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IN COLLABORATION WITH C0-PLAN,
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EMBASSY OF JAPAN

TODAY'S CHALLENGES OF CONSTRUCTION INDUSTRY AND RESILIENCE TO NATURAL HAZARDS

Scientific Periodicals

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TODAY'S CHALLENGES OF CONSTRUCTION INDUSTRY AND RESILIENCE TO NATURAL HAZARDS

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POLIS University

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PROGRAM OF THE
INTERNATIONAL SYMPOSIUM
"TODAY'S CHALLENGES OF CONSTRUCTION INDUSTRY AND RESILIENCE TO NATURAL HAZARDS"

Polis University
Department of Architecture and Civil Engineering

PROGRAM

Registration: **8:30 – 9:00**
Symposium Opening Words: **9:00 – 9:10**
1st Session: PRESENTATIONS
Moderator **Doc. Dr. Merita Guri**

9:10 – 9:20 **Dr. Erind Bejko**
General Director of Co-owned Facilities at the Municipality of Tirana
9:20 – 9:35 **Prof. Llambro Duni**
Academic, Seismologist at IGJEUM Institute
9:35 – 9:45 **Dr. Diana Lluka; Doc.Dr. Merita Guri**
Lecturer at Polytechnic University of Tirana
9:45 – 9:55 **Dr. Ervin Paci**
Lecturer at Polytechnic University of Tirana
9:55 – 10:10 **Prof. Andrew Charlesson**
Lecturer at Polis University

Discussions of session: **10:10 – 10:30**
Coffee Break: **10:30 – 11:00**

2nd Session: PLANNING: WHAT MAKES A TERRITORY RESILIENT?
Moderator **Dr. Ledian Bregasi**

11:00 – 11:45 **Prof. Dr. Aya Kubota**
Tokyo University
11:45 – 12:15 **PhD. Maki Morikawa**
Urban Planner

Discussions of session: **12:15 – 12:40**
Free Time at lunch: **12:40 – 14:00**

PROGRAM OF THE
INTERNATIONAL SYMPOSIUM
"TODAY'S CHALLENGES OF CONSTRUCTION INDUSTRY AND RESILIENCE TO NATURAL HAZARDS"

Polis University
Department of Architecture and Civil Engineering

3rd Session: DISCUSSION PANEL
Moderator PhD. **Ilda Rusi**

14:00 – 14:10 Remarks for opening the Panel Discussion, **Mr. Makoto Ito**, Ambassador of Japanese Embassy in Tirana

14:10 – 14:25 **Prof. Dr. Aya Kubota**
Lecturer at Tokyo University
14:25 – 14:40 **Dr. Dastid Ferati**
Assistant Lecturer at Tokyo University
14:40 – 14:55 **Prof Emeritus Luljeta Bozo**
Lecturer at Polis University
14:55 – 15:10 **Doc. Dr. Merita Guri ; Dr. Diana lluka**
Lecturer at Polis University
15:10 – 15:25 **Dr. Rudina Toto**
Co-PLAN Institute for Habitat Development

Discussions **15:25 – 15:55**
Closing Session **15:55 – 16:00**

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INTRODUCTION

On December 6, 2019, POLIS University in co-operation with Co-PLAN, AUA and with the support of the Embassy of Japan, organized a scientific and awareness-raising forum on "Challenges of the Construction Industry and Resilience to Natural Disasters". This intensive, six-hour activity brought together professionals and technicians, scientists, academics, specialists of public institutions, media, students and civil society representatives, who discussed city development issues, the challenge of construction and reconstruction in Albania in the context of two seismic events with significant consequences on human lives and economic damage, September and November 2019.

Experts from POLIS University and Co-PLAN, experts from the Polytechnic University of Tirana, IGJEUM Institute and the Municipality of Tirana contributed to this technical, scientific and awareness raising forum. A group of experts from Japan brought their country's historical experience in dealing with natural disasters, post-crisis response and society and city recovery, and in particular planning the resilient reconstruction of the city, in anticipation of future crises.

Summary of the speech delivered during this symposium, along with a reflection of the situation after the November 26th earthquake, constitute this technical bulletin prepared by the Department of Architecture and Engineering.

RESILIENCE IN TECHNOLOGIES, QUALITY AND SAFETY IN CONSTRUCTION AND HOUSING

Prof. Dr. Besnik Aliaj
Rector of Polis University

1. It is suggested to create a national methodology on the assessment, reinforcement and repair / rehabilitation of structures damaged by the earthquake. This methodology can be unified and should be applied rigorously, the assessment findings should be transparent and reconstruction decisions should be made based on them.

2. It is necessary, in an urgent manner, to carry out the engineering assessment of the stability and quality of structures, not only in cities, and not only in damaged areas, but also in informal and rural areas. In these construction areas were carried out independently by people and without a project, so their safety is unknown and controversial. The legalization legislation contains such provisions, but they have been ignored, meanwhile that the analysis before legalization has not been completed.

3. Based on the international experience, and especially that of New Zealand, it is recommended to raise a national and local monitoring system for buildings in relation to the performance and depreciation of them and on this basis to create housing policies. This system should be transparent and accessible by him all. This national database, created on the structural data of buildings, seismic data and geophysics of the land, will serve not only construction specialists, but also citizens. Information should be open and accessible to all. It is necessary for this database to serve as a kind of certification engineering-structural that informs citizens about the quality of housing and the security they offer. Beyond monitoring, the system must be supported with institutional and financial measures, which lead to the improvement of the situation and reducing the risk of problematic buildings. Also, especially for public and private institutions, which accommodate for long periods of time a considerable number of users, a monitoring system is needed times more detailed. It is very necessary, that such an instrument, as the establishment of the database, avoids the possibilities of speculation in the real estate market, and for this reason, it should be seen as an informative instrument that leaves themcitizens decision-making on access to housing. In the case of buildings which need to be demolished, the created space should be used as free public space.

4. From the international symposium "Today's challenges of construction industry and resilience to natural hazards" one of the main concerns was related to the legal basis on design and construction codes and annexes national, which must be completed urgently, and based on a broad and transparent discussion institutional-professional. While this legal basis should be based on the Eurocodes, it should also be adapted to special characteristics of the territory in Albania.

5. It is necessary to strengthen professional technical controls throughout the construction cycle until the issuance of the certificate of use, focusing on the public entity and correcting each form corruption. From a legal point of view, the obligation of the municipality for the system of supervision, control, approval and eventually the certification should come complete and clear, eliminating any ambiguity and overlap that today allows a hazy status. Beyond an awareness of the private sector that exercises a series of obligations during all steps of construction, municipalities have full legal responsibility for the safety of citizens and must guarantee it in all steps of project approval and certification implementation. If the municipality to carry out its function it needs more specialists, then it should cooperate with the construction institute, or any structure specially created public technical Also, the relevant documentation should be accessible online to everyone the citizens.

6. In the framework of legal changes and measures to increase security, it is necessary to see schemes of different types of building insurance. Schemes should set levels that reflect the company's solvency. Private choices are individual in nature.

SESSION 1

DATA REGARDING THE STRONG MOTION OF THE LAST TWO EARTHQUAKES IN DURRËS. SOME PRELIMINARY ASSESSMENT

Llambro Duni
IGJEUM, Department of seismology

EXTENDED ABSTRACT

Albania is characterized by high seismicity levels, which is proved by the large number of these events through centuries in the Albanian territory. For example, it can be said that Albania is characterized by an intensive microseismic activity ($1.0 < M \leq 3.0$), many small earthquakes ($3.0 < M \leq 5.0$), a small number of moderate earthquakes ($5.0 < M \leq 7.0$) and by very rare and strong earthquakes ($M > 7.0$). From the III- II century B.C until nowadays, Albania has been struck by 55 earthquakes of strong intensity Io≥ VIII, and 15 others which had an intensity of Io≥ IX. Of these 55 earthquakes of a timeline of more than 2000 years, 36 belong to the 19th century. In this context, beside the network for Weak Motion needed for the evaluation of the scale and epicentre of the earthquake, the Department of Seismology at IGEWE (Institute of Geosciences, Energy, Water and Environment) has been working in establishing and keeping in function another network for Strong Motions, known as Accelerograph Network. This network is necessary in order to measure, in terms of horizontal and vertical acceleration, every strong motion that is capable of causing damage to the structures. It consists of 17 accelerograph systems spread in the main cities of the country. The last two earthquakes that struck our country, on 21st September with ML= 5.8 and the other one on 26th November with ML= 6.3, have generated an amount of these accelerograms, providing a valuable information for the process of designing structures in Albania. The picture below shows some of the measurements obtained in Durrës and Tiranë from the two earthquakes.

