【原著論文】

# Effects of the Workshop for Building Seismic Safety by Introducing the Concept of Rapid Visual Screening:
## A Case Study in the Dominican Republic

## 目視による簡易耐震診断の概念を紹介する耐震ワークショップの効果：
## ドミニカ共和国における事例研究

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***SUMMARY***

In recent years, seismic education has been considered an integral part of disaster education programs for individuals living in seismic-prone countries. Seismic safety workshops serve as a good example of raising seismic risk recognition among people. Thus, this study aimed to propose a new workshop style for building seismic safety and to check the effects of the workshop using observed damage cases that had been partially evaluated in advance through rapid visual screenings (RVS). In particular, the effectiveness of the workshop for moderately educated individuals in the Dominican Republic was the primary focus. The authors conducted a workshop by creating tools that included presentations, questionnaires, cards, and interactive games. The workshop was given to 29 undergraduate students at a Dominican Republic university. A set of questionnaire surveys on the participants' recognition of the seismic safety of their houses and some national heritage buildings was conducted before and after the workshop. Then, the variation in the participants' responses to the survey was analyzed. The results indicate that more than half of the participants changed their feelings about their house safety. Therefore, the workshop was a good occasion for the participants to review their seismic safety, and it had a certain level of educational impact on the Dominican Republic participants.

***Key words***

Building Seismic Safety, Visual Screening, Workshop, Seismic Risk Recognition, Dominican Republic.

## 1. Introduction

In the last decades, seismic risk recognition has been considered an important aspect of society's education, especially in seismic-prone countries. Therefore, national educational system must provide interdisciplinary pedagogical learning in its curriculum for better capacity building in terms of preventing and mitigating seismic activities. Thus, educational institutes are of paramount importance when disseminating a majority of awareness and preparedness activities. Therefore, it is further prescribed to adopt highly intuitive techniques, involving hands-on tools, emotion-driven, curiosity-driven, and learn-by-playing approaches[1].

One of the efforts that has been made is the application of the strategy named service learning, where participants work as screeners. These strategies are based on participants' interaction by implementing seismic safety assessments. These evaluations are defined as the process of identifying structural deficiencies in a building that can prevent it from reaching its desired performance during an earthquake. These visualization techniques are fundamental to improving their level of seismic risk recognition. Nevertheless, they need to be conducted more frequently. Also, the use of communicative skills, such as user-friendly language and storytelling strategies with books, courses, textbooks, and presentations, is fundamental[2]. The important part of teaching seismic safety is that it serves as input information to formulate risk mitigation policies. One of the efforts on seismic capacity education is conducted by providing seismic safety workshops. However, the appropriate styles of the workshop are not well examined. There should be a wide variety of workshop styles, and the workshop organizers should select the best-fitted style depending on the participants' characteristics.

This study aims to propose a new workshop style for building seismic safety and to check the effects of the workshop. The workshop was designed to raise seismic risk recognition by introducing the concept of Rapid Visual Screening (RVS). Especially observed damage cases whose seismic safety was partially evaluated in advance by RVS[3],[4] were used. In particular, the effectiveness of the workshop for moderately educated individuals in the Dominican Republic was the primary focus. There are some training materials for RVS; however, utilization for the general public is a new attempt. These workshops can result in a first approach to raising seismic risk recognition among moderately educated individuals, whose opinions may have a large impact on decision-making in the country.

The Dominican Republic is located on Hispaniola Island, which is shared with Haiti. Due to its geographical location and geotectonic characteristics, the Dominican Republic is exposed to significant seismic risk. The country has a long history of destructive earthquakes, including notable events in 1551, 1562 (which destroyed Santiago and La Vega), 1673 (which destroyed Santo Domingo), 1691, 1751 (which devastated Azua and Port-Au-Prince), 1761, 1770, 1842, 1860, 1910, 1911, 1915, 1916, 1918, 1946 (which triggered a tsunami in Escocesa Bay), 2003 (Puerto Plata), and 2010 (Port-Au-Prince). The seismic risk in the Dominican Republic arises from its geodynamic situation at a tectonic plate boundary[5]. Although there is a long history of seismic damage, the experiences of seismic damage may not be shared with younger generations in the Dominican Republic. This is because the frequency of devastating earthquakes within the country is less than that in other seismic-prone countries such as Japan. Thus, the usage of actual seismic damage in the workshop may be quite important in a country such as the Dominican Republic.

Figure 1. (a) Presentation of the workshop to the participants in the Dominican Republic. (b) Seismic exercise during the workshop session.

## 2. Method:

### 2. 1. The Research Framework

This study aimed to propose a new workshop and to check the effects of the workshop presented in the Dominican Republic. For the methodology, the authors conducted a new style of workshop by creating tools that include presentations, questionnaires, cards and interactive games. The workshop was given to 29 undergraduate students at a Dominican Republic university. They can be regarded as moderately educated individuals since they are just freshmen and had no professional training before. Snapshot images of the workshop are shown in Figure 1. A set of questionnaire surveys on the participants' recognition of the seismic safety of their houses and some national heritage buildings was conducted before and after the workshop. Then, the variation in the participants' responses to the survey was analyzed.

Participants were informed about the research objective, and measures were taken to protect participants' private information.

### 2. 2. Workshop Procedure

The workshop procedure was composed of five phases. Figure 2 shows the workshop flowchart. This activity took a total of 50 minutes. The first phase was related to the introduction of the activity, where the objective of this workshop was explained. Also, the participants' agreement about the use of the workshop results for research purposes was confirmed. This phase had a duration of 5 minutes.

For the second phase, the workshop started by providing examples of safe and unsafe housing to the participants in the event of an earthquake. National and international cases of past events were presented throughout, showing photos of safe and collapsed buildings. The selected past events include the earthquakes in the Dominican Republic (2003), Japan (2016), and Türkiye (2023). This phase lasted 4 minutes.

In the third phase, a video about buildings collapsing after the 2023 Türkiye-Syria earthquake was presented. This video was approximately 1 minute long. After the video, reflexive questions were asked to the participants to raise their critical thinking and motivation. In that sense, direct answers were not necessarily registered. These questions were the following: How can we prevent these houses and buildings from collapsing? Are they all collapsed structures or not? Why can it be prevented? What are the weaknesses and difficulties of the method? After these questions, a seismic safety exercise was conducted. This exercise had a duration of 20 minutes. The total number of participants was 29, and 3-4 member groups were formed randomly.

