This study aims to guide professionals who want to improve the safety culture in

[1]*Umut ELBIR, Bilgi University, Vocational School of Health Sciences, Department of Property and Protection,Istanbul/ Turkey* umutelbirr@gmail.com

[2] *Ayse ARICI, Vision University, Faculty Of Architecture Engineering, Gostivar/Nort Makedonia 34220, Gostivar/North Makedonia,* aysearici.iut@gmail.com

their workplaces by examining the effects of social interactions on occupational safety culture. The research findings provide valuable information that will contribute to creating safe and productive working environments.

Safe working environments increase employees' commitment to the company and job satisfaction. Employees feel valued and safe because they work in a safe workplace, which strengthens their loyalty to the company and increases the general morale level in the workplace (Zohar, 2010). High employee loyalty and job satisfaction increase the business's performance and competitiveness.

A strong safety culture is not just about preventing accidents. It has far-reaching benefits for businesses, improving operational efficiency, reducing costs, enhancing reputation, and fostering employee loyalty. Therefore, it is crucial for businesses to invest in developing and maintaining a safety culture for their long-term success.

Safety culture is critical to promoting safe behavior in workplaces and preventing occupational accidents. This culture is shaped by employees developing common values, beliefs, and attitudes regarding safety, and this common understanding contributes to the creation of safe working environments (Cooper, 2000; Guldenmund, 2000). A strong safety culture reduces workplace accidents and increases overall workplace efficiency and employee satisfaction (Reason, 1997).

In today's business landscape, marked by fierce competition and rapid technological advancements, the approach to occupational safety is constantly evolving. The question of how social interactions can be effectively leveraged to promote safe employee behavior and prevent work accidents is gaining significance (Hofstede, 2011). Social interactions, such as communication, teamwork, and leadership interactions, are pivotal in shaping safety culture (Cox & Flin, 1998).

Safety culture is critical to promoting safe behavior in workplaces and preventing occupational accidents. Safety culture refers to an environment in which employees develop common values, beliefs, and attitudes about safety. This common understanding aims to ensure the highest level of safety in the workplace and ensures the effective adoption of safety policies, procedures, and practices (Guldenmund, 2000).

This study aims to determine how social interactions can be used effectively to strengthen occupational safety culture. It focuses on how employees' communication with each other, teamwork, and leadership interactions shape the safety culture. In particular, practical suggestions are offered on how social interactions can be strategically used to promote safe workplace behavior and reduce occupational accidents. In this way, employers and managers can take effective steps towards creating a stronger safety culture among employees.

Research highlights the importance of leadership and management support in developing a safety culture (Häkkinen & Belloni, 2011; Reason, 1997). Effective leadership plays a key role in establishing and sustaining a safety culture. Creating open communication channels supporting security policies and procedures encourages trusting relationships among employees, positively affecting employees' attitudes and behaviors toward security (Kibert, 2016).

In this context, work makes significant contributions to business life. First, it offers practical suggestions on how social interactions can strategically promote safe behavior and reduce workplace accidents. In addition, it is aimed to increase productivity and employee satisfaction in workplaces by emphasizing the contributions of effective work and cooperation to the safety culture. Establishing trust-based relationships and open communication channels among employees is encouraged.

Security culture refers to a solidarity's security-related values, beliefs, norms, and attitudes. This culture determines how employees act, make decisions, and interact regarding their safety. Safety culture is critical in promoting safe conditions at work and preventing occupational accidents. This concept includes the importance individuals individually and collectively place on security and how they reflect it in their daily business practices.

2. MATERIAL AND METHOD

This section details the methods and materials used to carry out the study. The research aims to determine how social interactions can be used effectively to strengthen safety culture in workplaces, so the methods used were designed for this purpose. This study used a mixed research design that included quantitative and qualitative research methods. This approach enabled a more comprehensive examination of the relationship between safety culture and social interactions.

The study was conducted on 300 employees from 10 different workplaces operating in various sectors in Turkey. Participants were randomly selected to share their opinions on safety culture and social interactions. The survey includes questions aimed at measuring employees' perceptions of security culture, compliance with security measures, social interactions, and leadership interactions. Survey questions were structured using a Likert-type scale (1: Strongly Disagree - 5: Strongly Agree). Surveys were distributed to participants online and in print format and were answered anonymously.

In-depth interviews were conducted with 30 employees who participated in the survey. These participants were selected from different age groups, genders, and job roles. Semi-structured questions were used to gain a deeper understanding of employees' personal experiences, perceptions, and suggestions regarding safety culture. The interviews were recorded using a voice recorder and then transcribed verbatim.

Direct observations at participating workplaces supported the study. Observations were conducted to observe compliance with safety rules and employees' social interactions in their daily work routines. Notes were taken using standard observation forms during the observations, and certain behavioral patterns were recorded. Observation data were evaluated using qualitative analysis methods.

Thematic analysis aimed to gain an in-depth understanding of the relationship between safety culture and social interactions. It was planned and implemented in detail to increase the reliability and validity of the study. The data obtained provides a comprehensive analysis of how workplace safety culture can be improved through social interactions.

3. RESULTS

Findings from the survey reveal employees' perceptions of safety culture and their social interactions. 62% of participants stated that the safety culture in the workplace is strong. These participants expressed a high level of compliance with security policies and procedures. While 75% of employees from the western regions of Turkey fully complied with the safety rules, only 45% of employees from Central Anatolia demonstrated the same compliance. This highlights the importance of regional awareness and education programs. 70% of the participants stated that teamwork positively affects the safety culture. Strong team dynamics support safe working conditions. 55% of the participants stated that their leaders attach sufficient importance to security issues, contributing to their feeling safer. 45% of the participants evaluated their attitudes towards security measures as positive. 30% had a neutral attitude, and 25% had a negative attitude. This distribution shows that there are differences in the perception of safety culture.

Findings from the interviews allowed us to gain a deeper understanding of employees' personal experiences and perceptions of safety culture and social interactions. Most participants stated that regional differences affected security awareness. In particular, while employees from the western regions of Turkey attach more importance to security procedures, it has been observed that this awareness is lower among employees from Central Anatolia. Interview participants emphasized that regular and regional awareness-sensitive training is important in increasing security awareness. 68% of employees stated that more training and cross-cultural communication workshops should be held to improve safety communication. Language barriers and differences in cultural understanding have been identified as the biggest obstacles to security communication. Participants stated that creating open and effective communication channels will strengthen the security culture.

Observation studies have provided important information in assessing employees' levels of compliance with safety rules and social interactions in their daily work routines. Observations revealed that 60% of employees regularly comply with safety rules, while 25% neglect them from time to time. The remaining 15% rarely complied with safety rules. It

has been observed that compliance with safety rules is higher in teams with strong social interactions. In particular, it has been determined that trust-based relationships and intra-team support mechanisms positively affect the security culture.

4. DISCUSSION AND CONCLUSIONS

He has obtained several important findings by investigating how safety culture in workplaces can be improved through social interactions. Through surveys, interviews, and observation studies, it has been determined that employees' safety culture perceptions and behaviors are significantly affected by social interactions and regional awareness.

First, it has been determined that employees from the western regions of Turkey comply with the security culture and rules at a higher level. These employees pay more attention to security procedures and exhibit more conscious behavior regarding security awareness. It has been observed that this awareness and compliance are at lower levels among employees coming from Central Anatolia. This finding highlights the importance of regional education and awareness programs.

Employees' perceptions of safety culture and attitudes towards safety measures are closely related to the strength of social interactions. Strong teamwork and leadership interactions positively impact safety culture and increase employee compliance with safety rules. Most participants stated that team dynamics and leadership support support safe working conditions.

Language barriers and differences in cultural understanding have been identified as significant barriers to security communication. It has become clear that regular training and intercultural communication workshops must be organized to overcome these obstacles. Most participants stated that such workshops and training are necessary to improve security communication.

As a result, strategic use of social interactions is important for developing and sustaining a safety culture. Management support, employee participation, regular training, and the creation of effective communication channels play a critical role in strengthening the security culture. Differences in the security awareness and compliance levels of employees from different regions of Turkey reveal the importance of regional training programs and cultural awareness studies. This study offers valuable suggestions for occupational safety professionals and managers who want to improve the safety culture and contribute to creating safe and productive working environments.

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Sustainable Building Materials and Design: The Macedonian Mavrova Case and Future Perspectives

Ayse Arici[1], Pinar Usta[2]

Abstract

Sustainability in the construction industry is of increasing importance today because it has major impacts on the environment and the economy. In this context, the sustainability of building materials is a prominent research topic in civil engineering and architecture.This study takes a unique approach to the concept of sustainability of building materials, examining various sustainability criteria in detail. These criteria include factors such as environmental impact, economic cost, durability, recyclability and energy efficiency.The study provides a practical resource for professionals in civil engineering and architecture, evaluating the current situation and future trends regarding the sustainability of building materials. This research aims to contribute to the construction of more environmentally friendly and economically sustainable buildings.In addition, this study aims to develop earthquake-resistant building proposals with unique identity structures specific to the region and sustainable building design and building materials that are compatible with the nature and ecology of the region and sustainable in the case of Mavrova, Macedonia. In this context, building materials and design principles suitable for the natural characteristics of the region will be examined, and suggestions for sustainable and environmentally friendly buildings will be presented. These suggestions will contribute to developing structures providing environmental and social benefits by preserving the architectural elements and cultural identity specific to the region.

Keywords: Building Materials, Sustainability, Earthquake Resistant Buildings, New Generation Building Materials, Ecological Building Materials.

1. INTRODUCTION

The concept of sustainability in the construction industry is becoming increasingly important due to its environmental and economic impacts (Deng et al., 2020; Scheubel et al., 2021). In this context, the sustainability of building materials has become a priority research topic in civil engineering and architecture.

Environmental impact refers to the negative effects of construction activities on nature and ecosystems. The extraction, transportation, processing, and installation of materials used during construction can result in large energy consumption and greenhouse gas emissions. In addition, elements such as energy consumption and waste production throughout the life of the buildings are also evaluated within the scope of environmental impact. Sustainable architecture aims to minimize these impacts and encourages the design of green buildings that increase environmental compatibility (Kibert, 2016).

[1]*Ayse ARICI: Vision University, Faculty Of Architecture Engineering, Gostivar/Nort Makedonia 34220, Gostivar/North Makedon, .aysearici.iut@gmail.com*

[2]*Pinar USTA, Isparta University of Applied Sciences, Technology Faculty, Civil Engineering Department, Isparta/Turkey , pinarusta@isparta.edu.tr*

Economic cost covers all expenses in construction projects' planning, design, construction, and maintenance processes. Project cost-effectiveness is important for investors and society. However, in addition to short-term cost advantages, long-term economic impacts must also be taken into account. Sustainable building practices may initially cost more, but they provide economic benefits over time thanks to energy savings, low maintenance costs, and long lifespans (Häkkinen & Belloni, 2011).

Durability is the ability of structures to maintain their physical and functional properties for a long time. Resilient structures are resistant to factors such as natural disasters, climate change and daily wear and tear. This increases the sustainability of structures in the long term and plays a significant role in minimizing resource use and environmental impacts by reducing the need for reconstruction. Durable materials and construction techniques ensure that structures maintain their performance throughout their life cycle (ISO 15686-5, 2008).

Recyclability refers to the potential of construction materials and building elements to be reprocessed and used in other products at the end of their useful life. Using recyclable materials reduces waste and contributes to the conservation of natural resources. Sustainable architecture supports the circular economy by prioritizing recyclable and reusable components in material selection (Thormark, 2002).

Energy efficiency means that a building consumes minimum energy while performing its functions. Energy-efficient designs reduce energy consumption and carbon footprint by optimizing buildings' heating, cooling, lighting, and other energy requirements. Passive design strategies, high insulation, energy-efficient systems, and integration of renewable energy sources are ways to increase energy efficiency. Energy-efficient buildings reduce operating costs and promote environmental sustainability (Perez-Lombard et al., 2008).

Sustainable building materials are evaluated by various criteria, including environmental impact, economic cost, durability, recyclability, and energy efficiency (Jeong et al., 2019; Saidani et al., 2020). These criteria play an important role in achieving sustainability goals by being considered when selecting and using building materials.

This study aims to guide civil engineering and architecture professionals by examining the current status and future trends of building materials regarding sustainability (Smith & Johnson, 2018; Chopra & Goel, 2019). In this way, it aims to contribute to efforts to build more environmentally friendly and economically sustainable buildings.

In addition, this study aims to develop earthquake-resistant building proposals with sustainable design and building materials compatible with the ecology and cultural heritage of the region and in harmony with nature, as in the case of Mavrova, Macedonia. These suggestions will contribute to developing structures that provide environmental and social benefits while respecting the region's natural characteristics and cultural identity.

In this context, a more comprehensive perspective can be presented by benefiting from research on the sustainability of building materials. For example, studies such as the evaluation of concrete quality in the study by Smith and Johnson (2018) and the examination of the earthquake response of short-column reinforced concrete structures in the study by Chopra and Goel (2019) play an important role in considering building materials in terms of sustainability and durability.

Building materials play a critical role in designing and constructing sustainable structures. The selection and use of these materials are important to ensure durability and economic efficiency while minimizing environmental impacts. Different building materials, such as concrete, steel, wood, glass, and plastic, are widely used in creating sustainable structures.

For example, concrete is a common choice for sustainable buildings because it is durable and fire-resistant, and its environmental impacts can be reduced using recyclable and renewable aggregates (Smith & Johnson, 2018). Similarly, wooden building materials are environmentally friendly and can be obtained from renewable resources. The use of wood can reduce carbon emissions and reduce energy costs during the construction process (Chopra & Goel, 2019).

Materials such as glass and plastic also play an important role in sustainable buildings. These materials have energy-efficient insulation properties and can reduce the energy consumption of structures (Jeong et al., 2019). Additionally, steel building materials are recyclable and reusable, which provides a significant advantage in terms of sustainability (Deng et al., 2020).

2. MATERIAL AND METHOD

In line with the principle of sustainability in the construction sector in the Mavrova Region in Macedonia, it evaluates the use of earthquake-resistant building materials that are suitable for the climate and nature of the region and will also provide a balance of security. Within the scope of the research, the use of different building materials in the region was examined, and the properties of these materials, such as thermal insulation and water insulation, were investigated. In addition, it was emphasized whether building materials that are easy to apply and provide comfort were preferred and which building materials were preferred in the region.

Building materials were examined regarding suitable stone and earthquake performance using field studies, photography, and literature searches. This evaluation determined the advantages and disadvantages of building materials regarding sustainability.

The study is based on the results of reports prepared by various institutions and organizations and a literature review. This information and data have been compiled using a scientific and systematic approach to contribute significantly to future sustainable buildings. As a result, the study aims to provide an important step towards creating a scientific basis for constructing sustainable structures and being prepared for future earthquake risks.