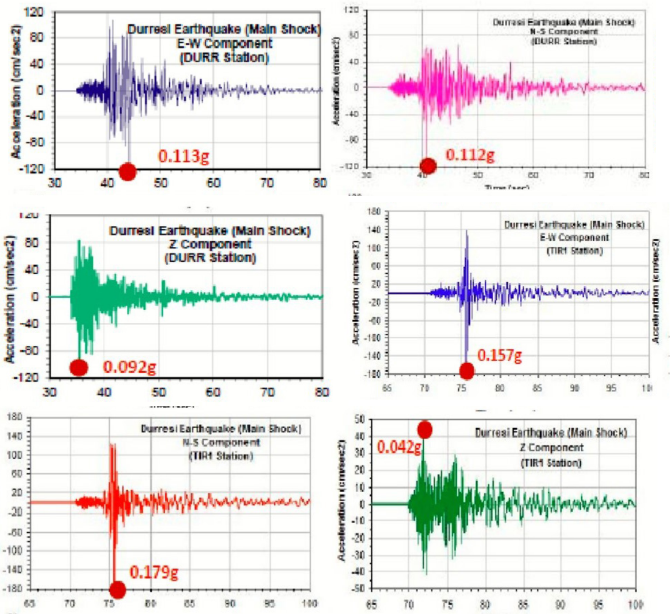

Fig 1. *Measurements of the 21 September 2019 Earthquake in Durrës station (upper pictures) and in Tiranë (bottom pictures). In the picture are shown the peak ground horizontal and vertical acceleration in percentage to the gravitational acceleration.*

1.2 THE EFFECT OF CYCLIC LOADS ACTION OF REINFORCED CONCRETE STRUCTURES IN INDUSTRIAL STRUCTURES

Diana Lluka
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Abstract

Reinforced concrete structures are critical components of many industrial settings due to their strength, durability, and ability to withstand heavy loads. However, these structures are often subjected to cyclic loads, which can lead to damage and compromise their long-term safety and integrity. This paper aims to provide a comprehensive analysis of the mechanisms of damage caused by cyclic loads on reinforced concrete structures in industrial settings. The paper begins by examining the different types of cyclic loads and their effects on reinforced concrete structures. The mechanisms of damage caused by cyclic loads are then discussed, including cracking, fatigue, and corrosion, as well as the factors that influence the severity of the damage. Through the review of case studies, the paper analyzes the impact of cyclic loads on reinforced concrete structures in industrial settings, and draws out the lessons learned from the results. The implications of these findings on the design, construction, and maintenance of reinforced concrete structures are also discussed in detail. Finally, the paper presents a comprehensive discussion of the different mitigation strategies available to reduce the effects of cyclic loads on reinforced concrete structures. These strategies include improving the design, enhancing the durability of the concrete and reinforcing steel, and implementing maintenance and inspection programs.

Overall, this paper provides engineers and facility managers with a deep understanding of the impact of cyclic loads on reinforced concrete structures in industrial settings. By implementing effective mitigation strategies, such as those discussed in this paper, these professionals can ensure the long-term safety and integrity of these critical structures.

I. Introduction:

Reinforced concrete structures are widely used in industrial settings due to their strength, durability, and ability to withstand heavy loads. These structures are critical components of many industrial facilities, including factories, warehouses, and processing plants. However, over time, reinforced concrete structures can be subjected to a variety of stresses, including cyclic loads, which can lead to damage and compromise their long-term safety and integrity.

Cyclic loads are caused by the repeated application of loads to a structure, resulting in alternating stresses that can cause fatigue and ultimately lead to failure. In industrial settings, cyclic loads can arise from a variety of sources, including machinery operation, vehicular traffic, seismic activity, and wind loading. While these loads may not cause immediate damage, over time, they can lead to cracking, spalling, and other forms of deterioration.

To ensure the long-term performance and safety of reinforced concrete structures in industrial settings, it is important to understand the mechanisms of damage caused by cyclic loads and implement effective mitigation strategies. This paper aims to provide a comprehensive analysis of the impact of cyclic loads on reinforced concrete structures in industrial settings, including the mechanisms of damage, case studies, and mitigation strategies. The analysis in this paper is based on a review of the latest research in the field, including scholarly articles, industry reports, and government publications. The paper draws on a variety of sources to provide a comprehensive understanding of the impact of cyclic loads on reinforced concrete structures in industrial settings. Overall, this paper provides a valuable resource for engineers and facility managers seeking to ensure the long-term safety and integrity of reinforced concrete structures in industrial settings. By understanding the mechanisms of damage caused by cyclic loads and implementing effective mitigation strategies, these professionals can minimize the risks associated with cyclic loading and ensure the continued performance of these critical structures.

II. Mechanisms of Damage Caused by Cyclic Loads:

The mechanisms of damage caused by cyclic loads on reinforced concrete structures in industrial settings are complex and multifaceted. Cyclic loading can result in various types of damage, including cracking, fatigue, and corrosion.

Cracking is one of the most common forms of damage caused by cyclic loads. It can occur due to a variety of factors, including inadequate reinforcement, improper construction techniques, and inadequate detailing. Cracking can reduce the load-carrying capacity of a structure and lead to further damage over time. The propagation of cracks under cyclic loading is well-documented in the literature (1), and can be a major cause of structural failure.

Fatigue is another mechanism of damage caused by cyclic loads. It can occur when a structure is subjected to repeated loading and unloading cycles, resulting in the gradual weakening of the structure over time. Fatigue can result in the formation of cracks, as well as the propagation of existing cracks, ultimately leading to failure. The fatigue behavior of reinforced concrete structures under cyclic loading has been extensively studied (2), with researchers investigating the effects of factors such as the stress range, frequency, and loading history.

Corrosion is another significant mechanism of damage caused by cyclic loads, particularly in reinforced concrete structures that are exposed to harsh environmental conditions. Corrosion can lead to the deterioration of reinforcing steel, resulting in reduced structural integrity and load-carrying capacity. The effects of cyclic loading on the corrosion of reinforcing steel have been studied in the literature (3), with researchers investigating the relationship between the number of cycles and the rate of corrosion.

In summary, the mechanisms of damage caused by cyclic loads on reinforced concrete structures in industrial settings are varied and complex. Cracking, fatigue, and corrosion can all result in structural damage and compromise the long-term safety and integrity of these critical structures.

III. Case Studies:

The Ferrochrome Plant in Elbasan is a complex of buildings featuring reinforced concrete and steel structures.

The main building is a unique structure with a reinforced concrete and steel roof, designed to withstand various loads, including permanent and live loads, cyclic loads caused by the supply and transportation of minerals, thermal loads generated by hot water used for cooling the furnace, cyclic loads of cranes, wind loads, and seismic loads.

The design's peculiarity lies in the impact of cyclic loads on beams and columns due to the loading and unloading of the furnace via silos suspended from reinforced concrete beams. The design also considered the thermal loads of water undergoing a cooling process and being recycled.

The industrial buildings were designed in accordance with Eurocodes, and the utilization charges were dictated by the technological line. The loading and unloading of silos, transportation of ore from storage sites to the furnace, and the movement of processed products resulted in continuous cyclical loads on the building structure.

The implementation of technical details for each constructive element is crucial to achieving the desired results and positively impacting the structure's lifespan. Constructive details play a significant role in the successful implementation of the technical project on-site, and their proper implementation is essential for the project's success.