For each group, a set of printed materials was shared. Each of these materials was a card representing one building from a total of 32 buildings, and an answer sheet to be filled out. Figure 3 shows the detailed locations of the buildings used for this activity. The buildings were selected from Türkiye based on the M7.7, 2023 earthquake[4],[6]. The list of the total buildings is shown in Table 1. This list presents the number of buildings from 1-16 that were safe, and 16-32 that collapsed. Note

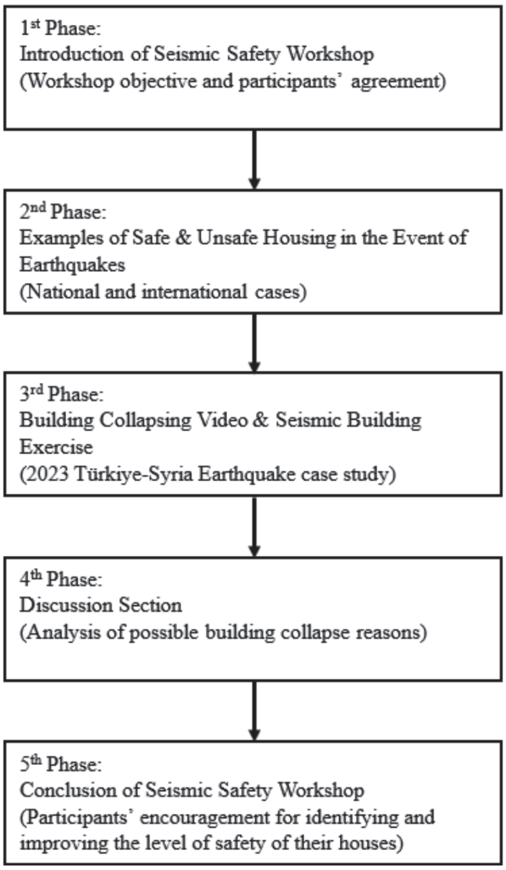


Figure 2. Workshop sequence procedure.

Figure 3. Location of 32 buildings at Islayiheh district (Gaziantep province) after the 2023 Türkiye-Syria Earthquake used in the seismic safety exercise at the workshop. The dark grey color represents 16 collapsed housing. The light grey color indicates 16 safe housing. Source: Adapted from Google Maps.

Table 1 List of Buildings used in the Seismic Safety Exercise

| Number of Building | Location (Latitude, Longitude) | Features |
|---|---|---|
| 1 | (37.014668, 36.629194) Şht. Polis Memuru Yakup Çirkin Cd., İslahiye, Gaziantep Province | Safety building. Regular square plan in structure. Continuous wall. |
| 2 | (37.017652, 36.632157) 229 Nolu Sk.,İslahiye, Gaziantep Province | Safety building. Continuous columns from 4th to 1st story. Symmetric in structural plan and non-structural element distribution. |
| 3 | (37.021209, 36.630437) 8 Menekşe Sk., İslahiye, Gaziantep Province | Safety building. Regular square plan in the structure. Continuous wall. |
| 4 | (37.024632, 36.628970) 846. Sk., İslahiye, Gaziantep Province | Safety building. Regular square plan in the structure. Continuous wall. Symmetric in structural plan and non-structural element distribution. |
| 5 | (37.021357, 36.629844) 3 Menekşe Sk., İslahiye, Gaziantep Province | Safety building. Regular square plan in the structure. Continuous wall in both directions. |
| 6 | (37.024284, 36.630318) 6 Şht. Kamil Cd., İslahiye, Gaziantep Province | Safety building. Regular square plan in the structure. Continuous wall. Symmetric in structural plan and non-structural element distribution. |
| 7 | (37.023669, 36.629348) Şht. Osman Göğebakan Sk., İslahiye,Gaziantep Province | Safety building. Regular square plan in the structure. Continuous wall. Symmetric in structural plan and non-structural element distribution. |
| 8 | (37.012832, 36.622833) Gaziantep Antakya Yolu, İslahiye,Gaziantep Province | Safety building. Dual system. Continuous shear wall. |
| 9 | (37.018764, 36.629361) 7309 Nolu Sk.,İslahiye, Gaziantep Province | Safety building. Regular square plan in the structure. Continuous wall. |
| 10 | (37.018002, 36.628530) 1 222 Nolu Sk.,İslahiye, Gaziantep Province | Safety building. Regular square plan in the structure. Continuous walls. |
| 11 | (37.020264, 36.629524) 57 Vatan Cd.,,İslahiye, Gaziantep Province | Safety building. Regular rectangular plan in the structure. Continuous wall. |
| 12 | (37.019666, 36.631353) 8 56 Nolu Sk.,İslahiye, Gaziantep Province | Safety building. Regular rectangular plan in the structure. Continuous wall. |
| 13 | (37.015919, 36.628019) 2 Ali Rıza Çelik Sk., İslahiye, Gaziantep Province | Safety building. Regular square plan in the structure.Continuous walls. |
| 14 | (37.022630, 36.631318) Latif Sk.,İslahiye, Gaziantep Province | Safety building. Regular rectangular plan in the structure. Continuous walls. |
| 15 | (37.021356, 36.631047) 49 Vatan Cd.,İslahiye, Gaziantep Province | Safety building. Regular rectangular plan in the structure. Continous walls and columns. |
| 16 | (37.015813, 36.624606) 246 Atatürk Blv.,İslahiye, Gaziantep Province | Safety building. Regular rectangular plan in the structure. Continuous walls. More distribution of masses in 1st story than upper stories. |
| 17 | (37.023030, 36.630213) Atatürk Blv., İslahiye, Gaziantep Province | Collapse building. Plan irregularity: torsional eccentricity. Vertical irregularities: soft story effect, weak story effect). Non-uniform column span. |
| 18 | (37.018467, 36.628625) 14 Reyhanlı Cd.,İslahiye, Gaziantep Province | Collapse building. External staircase columns are slender—there is a possibility of structural deterioration due to material aging. |
| 19 | (37.015097, 36.624938) Reyhanlı Cd.,İslahiye Gaziantep Province | Collapse building. Non-uniform column spans. Lack of seismic-resisting shear walls. Non-uniform column. No structural continuity between balcony slab and story slab. |
| 20 | (37.018402, 36.628478) 16 Reyhanlı Cd.,İslahiye Gaziantep Province | Collapse building.Vertical irregularities: 1st and 2nd stories soft story effect and weak story effect. Non-uniform column. Absence of exterior cladding or finish materials. |
| 21 | (37.024251, 36.631003) Zambak Sk.,İslahiye Gaziantep Province | Collapse building. Vertical irregularities: first story soft story effect and weak story effect in upper stories. Pounding. |
| 22 | (37.021760, 36.630451) Karasu Sk., İslahiye Gaziantep Province | Collapse building.Vertical irregularity. Due to being a 3-story structure, the dead load and seismic forces are significant. Potential structural deterioration. |
| 23 | (37.024943, 36.629551) 26 Şht. Osman Göğebakan Sk., İslahiye, Gaziantep Province | Collapse building. Plan & Vertical irregularities. Non-symmetric in structural plan and non-structural element distribution. Large separation of the center of mass and center of rigidity. Potential for eccentricity. |
| 24 | (37.021160, 36.630523) 54 Vatan Cd., İslahiye Gaziantep Province | Collapse building.Vertical irregularities:1st story soft story effect and weak story effect in upper stories. Peeling of exterior wall paint. 5-story building subjected to substantial dead load and seismic forces. |
| 25 | (37.018026, 36.631294) 6 107 Nolu Sk., İslahiye Gaziantep Province | Collapse building. Vertical irregularity: Imbalanced story stiffness (rigidity). Weak story effect in upper stories. Undersized columns cross-sections. |
| 26 | (37.022996, 36.632339) 24 Vatan Cd., İslahiye Gaziantep Province | Collapse building. Structural degradation. Non-uniform column. Non-uniform column span distribution Plan and vertical irregular building geometry: 1st story soft story effect and weak story effect in upper stories. . |
| 27 | (37.015622, 36.627812) 214 Nolu Sk.,İslahiye Gaziantep Province | Collapse building.Vertical irregularities: 1st story soft story effect and weak story effect in the upper stories. Variation in story heights across floors. Excessive overhang of balcony slabs. Non-uniform column span. |
| 28 | (37.022421, 36.631910) 33 Vatan Cd., İslahiye Gaziantep Province | Collapse building.Vertical irregularity: weak story effect. Peeling of exterior wall paint. Possibility of degradation. |
| 29 | (37.013240, 36.623172) Gaziantep Antakya Yolu, İslahiye, Gaziantep Province | Collapse building.Vertical irregularity: weak story effect in the upper stories. Non-uniform column span distribution. Inadequate column cross-sectional dimensions. |
| 30 | (37.014753, 36.628936) Şht. Polis Memuru Yakup Çirkin Cd., İslahiye, Gaziantep Province | Collapse building. Vertical irregularities: 1st story soft story effect and weak story effect in the upper stories. Variations in story-to-story heights across different levels. |
| 31 | (37.020217, 36.631028) 44 Salim Sk., İslahiye, Gaziantep Province | Collapse building.Vertical irregularity: 1st story soft story effect. Non-uniform column spans. The concentration of mass with the external staircase generated a torsion effect. |
| 32 | (37.020118, 36.628705) 2 Namık Kemal Cd.. İslahiye, Gaziantep Province | Collapse building. Vertical irregularity: weak story effect in the upper stories. Non-symmetrical structure. Inadequate column cross-sectional dimensions. Excessive overhang of the balcony floor slab. |