3. RESULTS

Mavrova is located in the west of Macedonia and has various climatic characteristics. Its location, in the northwest of the Balkan Peninsula, shows the effects of both continental and Mediterranean climates. However, due to its geographical location, especially its mountainous and high altitude, it generally prefers a continental climate. The climatic characteristics and location of Mavrova play an important role in understanding the region's physical and geographical features.

The region's topographic structure is mountainous and has rugged terrain. The mountains and valleys in the region have significant effects on the climate. High mountains play a decisive role in the amount and distribution of precipitation. Additionally, the presence of mountains changes wind patterns and climate. These topographic features contribute to the formation of Mavrova's microclimates and the presence of various types of vegetation.

Mavrova's climatic and topographic characteristics affect agriculture, water resources management, and wildlife. The region's mountainous terrain can increase the risk of erosion and result in limited agricultural land. Additionally, the management of water resources is closely related to rainfall patterns and river regimes in the region.

All these factors shape Mavrova's environmental, economic, and social dynamics and influence the region's sustainability efforts. Therefore, planning and resource management practices in the region require considering climatic and topographic features.

In Macedonia's traditional building styles, simple and durable carrier systems are generally used. These systems generally consist of stone walls or wooden frames. Stone structures are usually supported by thick walls made of rough stones, while wooden beams and columns usually support wooden structures. Both building styles were designed to be compatible with the region's climatic conditions and local resources.

Traditional and natural building materials, such as those in the Mavrova region of Macedonia, are generally determined in accordance with the region's geographical and climatic characteristics.

Natural stone is abundant in the mountainous regions of Macedonia. These stones are used for various purposes, from the foundations to the walls of buildings. Natural stones are preferred to create durable and long-lasting structures. They are also aesthetically appealing.

There are plenty of trees in the forest areas of Macedonia. Therefore, wood is among the traditional building materials. Wood is used in the structural systems of buildings, roofs, and floors. It offers a natural and warm look and is an environmentally friendly option.

Natural materials such as adobe and clay are also widely used in Macedonia. These materials are traditionally obtained and easily processed. Adobe and clay are used in wall and roof coverings and play an important role in creating structures specific to the local architectural style.

Many of the traditional buildings in Macedonia use wooden roofs and cladding. These boards are obtained from the region's tree diversity and support the roofs of the buildings. Additionally, tile or wooden roof coverings are generally preferred for roof coverings.

Picture 1 Mavrova Traditional Houses (ARICI, 2024)

4. DISCUSSION AND CONCLUSIONS

Examining Mavrova in terms of environmental impact, economic cost, durability, recyclability, and energy efficiency is important to assess the sustainability potential of the region. Here is an examination of these factors in the context of Mavrova:

Mavrova's natural environment determines the area's environmental impacts. Environmental problems in the region, such as deforestation, erosion, and water pollution, may threaten the region's natural resources. Therefore, construction and development projects should be designed to protect wildlife and ecosystems.

Construction projects and the cost of building materials affect the region's economic sustainability. In Mavrova, using locally sourced building materials and local labor can reduce economic costs and support the local economy.

It is important for Mavrova to build structures that are resistant to natural disasters, such as earthquakes. The durability of local building materials and construction techniques can ensure the long-term strength and durability of structures in the region.

Recyclability of building materials is important for waste management and resource use. In Mavrova, recyclable building materials and waste management practices can reduce environmental impact and preserve natural resources.

Energy efficiency in Mavrova is closely related to climatic conditions and the design of structures. Factors affecting energy consumption, such as heating, cooling, and lighting, should be considered to increase the energy efficiency of buildings in the region. Building materials and design strategies suitable for local climatic conditions can reduce energy consumption and promote sustainable energy use.

Planning and practices based on sustainability principles, considering the environmental, economic, and social dynamics of Mavrova, can ensure the region's long-term sustainability. In this context, strategies such as using local resources, employing local workforce, and reducing environmental impacts are important.

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The Role of Social Interaction in Safety Culture: Promoting Safe Behaviors through Effective Working and Collaboration

Umut Elbir[1], Ayse Arici[2]

Abstract

This study examines the role of social interaction in developing a safety culture. Safety culture is critical in promoting safe workplace behavior and preventing occupational accidents. This context investigates how social interactions affect employees' security perceptions and behaviors. The study's main purpose is to determine how social interactions can be used effectively to strengthen occupational safety culture. In this context, the role of effective working methods and collaboration in promoting safe behavior is examined. In particular, it focuses on how social dynamics such as employees' communication with each other, teamwork, and leadership interactions shape the safety culture. The study makes several important contributions to business life. First, it offers practical suggestions on how social interactions can strategically promote safe behavior and reduce workplace accidents. In this way, employers and managers can take effective steps towards creating a stronger safety culture among employees. Secondly, it aims to increase productivity and employee satisfaction in workplaces by emphasizing effective work and cooperation contributions to the safety culture. Establishing trust-based relationships among employees and creating open communication channels are encouraged in this context. In conclusion, this study provides valuable insights into how occupational safety culture can be improved through social interactions. Strengthening the safety culture is of great importance in preventing work accidents, improving the general workplace atmosphere, and increasing employee motivation. In this regard, the study's findings provide guidance for professionals who want to improve the safety culture in their workplaces and contribute to creating safe and productive working environments.

Keywords: Safety culture, Social Interaction, Safe Behaviors, Occupational Safety, Multicultural Work Environment

1. INTRODUCTION

Today, creating a safety culture in workplaces is of great importance in ensuring employees' safety and minimizing work accidents. However, in multicultural business environments, this process becomes more complex. Employees with different cultural backgrounds may have different security awareness and communication approaches. These differences are important to consider in order to establish and maintain an effective safety culture.

[1]*Umut ELBIR, Bilgi University, Vocational School of Health Sciences, Department of Property and Protection,Istanbul/ Turkey* umutelbirr@gmail.com

[2]*Ayse ARICI, Vision University, Faculty Of Architecture Engineering, Gostivar/Nort Makedonia 34220, Gostivar/North Makedonia,* aysearici.iut@gmail.com

Safety culture refers to a workplace atmosphere in which employees develop common values, beliefs, and attitudes regarding safety (Cooper, 2000). A strong safety culture contributes to reducing occupational accidents and increasing the overall safety level in the workplace (Guldenmund, 2000). However, establishing and maintaining a safety culture may take longer in work environments with high cultural diversity. Employees from different cultural backgrounds may respond differently to safety rules and procedures, which can affect harmony and cooperation in the workplace (Cox & Flin, 1998).

Increasing cultural diversity in working life requires restructuring security management strategies to account for this diversity. Designing security communication and training programs according to the needs and expectations of different cultural groups plays a critical role in increasing security awareness (Hofstede, 1991). It is also important to understand the effects of cultural differences and develop appropriate strategies to promote safe behavior and reduce risks (Reason, 1997).

This article discusses establishing a safety culture in multicultural business environments and the challenges encountered. It aims to offer strategies for strengthening the safety culture in the workplace by examining the effects of employees from different cultural backgrounds on safety awareness and communication. In light of the findings of existing studies in the literature, suggestions will be made for effectively creating a safety culture in multicultural business environments.

2. MATERIAL AND METHOD

This study was designed to examine the difficulties encountered in creating a safety culture in multicultural business environments. The research includes quantitative and qualitative data collection techniques using a mixed-methods approach. While quantitative data was collected through surveys assessing security awareness and communication, qualitative data was obtained through in-depth interviews and focus group studies.

The research sample was selected from an international construction company with employees from different cultural backgrounds. A total of 200 employees were determined by random sampling and included in the study. The cultural diversity of employees was considered one of the key variables of the research. Specially developed survey forms were used to evaluate security awareness and communication. The survey questions aimed to measure employees' perceptions of safety culture, compliance with safety rules, and safety communication in the workplace.

Semi-structured interviews with employees aimed to understand their personal experiences in creating a safety culture and the effects of cultural differences on this process. The interviews lasted approximately 45 minutes with each participant and were audio recorded and transcribed.

Focus group studies, bringing together employees from various cultural groups, were organized to discuss common problems and solutions regarding safety culture and communication. Each focus group study was conducted with an average of 10 participants, and the sessions lasted approximately 90 minutes. The reliability and validity of the research were ensured by pre-testing the data collection tools. The consistency and accuracy of the surveys and interview forms in measuring safety culture and communication were evaluated by taking expert opinions. Additionally, coder reliability was ensured among researchers in qualitative data analysis.

3. RESULTS

This research examined the difficulties encountered in creating and maintaining a safety culture in multicultural business environments and the factors affecting this process.

According to the results of this study, various findings were obtained based on the results of in-depth interviews on security awareness and cultural background among a mixed group of 200 people in Turkey. The findings are based on an analysis of data collected through surveys, in-depth interviews, and focus groups.

Survey results revealed that security awareness varies significantly by cultural background. It has been determined that employees from Western countries comply with security rules more, while employees of Asian and African origin have lower security awareness. This shows that cultural education and past experiences can affect security awareness (Hofstede, 2011).

While 45% of the participants expressed their attitudes towards security measures positively, 30% were neutral, and 25% were negative. This distribution reflects the diversity of employees' perceptions of safety culture. Additionally, further research and analysis are needed to better understand the impact of cultural background on security awareness and attitudes.

Employees' evaluations of safety communication showed that the difficulties encountered in communication resulted from cultural differences. According to survey data, language barriers and differences in cultural understanding have been identified as major obstacles to effective security communication (Guldenmund, 2010). Additionally, 68% of employees stated that more training and cross-cultural communication workshops should be held to improve safety communication.

In-depth interviews revealed the effects of cultural differences on security culture in more detail. In particular, cultural norms and values shape some employees' attitudes toward safety procedures. For example, some employees of Asian descent consider compliance with safety measures a sign of trust in authority, while Western employees view these measures as individual responsibility (Reason, 1997).

In focus group studies, employees from different cultural groups discussed common problems and suggested solutions regarding safety culture and communication. These discussions emphasized the need to increase cultural sensitivity and improve intercultural communication. Participants emphasized the importance of leadership support and continuing education programs for improving safety culture (Zohar, 1980).

4. DISCUSSION AND CONCLUSIONS

This research highlights the critical importance of cultural awareness and effective communication in establishing and maintaining a safety culture in multicultural business environments in Turkey. The findings show that employees' perceptions of safety culture are shaped according to their cultural background. Therefore, training and awareness programs for security culture must be designed to include employees from different cultural backgrounds.

The study's outcomes underscore the necessity of considering cultural diversity in policies and practices related to security culture. It advocates for a continuous review and enhancement of security policies and procedures, with a strong emphasis on incorporating employee feedback. This approach not only respects the diverse cultural backgrounds of the workforce but also ensures that their perspectives are valued and integral to the process of improving security culture.

The results reveal the need better to understand the impact of cultural awareness on safety culture and strengthen diversity in work environments. In this context, managers need to accept their employees' cultural diversity and turn it into an advantage in terms of safety culture and cooperation.

In conclusion, this study highlights the importance of cultural awareness in safety culture. It reveals that effective communication and cultural awareness are critical in creating and maintaining a safety culture in multicultural business environments. These findings provide an important foundation that will guide future research and practice.

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Factors Influencing the Acceptance of Y Series among the Residents in the Three Southern Border Provinces of Thailand

***Chetsada Noknoi*[1]**

Abstract

This research aims to 1) investigate the levels of acceptance of sexual diversity, image of Y series actors, media exposure, and Y series acceptance among the residents in the three southern border provinces of Thailand, and 2) examine how acceptance of sexual diversity, image of Y series actors, and media exposure influence Y series acceptance in these provinces. The sample consisted of 322 participants from the three southern border provinces of Thailand. The research instrument used was a questionnaire, and data were analyzed using frequency, percentage, mean, standard deviation, and multiple regression analysis. The findings revealed that overall, acceptance of sexual diversity, Image of Y series actors, and Y series acceptance among the residents in the three southern border provinces of Thailand were at a high level, while media exposure was moderate overall. However, the two factors that had the most significant impact on Y series acceptance in these provinces, ranked from highest to lowest influence, were media exposure and acceptance of sexual diversity.

Keywords: acceptance, image, media exposure, sexual diversity, Y series

1. INTRODUCTION

Since the popularity of men couples in Thai entertainment, the landscape of our entertainment industry has seen significant changes. "Y series" or series featuring the love story of two men have gained immense traction. This is evident from the increasing frequency of their broadcasts, with the number of airing days rising steadily. Unlike the past when they aired only once or twice a week, now we can watch Y series every day of the week, even online. It is clear that Y series have become highly popular and have created a significant trend, both on social media and through word of mouth. In recent times, numerous Thai Y series have gained international attention and topped the charts on platforms like Twitter, both regionally and globally. This reflects Thailand's ability to compete and produce content that resonates with international audiences.

While the lives of men couples in Y series may seem smooth, the reality for LGBTQ+ individuals in Thailand is quite different from what is portrayed on screen. They often face challenges, including the need to gain acceptance from their families and the lack of legal recognition for their relationships within the country. This leads to missed opportunities in various aspects of life compared to heterosexual couples. Given that Y series serve not only as a source of entertainment but also as a platform for educating and informing viewers, raising awareness about the importance of recognizing gender diversity becomes crucial [1].

The success of Y series is also partly attributed to the image of the actors. Image plays a significant role in an actor's career, as it reflects the audience's perception of them. A positive image often leads to strong support from the audience, while a negative one can result in criticism and a lack of acceptance in society. This has been observed in the past [2].

[1]*Corresponding author: Faculty of Economics and Business Administration, Thaksin University, Songkhla 90000 Thailand. cnoknoi@hotmail.com*

Media exposure is another vital factor in the success of Y series. Communication is essential for everyone, especially in an era with numerous communication channels. While traditional media still holds considerable influence, the rise of digital platforms has made information easily accessible. Consequently, mainstream media often takes topics from online sources to keep up with rapidly changing information [3]. As a result, media influence has a significant impact on people's behavior and lifestyles, which cannot be ignored.

Although it may appear that the LGBTQ+ community is gaining more acceptance in society compared to the past, the truth is that human rights for gender-diverse individuals are not universally protected worldwide. Especially those with a predominant Islamic population, members of the former Soviet Union, and African nations, have not fully embraced these principles. These countries often have conservative religious views that consider gender diversity a sin, and engaging in same-sex relationships or gender-nonconforming behavior is against the law [4].

Therefore, this research aims to explore the acceptance of Y series among the residents in the three southern border provinces of Thailand, namely Pattani, Yala, and Narathiwat. These provinces, with a population of approximately 1.9 million people, are predominantly Muslim [5]. The goal is to understand how Y series can serve as a form of soft power, influencing the thoughts and actions of people in society and promoting gender equality in Thailand.