Fig 1. *During the construction of the furnace and tanks.*

***Fig 2**. The connection between concrete slabs and silos, some details.*

The presented case studies showcase the significance of adequately factoring in the ramifications of cyclic loading on the durability and safety of reinforced concrete structures within industrial environments. It is imperative for engineers and designers to take into account the unique loading conditions and environmental factors that each facility presents to ensure the enduring integrity of the structures. Moreover, implementing appropriate maintenance and inspection programs can serve to diminish the impact of cyclic loading and forestall the occurrence of premature structure failure, thus optimizing safety and longevity.

IV. Mitigation Strategies

To mitigate the effects of cyclic loads on reinforced concrete structures in industrial settings, there are several strategies that can be implemented. These strategies can include improving the design of the structure, enhancing the durability of the concrete and reinforcing steel, and implementing maintenance and inspection programs.

➤ Improving the Design

Proper design is essential for reducing the effects of cyclic loads on reinforced concrete structures. Designers can use a variety of techniques to improve the performance of structures, including selecting appropriate materials, optimizing the layout of reinforcing steel, and considering the effects of cyclic loads on the design (5).

➤ Enhancing the Durability

Enhancing the durability of concrete and reinforcing steel can also help to mitigate the effects of cyclic loads. This can be achieved by selecting high-performance concrete and corrosion-resistant reinforcing steel, as well as implementing protective coatings and other measures to prevent corrosion (6).

➤ Maintenance and Inspection Programs

Regular maintenance and inspection programs can help to identify and repair damage caused by cyclic loads before it becomes severe. This can include visual inspections, non-destructive testing, and monitoring of the structural performance over time. A detailed discussion of the benefits and limitations of each mitigation strategy is essential for determining the most effective approach for mitigating the effects of cyclic loads on reinforced concrete structures. Such discussions can involve evaluating the cost-effectiveness, feasibility, and practicality of each strategy. This way, engineers and designers can select the most appropriate mitigation strategies that provide the best balance between effectiveness and cost.

It is essential to note that each mitigation strategy has its benefits and limitations. Therefore, engineers and designers must evaluate the cost-effectiveness, feasibility, and practicality of each approach before implementation. Furthermore, the selection of the most appropriate mitigation strategy should involve a careful balance between effectiveness and cost.

In conclusion, the implementation of appropriate mitigation strategies is crucial for minimizing the potential consequences of cyclic loading on reinforced concrete structures. Proper design considerations, the use of high-performance materials, and implementation of maintenance and inspection programs are examples of mitigation strategies that can be employed to enhance the durability and safety of these structures.

V. Coclusions

Cyclic loads can have a significant impact on the durability and safety of reinforced concrete structures in industrial settings. Understanding the mechanisms of damage caused by cyclic loads, as well as implementing effective mitigation strategies, can help to prolong the life of these structures and ensure the safety of those who use them. By improving the design, enhancing the durability of the concrete and reinforcing steel, and implementing regular maintenance and inspection programs, engineers and facility managers can reduce the effects of cyclic loads and ensure the long-term performance of their structures.

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1.3

REHABILITATION OF HISTORICAL MASONRY BUILDINGS, CASE OF MINISTRY OF URBAN DEVELOPMENT (MZHU) BUILDING

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Department of Building Constructions and Transport Infrastructure,
Polytechnic University of Tirana

EXTENDED ABSTRACT

The rehabilitation of masonry buildings is a very difficult case, both in terms of recognizing the actual state of the building structure, as well as the structural interventions needed in historic buildings to convert it to current standards (retrofit). Bringing masonry under seismic loads again, despite recent developments, presents considerable uncertainties and large differences in various design standards EC6, SIA 266, FEMA 310,356.

The MZHU building represents a typical case of the complexity of rehabilitation of historic masonry buildings. The presentation presents the work on assessment, design, site work and structure performance during the recent earthquake.

General description of the building

The building consists of three structures: 4 floors with a limited part and 1 basement floor. The original structure was 3 floors and it has been added an upper floor. The 3-storey structure is a masonry building with 38cm full bricks. From the first observations it is noticed that to the building has been added an additional floor. The structural condition of the masonry and supporting beam appear problematic, with extensive damages. Existing building projects do not exist in the facility, but do not exist either in the Central Technical Construction Archive. However, we have carried out a measurement for all three buildings.

Fig 1. *Plans of MZHU building*

The need for structural rehabilitation

The main reasons for conducting structural evaluation of existing buildings are:

- The design life of buildings (their age);
- Today's seismic risk assessments;
- Changes in design codes from the construction period to the present;
- Various damages that the Ministry buildings have suffered over the years;
- Planned architectural interventions;

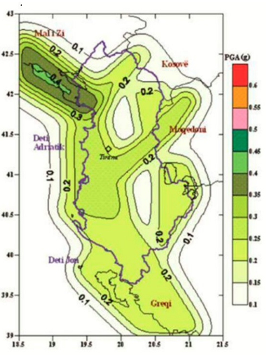
- Injuries after a calculation event;

Fig 2. *Damages of MZHU building*

The data analysis should be reflected in the structural report. It shall contain the following, not limited to:

- description of the building importance class;
- data on the seismic design criteria of the building (at the time of its design);
- reassessment of loads exerted in cases where the building serves purposes other than those anticipated at the time of design;
- data on the dimensions of structural elements and on the properties of their constituent materials;
- identifying the structural system, meeting or not meeting the regularity requirements (according to EN 1998-1);

- identification of conditions on the ground for seismic analysis purposes (according to EN 1998-1);
- identifying the type of foundation;
- data on poor material properties or inadequate structural details;
- data on current or previous structural damage (if any), including potential repairs that have been timely performed;



Design Seismic Action

The analysis in the structure modeled according to the general rules of Eurocode 8 (2004 version), the analysis was made taking into account:

- Horizontal operating load on Type C soil, ag 0,20
- The behavior coefficient of the structure q= 1.5

Based on this map, we obtained the PGA peak acceleration in the base rock deposits for a return period of 475 years.

Fig 3. *Map of PGA peak acceleration in Albania in base rock deposits for a return period of 475 years.*

Materials: The materials used and the stress calculation are:
Concrete, based on modern technology and observations is classified - Class C12/15
Steel, Steel rods are of type C3
Masonry, for full brick masonry with cement mortar + lime we have:

f_m	G_m	t_o	Pesha vetjake	E_m
16 daN/cm^2	15000 daN/cm^2	0.55daN/cm^2	1800kg/m^3	15000daN/cm^2

Corrective coefficients are not obtained because the condition of the mortar is not known, the bracings can not be conceived properly, reinforcement of sketch masonry. Evaluation is best done in dealing with "expiration of changes", with a determination to be clear and readable and with the consequences of possible seismic actions. Service evaluation is based on nonlinear analysis, containing today's seismic research with the actual capacity of structures.

Design of structural interventions

Based on the conclusions of the structural evaluation, two types of interventions can be made:

- Repair interventions

If justified by structural evaluation, the building may be subject only to light interventions, or non-structural interventions (e.g., intervention in architecture elements).

- Interventions to meet structural response requirements

Significant structural intervention may be necessary to meet the requirements of the structural response. The consultant will design the detailed design for the most suitable variant. Accompanying projects will also be designed to respond to changes to the structure and meet the needs of the building. In conclusion, structures need reinforcement to adapt to today's design conditions. The analysis performed in this case is nonlinear static (Pushover). The analysis was carried out through a specialized program. Below are some of the results.