that the order and numbers of the cards of the buildings were randomized in the workshop. These card contents have photos of buildings taken before the earthquake using Google Street View. Thus, even for the collapsed buildings, the images before the earthquake were used. Due to copyrights, the original photos used in the workshop cannot be included in this paper. However, a sample image is shown in Figure 4. Each one of these cards contains (3) photos from different angles and a satellite image before the earthquake. These cards visualize important information to recognize the seismic risk of buildings. The task of this exercise was to identify which buildings had collapsed after the earthquake. It was indicated to the students that half of the buildings (16) had collapsed. In addition, the answers were discussed by each group regarding which building they considered collapsed. Then, they were instructed to show the possible reasons for the collapse by filling in the answer sheet given by each group. A snapshot of the answer sheet is shown in Figure 5. Finally, the number of question sheets was requested to be placed on the answer sheet.

In the fourth phase, a discussion of the answers provided from the exercise was conducted. In this session, the possible reasons for the collapse of the analyzed buildings were explained. Then, the best group performance was checked and shared with the participants. This discussion section was important to raise the seismic risk recognition of the participants, whether they could identify a building's


Figure 4. Example of a building card to be distributed to the participants during the proposed workshop. Source: Ozkula et al. (2023), Arolat (2022), Google Maps.

○：Safe　×：Collapse

| Case | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ or × | | | | | | | | | | | | | | | | |
| Reason | | | | | | | | | | | | | | | | |

| Case | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) | (25) | (26) | (27) | (28) | (29) | (30) | (31) | (23) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ or × | | | | | | | | | | | | | | | | |
| Reason | | | | | | | | | | | | | | | | |

Group Members in the No. of question sheet:

Figure 5. Answer sheet distributed to the participants during the seismic safety exercise.
The case numbers were randomly renumbered from Table 1.

weaknesses only from the outside view of the facade. Thus, the benefits of Rapid Visual Screening (RVS) were explained. In addition, the RVS's disadvantages were also mentioned. Also, research achievements by the authors on the applicability of RVS was presented to the participants. This phase had a duration of 15 minutes.

In the fifth phase, the conclusion of the workshop was presented. During this phase, the participants were instructed to think about the level of safety of their houses and how to improve this level of safety. In addition, they were asked to think about how to improve the stability of furniture as a prevention method before an earthquake occurs. This phase had a duration of 5 minutes.

### 2. 3. Questionnaire Procedure

The methodology implemented consisted of using two closed and open-ended survey questionnaires during the workshop: one before and one after the activity. This included structured, closed-ended questions with predefined response options. Open-ended questions were included in the quantitative data, providing an overview of the participants' knowledge and perceptions. These questionnaires were based on six questions (Q1 to Q6) for the first survey and four questions (Q7 to Q10) for the second one. The list of questions and possible answer options is summarized in Table 2.

Before starting the workshop, the first questionnaire survey was conducted. This closed and open-ended questionnaire was implemented for 5 minutes. The content asked the participants about their houses and the seismic risk recognition of a sample of heritage buildings. Questions Q1 to Q3 are related to the participants' housing conditions. Additionally, questions Q4 to Q6 focus on the participants' seismic risk recognition.