2. RESEARCH OBJECTIVES

1) To investigate the levels of acceptance of sexual diversity, image of Y series actors, media exposure, and Y series acceptance among the residents in the three southern border provinces of Thailand.

2) To examine how acceptance of sexual diversity, image of Y series actors, and media exposure influence Y series acceptance among the residents in the three southern border provinces of Thailand.

3. RESEARCH METHODOLOGY

3.1. Population and Sample

The population in this research consists of the residents in the three southern border provinces of Thailand, namely Pattani, Yala, and Narathiwat, totaling 1.9 million people [5]. The sample size was determined using a pre-established table [6] with a confidence level of 95% and a margin of error of 5%, which resulted in a sample size of 322 respondents. The sample was then selected through accidental sampling from April 1 to April 30, 2023.

3.2. Research Instrument

The instrument used in this study is a self-administered questionnaire developed by the researcher after reviewing relevant documents and research studies. The questionnaire is divided into five parts. Part 1: Personal factors, including questions related to gender, age, marital status, religion, education level, and monthly income, with multiple-choice answers. Part 2: Acceptance of sexual diversity. Part 3: Image of Y series actors, including questions about personality, acting roles, achievements, and success. Part 4: Media exposure, including questions related to requirements, attitudes, goals, abilities, utilization, and circumstances. Part 5: Acceptance of Y series among the residents in the three southern border provinces of Thailand. Part 2-5 scored on a Likert Scale with 5 levels.

3.3. Development Research Instrument

First, review relevant documents and research studies to create the questionnaire. Second, consult with three experts and make necessary revisions to ensure completeness. Third, pretest the instrument to assess validity and reliability. The researcher had experts evaluate the questionnaire's content validity using the Index of Item-Objective Congruence (IOC), with all items having an IOC value greater than 0.5. The questionnaire was administered to a sample of 30 individuals for testing reliability, and Cronbach's Alpha coefficient was used to assess internal consistency. The reliability coefficients for the acceptance of sexual diversity, image of Y series

actors, media exposure, and acceptance of Y series were all found to be highly reliable, with coefficients of .919, .802, .811, .890, and .827, respectively. Lastly, Use the finalized questionnaire for data collection in the subsequent research.

3.4. Data Analysis

Descriptive statistics, including frequency and percentages, were used to describe the data from Part 1 of the questionnaire, while mean and standard deviation were used for Parts 2 to 5. Inferential statistics, specifically multiple regression analysis, were employed to create a model and study the significant factors influencing the acceptance of Y series among the residents in the three southern border provinces of Thailand at a significance level of .05.

4. RESEARCH RESULTS AND DISCUSSION

4.1. Personal Factors of the Sample

A study on the personal factors of the sample in the three southern border provinces of Thailand, with a sample size of 322 people, found that the majority of the sample were female, accounting for 55.90%. They were in the age range of 21-30 years, accounting for 45.34%. The majority were single, accounting for 61.18%. They practiced Islam, accounting for 75.47%. They had a bachelor's degree, accounting for 58.07%. Their monthly income ranged from 15,001 to 30,000 baht, accounting for 48.45%.

4.2. Acceptance of Sexual Diversity

A study on the acceptance of sexual diversity found that overall acceptance was high, with an average score of 3.84 and a standard deviation of 0.864. This is in line with the findings of [7], which showed that Thai society is becoming more open and accepting of sexual diversity, with people today more accepting of same-sex relationships than in the past. For instance, countries like Argentina, Australia, Malta, and Scandinavian nations have passed laws recognizing sexual diversity [4]. However, there are still many individuals with diverse sexuality who face discrimination and lack acceptance from both their families and the surrounding community. Even though Thai law does not fully support same-sex couples [1], it is evident that there is a positive shift in society's attitude towards sexual diversity. Acceptance of sexual diversity is considered a fundamental right that everyone should have the freedom to choose.

4.3. Image of Y Series Actors

A study on the image of Y series actors found that the overall image was highly favorable, with an average score of 4.01 and a standard deviation of 0.861. This aligns with the findings of [8], which examined the impact of actors' images on fan satisfaction in the Bangkok metropolitan area. Notably, the image of well-known actors significantly influences their success in the entertainment industry [9]. Actors must continuously work to create and maintain a positive image as it can impact their careers greatly, determining their success or failure.

4.4. Media Exposure

A study on media exposure found that media exposure overall was at a moderate level, with an average score of 3.34 and a standard deviation of 0.933. This differs from the findings of [10], which found high media exposure. The study found that media exposure differ based on factors such as gender, age, occupation, and income. The highest media exposure occurs between 5:00 PM and 10:00 PM, which is consistent with the findings of [11], with an average viewing time of one hour and a frequency of 2-3 times a day, primarily on smartphones.

4.5. Acceptance of Y Series

A study on the acceptance of Y series found that overall acceptance was high, with an average score of 3.89 and a standard deviation of 0.867. This is consistent with the findings of [12]. Additionally, [1] noted the

increasing number of Y series airing multiple times a week, reflecting the growing acceptance of Y series among the population. Nowadays, viewers can watch Y series from Monday to Sunday, even through online media platforms, making it convenient. This reflects the positive acceptance of Y series among the population. Furthermore, Thailand is recognized as a global leader in Y series production and holds a prominent position in Asia's LGBTQ+ entertainment industry [13]. Factors contributing to the increased acceptance of Y series include inspirational content, the provision of advice or knowledge, entertainment value, target audience relevance, and uniqueness [14].

4.6. Factors Influencing the Acceptance of Y Series among the Residents in the Three Southern Border Provinces of Thailand

By considering the standardized coefficients, it was found that there were two significant factors influencing the acceptance of Y series among the residents in the three southern border provinces of Thailand, ranked in descending order: media exposure and acceptance of sexual diversity. These two factors together explained 40.7% of the variance in the acceptance of Y series as in Table 1.

Table 1. Regression coefficient

	Unstandardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**
	B	**S.E.**	**Beta**		
(Constant)	.068	.209		.381	.830
Acceptance of sexual diversity	.112	.116	.103	4.287	.000*
Image of Y series actors	.076	.102	.069	.972	.354
Media exposure	.137	.099	.122	2.694	.014*
F = 13.258, Sig. = .000, R = 0.519, R^2 = 0.407, Adjusted R^2 = 0.362, * Significance at .05					

Media exposure is crucial [12] as it affects communication. In the process of communication, recipients interpret messages differently based on their experiences, needs, beliefs, attitudes, or knowledge. Even with good communication preparation using capable and credible communicators or high-quality media, communication can fail if the information does not align with the recipient's attitude or needs [15]. Therefore, media exposure and relevance play a crucial role. However, the impact of media exposure on the acceptance of Y series varies depending on individual differences and their ability to access media [16].

Acceptance of sexual diversity is increasingly visible in society at all levels, with the emergence of new terms, identities, definitions, or gender expressions. This signifies greater diversity, self-disclosure, and clarity in various gender identities. Younger generations are more inclined to openly express themselves, explore their sexual preferences, and incorporate their sexual identity into their self-concept. Therefore, the Thai entertainment industry, especially Y series, has seen significant growth and popularity [1]. However, it is suggested that Y series could gain even more acceptance if they introduce more diverse characters and prioritize the process of creating gender identities, rather than adhering to traditional gender roles [17].

5. RECOMMENDATIONS

1) Government agencies should take measures to promote sexual diversity and equality by eliminating social discrimination against gender-diverse individuals. This includes promoting equal rights, ending stigmatization, legalizing same-sex relationships, implementing anti-discrimination laws, and recognizing gender identities. This will ultimately lead to greater acceptance of Y series.

2) Producers of Y series should work on increasing media exposure by focusing on the abilities, benefits, goals, attitudes, and needs of the target audience. Understanding these factors will help create content that resonates with viewers and enhances acceptance.

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The Credibility and Role of Social Media Influencers (SMIs) in the Beauty Market's Purchasing Behavior

***Irisi Kasapi*[1]**

Abstract

The adoption of social media influencer collaboration is growing at a steady rate. The purpose of this paper is to examine the effectiveness of influencer marketing as a tactical marketing tool employed to reach out to the beauty market. Further, the study aims to shed some light on the credibility and role of Social Media Influencers (SMIs) in inducing purchasing behavior in this market which is experiencing an upward trajectory. According to the literature investigation, adopting SMIs benefits businesses since it increases brand recognition, boosts the company's reputation, and is a cost-effective strategy. This may result in sustainable relationships built on sales and marketing. Data collected from an online self-administered survey yielding 142 usable observations, was used to generate insights on the topic in the Albanian context. Results of the ANOVA tests and t-tests show that although Albanian consumers perceived influencers as credible, their purchasing decisions were not impacted by influencers. Furthermore, foreign influencers were perceived as more credible compared to Albanian influencers. They were considered to play a significant role in the consumers' purchase decisions. It is advised that Albanian beauty companies use influencer marketing more effectively in their marketing plans to draw in more customers and reap the reward.

1. INTRODUCTION

Despite the adverse economic conditions caused by the Covid-19 pandemic, research shows that influencer marketing in general, and Social Media Influencers (SMIs) in particular, are continuing to develop strongly. In recent years, the development of social media and the growth of online users have created an innovative type of marketing that has disrupted the old marketing model. Influencer Marketing is becoming increasingly popular, displacing traditional marketing tactics such as paid commercials, web advertisements, and e-mail marketing. According to [10], [2], [5], Influencer Marketing is a type of social media marketing that uses endorsements and product mentions from influencers– individuals who have a dedicated social following and are viewed as experts within their niche. Global investment in influencer marketing grew from $1.7 billion in 2016 to an estimated $24 billion at the end of 2024 [7].

According to [12], social media influencers are "online personalities who influence their followers across one or more social media platforms". They are categorized as people who have created online personalities by sharing content that is created originally by them or people who have already been popular from their occupation in an industry and from there have developed a fan base on a social medial platform [11]. Influencer marketing has taken hold, since it is used by 86% of marketers, with 92% believing it to be an efficient approach for growing business further [7]. This strategy is seen as successful and preferable, as more businesses are growing budgets allocated to influencer marketing. According to the Influencer Marketing Benchmark Report, a little over two-thirds (65.8%) acknowledge having a separate budget for content marketing. This number is increasing annually; it was 63% in 2020, 61% in 2022, 59% in 2021, and 55% in the previous year further [7].

[1]*Corresponding author: University of New York Tirana, Department of Business Administration, Tirana, Albania, irisikasapi@unyt.edu.al*

The rise of social media has positively disrupted many industries and has become a primary tool that brands and businesses use to increase their brand awareness and reach potential and existing customers [8]. According to [14], positive overall business performance is related to the usage of social media platforms by businesses. To gain a better understanding of the specific usage of the main social media platforms in the beauty industry, their target audience, and the way that each platform is used by different brands, a detailed description is given in the section below.

One of the industries that relies the most on this type of marketing is the beauty industry, which includes, among others, skincare, haircare and make-up products, perfumes, toiletries, etc. In 2021, the beauty industry was valued at around USD 511 billion worldwide, and by 2025 it is expected to reach a market size of USD 716 billion [7] [6]. The integration of social media and influencers in this industry has been unavoidable with beauty brands being the early adopters of such strategies into their core business [6] [9]. Influencer marketing has now become an important element of the beauty industry and it has shown that digital entrepreneurs have helped brands with their advocacy to build more awareness and drive higher sales.

In recent years, there has been an emergence of Albanian influencers in the market of beauty products in Albania. Nonetheless, further research is needed to determine the extent to which social media influencers influence customers' purchasing decisions. This study has three objectives. First, examine the credibility of the social media influencers that these consumers follow. Second, determine whether influencers who endorse beauty products have an impact on consumers' purchasing decisions, and third, understand whether Albanian consumers are more influenced by Albanian social media influencers or foreign ones.

2. MATERIALS AND METHODS

2.1. Data collection

For the purpose of this study, primary data was collected following a convenience sampling approach due to the unavailability of a database containing information about social media users in Albania. “Convenience sampling is a method of collecting responses by taking samples that are conveniently located around a location or internet service” [6]. The research approach employed is quantitative, and the research strategy implemented is survey research. The survey instrument is composed of three sections:

- Section 1: Demographic profile
- Section 2: Usage of Social media platforms
- Section 3: Purchasing behavior & social media

The demographic set of questions is presented in the beginning, followed by the other sections that contain questions regarding the usage of social media platforms. The third part of the survey aims to address the connection between the participants of the survey with the beauty industry and their purchasing patterns regarding beauty products. Lastly, the final part of the survey is dedicated to social media influencers and their impact on consumers’ purchasing behavior in the beauty industry. The first part contains close-ended questions such as age, gender, and nationality. These questions are important to help this paper in analyzing the target group correctly. The second part of the survey moves on to multiple open and close-ended questions regarding social media platforms, the main reasons behind why the participants use social media platforms and whether they use such platforms to purchase products or not. The last part of the survey links the purchasing behavior of the participants for beauty products with their usage of social media platforms and through the questions presented, it aims to clarify whether such platforms are used to purchase or at least impact the purchase of beauty products or not.

The survey was created using Google Forms online, sent to respondents by email and WhatsApp, and open to response for three weeks. It was planned to conduct an online survey as it is cost-effective and allows for the gathering of a higher amount of data. The survey makes it simple to compare the responses of the respondents with the existing research data on this topic [4]. The two main types of tests that will be conducted to analyze the data from the survey are ANOVA and t-Test. According to [4], ANOVA test is a statistical technique that determines whether three or more means are statistically different from one another. Furthermore, t-Test is a hypothesis test procedure that uses t-distribution. Such statistical tests work well with small sample sizes.

To better grasp the topic and come to more accurate findings, the secondary data used to investigate it came from several sources and attempted to make connections between recent publications and behavioral theories. Based on the Literature Review gleaned, the following hypotheses are summarized on Table 1.

Table 1. Operationalization of the variables

Hypotheses	Measurement	Reference
H1: Influencer-endorsed cosmetic products are perceived as credible.	Likert scale	[1]
H1a: Influencer-endorsed cosmetic products are perceived as more credible when showcased by foreign influencers than Albanian influencers.	Likert scale/ Single-choice question	[1]
H2: Social media beauty influencers impact their followers' purchasing decisions.	Likert scale	[13]
H2a: Foreign social media beauty influencers have a greater impact on their followers' purchasing decisions than Albanian social media beauty influencers.	Likert scale/ Single-choice question	[13]

Source: Author's own work

3. RESULTS AND DISCUSSION

3.1. Respondents' Demographic profile

The number of respondents in the survey conducted is 142. The demographic characteristics of the sample are summarized in Table 2. The most frequent gender was female with n=117, accounting for 82.4% of the total respondents, then male (n=24,16.9 %) and (n =1, 0.7%) of respondents prefer not to say their gender. Further, the participants' age ranged from under 18 to 46+ years old. The most frequent group age was 26-34 years old (n=67, 47.2%), followed by the group age 19-25 years old with a percentage (n=42, 29.6%), under 18 years old (n=12, 8.5%) and 35-45 years old (n=14, 9.9%), 46+ years old group age had the lowest participation (n=7, 4.9%).