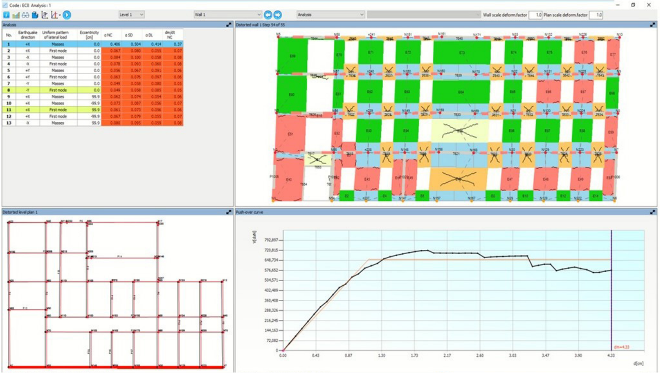


Fig 4. *Photo of analysis model of the building*

Fig 5. *Photos of the building during construction works*

Conclusion

As shown in the images above, it results that the longitudinal direction of the building is damaged by bending mechanisms and special cutting panels. In transverse direction, all panels are damaged by bending and shearing. Based on these results, we should make concrete column reinforcement, as well as masonry reinforcement. After the reinforcement, it turns out that the building is preserved against all destruction mechanisms and under vertical loads, as well as it will comply with the requirements of European technical conditions.

1.4

SEISMIC SAFETY POLICY REGARDING EXISTING BUILDINGS IN NEW ZEALAND

Andrew Charleson
Department of Achitecture and Civil Engineering, Polis University

EXTENDED ABSTRACT

A new core framework for managing earthquake-prone buildings took effect from a 1 July 2017 amendment to the New Zealand Building Act 2004. The 2017 system affects owners of earthquake-prone buildings, territorial authorities (local councils), engineers, other building professionals and building users. The amendment defines an earthquake-prone building as “If a building, or part of it, will have its ultimate capacity exceeded, and would collapse in a moderate earthquake”. This has been taken as meaning that an earthquake-prone building has less than 33% of the strength of a new building (New Building Standard (NBS)). The NBS is determined by Chartered Engineers who have a clear understanding of the structure and how it will respond in an earthquake, and be confident that there are no aspects of the structure that require more specific or detailed investigation and assessment; ie no potential Critical Structural Weaknesses that could lead to a %NBS that is less than 34%NBS.

The procedures involved in implementing this section of the Building Act are as follows:

- Territorial authorities (TAs) identify potentially earthquake-prone buildings, often through commissioned consulting engineers who conduct an Initial Seismic Assessment.
- Owners who receive an unfavorable assessment must obtain their own engineering assessment of the building carried out by qualified engineers who will complete a Detailed Seismic Analysis.
- TAs determine whether buildings are earthquake prone, assign ratings, issue notices and publish information about the buildings in a public register
- Owners must display notices on their building and remediate their building.

In the central, high seismic risk area in New Zealand, owners of earthquake prone buildings have between 7.5 and 15 years to either seismically-retrofit or demolish them depending whether a building is considered High Priority (say alongside a main) or not.

The key technical resource used by engineers is “Seismic assessment of existing buildings”
Published Nov. 2018. It is available on-line . Its contents include the following sections:

- Geotechnical consideration
- Concrete, steel and timber buildings
- Moment frames with infill panels
- Non-structural elements
- Report and assessment templates

A register of earthquake-prone buildings is provided on-line for anyone to access.

Final discussion session:

Andrew Charleson stated that after recent earthquakes in New Zealand (2011 and 2016) it has become apparent that changes need to be made to the way buildings are designed. In particular, now designers are providing stiffer structures to resist earthquake, are adopting “low-damage” systems, and are taking a far more cautious approach to using precast concrete flooring systems. Similarly, following the damage of the recent Durres earthquake,
Albanian designers need to avoid the incompatibility of large areas of exterior and interior stiff and brittle hollow brick masonry walls and flexible reinforced concrete frames. Moment frames need to have regularly orientated columns in-plan and deeper beams to reduce horizontal deflections. Infills need to be separated from frames and all brick walls need physical support to prevent them collapsing.

Key words: Durres earthquake, moment frames, orientated columns in-plan, flexible reinforced concrete frames, collaps.

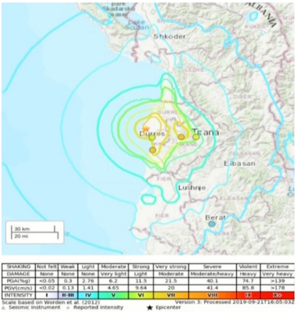
1.5

RISK MANAGEMENT: FLOODING, EROSION AND EARTHQUAKES.

Erind Bejko
Director of Civil Emergencies, Municipality of Tirana

EXTENDED ABSTRACT

Tirana and Albania also, are highly exposed to disasters, the causes of which are different, ranging from natural to human and ecological ones.
Some of the risks are those of flooding, heavy rainfall and extreme heat in peak seasons, erosion and landslide. Natural and man-made disasters are increasing in the last decades (Erosion) due to urban development trend.



According to the situation created by the last two earthquakes:
Located: (29 km) to the west of Tirana.
Sunday 4:04 21/09/2019
Magnitude 5.6 on the Richter scale
Located: (30 km) to the west of Tirana.
Tuesday 03:54 a.m 26/11/2019
Magnitude 6.4 on the Richter scale
Albania's strongest earthquake in 30 years

The most damaged areas in the territory of Tirana with uninhabited residencies, are as follows:

Administrative Unit 3- 3 buildings
Administrative Unit 4- 7 buildings
Administrative Unit 6- 24 buildings
Administrative Unit 11- 1 building
Administrative Unit 14- 1 building

Natural disasters don't recognize administrative borders. They are common in their effects, but what is important is inter-institutional cooperation and the measures taken for a better disaster response. Emergency management is related to the management of resources, human and logistics. A natural disaster is a challenge of how the level of organization aligns with risk planning, coordination and management.

The ways we operate (Municipality of Tirana) to prevent or minimize the consequences of a natural disaster are:

- **Evacuation.** Emergency relief, evacuation of people in high-risk areas from their homes at risk of collapse.
- **Unsolicited support.** The distribution of tents, blankets, food, beds, as the first aid in the first moment of the disaster according to the needs of people affected by the earthquake.
- **Damage management.** After the verification, the consequences of damage to the structure of the buildings resulted.

Recommendations

- Emergency Fund
- Emergency Warehouse (storage space)
- Mapping the most problematic areas in the city
- Improvements and enlargement of riverbeds
- Drainage of surface water through the drainage system.
- Reforestation to impact soil sustainability and increase erosion and land slide resilience
- Strengthening the cross-institutional collaboration
- Smarter and more resilient urban planning practices

SESSION 2

HISTORICAL REVIEW OF DISASTER PLANNING IN JAPAN

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EXTENDED ABSTRACT

Why is the historical review of disaster planning important? If we could rely on one all-purpose strategy after disasters, how easy it would have been. However, we cannot construct a solution that works everywhere. What we, as planners and researchers, can do is to learn from specific cases, including failures and efforts for overcoming them, to consider the universal meaning of cases, to localize it in appropriate ways of planning based on the local character, and to envision the future of the damaged area with the affected people. We have to keep asking such questions to ourselves, as there are many questions to ask. Among them is the question of what a disaster is (as the disaster can be understood in endless ways, this question should not be stopped asking). The history of disasters teaches us that the disaster itself is inevitable, therefore, we have to prepare for it. The evacuation drill in Kamaishi City, Iwate Prefecture, resulted that are said to be Miracle in Kamaishi. Most students escaped and survived the Tsunami once every 1000 years of the Great East Japan Earthquake of 2011. In many areas where tsunamis were frequently hit, the evacuation drill itself was not unusual. What was difference between the effective drill and useless one? During evacuation drills at school in Kamaishi, students often cried. In my understanding, they must imagine the disaster may take their and their families' lives through the drill. That is the reason why they could behave to save \

their lives by their own judgement for escape. Even in Japan, where many disasters attack many times, most evacuation drills become mere routines. We have to consider the meaning of practices, not just follow practices superficially.In order for daily life, which has been lost by the disaster, to be recovered the local society needs to commit as we cannot live alone. That is the reason why the recovery planning is required. Since we cannot prevent disasters, it is very essential that the local society nurtures its own capability to deal with any disasters through the recovery planning. The main interest of the local society after the disaster tends to be that certain disaster. Planners can support them by understanding other possible disasters including uncertain risks which may happen in the future. For that purpose, planners should understand what lives they had before the disaster and how the affected people feel. No one else except the damaged people could talk how precious the daily life before the disaster was. It is the only way to avoid the planning disaster, which is a disaster caused by a plan. What planners can do is to provide shapes of physical environment. But it is not the end of the planning. Influencing and responding each other, the physical environment and the social aspects have supported the local life together. If the relationship between them is creative and stable, the life will become cultural. This means that you can pass on your experiences and knowledge to the next generations. Then they can overcome their disaster.