After the workshop, the second questionnaire was implemented. This closed and open-ended questionnaire was conducted for 5 minutes. The content asked participants about the level of safety of their houses and the seismic risk recognition of a sample of heritage buildings to check the variation in their responses from the first questionnaire. Q7 is the same question as Q4, but focuses on the level of variation. Q8 aims to obtain the reasons for a change in the variation. Q9 is intended to identify the recognition of prob-

Table 2 Before & After Workshop Questionnaires

| No. Question | Questions | Options |
|---|---|---|
| | Before | |
| Q1 | What kind of house do you live in? | ☐ Reinforced concrete (RC)<br>☐ Masonry<br>☐ Steel<br>☐ Wood<br>☐ Mixture<br>☐ I do not know<br>☐ Others: please specify |
| Q2 | How many floors does your house have? | ☐ 1<br>☐ 2-3<br>☐ 3-5<br>☐ 6-10<br>☐ 10-20<br>☐ 21 or more |
| Q3 | What is the width of your house? | ☐ < 5m<br>☐ 5-10m<br>☐ 10-20m<br>☐ 20-40m<br>☐ 40m or more |
| Q4 | How much do you think your house is safe against future earthquakes? | Very Safe Average Very dangerous<br>☐+ + + + +☐+ + + + +☐+ + + + +☐+ + + + +☐ |
| Q5 | Why do you think your house is safer (or more dangerous) than average? | |
| Q6 | Do you think the following heritage buildings in the Dominican Republic are safe against future earthquakes? | (a) Edificio Baquero Score: (b) Edificio Plavime Score:<br>(c) Edificio Cerame Score: (d) Edificio Díez Score:<br>(e) Edificio Casa del Pudín Score: (f) Edificio Copello Score: |
| | After | |
| Q7 | How much do you think your house is safe against future earthquakes? (After the workshop) | Very Safe Average Very dangerous<br>☐+ + + + +☐+ + + + +☐+ + + + +☐+ + + + +☐ |
| Q8 | If you changed the answer above from the answer to the initial question, why? | |
| Q9 | What do you think is necessary to improve seismic safety in the Dominican Republic? (In other words, what may be insufficient in the Dominican Republic to live safely against future earthquakes?) | |
| Q10 | Do you think the following heritage buildings in the Dominican Republic are safe against future earthquakes? (This is the same question as before the workshop, but the variation shall be examined). | (a) Edificio Baquero Score: (b) Edificio Plavime Score:<br>(c) Edificio Cerame Score: (d) Edificio Díez Score:<br>(e) Edificio Casa del Pudín Score: (f) Edificio Copello Score: |

lems in the Dominican Republic. Q10 is the same question as Q6, but it focuses on the level of variation for buildings where participants do not live.

## 3. Results of Questions and Seismic Safety Exercises

### 3. 1. Participants' Housing Characteristics

The questions asked to the participants based on their housing characteristics are as follows:

Q1: What kind of house do you live in?

Q2: How many floors does your house have?

Q3: What is the width of your house?

The majority (19) of participants referred to living in reinforced concrete buildings, representing 65.52% of the total participants in the workshop. In addition, 17.24% of participants live in masonry buildings (Q1). The statistics of the buildings' characteristic materials used in the Dominican Republic (DR) and the capital city of Santo Domingo (SD)[7] show that 66.50% of the material used in DR corresponds to concrete or concrete blocks. In regard to SD, concrete and concrete blocks represent 80.70% of the use of this material. This means that the participants have similar proportions to the people in SD in terms of the characteristics of their houses.

Additionally, the results show that a great number of the participants (9) expressed that they mostly live in tall buildings, representing 31.03% of the total sample of n = 29. While (15) of the participants live in average and tall buildings, summing 51.72% of the total group (Q2). Most participants (9) considered living in houses with a width of more than 5 meters, while (8) of them expressed that they inhabit housing with 10 to 20 meters in width (Q3).

Due to the lack of statistics in the Dominican Republic, we cannot compare these answers to the statistics.

### 3. 2. Participants' Seismic Risk Recognition: Before Workshop Section

The other questions asked to the participants before the workshop are as follows:

Q4: How much do you think your house is safe against future earthquakes?

Based on this question, the participants showed their level of awareness by selecting a score from a safety scale (very safe, safe, average, dangerous, and very dangerous) to identify the level of safety of their respective structures. 72.40% (21 out of 29) of the participants think their houses are safer than average. Figure 6 shows the variation in the participants' responses considering each of the parameters of their housing characteristics previously mentioned. According to these correlations, reinforced concrete houses are considered the safest housing type by the participants. Regarding the number of floors, mid-rise buildings (3-5 floors) give the lowest feelings of safety for the participants. While the width of floors has almost no impact on their feelings.

Q5: Why do you think your house is safer (or more dangerous) than average?

Figure 7 shows the participants' responses obtained by categorization of free-writing answers. Of the participants who stated that their houses are safer than average, 8 partici-