Table 2. Demographic Characteristics

Table 3 shows the amounts spent on cosmetics in a month. The most frequent spending on cosmetics in a month was *€40 - €100* (n=60, 42.3%), followed by *Less than* €40 (n=45, 31.7%) and *€100 - €200* (n=21, 14.8%). Only 7% of the respondents spent €200 - €300 in a month, 2.8% of respondents spent €300 - €400 in a month and just 2 responders (1.4%) spent more than *€*400 in a month on cosmetics.

Table 3. Amounts spent on cosmetic products monthly

Spending on cosmetics per month	Frequency	Percentage (%)
Less than €40	45	31.7
€40 - €100	60	42.3
€100 - €200	21	14.8
€200 - €300	10	7
€300 - €400	4	2.8
More than €400	2	1.4
Total	142	100

Additionally, Table 4 shows the number of social media influencers the responders in this study follow. The most frequent response was less than 5 influencers (n=84, 59.2%), followed by the second most frequent response 5 to 10 influencers (n=31, 21.8%), more than 20 influencers (n=14, 9.9%), and 6.3% of respondents follow 10 to 20 influencers. Only two responders in this study do not follow any Influencer on social media (n=2, 2.8%).

Table 4. Number of influencers followed online

How many influencers do you follow?	Frequency	Percentage (%)
Less than 5	84	59.2
5-10	31	21.8
10-20	9	6.3
More than 20	14	9.9
I don't follow any influencers on my social media platforms	4	2.8

	Variable	Frequency	Percentage (%)
Gender	Male	24	16.9
	Female	117	82.4
	Prefer not to say	1	0.7
Age	Under 18	12	8.45
	19-25	42	29.58
	26-34	67	47.18
	35-45	14	9.86
	46+	7	4.9

Total	142	100

3.2. Hypothesis Testing

3.2.1 H1: Influencer-endorsed cosmetic products are perceived as credible.

To test hypothesis H1a, a One-sample T-test was conducted. The hypothesized population mean is 3, corresponding to our Test Value.

Table 5: One-Sample T-test

Test Value = 3

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
How credible do you find SMIs?	2.036	141	0.044	0.211	0.01	0.42

Since p=0.044 < 0.05, we reject the null hypothesis that the mean of the credibility scale is equal to 3 (test value) and conclude that the mean is significantly different than 3, by accepting *H1: Influencer-endorsed cosmetic products are perceived as credible* (t=2.036, p=0.044<0.05, df=141). Based on the results, it can be stated that influencer-endorsed cosmetic products are perceived as credible by the respondents.

3.2.2 H1a: Influencer-endorsed cosmetic products are perceived as more credible when showcased by foreign influencers than Albanian influencers.

An ANOVA analysis was conducted to test whether the participants' perceived credibility level for beauty products promoted by the SMIs differed depending on the nationality of the social media influencer (Albanian vs. foreign). The results are shown in Table 6 below.

Table 6: Perceived credibility based on the nationality of the SMIs

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.316	1	6.316	4.224	0.042
Within Groups	209.346	140	1.495		
Total	215.662	141			

The analysis revealed that there was a statistically significant difference in the mean scores between the two groups (F (1, 140) = [4.224], p = 0.042). With a p-value 0.042 < 0.05, there is enough statistical evidence to reject the null hypothesis and accept the alternative hypothesis *H1a: Influencer-endorsed cosmetic products are perceived as more credible when showcased by foreign influencers than Albanian influencers (F=4.224, df=1, p=0.042).* As such, the results indicate that Albanian consumers tend to perceive foreign influencers as more credible compared to Albanian influencers.

3.2.3 H2: Social media beauty influencers impact their followers' purchasing decisions.

To test hypothesis H2, a One-sample T-test was conducted. The hypothesized population mean is 3, corresponding to our Test Value. Since p=0.323 > 0.05, we accept the null hypothesis that the mean of the 'level of influence on purchasing decision' is equal to 3 (test value) and conclude that the mean is not significantly different than 3. A such, the alternative hypothesis denoted as *H2: Social media beauty influencers impact their followers' purchasing decisions,* is rejected (t=2.036, p=0.323>0.05, df=141). Based on the results, it can be stated that social media beauty influencers do not influence their followers' purchasing decisions.

Table 7: One-Sample T-test

Test Value = 3

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Level of influence on the purchasing decision	0.991	141	0.323	0.106	0.01	0.32

3.2.4 H2a: Foreign social media beauty influencers have a greater impact on their followers' purchasing decisions than Albanian social media beauty influencers.

The ANOVA analysis reveals a statistically significant difference in purchase decisions based on whether the influencer is local or foreign (F (1, 140) = [4.029], p = 0.047< 0.05). As such, the results indicate that Albanian consumers are more influenced by foreign SMIs, if compared to Albanian SMIs.

Table 8: Purchase decision influence based on the nationality of the SMIs

	Sum of Squares	df	Mean Square	F	Sig.
Between	6.361	1	6.361	4.029	.047
Within Groups	221.055	140	1.579		
Total	227.415	141			

4. CONCLUSIONS

Influencer Marketing as a marketing strategy has been growing in popularity, displacing traditional marketing tactics such as paid commercials, web advertisements, and e-mail marketing. Many studies show that businesses have incorporated this type of marketing strategy into their core business by using influencers' testimonials to increase brand awareness, boost sales and enhance consumer loyalty. Additionally, previous studies have shown that influencer marketing has also affected the consumer behaviour towards their purchasing decisions, especially the Generations Y and Z.

One of the industries that relies the most on this type of marketing is the beauty industry, which include, among others, skincare, haircare and make-up products, perfumes, toiletries, etc. In this industry digital entrepreneurs have helped brands with their advocacy to build more awareness and drive higher sales.

This paper has studied whether the beauty products that the influencers endorse and advertise on social media perceived as credible by the Albanian consumers. Furthermore, the impact that social media influencers have on consumers' purchasing decisions for beauty products, specifically those endorsed by Albanian influencers versus foreign influencers is evaluated. The data used to answer the objectives of this paper was gathered from an online survey. From the conducted tests, it was found that as expected that influencer- endorsed cosmetic products are perceived as credible by the respondents. However, the cosmetic products which are endorsed by foreigner influencers were perceived as more credible compared to when endorsed by Albanian influencers.

Contrary to the previous research, this study shows that the respondents (all of Albanian nationality) remained neutral in regard to making a purchasing decision based on the recommendations of an influencer. Nevertheless, foreign social media beauty influencers have a greater impact on their followers' purchasing decisions than Albanian social media beauty influencers.

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Effect of different floor types on masonry structural behavior

Ozge Onat[1], Pinar Usta[1], Ayse Arici[2]

Abstract

This comprehensive study examines the impact of different flooring materials on the structural integrity of masonry buildings, using Finite Element Analysis (FEA) to provide insights into optimising the design for improved durability and safety. The sensitivity of masonry structures to seismic and mechanical loads requires a detailed examination of how different types of flooring affect their overall structural behaviour. To this end, the research used SAP2000, a sophisticated finite element program, to model masonry buildings with two primary floor slab materials: concrete and timber. The aim was to assess how these materials affect the response of the structures to both static and dynamic loads, and to gain a clearer understanding of the impact of flooring choice on structural performance. The study conducted non-linear analyses of the modelled structures, focusing on key structural performance indicators, including stress distribution, displacement and failure modes, under various seismic loading scenarios. Through rigorous simulation, the research identified critical differences in how concrete and timber floors influence the structural behaviour of masonry buildings, particularly under the stress of seismic activity. Key findings from the article highlight the significant role that the choice of flooring material plays in the structural resilience and seismic performance of masonry structures. The results show that while concrete floors contribute to increased stiffness and load-bearing capacity, timber floors offer advantages in terms of flexibility and energy dissipation. These differences are critical in designing masonry buildings that are not only safe, but also capable of withstanding the forces of nature without catastrophic failure. In addition, the study's findings on the differential impact of flooring materials on structural performance provide architects and engineers with valuable guidance on material selection and structural design. By incorporating these findings into the design and refurbishment of masonry buildings, professionals can significantly improve the durability, safety and seismic performance of these structures. Ultimately, this research enriches the field of structural engineering with practical knowledge and contributes to the ongoing effort to develop safer, more durable buildings capable of withstanding the challenges posed by natural and man-made loads.

Keywords: Masonry, Floor, Timber, Concrete, Seismic analysis

1. INTRODUCTION

In the field of structural engineering, the integrity of masonry buildings subjected to various mechanical and seismic stresses is of paramount importance. Consequently, the resilience and safety of masonry structures under seismic loads have been subjects of intense research due to their critical implications for urban safety and architectural heritage preservation. Masonry, a composite construction material comprising individual units bound by mortar, exhibits distinctive structural behaviours influenced by its composition, configuration, and interaction with other building elements, such as floor systems (Smith, 2019; Johnson & Smith, 2021). Recent

[1]*Corresponding author: Isparta University of Applied Science, Department of Civil Engineering, 3220, Merkez/Isparta, Turkey. pinarusta@isparta.edu.tr*

[2] *Vision University, Faculty Of Architecture Engineering, Gostivar/Nort Makedonia 34220, Gostivar/North Macedonia aysearici.iut@gmail.com*

earthquakes have highlighted the vulnerability of these structures to dynamic loads, prompting investigations into innovative strategies for enhancing their seismic performance (Doe et al., 2020).

One of the most crucial aspects of masonry building design is the selection of the appropriate floor type. The floor systems employed in masonry buildings not only bear the dead and live loads, but also significantly influence the building's modal properties and its response to seismic activities (Brown & Green, 2018; White et al., 2022). Concrete floors are renowned for their ability to enhance structural stiffness due to their substantial mass and rigidity. However, timber floors offer distinct advantages in terms of energy dissipation and flexibility, which can be advantageous under seismic loading (Lee & Kim, 2017).

Some studies have been performed on the seismic safety of structures; Karimzadeh et al. (2018) proposed a framework for seismic damage prediction in which local building vulnerabilities are modeled based on a set of simulated ground motions in the region of interest [9]. Usta and Bozdag (2019) proposed a simple and fast procedure based on a simplified geometric approach for the immediate screening of masonry buildings that are at risk [10]. Usta and Bozdag (2020) evaluated the structural safety of the Basdurak mosque using FEM. [11]. Karimzadeh et al. (2020) derived analytical fragility curves of masonry structures in Erzincan (Turkiye) using SDOF models [12]. Celik and Tanrverdi (2021) discussed repair and strengthening methods for vaults, particularly damage to joints and upper parts of historic vaults [13]. Ural and Celik (2021) analyzed the structural condition of the Tahtani (Stork) Mosque [14]. Hoveidae et al. (2021) assessed the seismic damage of a historic masonry building, named Arg-Tabriz, using region-specified simulated ground motion records [15]. Koc et al, (2023) conducted a parametric study based on Equivalent Single Degree of Freedom (ESDOF) models for simplified seismic analysis of unreinforced masonry (URM) structures [16].

This research examines the differing responses of timber and concrete floors under seismic stress, thereby illuminating the crucial role of material selection in the structural performance of masonry buildings. Concrete floors are renowned for their enhanced stiffness and load-bearing capacity, whereas timber floors are lauded for their flexibility and energy dissipation properties. These attributes are of paramount importance in the design of buildings that are not only structurally sound but also capable of withstanding natural forces without catastrophic failure. Masonry structures, which have historically demonstrated a significant sensitivity to seismic activities, require robust analytical approaches to ensure their resilience.

In this study, the researchers employed finite element analysis (FEA) using SAP2000, a sophisticated finite element program, to simulate the structural behaviour of a historical masonry building located in Kahramanmaras, Turkey. The building was constructed using two primary floor slab materials: concrete and timber. This approach enables a comparative analysis of the influence of these materials on the structural response of masonry buildings under both static and dynamic loading conditions. By examining the stress distribution, displacement, and failure modes under various seismic scenarios, the study aims to provide deeper insights into the differential impact of floor material selection on the performance of masonry structures. The findings of this comprehensive study provide valuable insights for architects and engineers, guiding them in material selection and structural design to improve the durability, safety, and seismic performance of masonry buildings.

This research contributes to the ongoing development of design and rehabilitation practices that enhance the durability, safety, and seismic resilience of masonry buildings. Furthermore, this research contributes significantly to the field of structural engineering by offering practical knowledge that enhances the development of safer and more resilient buildings capable of confronting the challenges posed by both natural and man-made loads.

In essence, the introduction of this article sets the stage for a detailed exploration of the effects of different floor types on the structural integrity of masonry buildings. The aim is to provide the construction industry with data-driven insights for making informed material and design choices.

2. BUILDING DESCRIPTION AND MODELLING

The historical building being examined is located in Kahramanmaras, Turkey. It has two floors and features brick walls. The building measures 11.3 m in length and 7.2 m in width, with a height of 5.8 m. The map of Turkiye, which shows the building's location, is provided in the figure.

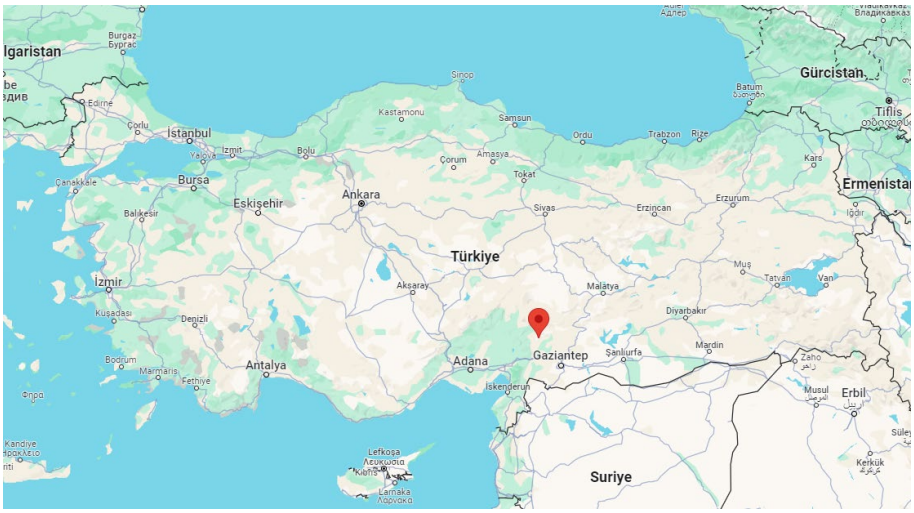

Figure Location of historical building

The historical building was modeled using the SAP2000 finite element program, with bricks represented as shell elements. The model of the historical building in SAP2000 is shown in the figure. The building was then modeled in two different ways, using timber and concrete slabs. The properties of the materials used in the modeling are provided in the table.