2.2

EFFORT TO PREPARE FOR DISASTER AND RECOVER FROM THE EARTHQUAKE DAMAGES, EXPERIENCE OF JAPAN.

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The University of Tokyo

EXTENDED ABSTRACT

There is a saying in Japan as;
"Great natural disasters come to us when we forgot the last one."

Another saying in Japan is;
"Be prepared and have no regrets."

We Japanese have a lot of experiences of disaster damages and recovery. We can utilize lessons and learnt from those experiences after the disaster, however, most of the people may be easy to lose their tension after many years. It is necessary to keep in mind that how to prepare disaster prevention and readiness to do at any time disasters come. In Japan, people have had various and lots of opportunity to receive education and attending the drills for disaster prevention since childhood at school, community, office, etc. Those are valuable actions to increase knowledge and strengthen capacity of preventing disaster, preventing expansion of damages when disaster happens, and recovery and reconstruction from damages. In addition, to promote awareness of disaster prevention and foster cooperation system and structure in each district/community are also significant for avoiding much dependency on the central government. Initiatives and leading role by local governments and communities are most powerful source for the actions when disaster happens and many activities including planning and project implementation for recovery and reconstruction stages. It is also dispensable thing that we need to take care of "mental care". People receive strong shock by earthquake and

aftershocks, cannot forget feeling of ground shaking, scene of building collapse, as well as remember the situation of people's panic just after the earthquake. The mentioned things cause chronic fear, strong stress, and disease like headache, stomach ache, autonomic ataxia, insomnia, character change, and committing suicide in the worst case. Taking good care of people's feelings and emotions after earthquake as a manner of mental care is one of substantial points for not only those affected by the disaster but rescuers and helpers at the sites. Presenter would strongly recommend as desirable ways to include views of the mental care in planning of recovery and reconstruction from the disaster damages as well as in project implementation.

2.3

USING INNOVATION AS A TOOL FOR INVERTING EMIGRATION TRENDS IN DROPULL. HOW DIGITAL MANUFACTURING COULD LEAP THE TECHNOLOGICAL GAP AND STRENGTHEN THE RESILIENT BEHAVIOR OF THE COMMUNITY AND ITS TERRITORY.

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ABSTRACT

Dropull municipality is one of the “newest” municipalities created as a result of the territorial reform that reorganized Albania passing from 384 administrative units and municipalities to 61 new municipalities. Located in the south-eastern part of Albania, this municipality is part of Gjirokastra region. It is neighbored to the east by the national border with Greece. The historically good cross-border relationship with Greece has always been reinforced by the presence of Greek minority living in this municipality. In Albania 2-3% of the population is composed by minorities, and in the case of Dropull municipality this population represents a very significant part of the total population of 7,128. (Census: Instat 2011). Dropull is an important gateway in the connection with Greece, the main infrastructure route connecting the capital with Greece goes through the municipality, connecting all 41 villages to each other and the economic areas in-between. However, the lack of complementary secondary and tertiary infrastructure and the structure and nature of the economic sectors has increased the abandonment and decay of some urban areas. More than 479 building in this municipality are abandoned and in a ruined state, some of them represent entire neighborhoods, impacting urban space quality, infrastructure and environmental conditions as well. These phenomena are a result of insufficient public investments and low economic conditions that increased the need for inner and outer migration. As a result, people abandoned their homes and the low number of residents made it very difficult for the municipality to provide efficient public services.

As result of these trends Dropull municipality is currently suffering the lack of: Experience in managing the new and larger territory; Institutional capacities; Coordinated services; Detailed and representative data for the new territory.
According to the census and recent statistic the municipality's population is dominated by relatively young population. Keeping these statistics in mind the main sectors of employment are dominated, 72% by industries and service, 22 % by agriculture and 6% of public administration. There are no official unemployment data for Dropull municipality, but the region statistics indicate a 16% of unemployment rate.

However, this situation is slowly starting to change, as a result of the turn in the economic conditions in Greece, many people are looking for opportunities to move back into their old houses. These attempts are bringing back small initiatives and new innovative business.
Some of the institutional focus is recently placed into increasing social cohesion, identifying new potentials and investing in virtuous indicatives.

POLIS University has drafted the General Local Plan for the newly formed municipality of Dropull. This plan provides a deep analysis of the territory and environment of the municipality. The analysis covers socio-cultural conditions and economic factors that has served as an important database for recognizing resources to be involved in local actions. Parts of the consulting groups engaged in drafting the general local plan can facilitate contacts with the community and with key-actors of the already built network.

Supported by the new General Local Plan that was recently approved, some of the priority objectives include small intervention to deal with abandoned spaces and neglected urban areas. A priority was placed on the preservation and renovation of cultural and historical assets, the stimulation of renovation of historic houses applying long-term solutions. Special focus is placed on community participation and growth.

On these principles, the case of Dropull was used as a proving ground for developing part of a research proposal called COMMON. The consortium developing the proposal was led by the University of Bologna and composed by institutions representing European areas risked by depopulation. One of the aims was to use ICT tools as instrument for reversing the abandonment trend. POLIS University developed in this framework a concept for the Municipality of Dropull in line with the general strategic vision considering Dropull as a polycentric development of settlements along the main highway connecting

Albania to Greece. In this perspective, Dropull is expected to slowly grow into a rural development pole between Gjirokastra and Ioannina regional centers, and the southern Albanian and Ionian coasts. This territory should build upon a strong historical and cultural identity, a model of coexistence between different nationalities, an important gateway to the cross-border area and a bridge between Albania and Greece. Dropull has the potential to become a center focused on the development of tourism, agriculture, livestock, and processing industry that puts in use domestic products to create a complete production cycle and tracking. A region that welcomes and provides space for research and establishment of tourism-based and biological products start-ups, thus becoming a cross-border "pole" that uses steadily the potentials for a consolidated local economy and a favorable atmosphere for returning population and attracting investment. In this perspective the role of new technologies will provide a proper environment for the emergence of a new creative community. The crises of the existing situation are considered to provide a prolific ground for people/place based innovative blueprints.

The emerging creative individual and enterprises will use the makers' culture for the development of the branches of agriculture and livestock, the support of business development and processing industries, which currently constitute an important sector of the Municipality of Dropull. Although the development of different business units currently utilizes the Municipality of Dropull for their physical placement, without a significant impact on the employment of the local population or investments to improve the conditions of the territory, the establishment of a cooperation strategy between the Municipality of Dropull and innovative/creative business units would create a greater positive impact in the territory of the Municipality.

In this cooperation, the Municipality can provide the physical location of their placement using some of the most interesting abandoned space in the territory, while innovative/creative business units provide safe and appealing employment for the local population and provide for an investment plan for the local infrastructure and the environment in which they operate. In this way, not only will a full economic cycle be created, but the real benefits of this cycle will not be transferred to the larger economical centers of the region, but become tangible and useful for the local communities leveraging site-specific values.

The strategic program aims empowering the local economy and supporting the creation of a maker culture environment. It proposes the creation of a specific network of areas of innovation, education, exploration and development. This network of areas under the name of "Innovation Network" will provide space for specialized and informal education (schools, vocational courses and craftsmanship knowledge transmission), research, testing and establishment of enterprises, all of which will aim to integrate the local population and promote local products and cultural landscape. Located near the cross-border area, this network of areas will aim to turn the Drinos Valley into a bridge between Gjirokastra and Ioannina centers and the economic zones around them, serving as a common space of research and development, for a commonly shared and sustainable development.