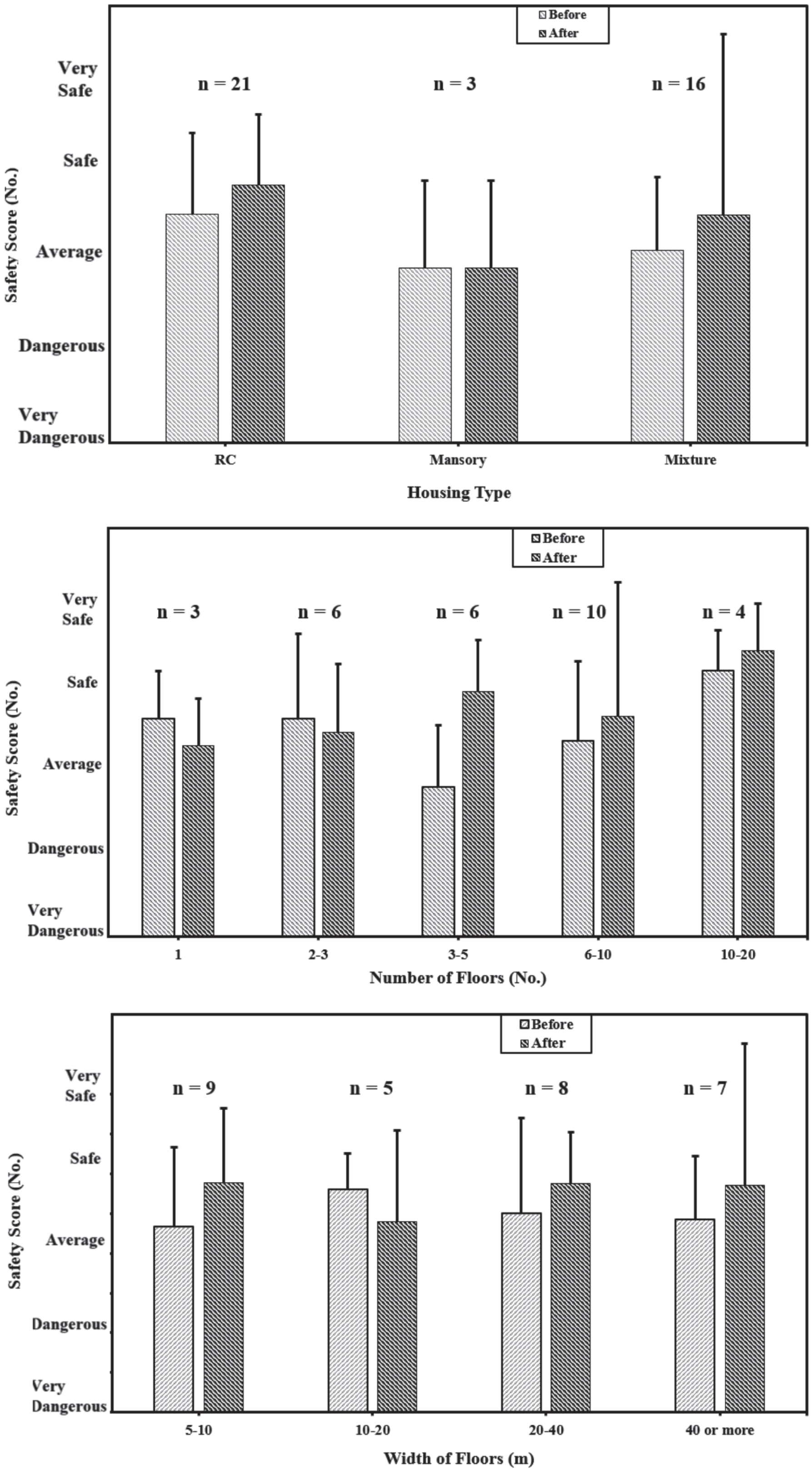


Figure 6. Participants' housing characteristics and the responses for Q4 (before the seismic workshop, grey color) and for Q7 (after the workshop, black color).

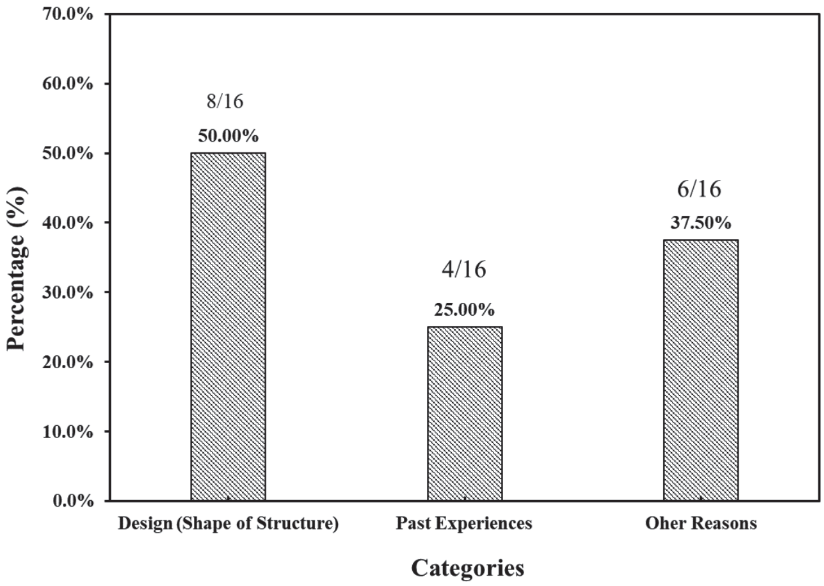

Figure 7. Participants' responses for Q5 from the people who think safer than average.

pants out of 16 (50.00%) mentioned this was because they considered their houses to be constructed with a good design (shape of structure). While 4 participants out of 16 (25.00%) thought their structures were stable since they had not been affected by previous earthquake events, examples of other reasons (6 out of 16: 37.50%) are as follows:

- The building is in a good geological location.
- The building has a good foundation (base).
- Made of more resistant materials than other more common materials.
- Because it doesn't present cracks.
- It is a building that complies with construction regulations.
- It seems safe.

Although only 5 participants stated that their houses are more dangerous than average, they have similar viewpoints. 3 participants out of 5 (60.00%) indicated their houses look bad now due to the presence of cracks. Another participant said the material and design were of bad quality and also implied the existence of cracks. Note that 1 participant mentioned the absence of an emergency staircase. He/she did not consider the stability of the building but focused on an emergency evacuation route.

As part of the questions given to the participants before the workshop, a special section related to heritage buildings was prepared. The question is as follows:

Q6: Do you think the following heritage buildings in the Dominican Republic are safe against future earthquakes?

For question Q6, six different heritage buildings were presented to the participants to provide a safety score from 1 to 5. This safety scale corresponds to very safe, safe, average, dangerous, and very dangerous, respectively.

The six heritage buildings were the following:

（a）Edificio Baquero
（b）Edificio Plavime
（c）Edificio Cerame
（d）Edificio Diez
（e）Edificio Casa del Pudin
（f）Edificio Copello

These buildings were shown using Google Street View photos, both in the before and after workshop questionnaire surveys. Nevertheless, due to copyright issues, these photos cannot be shown in this paper. Instead, the photos taken after the workshop are shown in Figure 8. Almost the same photos were shown to the participants. The results of the heritage buildings will be discussed in a later section.

### 3. 3. Results of Seismic Safety Exercise:

The results of the Seismic Safety Exercise, which consisted of 16 safe buildings and 16 collapsed buildings, shown in Table 1, are presented in this section. The correct rates of the responses given by the participants, divided into 8 groups of 3 or 4 people, are 71% for safe buildings and 74% for collapsed buildings. As a typical mistake, they disregarded the continuity of walls as an important structural characteristic for seismic safety. Although the information for exactly half of the buildings （16） was safe, some groups, specifically groups 3 and 4, did not mark 16 buildings as safe.