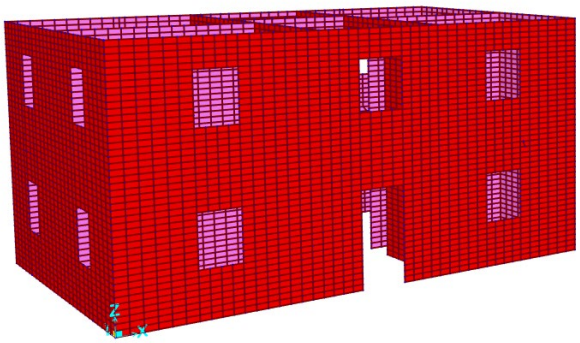

Figure Finite element model of historical building

Table Finite element model material properties

Element Type	Modulus of elasticity(kN/m^2)	Unit volume weight (kN/m^3)
Brick	400000	18
Timber Slab	9000000	5.88
Timber Beam	9000000	5.88

Conrete	28000000	25

The material properties were defined in the SAP2000 finite element program, with the concrete slab represented as a shell element. For the timber slab, the timber was initially defined as a shell element, and then timber beams were added along the short edge. Timber and concrete models are given in figure and figure respectively.

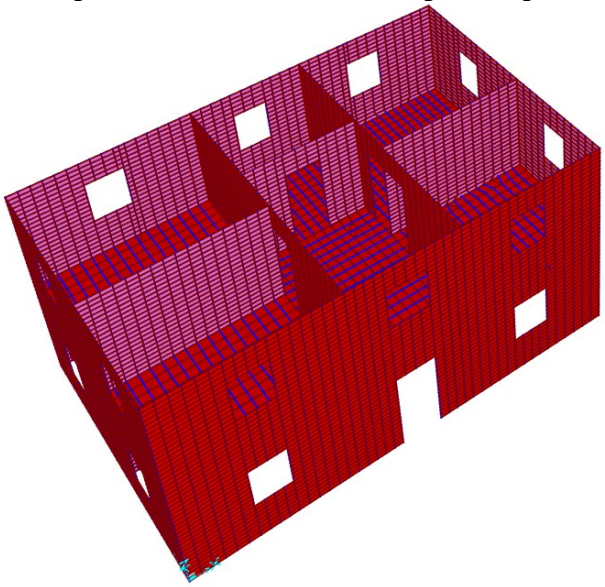

Figure Timber slab model

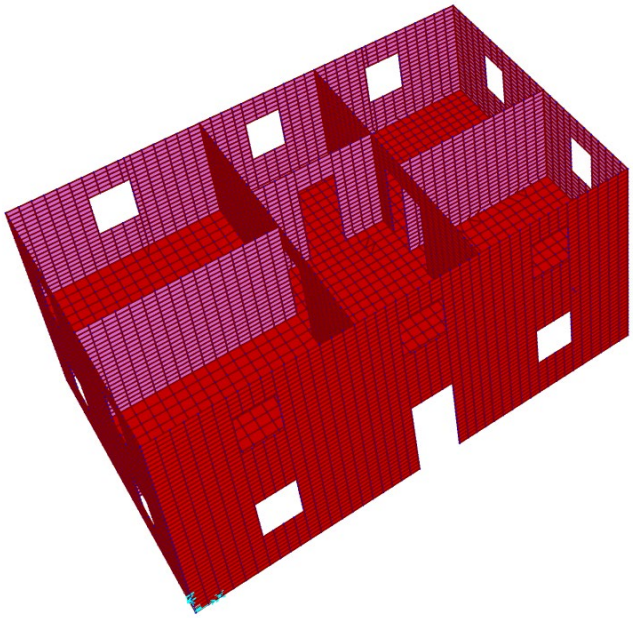

Figure Concrete slab model

Two different earthquake records were selected for nonlinear analysis in the time history. Data for these earthquakes were obtained using the AFAD data system. The data were scaled, and the acceleration-time graphs were defined in the SAP2000 finite element program. The characteristics of the selected earthquakes are

presented in the table. The acceleration-time values and scaled acceleration-time values from the AFAD data system are shown in the figure.

Table Earthquakes used for analysis in the nonlinear time history

Number	Name	Earthquake Code	Date	Magnitude (M_W)	Depth (km)	Epicenter	PGA (cm/sn^2)	PGV (cm/sn^2)
1	Kahramanmaras (Elbistan)	4631	6 February 2023 10:24	7.6	7	Elbistan (Kahramanmaras)	635.45	170.79
2	Kahramanmaras (Pazarcik)	615	6 February 2023 01:17	7.7	8.6	Pazarcik (Kahramanmaras)	2178.72	212.94

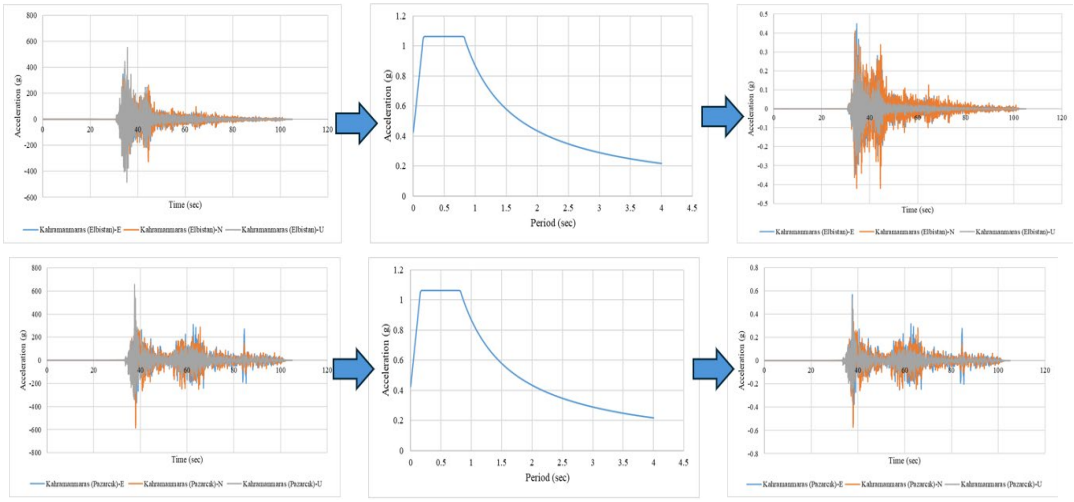

Figure Scaling of acceleration time graphs

3. PERFORMANCE ANALYSIS OF BUILGINS

Modal analysis was conducted on both modeled buildings, and the figure displays the period values, encompassing the first 12 modes, obtained from the analysis.

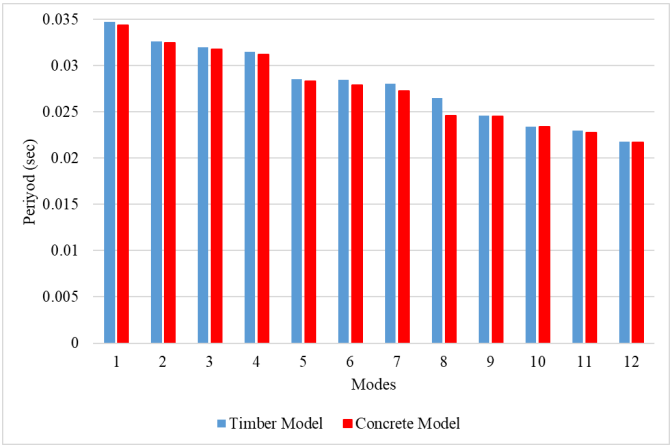

Figure . The period values of the structures

Upon examination of the period values derived from the analyses, it's evident that both models exhibit a decreasing trend in period values. Notably, the period values of both models are highly similar. The maximum period values for the first mode are 0.034764 for the timber model and 0.034361 for the concrete model.
Following the time history analysis, the base shear forces of the models were determined. The resulting values for both the x and y directions are depicted in the figures.

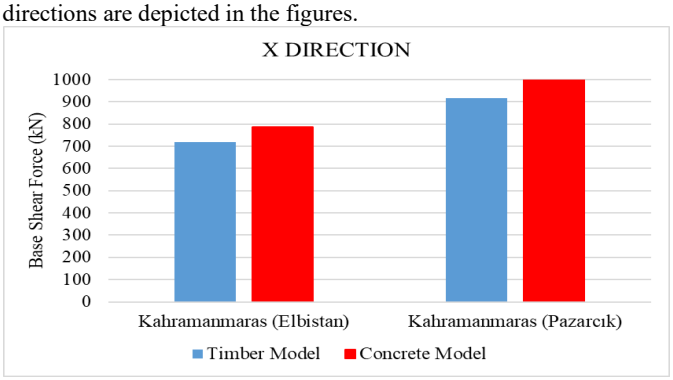

Figure Base Shear Force in X direction for models in x directions

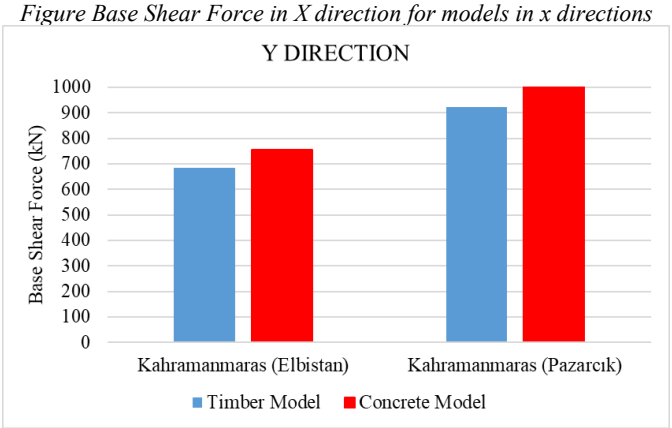

Figure Base Shear Force in Y direction for models in y directions

According to the earthquake analysis, the base shear forces in the X and Y directions for the Kahramanmaras (Elbistan) and Kahramanmaras (Pazarcik) earthquake records were analyzed for timber and concrete models. In the X direction, under the Kahramanmaras (Elbistan) record, the base shear force for the timber model was 720.152 kN, and for the concrete model, it was 786.102 kN. For the same direction under the Kahramanmaras (Pazarcik) record, the base shear force for the timber model was 918.174 kN, and for the concrete model, it was 1007.812 kN. In the Y direction, under the Kahramanmaras (Elbistan) record, the base shear force for the timber model was 685.896 kN, and for the concrete model, it was 755.243 kN. For the same direction under the Kahramanmaras (Pazarcik) record, the base shear force for the timber model was 923.342 kN, and for the concrete model, it was 1013.413 kN.
The structural models, Timber and Concrete, were analyzed for maximum and minimum displacements in both X and Y directions during two earthquake records, Kahramanmaras-Elbistan and Kahramanmaras-Pazarcik. Graphs showing the maximum and minimum displacement values of the structures are shown in the figure.

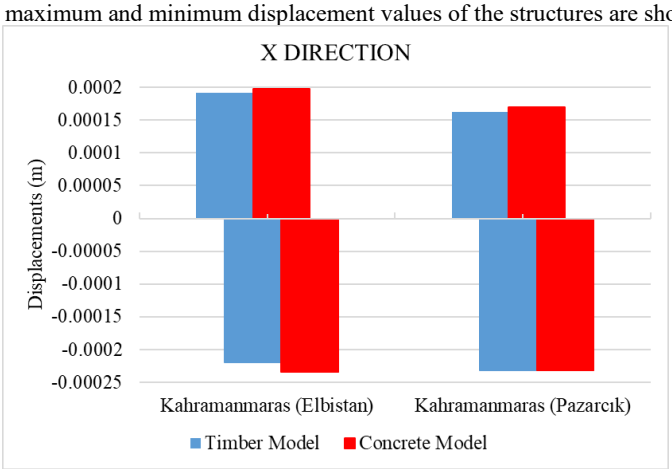

Figure Displacement values of models in x directions

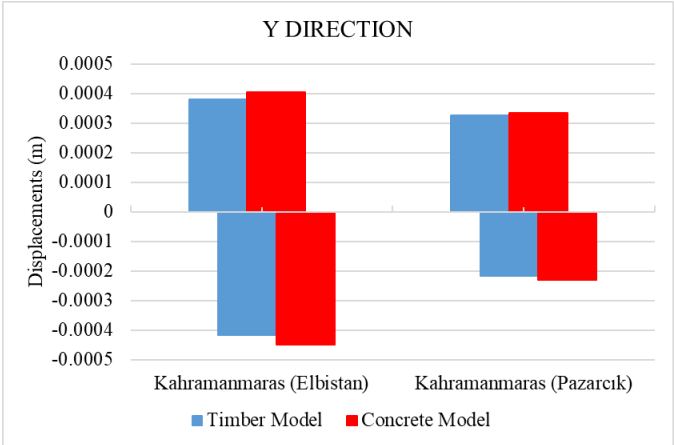

Figure Displacement values of models in y directions

According to the earthquake analysis, the maximum and minimum displacement values for the X-Direction displacements during the Kahramanmaras-Elbistan earthquake, the maximum displacement for the Timber model was 0.000192 meters, while the Concrete model exhibited a maximum displacement of 0.000197 meters. The minimum displacements for these models were 0.000219 meters and 0.000234 meters, respectively. During

the Kahramanmaras-Pazarcik earthquake, the maximum displacement for the Timber model was 0.000162 meters, with the Concrete model reaching 0.00017 meters. The minimum displacements were 0.000231 meters for the Timber model and 0.000232 meters for the Concrete model. In the Y-Direction displacements during the Kahramanmaras-Elbistan earthquake, the maximum displacement for the Timber model was 0.000381 meters, whereas the Concrete model had a maximum displacement of 0.000404 meters. The minimum displacements for the Timber and Concrete models were 0.000417 meters and 0.000449 meters, respectively. During the Kahramanmaras-Pazarcik earthquake, the maximum displacement for the Timber model was 0.000327 meters, while the Concrete model showed 0.000333 meters. The minimum displacements were 0.000216 meters for the Timber model and 0.000231 meters for the Concrete model.
The structural models, Timber and Concrete, were given in figures for their maximum and minimum element stresses in both X and Y directions during two earthquake records, Kahramanmaras-Elbistan and Kahramanmaras-Pazarcik.