Peculiarities of the case of Dropull

The territory of Dropull undergoes a specific abandonment pattern characterized by abandonment of remote areas of the territory because of lack of services, poor infrastructure, insufficient formal and informal education opportunities and reduction of job prospects. Two groups groups are considered the most affected: 15-25 year old group which is mostly influenced by the poor education and job opportunities; the working aged Greek minority living in Dropull which finds Greek job market more attractive. Considering these facts, the strategy tries involving these population groups in co-detecting and co-exploiting latent common values.

The local values are deeply related to the specific cultural and social specificities of the territory which offers very important economical and environmental assets. In this sense the thematic tourism can be considered the driving sector for an integrated and sustainable development. The General Local Plan document being approved by the municipality defines that a properly balanced tourism can act as activator of for all the strategic economic sectors of the region. In this perspective the environmental and socio-cultural potentials are to be explored.

It is important to put emphasis on the fact that the proposed “Innovation Network” will work as a cluster of enterprises that interact and complement each other creating a shared and diffused hub. Being sustainable tourism the communing activity, some of the main activities of the “Innovation Network” diffused hub comprise also trainings and sharing of expertise and know-how in the fields of agro-tourism, hospitality, food and medicinal plants processing, traditional and innovative manufacturing.

The important presence of technological tools will support also the creation of a common shared on-line platform of e-governance which will facilitate the active participation of a large part of the local community which has emigrated but is interested in returning to Dropull. The e-governance technology will additionally facilitate the governance and the presence of the local authorities in remote areas of the region, providing further services and incentives to local communities in reversing the abandonment trend.

The actions planned to be implemented, aiming to reverse the abandonment trend and supporting the creation of specific network of areas to innovation, education, exploration and development is supposed to act as a network of economic entities and spaces located following a polycentric logic. Following the provisions of the General Local Plan of the Municipality five existing urban centers are defined as new nodes of the polycentric development. Abandoned public and private buildings like schools, warehouses and similar typologies in Dervican, Sofratike, Poliçan, Vrisera and Jorgucat will be reused and reconverted into spaces of exploration, education, sharing, innovation and creation.

This network of areas under the name of "Innovation Network" will comprise two more areas, the natural protected area of Sotira as part of the national 100+ Villages program and the industrial area near Kakavija proposed in the General Local Plan.

The system approach oriented towards sustainable tourism would promote and valorize the environmental potentials, the cultural landscapes and the local community's social values. Environmental and cultural tourism would promote local food production and processing, asking for innovative approaches. This approach would require also vocational and live long education. The physical spaces for the activities to happen are located in five urban centers and will reactivate abandoned public buildings and spaces.

The "Innovation Network" will work as a diffused hub and will create a cluster of ateliers and spaces of creation. The pop-up ateliers will find the newest and unforeseeable ways of reusing the abandoned structures. A multitude of uses will mix, alternate and follow incrementally. The interventions will need to avoid mono-functionality since the co-existence of functions and activities allows the flexibility of the start-up to adapt during the first stages of its development. The very strong sense of community of the people of Dropull will enhance this ecosystem based on shared values and will be incentivized to naturally develop into formal partnerships and chains of value.

So, the innovative creation model will lead to innovative organization models what in association with the local government will explore new and innovative ways of governance. The presence of new technologies will facilitate this process. As architecture represents in space the spirit of its time, these innovative instruments, as historically proven, will create spatial innovation. The clustering and spatial proximity of the workshops and ateliers will enhance co-creation and sustainable growth.

The great majority of the abandoned sites to be reactivated by the “Innovation Network” turning into a diffused hub are located inside or near urban settlements. They are so able to interact with nearby spaces and activities contributing in creating a virtuous circle of urban upgrade. The transformation prototypes to be tested need to share the following principles:

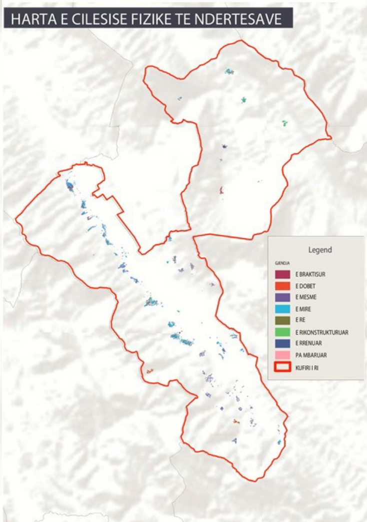
Mix Use: Dealing directly or indirectly with sustainable tourism development the pop-up ateliers will be organized following the mixed-use principles. A number of main activities will share space and time in the abandoned structures. So, every atelier and workshop will foresee some spaces for working and creating, some spaces for lecturing, debating, sharing, exchanging and retail, spaces for different forms of temporary living, opportunities to create or rebuild natural elements of the surrounding site and new infrastructures for the community. **Adaptability for unpredictability:** The compresence of a number of activities will allow the diversification of the economic activities and will allow future adaptability. These two characteristics will show to be very important for star-ups and new businesses due to the high risk these activities face during the first five years of activities. The highly unpredictable economic situation is a characteristic of Albania so the proposed approach is based on an incremental, adaptable and open-ended mentality. **Co-creation and sharing:** The “Innovation Network” will importantly rely on the existing sense of community of the inhabitants of Dropull. The ateliers will allow the sharing of ideas and methods under a common maker mentality. Due to the relatively small population, some expertise will not be contemporarily present in all ateliers. Models of time bank and examples of shared economy will be experimented in order to facilitate the flow of knowhow and the sharing of expertise in conditions when it will not always be possible to hire highly specialized figures in the embryonic enterprises. Emergence of novelty: the most difficult but at the same time exciting principle to be experimented in the pop-up ateliers will be the emergence of novelty. This idea is based on the fact that complex systems of interacting individuals are able to show group behaviors that are impossible to be achieved by the same number of individuals not interacting among themselves.

If the needed quantity and quality of exchange and interaction will be incentivized to develop among the different actors, the "Innovation Network" will be able to coevolve into new models of creative community where novelty and innovation will emerge spontaneously.

In conclusion, the prior actions focused on education and governance innovation constitute an indispensable basis to be able to develop new policies. Although the need for contextually informed and place-based policies is unanimously accepted, in countries like Albania where the capacities are scarce and the inclination towards "global north" models is strong, more often than not the adopted policies are imported from the developed countries. Therefore, a genuine place-based approach accounts for as a novelty. The recently approved territorial development plan is a starting point to this regard. Additionally, the deliberate focus of the project on the place makers rather than the land policies and instruments constitutes a welcomed departure from the existing policies.

The ambition to overcome the local scale is faced with a multitude of challenges (some of them explained above). The current size and capacities of the local actors are such that being competitive beyond the local scale is highly unlikely. Therefore, the organization into a network of place makers, which on the other hand can also become part of disembodied value chains with the neighboring territories in Greece, becomes a significant instrument to place Dropull into a cross-border and inter-regional setting.

Fig 1. *View from Dropull*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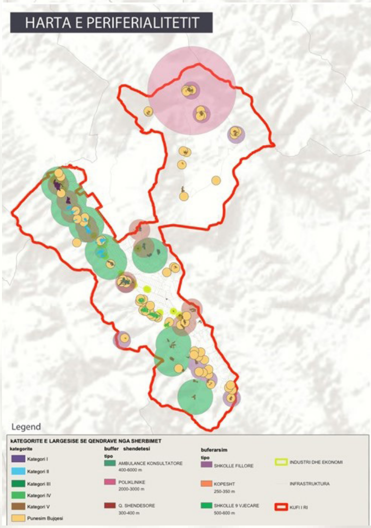
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THE IMPORTANCE OF KNOWING THE BASIC CONCEPTS OF SEISMIC GEOTECHNICAL ASPECTS

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EXTENDED ABSTRACT

The earthquake is a periodical and natural phenomenon that can be defined as a process where a huge amount of energy collected, due to the deformation in the contact zones between the tectonic plates and microplates, is released. One of the most active areas, where 25% of the earthquakes happen is the area of the contact between Euroasian plate and the African plate, where even Albania is situated. An engineer must:

- Know where these earthquakes happen;
- Know the values of vibration and motion;
- Be aware of the right measurements;

As an area with high seismicity levels, many studies have been conducted from the Seismology Institute which have compiled the seismic map of Albania. From this map results that 40% of the territory, using the Modified Mercalli scale, is of intensity 7, the other 40% of Intensity 8 and 20% of Intensity 9. The studies also show that in the Albanian territory we have 3 tectonic faults: the first one in North- South direction in the Adriatic and Ionian Sea, the second from Skopje which ends in Tepelene and the third one that passes in the region of Korçë- Pogradec and ends in Greece. Specialist from different fields of study, after the strong earthquake of the 1979, worked together to publish the Technical Codes of Design (Kushti Teknik i Projektimit) known widely as KTP- 89 which is still the legal code for design and construction in Albania.