### 3. 4. Effect of the Workshop: After Workshop Section

To evaluate the effect of the building's seismic safety workshop, a second questionnaire survey was prepared. These questions were mainly an overview of the previous questions given before the workshop section. These questions aimed to check the success of the workshop in terms of the increase in the level of seismic risk recognition among the participants after the event.

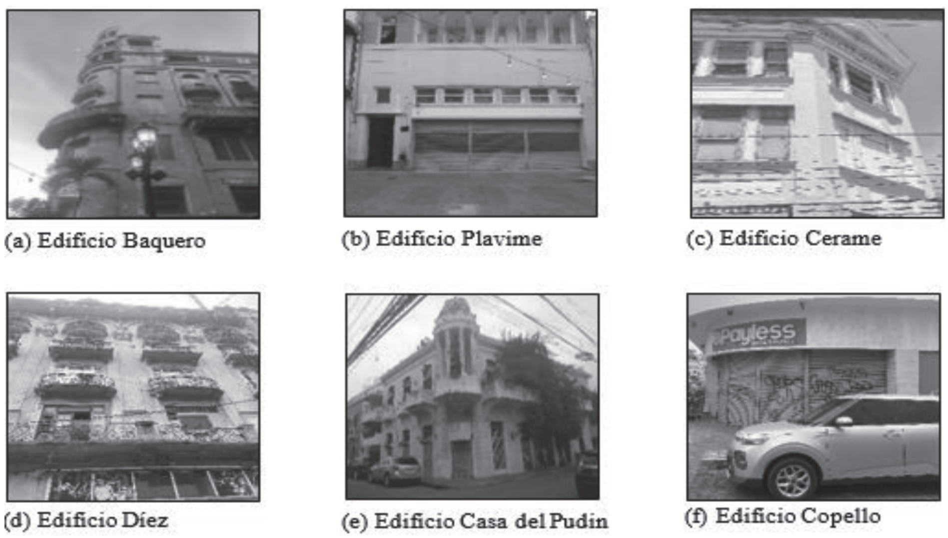


Figure 8. Heritage Buildings in the Dominican Republic considered for seismic safety assessments.

The questions asked to the participants after the workshop are as follows:

Q7: How much do you think your house is safe against future earthquakes? (After the workshop)

After the workshop, the authors asked the participants how safe they considered their houses to be, correlating this question with Q4. Figure 9 shows the participants' responses for Q4 and Q7. Interestingly, 18 participants changed their answers between the before and after workshop questionnaires. These changes represent 62.07% of the 29 students participating in the workshop. Note that the answer for Participant No. 29 was not available regarding question Q7.

Figure 10 shows the participants' response variation results from Q4 to Q7. 12 participants (41.38% of the total) considered their houses as having a safer level compared to their previous answers.

On the other hand, 6 participants changed their answers to indicate a more dangerous side. This variation could mean these participants identified some housing vulnerabilities that make their housing more dangerous, while (10) responses remained at the same level.

Q8: If you changed the answer above from the answer to the initial question, why?

Although 18 participants changed their answers, as shown in Figure 10, only 5 participants indicated that their answers had changed. This implies that the participants misunderstood the meaning of the question. Thus, we cannot obtain the information regarding the reasons for the variation in the answers from Q4 to Q7. However, from the variations of the answers corresponding to the participants' housing characteristics shown in Figure 6, we can estimate the reasons. First, people living in 3–5 floor buildings feel safer

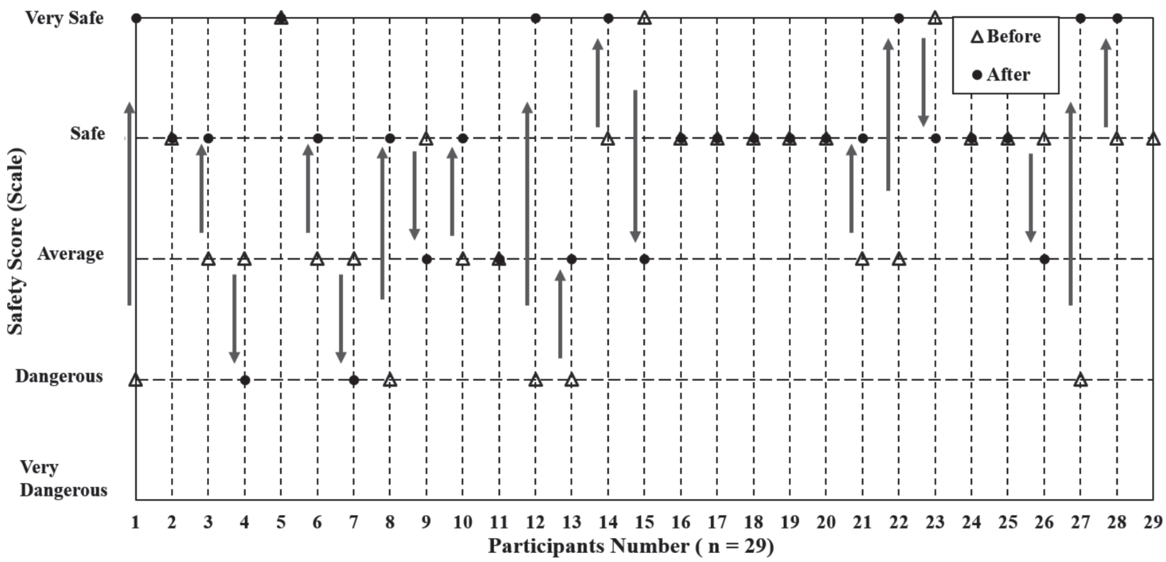


Figure 9. Participants' responses for Q4 and Q7 before and after starting the seismic workshop.
The grey arrows indicate the answers from the participants that were changed (12 for safer, 6 for dangerous).

than before the workshop. It may be because 3-5 story buildings in Santo Domingo tend to be old, and the residents are worried about this. However, the workshop safety exercise emphasized the importance of not only the age of buildings, but also the details of building design. Similarly, since the variations in risk recognition increased for people living in mixed-type housing or buildings with a width of 40 m or more (which tend to be hybrid types of residences and stores), we can estimate that people living in complicated structures started to reconsider their building safety.