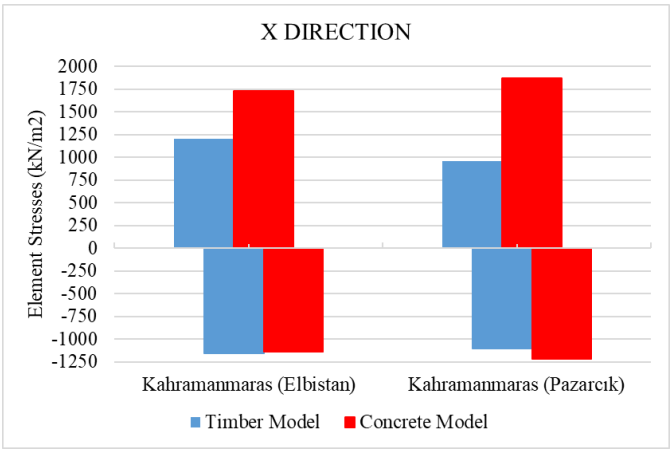

Figure Element stress values of models in x directions

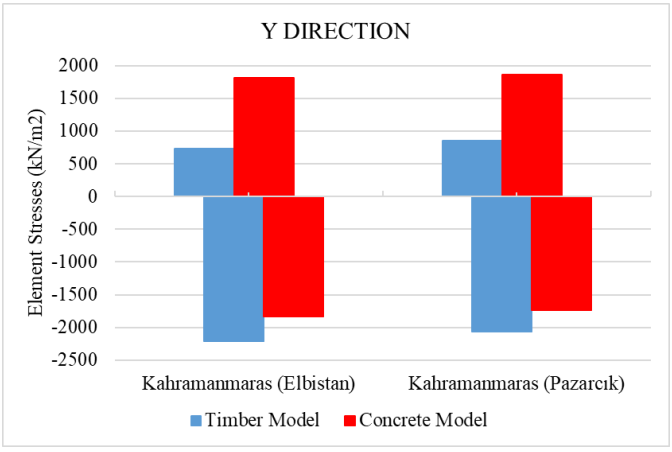

Figure Element stress values of models in y directions

According to the earthquake analysis, the maximum and minimum element stresses values for in the X-Direction during the Kahramanmaras-Elbistan earthquake, the maximum stress for the Timber model was 1200.66 kN/m2, while the Concrete model exhibited a maximum stress of 1729.24 kN/m2. The minimum stresses for these models were 1156.79 kN/m2 and 1136.37 kN/m2, respectively. During the Kahramanmaras-Pazarcik earthquake, the maximum stress for the Timber model was 960.33 kN/m2, with the Concrete model

reaching 1868.84 kN/m2. The minimum stresses were 1100.66 kN/m2for the Timber model and 1218.79 kN/m2for the Concrete model. In the Y-Direction during the Kahramanmaras-Elbistan earthquake, the maximum stress for the Timber model was 733.95 kN/m2, whereas the Concrete model had a maximum stress of 1808.04 kN/m2. The minimum stresses for the Timber and Concrete models were 2211.28 kN/m2 and 1829.19 kN/m2, respectively. During the Kahramanmaras-Pazarcik earthquake, the maximum stress for the Timber model was 854.68 kN/m2, while the Concrete model showed 1864.66 kN/m2. The minimum stresses were 2063.86 kN/m2for the Timber model and 1734.56 kN/m2 for the Concrete model.
The structural models, Timber and Concrete, were given in figures for their maximum and minimum element Shear stresses during two earthquake records, Kahramanmaras-Elbistan and Kahramanmaras-Pazarcik.

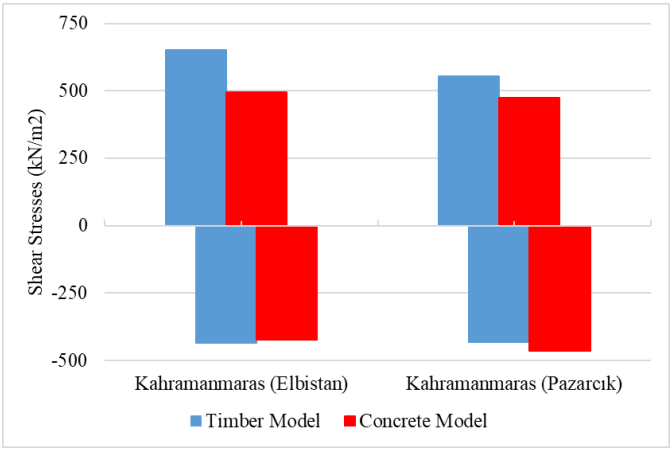

Figure Shear stress values of models

The analysis of shear stresses for the Timber and Concrete models during the Kahramanmaras-Elbistan and Kahramanmaras-Pazarcik earthquake records provided key insights into their structural behavior. For the Kahramanmaras-Elbistan earthquake, the maximum shear stress for the Timber model was 650.56 kN/m2, while the Concrete model exhibited a maximum shear stress of 496.31 kN/m2. The minimum shear stresses for the Timber and Concrete models were 433.97 kN/m2 and 423.64 kN/m2, respectively. During the Kahramanmaras-Pazarcik earthquake, the maximum shear stress for the Timber model was 554.49 kN/m2, while the Concrete model had a maximum shear stress of 475.47 kN/m2. The minimum shear stresses for the Timber and Concrete models were 433.09 kN/m2 and 465.3 kN/m2, respectively. The results indicate that the Timber model generally experiences higher maximum shear stresses, while the Concrete model exhibits more negative minimum shear stresses.

4. CONCLUSION

As a result of the modal analysis, the models were compared across 12 modes. The results showed that the Timber model consistently exhibited slightly higher period values than the Concrete model, with an average difference of 0.00041 seconds. Both models have similar trends, with duration generally decreasing as the number of modes increases. The average period of the Timber model was 0.027943 seconds, while the average period of the Concrete model was 0.027533 seconds. The close similarity between the period values of the models shows that both models may be suitable for structural applications.
When the base shear forces obtained as a result of the analysis are examined, for the X-Direction base reactions, the Kahramanmaras-Elbistan earthquake resulted in base reactions of 720.152 kN for the Timber model and 786.102 kN for the Concrete model, yielding a difference of 65.950 kN and a percentage increase of 9.15%. In the case of the Kahramanmaras-Pazarcik earthquake, the base reactions were 918.174 kN for the Timber model and 1007.812 kN for the Concrete model, with a difference of 89.638 kN and a percentage increase of 9.77%. For the Y-Direction base reactions, the Kahramanmaras-Elbistan earthquake resulted in base reactions of 685.896 kN for the Timber model and 755.243 kN for the Concrete model, yielding a difference of 69.347 kN

and a percentage increase of 10.11%. The Kahramanmaras-Pazarcik earthquake produced base reactions of 923.342 kN for the Timber model and 1013.413 kN for the Concrete model, resulting in a difference of 90.071 kN and a percentage increase of 9.75%.

The analysis of the base reaction forces in the X and Y directions for the Timber and Concrete models under the Kahramanmaras-Elbistan and Kahramanmaras-Pazarcik earthquake records reveals that the Concrete model consistently exhibits higher base reaction forces compared to the Timber model. This consistent trend across both directions and earthquake records suggests that the Concrete model, likely due to its higher mass or stiffness, experiences greater seismic forces. The Timber model, being lighter and more flexible, shows lower base reaction forces, indicating a structural preference for areas with high seismic activity. Additionally, the Kahramanmaras-Pazarcik earthquake record generally induced higher base reaction forces in both models compared to the Kahramanmaras-Elbistan record, highlighting potential differences in the seismic demands of the two earthquake events.

When the maximum and minimum displacements are examined as a result of the time history analysis, in the X-Direction during the Kahramanmaras-Elbistan earthquake, the maximum displacement for the Timber model was 0.000192 meters, while the Concrete model exhibited a maximum displacement of 0.000197 meters, showing a difference of 0.000027 meters, which is a 14.06% increase. The minimum displacement for the Timber model was 0.000219 meters, while the Concrete model recorded 0.000234 meters, showing a difference of 0.000037 meters, or a 15.94% increase. During the Kahramanmaras-Pazarcik earthquake, the maximum displacement for the Timber model was 0.000162 meters, while the Concrete model had a maximum displacement of 0.00017 meters, resulting in a difference of 0.000008 meters, or 4.94%. The minimum displacement for the Timber model was 0.000231 meters, and for the Concrete model, it was 0.000232 meters, showing a negligible difference. In the Y-Direction during the Kahramanmaras-Elbistan earthquake, the maximum displacement for the Timber model was 0.000381 meters, while the Concrete model exhibited a maximum displacement of 0.000404 meters, showing a difference of 0.000023 meters, which is a 6.03% increase. The minimum displacement for the Timber model was 0.000417 meters, while the Concrete model recorded 0.000449 meters, showing a difference of 0.000032 meters, or a 7.67% increase. During the Kahramanmaras-Pazarcik earthquake, the maximum displacement for the Timber model was 0.000327 meters, while the Concrete model had a maximum displacement of 0.000333 meters, resulting in a difference of 0.000006 meters, or 1.83%. The minimum displacement for the Timber model was 0.000216 meters, and for the Concrete model, it was -0.000231 meters, showing a negligible difference.

Overall, the Concrete model tends to exhibit slightly higher displacements compared to the Timber model in both directions, particularly during the Kahramanmaras-Elbistan earthquake, which may be due to its heavier and stiffer structural characteristics.

The analysis of maximum and minimum element stresses for the Timber and Concrete models in both X and Y directions during the Kahramanmaras-Elbistan and Kahramanmaras-Pazarcik earthquake records reveals several key insights. In the X-direction, during the Kahramanmaras-Elbistan earthquake, the maximum stress for the Timber model was 1200.66 kN/m2, while the Concrete model exhibited a maximum stress of 1729.24 kN/m2, resulting in a difference of 528.58 kN/m2 or a 44.02% increase. The minimum stresses for these models were 1156.79 kN/m2 and 1136.37 kN/m2, respectively, showing a smaller difference of 20.42 kN/m2 or a 1.76% increase. During the Kahramanmaras-Pazarcik earthquake, the maximum stress for the Timber model was 960.33 kN/m2, while the Concrete model reached 1868.84 kN/m2, leading to a larger difference of 908.51 kN/m2 or a 94.61% increase. The minimum stresses for these models were 1100.66 kN/m2 and 1218.79 kN/m2, respectively, showing a difference of 118.13 kN/m2 or a 10.73% increase. In the Y-direction, during the Kahramanmaras-Elbistan earthquake, the maximum stress for the Timber model was 733.95 kN/m2, while the Concrete model had a maximum stress of 1808.04 kN/m2, resulting in a substantial difference of 1074.09 kN/m2 or a 146.38% increase. The minimum stresses for these models were 2211.28 kN/m2 and 1829.19 kN/m2, respectively, showing a difference of 382.09 kN/m2 or a 17.28% increase. During the Kahramanmaras-Pazarcik earthquake, the maximum stress for the Timber model was 854.68 kN/m2, while the Concrete model showed 1864.66 kN/m2, leading to a significant difference of 1009.98 kN/m2 or a 118.15% increase. The minimum stresses for these models were 2063.86 kN/m2 and 1734.56 kN/m2, respectively, showing a difference of 329.30 kN/m2 or a 15.95% increase.

In summary, the analysis revealed that the Concrete model consistently exhibits higher maximum stresses across both directions and earthquake records, indicating a stiffer and more rigid structural response. The Timber model, on the other hand, exhibits lower maximum stresses but more negative minimum stresses, reflecting a more flexible structural response.

Maximum and minimum shear stresses for Timber and Concrete models in the Kahramanmaras-Elbistan and Kahramanmaras-Pazarcik earthquakes were numerically examined. During the Kahramanmaras-Elbistan earthquake, the maximum shear stress for the Timber model was 650.56 kN/m2 compared to 496.31 kN/m2 for the Concrete model, representing a difference of 154.25 kN/m2 or a 31.08% increase. The minimum shear stresses were 433.97 kN/m2 for the Timber model and 423.64 kN/m2 for the Concrete model, with a smaller difference of 10.33 kN/m2 or a 2.44% increase. During the Kahramanmaras-Pazarcik earthquake, the maximum shear stress for the Timber model was 554.49 kN/m2 compared to 475.47 kN/m2 for the Concrete model, resulting in a difference of 79.02 kN/m2 or a 16.61% increase. The minimum shear stresses were 433.09 kN/m2 for the Timber model and 465.3 kN/m2 for the Concrete model, showing a difference of 32.21 kN/m2 or a 7.45% increase. The analysis indicates that the Timber model generally experiences higher maximum shear stresses, while the Concrete model exhibits more negative minimum shear stresses. The percentage increase in maximum shear stresses is more pronounced during the Kahramanmaras-Elbistan earthquake, suggesting a larger difference in structural response for this event.

In summary, the Concrete model demonstrates a stiffer and more rigid structural response, while the Timber model is more flexible. The Concrete model's higher base reactions, stresses, and displacements indicate its suitability for areas with lower seismic activity. In contrast, the Timber model's lower base reactions and stresses suggest a preference for regions with high seismic activity.

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Effect of Opening Frame Materials with Different Mechanical Properties on the Behavior of Unreinforced Masonry Structures

Pinar Usta[1], Ali Ekber Sever[1], Elifnur Sakalak[1], Ayse Arici[2]

Abstract

This study critically examines the seismic vulnerability of unreinforced masonry (URM) structures. URM buildings are renowned for their aesthetic appeal and structural simplicity, but are particularly susceptible to damage during seismic events due to their non-reinforced nature and the brittleness of the construction materials. In earthquake-prone regions, the choice of materials used in the frames of openings, including windows and doors, can significantly affect the resilience of a structure. The language used is clear, objective, and value-neutral, with a formal register and precise word choice. The text adheres to conventional structure and formatting features, including consistent citation and footnote style. The sentences and paragraphs create a logical flow of information with causal connections between statements. The text is free from grammatical errors, spelling mistakes, and punctuation errors. No changes in content have been made, and the text remains balanced and objective throughout.This paper presents an in-depth analysis of how various framing materials, each with distinct mechanical properties, influence the seismic behavior of unreinforced masonry (URM) structures. The research involves using the advanced capabilities of SAP2000 V23 software to numerically model a two-story URM building subjected to seismic loads. The objective is to compare the seismic responses of the structure when different framing materials are used, specifically evaluating changes in displacement, stress levels, and base shear forces. The findings are expected to highlight the often-overlooked importance of selecting appropriate materials to enhance earthquake resistance in URM structures. The study aims to provide valuable insights into the optimization of unreinforced masonry (URM) construction for improved resilience against earthquakes by systematically assessing the impact of different frame materials on the building's seismic performance. This research enhances our comprehension of material science in the context of seismic engineering and provides practical recommendations for the design, renovation, and preservation of masonry buildings in seismically active areas. This contributes to creating safer and more sustainable urban environments.