Urban Planning is a difficult and complicated process with its main tasks consisting on: Mapping the planned to be developed and confront them with the seismic and micro seismic maps, and generating a plan for a period from 20 to 30 years.

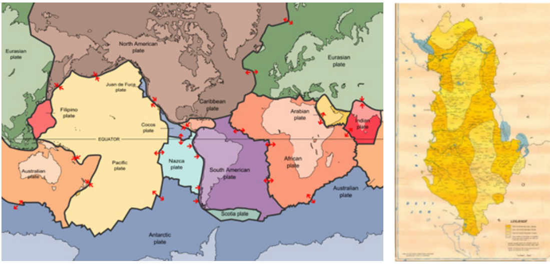


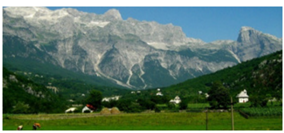
Fig 1. *a) Tectonic Plates* *b) Tectonic Plates*

Areas for development in Albania can be:

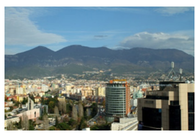
- Rural Areas
- Industrial Areas
- Mineral Areas
- Urban Areas
- Touristic Areas

The main issue of the development is that the areas which have the development potential have also high seismicity levels. In this case, the zone is either skipped or planned elsewhere or it may be used a huge amount of founds to save the investments and secure the lives of the habitants. Coastal tourism development, as one of the main directions of the economic development of Albania, is closely related with seismicity since the entire coastal area is situated in one of the three tectonic faults that pass through Albanian territory as mentioned above.

Mineral Areas



Rural / Touristic Areas



Urban / Industrial Areas

In the context of the development of high level seismic zones, the tasks of an urban planner consist on:

- Determining the distance from the sea taking in consideration not only the seismic action, but also the wave impact in order to avoid the problems related to erosion;
- Determining the spaces between objects in accordance with planned density and the possibility of evacuation, taking in consideration the objects of a special importance;
- Positioning of the objects in hilly areas, taking into account slope surface failure and seismic action.

In the architectural concept regarding seismic action, some key issues need to be considered:

- Symmetric plan of the object;
- The use of seismic gaps;
- The right distribution of the mass;
- The rational usage of underground objects;
- The correct application of cantilevers and correct design of structural elements like beams, columns, shear walls etc.

The role of the geotechnical engineer is very important in the anti- seismic studies and outlining situations, because without the proper collaboration of the geologist and seismologist it is impossible to solve the problems below:

- Soil- Structure Interaction in the case of an earthquake;
- Dynamic properties of soils;
- Determination of the Peak Ground Acceleration (PGA) in different levels in the soil deposit;
- Determination of the additional horizontal stress in the retaining walls, dams etc.;
- Determination of the additional forces in the slopes:
- Determination of the reduced resisting parameters:
- The right approach towards the problem of the liquefaction.

In conclusion it can be said that:

- The earthquake is a very dangerous natural phenomenon.
- The power of an earthquake is measured using the Modified
- Mercali scale of Intensity and the Richter scale.
- The earthquake cannot be avoided, but general security measures can be taken.
- The role of a geotechnical engineer is very important.
- The importance of the group work – Planner, Environmental specialist, Urbanist, Architect, Structural Engineer, Geotechnical
- Engineer, Geologist, Seismologist.

3.2

EXISTING MASONRY BUILDING, SEISMIC BEHAVIOUR AND FAILURE MECHANISMS FROM THE 26 NOVEMBER 2019 MW 6.4 ALBANIAN EARTHQUAKE

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ABSTRACT

Albania is a country prone of earthquake. The Mw 6.4 earthquake that occurred Adriatic see, near the city of Durres, located on the west coast of Albania, may be considered small in comparison to the design earthquake, yet it caused an enormous amount of damage to buildings. Masonry buildings occupy a considerable place of construction in our country. They are built in different time periods but mainly before 1990. In our country masonry buildings built before the '90s make up most of the residential buildings, which are designed in accordance with the codes [KTP-63, 1963; KTP-78, 1978; KTP-89, 1989], and after 90s are bearing masonry with two to three storey that were mainly built by private investors for residential purpose. These buildings also serve for many different businesses and companies as work environments. Most of these constructions are built on private initiatives, based on traditional construction techniques, with no engineering projects supported by codes of design. The paper presents seismic behaviour, failure mechanisms, and type earthquake damage in masonry buildings. Seismic assessment of masonry buildings involves evaluating the structural integrity and seismic resistance of buildings constructed primarily of brick, stone, or concrete masonry units. The assessment process typically involves a combination of visual inspection, non-destructive testing, and structural analysis. Visual inspection involves assessing the condition of the building, including its foundation, walls, roof, and any additional features such as balconies or parapets. In order to achieve more resilient buildings in the future, local engineers will need to re-evaluate especially two aspects of their current evaluation approaches that cause structural or non-structural damages; The challenge for engineer's evaluation of the level of damage with the empirical method uses a form field study to collect information on important parameters of the building and Analytical assessment of damage to the building, based on non-linear analysis methods (pushover) of the construction with masonry . The decision for strengthening or demolish will be made after evaluating their current situation, seismic performance based KTP-N.2-1989, EN1996, FEMA 440, ATC40.

Key words:
Seismic vulnerability, Structural damage, empirical methods, seismic assessment, masonry structures.

1. INTRODUCTION

Albania is a country prone of earthquake. The Mw 6.4 earthquake that occurred Adriatic see, near the city of Durres, located on the west coast of Albania, may be considered small in comparison to the design earthquake, yet it caused an enormous amount of damage to buildings. The epicentre, with a focal depth of about 20 km was located close to the Adriatic coastline, about 7 km north of the city of Durres, and 30 km west of Tirana, the capital city of Albania (Figures 1 and 2).

Fig 1: *Location of Quake M6.4 affected area*

Aftershocks of the 2019 Albania earthquake above M_w 4.0

Date	Time (UTC)	M	MMI	Depth	Ref.
26 November	02:59:24	5.1	–	10.0 km (6.2 mi)	[22]
26 November	03:03:00	5.3	VII	10.0 km (6.2 mi)	[23]
26 November	06:08:22	5.4	VII	10.0 km (6.2 mi)	[24]
26 November	07:27:02	4.8	V	10.0 km (6.2 mi)	[25]
26 November	12:14:13	4.4	–	10.0 km (6.2 mi)	[26]
26 November	13:05:00	4.9	IV	10.0 km (6.2 mi)	[27]
26 November	15:11:56	4.2	–	10.0 km (6.2 mi)	[28]
26 November	17:19:13	4.7	VI	10.0 km (6.2 mi)	[29]
27 November	11:03:35	4.1	III	10.0 km (6.2 mi)	[30]
27 November	14:45:24	5.3	VI	12.6 km (7.8 mi)	[31]
27 November	17:11:04	4.5	–	10.0 km (6.2 mi)	[32]

Fig 2: *Aftershocks of the 2019 Albania earthquake*

Aftershocks of the 2019 Albania earthquake above Mw 4.0 as show in Figure 2 are happened a lot, although this paper is written just one week after the earthquake, another report also of a preliminary nature contains information about the history of local building codes and construction approaches, aftershock occurrence and the performance of building types including schools, hospitals and housing. Regarding the characteristics of the earthquake shaking, so far only two response spectra are available (Figure 3), (Geo.edu.al, 2020). They are obtained from two accelerograms recorded in Tirana, 30 km from Durres. Unfortunately, an accelerometer in Durres stopped recording after 15 seconds of shaking but 'reconstituted' spectra may be available in the future. Due its lesser epicentres distance and greater amplification from soft soils, the Durres spectra are likely to exhibit higher spectral accelerations and over a longer period range. The duration of strong shaking in Tirana was approximately 40 seconds, about four times longer than the smaller.