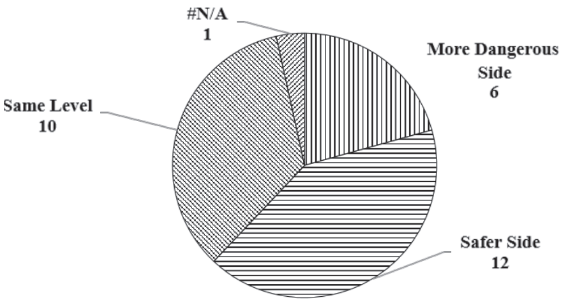


Figure 10. Participants' response variation results in the safety consideration of their houses (variation from Q4 and Q7).

Q9: What do you think is necessary to improve seismic safety in the Dominican Republic? (In other words, what may be insufficient in the Dominican Republic to live safely against future earthquakes?)

Figure 11 shows the results obtained by categorizing free-writing answers. 11 participants (39.29%) expressed that the building's

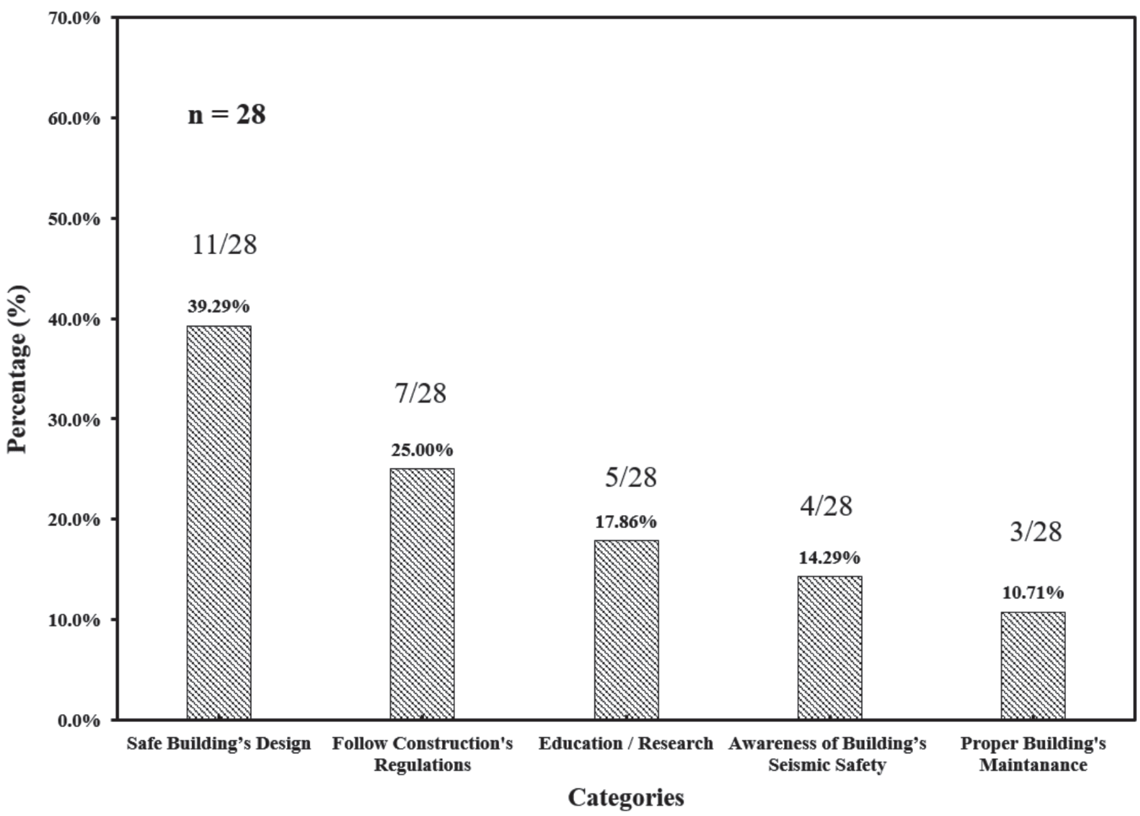


Figure 11. Participants' responses for Q9 after the seismic workshop (variation in the number of people who mentioned the Dominican Republic's necessities for improving seismic safety).

design (shape of structure) should be the most important. Following construction regulations was also pointed out by 7 participants (25.00%). In this context, construction regulations mean complying with national laws and regulations such as the seismic code. Education/research and awareness of building's seismic safety were mentioned by 5, and 4 participants, respectively (17.86%, 14.29%). Note that due to the free-writing questions, 4 participants' answers were input into more than one category, and the answer for Participant No. 29 was not available regarding question Q9.

Q10: Do you think the following heritage buildings in the Dominican Republic are safe against future earthquakes? Give the scores (5: Very safe, 3: Average, 1: Very dangerous). (This is the same question as before the workshop, but the variation shall be examined.)

Figure 12 shows the workshop's effect on the participants' responses regarding the heritage building safety level selected before and after the workshop. The selection of the targeted buildings was based on vertical irregularities, especially transparency on the first floor, known as soft story. In short, from the visual screening point of view, these are not safe. However, initially, the participants believed that these were slightly safer than average. Even after the workshop, their responses did not show a significant change. Only for the Edificio Plavime did they slightly recognize the lower seismic safety.

## 4. Discussion

The change of 18 answers in Q7 (12 for safer, 6 for more dangerous) compared with Q4 could be due to the effect of the workshop on the participants. These could have been made as a reflection on the design (shape of structures) of their houses. Although the authors do not know whether these are better answers or not, it may be from a better understanding of their house safety. Thus, the fact that more than half of the participants changed their seismic risk recognition of their