Keywords: Masonry, PVC, Timber, Aluminum, Seismic analysis

1. INTRODUCTION

Turkey is located at the intersection of the Eurasian and Arabian tectonic plates, making it vulnerable to significant seismic activity. The historical architecture in Turkey consists mainly of unreinforced masonry (URM) buildings, which are constantly threatened by earthquakes. This article reviews the challenges faced by URM structures in Turkey due to seismicity and examines current retrofitting strategies and policies in place to mitigate these risks. Throughout history, the intersection of the North Anatolian Fault (NAF) and East

[1]*Corresponding author: Isparta University of Applied Science, Department of Civil Engineering, 3220, Merkez/Isparta, Turkey. pinarusta@isparta.edu.tr*

[2] *Vision University, Faculty Of Architecture Engineering, Gostivar/Nort Makedonia 34220, Gostivar/North Macedonia aysearici.iut@gmail.com*

Anatolian Fault (EAF) in Turkey has caused several devastating earthquakes. Unreinforced masonry buildings, which constitute a significant portion of Turkey's built heritage, are particularly vulnerable to seismic forces due to their mass and the brittleness of their construction materials. It is important to note that the risk to human life and cultural heritage is significant. To mitigate this risk, it is crucial to implement appropriate measures to protect these structures.

Turkey's architecture reflects its rich history, ranging from grand ancient temples to humble traditional homes. However, this architectural heritage is under constant threat from the country's intense seismic activity, particularly in urban centres like Istanbul where many such structures are located. Turkey is situated at the intersection of major tectonic plate boundaries, resulting in frequent and sometimes devastating earthquakes that pose significant risks to life, property, and cultural heritage. Unreinforced masonry (URM) buildings are highly vulnerable to seismic activity and constitute a significant portion of the country's built environment [1, 2]. (Erdik, 2003; Bozorgnia & Bertero, 2004).

Unreinforced masonry buildings are structures with load-bearing walls constructed from brick, stone, or block masonry that are not reinforced with steel or any other materials. Although these buildings are aesthetically pleasing and historically significant, they are often ill-equipped to withstand the lateral forces induced by seismic events. Turkey has a history of URM buildings suffering extensive damage and collapse during earthquakes, resulting in tragic losses of both human life and irreplaceable historical structures [3]. (Stratan et al., 2008).

The seismic threat to URM buildings is multifaceted, involving not only the inherent vulnerabilities of these structures but also factors such as urbanization, legal frameworks, and historical preservation challenges. For instance, Istanbul is a densely populated city that serves as an economic and cultural hub. However, it is also an area that is highly prone to seismic events, which significantly increases the risk factor for its many URM buildings [4] (Parsons et al., 2000).

Historical earthquakes have shown that URM structures are vulnerable. The 1999 Izmit earthquake caused many URM buildings to collapse, resulting in significant casualties and loss of heritage. Studies, such as Erdik et al. (2003) [5], have analyzed the performance of these buildings and emphasized the need for effective seismic retrofit strategies.

In recent decades, the Turkish government and engineering community have taken steps to address seismic risks through improved building codes and retrofitting programs. However, implementing these measures, particularly in historical buildings, remains a complex challenge. Balancing the preservation of architectural heritage with the necessity of seismic safety requires innovative approaches and ongoing research [6-7] (D'Ayala & Speranza, 2003; Dogangun et al., 2006).

As seismic resilience methods and understanding continue to advance, the experiences and strategies developed in Turkey offer valuable lessons for other seismically active regions. By studying the successes and shortcomings in addressing the seismic vulnerability of URM buildings in Turkey, we can better prepare for the future and safeguard both people and their heritage against the inevitable tremors of the Earth [8]. (Langenbach, 2007).

Some studies have been performed on the seismic safety of structures; Karimzadeh et al. (2018) proposed a framework for seismic damage prediction in which local building vulnerabilities are modeled based on a set of simulated ground motions in the region of interest [9]. Usta and Bozdag (2019) proposed a simple and fast procedure based on a simplified geometric approach for the immediate screening of masonry buildings that are at risk [10]. Usta and Bozdag (2020) evaluated the structural safety of the Basdurak mosque using FEM. [11]. Karimzadeh et al. (2020) derived analytical fragility curves of masonry structures in Erzincan (Turkiye) using SDOF models [12]. Celik and Tanrverdi (2021) discussed repair and strengthening methods for vaults, particularly damage to joints and upper parts of historic vaults [13]. Ural and Celik (2021) analyzed the structural condition of the Tahtani (Stork) Mosque [14]. Hoveidae et al. (2021) assessed the seismic damage of a historic masonry building, named Arg-Tabriz, using region-specified simulated ground motion records [15]. Koc et al, (2023) conducted a parametric study based on Equivalent Single Degree of Freedom (ESDOF) models for simplified seismic analysis of unreinforced masonry (URM) structures [16].

2. MATERIAL AND METHOD

For this study, a two-storey unreinforced brick masonry building, which is commonly used in rural areas, was chosen. Four different material types were considered for the open frame material properties of the masonry building: timber, aluminum, and PVC. Therefore, 4 different numerical models with different materials were created and each model was analysed separately. The 3D finite element model of the brick building was modelled using SAP2000 V23, as shown in Figure 1.

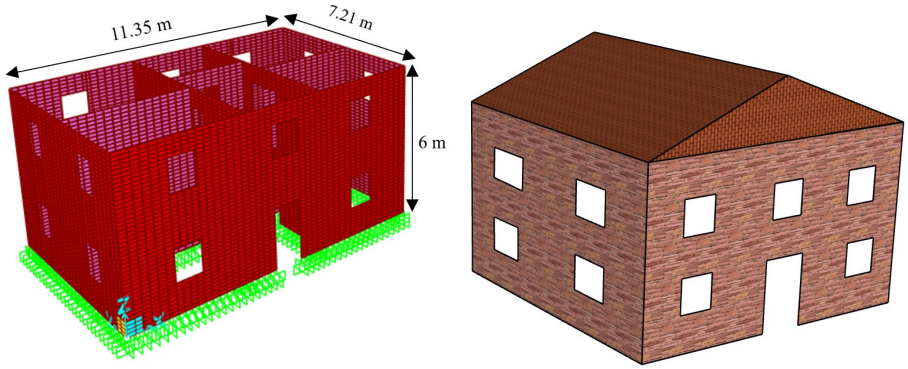
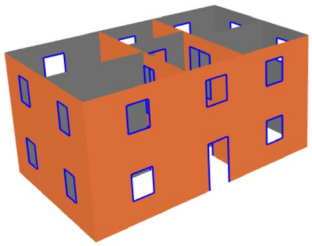
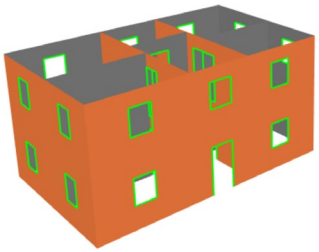
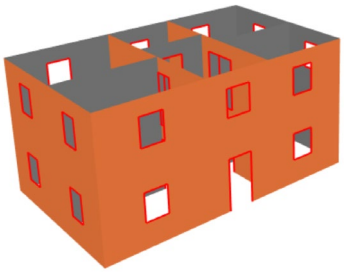


Figure 1. The mathematical model of 2 storey URM building

The first model is the frameless model, the other models are aluminum, PVC and, timber . The two-storey brick masonry houses were designed using SAP 2000 version 23. Each model has the same type of 250 mm thick masonry wall and flexible roof membrane. A rectangular shell element was considered for the wall model. The shell element can be modelled as homogeneous and layered shell. In our study, the layered shell area element was considered to obtain the full shell behaviour. In the model, lateral loads are carried by shear walls. Modelling of the masonry building without and with beams shown in Figure 2. The masonry building was modelled as a shell and area, the material of the building was chosen as brick and the material properties of the opening frame are given in Table 1.

Table 1. Material properties of the opening frame material (Xekalakis et al., 2023)

		Density (kg/m3), d	Modulus of Elasticity (Mpa), E	Poisson ratio, ν	Shear Modulus (Mpa), G
	Aluminum	2710	69000	0.33	25940

	PVC	480	9200	0.47	3129
	Timber	2490	86000	0.22	35246

A non-linear time history analysis is performed to evaluate the behavior of buildings under seismic loads. For this purpose, 11 earthquake records selected from the PEER database are used. The TSC 2018, DD2 target response spectrum is used to obtain a realistic response and to select the ground motion records. The seismic hazard is defined assuming seismic zone V (highest seismic level) with a peak ground acceleration (PGA) of 0.4g for a typical building on medium ground (importance factor I = 1). The acceleration response spectrum corresponding to 5% equivalent damping is used. The earthquakes are represented by the data shown in Figure 3 and the characteristics of the selected ground motions are shown in Table 2. Spectra of earthquakes are shown in Figure 2

Table 2. Characteristics of the selected ground motions

Result ID	Record Sequence Number	Scale Factor	Earthquake Name	Year	Magnitude	Mechanism	Vs30 (m/sec)
1	RSN88	20.693	"San Fernando"	1971	6.61	Reverse	389
2	RSN 164	11.966	"Imperial Valley-06"	1979	6.53	strike slip	471.53
3	RSN 755	0.896	"Loma Prieta"	1989	6.93	Reverse Oblique	561.43
4	RSN 1083	15.405	"Northridge-01"	1994	6.69	Reverse	402.16
5	RSN 1614	19.592	"Duzce_ Turkey"	1999	7.14	strike slip	481
6	RSN 1633	0.4421	"Manjil_ Iran"	1990	7.37	strike slip	723.95
7	RSN 3750	0.6765	"Cape Mendocino"	1992	7.01	Reverse	515.65
8	RSN 3757	14.524	"Landers"	1992	7.28	strike slip	367.84
18	RSN 5270	14.698	"Chuetsu-oki_ Japan"	2007	6.8	Reverse	375.22
24	RSN 5663	0.4247	"Iwate_ Japan"	2008	6.9	Reverse	479.37

30	RSN 6915	0.6924	"Darfield_ New Zealand"	20 10	7	strike slip	422

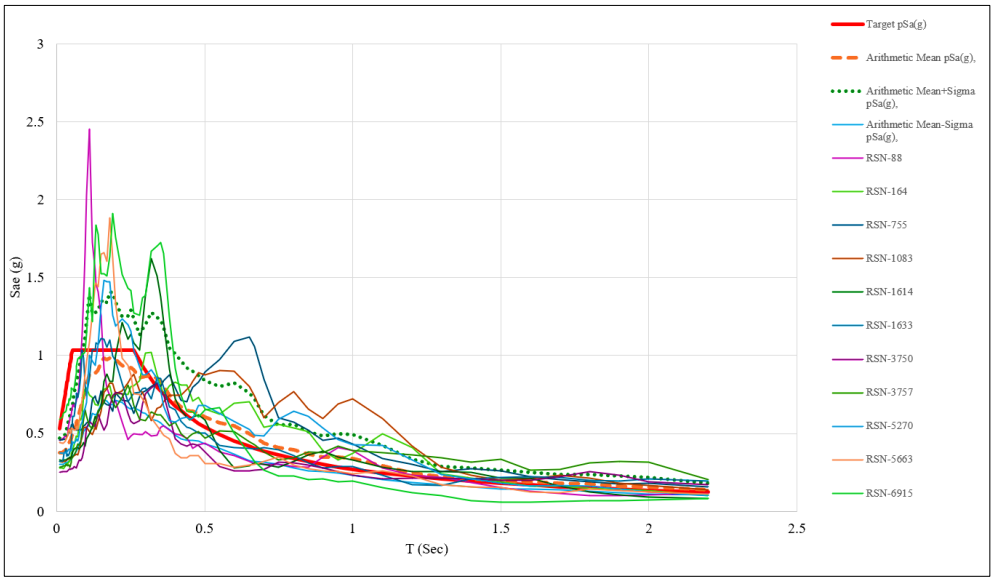


Figure 2. Spectrums of earthquakes

2.1. Frame Materials and Their Mechanical Properties

Frame materials are pivotal in determining a building's performance in terms of strength, durability, thermal insulation, and environmental impact. Among the myriad options available, PVC, timber, and aluminum stand out due to their distinct mechanical properties and suitability for specific applications. This analysis delves into the comparative aspects of these materials, providing insights into their structural and environmental implications.The choice of frame materials for openings in unreinforced masonry structures typically includes timber, aluminum, and PVC. Each material has different mechanical properties that affect its performance during seismic events.

1. Timber: Timber frames offer flexibility and lightness, making them suitable for seismic regions. Timber's ability to deform without catastrophic failure allows it to absorb seismic energy and reduce the im t on masonry pac structures. However, timber can deteriorate over time due to moisture and insect damage, requiring regular maintenance.

2. Aluminum: Aluminum frames provide high strength and ductility, making them effective in resisting seismic forces. The superior tensile strength of aluminum allows the construction of slender frames that can withstand significant deformation during earthquakes. In addition, aluminum frames can be designed to dissipate seismic energy efficiently, minimising damage to masonry walls.

3. PVC: PVC frames offer a good balance of strength and rigidity, making them durable under normal loads and conditions. While not as strong as metals like aluminum, they provide sufficient strength for window and door applications, supporting the structure and resisting

everyday wear and tear. PVC frames are low maintenance compared to timber or aluminum frames. They do not require painting or sealing and can be cleaned easily with soap and water. PVC is resistant to decay, termite damage, and weathering, which contributes to its long lifespan.

2.2. Impact on Unreinforced Masonry Structure Behavior:

The selection of frame materials for openings significantly influences the behavior of unreinforced masonry structures under seismic loading. The mechanical properties of frame materials determine factors such as stiffness, strength, and energy dissipation capacity, all of which affect the overall seismic performance.

1. Stiffness: Frame materials with higher stiffness, such as can effectively limit lateral deformations in unreinforced masonry structures during earthquakes. This helps maintain the structural integrity of the building and reduces the risk of partial or total collapse.
2. Strength: Materials with high strength, such as aluminum, enhance the load-bearing capacity of unreinforced masonry walls, reducing the likelihood of structural damage during seismic events. Timber, although less strong than aluminum, can still provide adequate support when properly engineered.
3. Energy Dissipation: During seismic events, the ability of frame materials to dissipate energy is crucial in reducing the impact on unreinforced masonry structures. Ductile materials like can absorb seismic energy through plastic deformation, thereby reducing the forces transmitted to the masonry walls and minimizing damage.

3. RESULT OF TIME HISTORY ANALYSIS

The largest displacements in the x and y directions as a result of time history analysis are shown in Figure 3 and Figure 4.