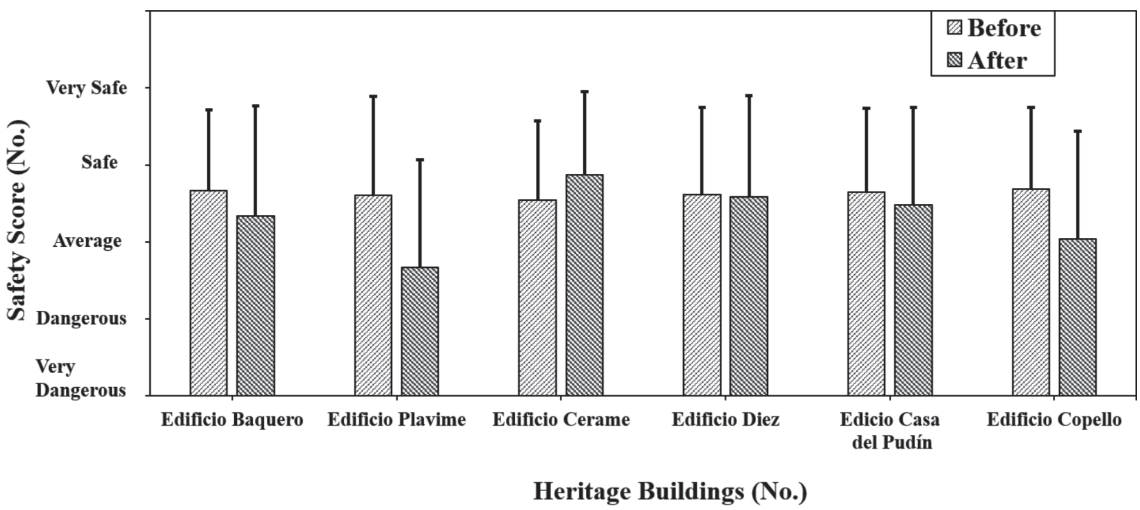


Figure 12. Participants' responses for Q6-Q10 before and after the seismic workshop.

houses after the workshop means that the workshop was a good occasion for the participants to review their seismic safety. This indicates that it had a certain level of educational impact on the participants. However, we cannot conclude that their ability has increased since we do not know whether their answers after the workshop are correct or not.

In contrast, almost no change was observed in Figure 12, where the safety of national heritage buildings was focused on. It may be because the participants had information about their houses, but for the heritage buildings, they did not know any detailed information about the structures. It implies the workshop of RVS emphasized the importance of the details of the buildings. Only for (b) Edificio Plavime, the wide span on the 1$^{st}$ floor can be identified in the picture as shown in Figure 8. That is why the decrease in the safety score is slightly larger for (b) Edificio Plavime than for other buildings. Thus, the workshop made the participants focus on the details of the buildings, and it is a good initiation to start thinking of building safety from an engineering point of view.

In Q5 and Q9, the participants' responses were both mentioned regarding a good design (shape of structure). This implies that the importance of seismic design was already shared with the participants. Note that the participants in the Dominican Republic are 1$^{st}$-year students at university majoring in civil engineering. Although they have not been well-trained as professionals, they may not be usual people, but individuals who understand the importance of engineering. More various trials of the workshop with moderately educated individuals, usual people, high school students, university scholars, etc., remain for future study.

Even for the free-writing answers, especially in Q9, the participants who mentioned seismic risk recognition was very low. That was a surprising result. Since the participants were civil engineering students, it is reasonable that they focused on the design aspect. However, they were not equally thinking the importance on seismic risk recognition. Thus, these results show the importance of this new proposed workshop style to enhance the seismic risk recognition of people.

## 5. Conclusions

This research aimed to propose a new workshop style for building seismic safety and to check the effects of the workshop presented in the Dominican Republic.

The main conclusions obtained in this study are as follows:

1) We developed a new workshop style using real cases of survived and collapsed buildings based on a past earthquake. In a trial workshop with university students, it was successfully conducted in 1 hour. This is the only workshop given to moderately educated individuals by introducing Rapid Visual Screening.
2) As an effect of the workshop, more than half of the participants changed their feelings about their house safety. Both the variation toward the safer side and the more dangerous side are more observed. It may be due to a better understanding of

their house safety, and the workshop had a certain level of educational impact on the seismic risk recognition of non-professional people.

3) In contrast to the variation in the safety scale of their houses, the average safety feeling regarding national heritage buildings did not change. This may be because the participants did not know any detailed information about these structures. It implies that the workshop of RVS emphasized the importance of the details of the buildings.

4) As a result of the workshop, the participants recognized the lower seismic safety of one of the heritage buildings. They may have identified the wide span on the 1st floor through the pictures shown in the workshop. It may have been a good initiation for the participants to start thinking about building safety from an engineering point of view.

5) Even for the free-writing answers, the participants who mentioned seismic risk recognition were very low. This implies the importance of this new proposed workshop style to enhance the seismic risk recognition of people.

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## References

[1] Musacchio, G., S. Falsaperla, A.E. Bernhardsdóttir, M.A. Ferreira, M.L. Sousa, A. Carvalho, and G. Zonno (2016). Education: Can a bottom-up strategy help for earthquake disaster prevention? Bull. Earthq. Engin., 14, 7, 2069-2086.

[2] Arroyo, B., Barrero Tovar, C, and Feliciano, D (2022). Service learning as a teaching strategy for seismic vulnerability during the covid-19 pandemic. *International Journal of Engineering Education*, vol. 38, pp. 1484-1494.

[3] Federal Emergency Management Agency (US). Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook Third Edition, 2015. Online: www.ATCouncil.org. (checked: 2025/02/21)

[4] Yamamoto, M., Goto, E., and Ichii, K. (2023). Visual Screening Scores of Visual Screening Scores of Damaged/Undamaged Buildings in Turkey-Syria Earthquake. A13-151, *43rd JSCE Annual Meeting of Earthquake Engineering*. (in Japanese).

[5] Escuder-Viruete, J., Pérez, Y., Suárez Rodríguez, A., García Senz, J., Roque, B, Calzadilla, M., (2018). Geodinámica, Neotectónica, Sismotectónica y Tectónica Activa en la Cordillera Septetrional de la República Dominicana: implicaciones para la Evaluación del Riesgo Sísmico. In: Proyecto SGN-IGME 2015-1B3-118. Programa FONDOCYT del Gobierno Dominicano, p. 148. Informe Final, https:/www.sgn.gob.do. (checked: 2025/02/21)

[6] Goto, E., Yamamoto, M., and Ichii, K. (2023). Differences of Collapsed and Non-Collapsed Buildings in the Turkey-Syria Earthquake. A13-115, *43rd JSCE Annual Meeting of Earthquake Engineering*. (in Japanese).

[7] Oficina Nacional de Estadística (ONE) of the Dominican Republic. Online: https://www.one.gob.do/datos-y-estadisticas/

temas/censos/poblacion-y-vivienda/2002/
（checked: 2025/02/21）

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