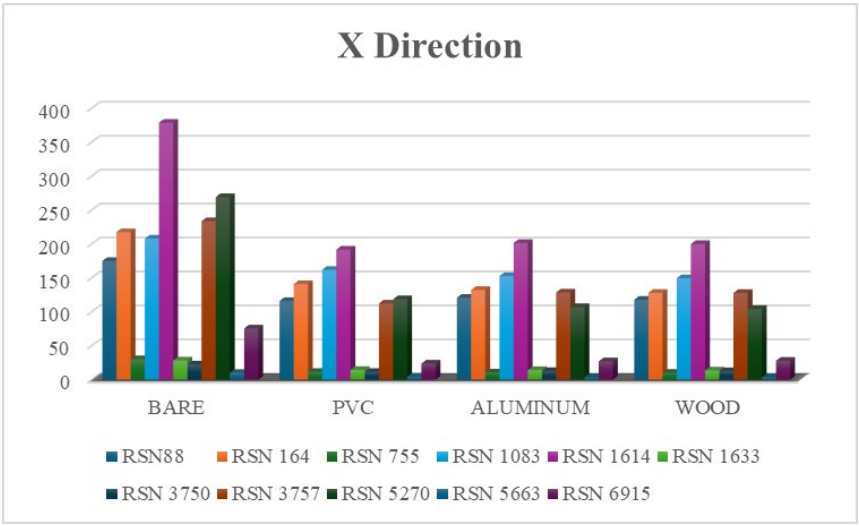


Figure 3. The largest displacements in the x direction

The "BARE" condition, which represents the frameless masonry building, shows different values of displacement due to the earthquake. This condition serves as a basis for understanding the effect of frame addition.PVC frames show variable displacement values, suggesting a moderate effect on the structural behaviour during seismic events. Aluminium frames show a significant reduction in displacement in some earthquakes (e.g. RSN 1083), indicating better performance in terms of energy dissipation or stiffness. Timber, traditionally considered flexible and energy absorbing, offers mixed performance with some RSNs (such as RSN 755) showing significant displacement.

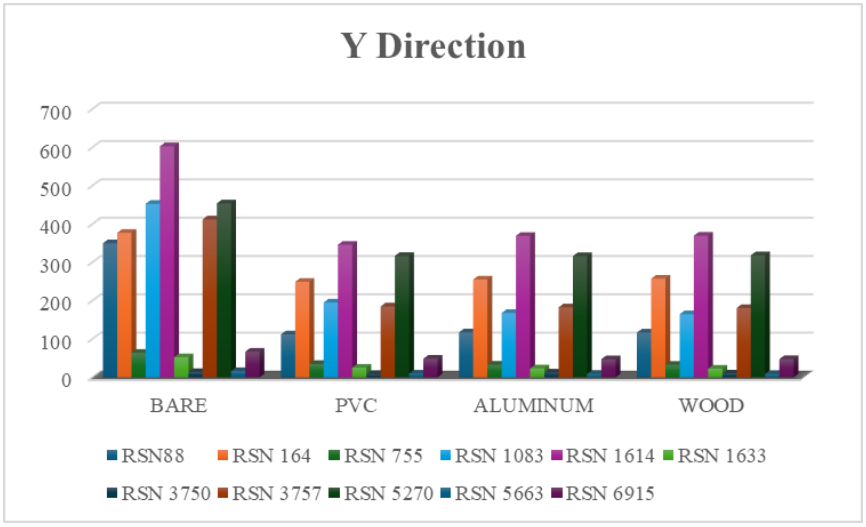


Figure 4. The largest displacements in the y direction

The 'BARE' category is believed to represent the structure's response without any framing support. It experiences a wide range of displacement values depending on the earthquake event. This provides a comparative baseline for assessing the effectiveness of different framing materials.

PVC frames exhibit significant variability in displacement values, indicating inconsistent performance under seismic loads across different types of seismic events.

Aluminum frames seem to reduce displacement during certain earthquakes, such as RSN 3757. This suggests a positive interaction between the properties of aluminum and seismic forces in the Y direction.
Timber frames also display a range of displacements during earthquakes, with some seismic events (such as RSN 755) resulting in high displacement values. The natural flexibility of timber may contribute to greater displacements under specific seismic forces, which can potentially absorb energy but also lead to larger deflections that need to be controlled during the design process.

The PVC-framed structure experienced a significantly larger displacement under the RSN88 earthquake compared to other materials and RSN combinations. This suggests that PVC may be less reliable as a frame material in the Y direction under certain seismic conditions.

The displacement in the Y direction highlights the importance of material selection in the seismic design of unreinforced masonry structures. The data indicates that the choice of framing materials can have a significant impact on seismic response. It is important to carefully consider these factors when selecting framing materials. Aluminum and timber offer advantages in certain conditions, while PVC frames exhibit complex material

behavior under seismic loading and result in extreme displacement. These insights are important for structural engineers and conservationists working to improve the seismic resilience of historical masonry buildings. It is particularly important to select framing materials that reduce risk while preserving architectural integrity.

Table 3 displays the contribution percentage of the bare model and other models in terms of displacement and framework application in the modeling.

Table 3. Contribution percentage of bare model and other models

	Contribution %					
	PVC		ALUMINUM		TIMBER	
Earthquakes	X Direc.	Y Direc.	X Direc.	Y Direc.	X Direc.	Y Direc.
RSN88	0.34	0.68	0.31	0.66	0.33	0.67
RSN 164	0.35	0.34	0.39	0.32	0.41	0.32
RSN 755	0.62	0.46	0.65	0.48	0.66	0.49
RSN 1083	0.22	0.57	0.27	0.63	0.28	0.64
RSN 1614	0.49	0.43	0.47	0.39	0.47	0.39
RSN 1633	0.50	0.52	0.50	0.56	0.52	0.57
RSN 3750	0.49	0.38	0.43	0.08	0.44	0.29
RSN 3757	0.52	0.55	0.45	0.56	0.45	0.56
RSN 5270	0.56	0.30	0.60	0.30	0.61	0.30
RSN 5663	0.58	0.40	0.65	0.46	0.66	0.48
RSN 6915	0.68	0.28	0.64	0.29	0.63	0.29

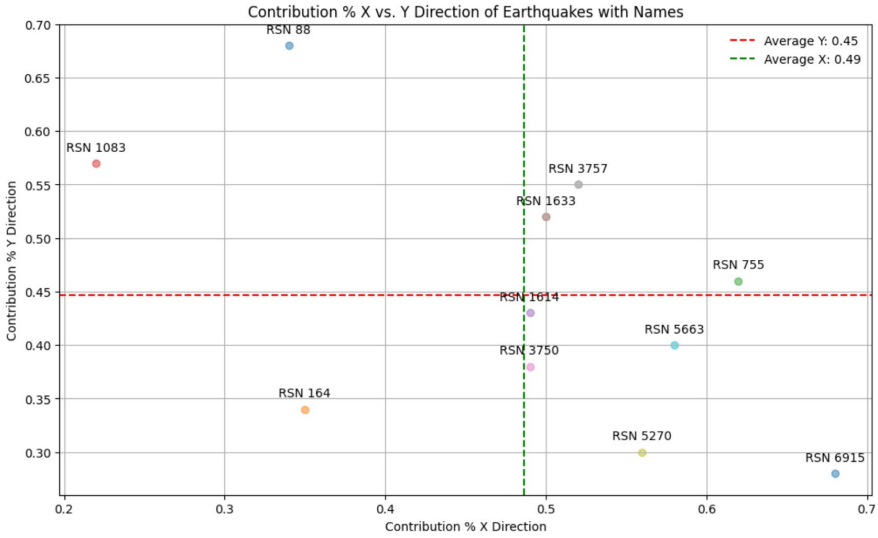


Figure 5. X% and Y Direction Contribution of the PVC model with the names of the earthquakes

Examination reveals similarities and differences in the distribution of contribution percentages in both directions. The graph displays the contribution percentages of earthquakes in the X and Y directions, along with the names of the relevant earthquakes. The analyzed dataset presents the contribution ratios of various earthquakes in the X and Y directions. On average, the contribution percentage in the X direction is 48.69%, while in the Y direction it is 44.55%. This suggests that contributions in the X direction are slightly higher than those in the Y direction. The standard deviation values are 13.56% for the X direction and 12.39% for the Y direction, indicating a similar spread around the average for both directions. The data point distribution indicates that most observed earthquakes have similar contribution percentages in both the X and Y directions.

[RSN 6915] has the highest contribution percentage in the X direction (68.50%), while [RSN88] has the highest contribution percentage in the Y direction (67.99%). This suggests that certain earthquakes can have more dominant effects in different directions.

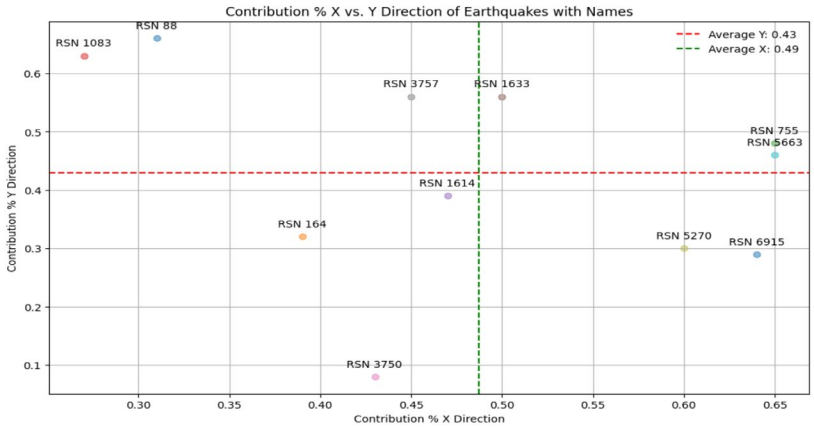


Figure 6. X% and Y Direction Contribution of the Aluminum model with the names of the earthquakes

Upon examination of the graph, it is evident that the average contribution in the X direction is 48.69%, while in the Y direction it is 44.55%, with a slightly higher average contribution in the X direction. The standard deviation is 13.56% in the X direction and 12.39% in the Y direction, indicating a slightly wider distribution around the mean for the X direction. The majority of earthquakes exhibit similar contribution percentages in both the X and Y directions. The RSN 6915 earthquake exhibits a notably high contribution in the X-direction, whereas RSN 88 has a high contribution in the Y-direction.

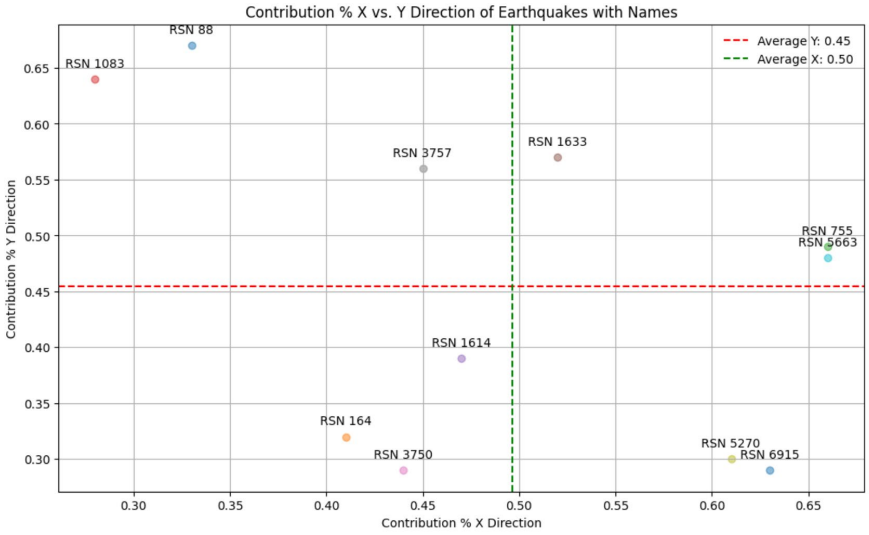


Figure 7. X% and Y Direction Contribution of the Timber model with the names of the earthquakes

Upon examination of the graph, it is evident that the majority of earthquakes are clustered at the intersection of these mean lines, resulting in a balanced seismic effect in both the X and Y directions for most events. However, the RSN 6915 earthquake displays an unusually high contribution in the X direction, approximately 65%, which is significantly above average. Similarly, the RSN 88 earthquake exhibits a similar difference in the Y direction, with its contribution being around 65%. The standard deviation was calculated to be 13.56% in the X direction and 12.39% in the Y direction. This numerical measurement confirms the visual observation that the spread of data points is slightly greater in the X direction, indicating a marginally higher variability of earthquake impact in this orientation.

4. CONCLUSION

The research examines the impact of different framing materials on the seismic resilience of unreinforced masonry (URM) structures. The study provides valuable insights for architectural conservation and engineering practices in seismically active areas. The mechanical differences between timber, aluminum, and PVC highlight the challenges of achieving seismic resilience. Timber's flexibility allows it to absorb energy during seismic events, potentially reducing structural damage. However, ongoing maintenance is necessary due to its vulnerability to environmental factors. On the other hand, aluminum frames have superior tensile strength and ductility, allowing them to endure substantial deformation without failure. This enables the design of slender yet robust frameworks. PVC frames, although not commonly used in seismic applications, offer a unique combination of concrete's compressive strength and aluminum's tensile strength, providing a multifaceted approach to seismic support.

The results of the time history analysis, which examined the response of URM structures to 11 different earthquake scenarios, highlight the importance of material selection in seismic performance. The contribution percentages vary across different seismic events, highlighting the complex relationship between framing materials and earthquake forces. This variability emphasizes the need for tailored approaches that consider local seismic patterns and specific architectural demands, rather than a universal solution.

The evidence indicates that selecting appropriate framing material, considering local seismic conditions and structural requirements, can greatly enhance the seismic performance of unreinforced masonry structures. Therefore, it is crucial to continue researching and advancing material technologies to develop innovative and resilient solutions that safeguard life, property, and cultural heritage.

In conclusion, the selection of framing materials for openings in unreinforced masonry structures is crucial in determining their behaviour during seismic events. Timber, aluminum, and reinforced concrete offer clear advantages in terms of stiffness, strength, and energy dissipation capacity. Engineers and designers can improve the seismic performance of unreinforced masonry structures by selecting appropriate frame materials based on the specific requirements and seismic conditions of the region.

Further research and advances in materials technology are necessary to develop innovative solutions for improving the seismic performance of unreinforced masonry buildings. Understanding the influence of framing materials on the behaviour of these structures can help stakeholders implement measures to mitigate the effects of earthquakes and ensure the safety of occupants and communities.

In the Turkish context, seismic risk to unreinforced masonry buildings is high. Preserving the architectural heritage while improving seismic safety is a challenging yet vital endeavour. This study contributes to a broader understanding of the seismic resilience of masonry structures. It is imperative that stakeholders, from engineers to policymakers, apply these findings to ensure the safety and preservation of Turkey's rich architectural landscape.

The seismic risk to unreinforced masonry (URM) buildings in Turkey is a critical issue that demands ongoing attention from engineers, policymakers, and conservationists. Retrofitting measures can significantly reduce risks, but they must be balanced with the need to preserve Turkey's valuable architectural heritage.

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