Mw 5.6 September earthquake.

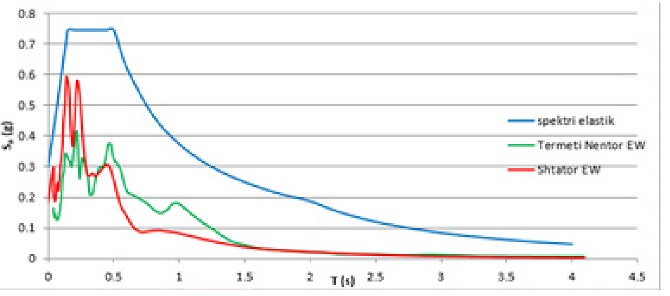


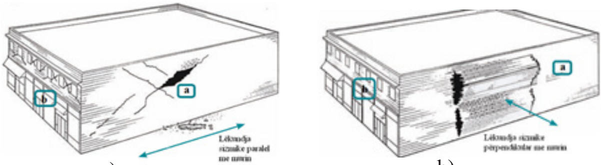
Fig 3. *Two response spectra from Tirana 21september, 26 November compared to the current design code elastic spectrum.*

2. SEISMIC BEHAVIOUR AND FAILURE MECHANISMS

Masonry buildings occupy a considerable place of construction in our country. They are built in different time periods but mainly before 1990. In our country masonry buildings built before the '90s make up most of the residential buildings, which are designed in accordance with the codes [KTP-63, 1963; KTP-78, 1978; KTP-89, 1989], and after 90s are bearing masonry with two to three storey that were mainly built by private investors for residential purpose. These buildings also serve for many different businesses and companies as work environments. Most of these constructions are built on private initiatives, based on traditional construction techniques, with no engineering projects supported by codes of design.

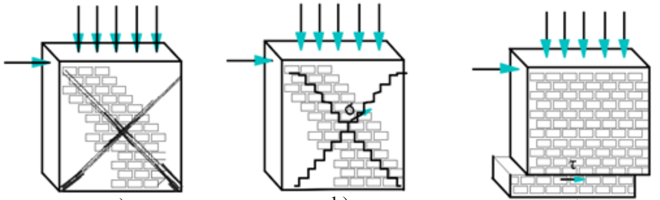
In-Plane and Out-of-Plane Earthquake Damage

Analysis of damage to buildings caused by earthquakes are important elements that serve in the development of design methods and the construction of anti-seismic structures. In fact, the bases of the compilation of anti-seismic codes are based on these observations and analyses.



a) b)

__Fig 4.__ Earthquake Damage of masonry structures: a) In-Plane; b) Out-of-Plane



a) b) c)

__Fig 5.__ In-Plane Earthquake Damage of masonry structures: a) Diagonal tension shear failure b) Stair-stepped joint shear failure; c) Sliding shear failure.

3. TYPICAL MASONRY BUILDING DAMAGE

3.1 Structural damage

The earthquake of 21st september with Mw 5.8 and 26th november with Mw 6.3 have caused significant damage to many social, residential, industrial and road structures in our country. Damages in these structures are categorized into two major groups: structural and non structural. In our country we have different types of buildings: with masonry dating mainly before the 90s and with the reinforced concrete system after the 90s.

In-Plane Failure Mechanisms for URM Shear Walls

a) b) c)

Fig 6. *In-Plane Earthquake Damage of masonry structures: a) Diagonal tension shear failure b) Stair-stepped joint shear failure; c) Sliding shear failure.*

Diagonal Tension Failure:

Diagonal cracks initially develop in the middle portion of the wall once the diagonal tensile strength ft is exceeded

Cracks propagate towards the compressed corners, and may result in local crushing of compressed corners due to excessive normal and shear stresses.

Stair-Stepped Joint Shear Failure:

Stair-stepped cracks - pass through vertical and horizontal mortar joints Also known as bed joint sliding failure

Sliding shear mechanism:

Due to low axial compression, usually occurs in low-rise buildings

Develops along a horizontal crack after flexural-tensile cracking occurs along a mortar bed joint. Characterized by significant lateral displacements, minimal visible damage

3.2 Non Structural damage

The most striking aspect of damaged masonry buildings is often the visible cracks and fractures in the walls. These can range from hairline cracks to significant breaks in the masonry, and they can occur for a variety of reasons, including settling of the foundation, exposure to extreme weather conditions, or structural damage from events like earthquakes.

In addition to visible damage, damaged masonry buildings can also exhibit other signs of distress, such as bulging or leaning walls, displaced or missing bricks or stones, and moisture infiltration. These issues can compromise the structural integrity of the building and pose a safety hazard to occupants.

Another striking aspect of damaged masonry buildings is the potential for historic or cultural loss. Many older buildings are constructed with traditional masonry techniques and materials that are no longer commonly used, making them important examples of architectural and cultural heritage. When these buildings are damaged, there is a risk of losing important historical and cultural artefacts, as well as valuable examples of traditional construction methods.

Overall, damaged masonry buildings can be visually striking and can present significant challenges for owners and communities. It is important to address these issues promptly and thoroughly to ensure the safety of occupants and to preserve important cultural and historic assets.

Cracking: Cracks in masonry walls or structures can be caused by a variety of factors, such as settlement, thermal expansion and contraction, or weathering. While small cracks may not necessarily indicate a serious problem, larger cracks can be a sign of more significant structural issues.

Spalling: Spalling is the process by which the surface of masonry begins to flake or peel away, often as a result of exposure to moisture or freeze-thaw cycles. This can weaken the masonry and compromise its durability over time.

Staining: Stains on masonry surfaces can be caused by a variety of factors, including environmental pollutants, organic growth such as moss and algae, or the use of harsh cleaning chemicals.

Deterioration of mortar joints: Mortar joints can deteriorate over time due to exposure to the elements or poor installation. This can result in water penetration and damage to the masonry structure. It's important to note that while these issues may not pose an immediate threat to the structural integrity of the building, they can lead to more significant problems if left untreated. Regular inspection and maintenance of masonry structures can help identify and address these issues before they become more serious.

4. CLASSIFICATION OF STRUCTURES DAMAGES

Residential buildings have a design period of 50 years and for buildings of particular importance the design period is up to 100 years. The level of design of structures during occupancy may be reduced due to the influence of several factors. The classification of structural damages to masonry structures can vary depending on the criteria used, but here are some common classifications based on the nature and severity of the damage:

i. **Degradation by seniority and atmospheric agents:**
Gradual degradation of the masonry materials due to exposure to environmental factors, such as water infiltration, freeze-thaw cycles, or chemical reactions, can weaken the structural integrity of the masonry. Damages from material degradation, Carbonization, Sulfate Degradation, Erosion, Freeze-thaw degradation. The effects of strain.

ii. **Damage from human activity:**

Side vertical and horizontal extensions over existing floors.

Criterion-free structural interference that causes damage to the building.

iii. **Damage from foundation settlement:**

Old buildings with masonry and reinforced concrete buildings have stone or concrete foundations without reinforcement. Buildings susceptible to cracking and masonry rifting. Movement or shifting of the masonry walls or foundation, can be caused by settlement, subsidence, or other geological factors, and can pose a serious structural hazard. Outward deformation of the masonry wall due to internal pressure or movement of the foundation, can indicate structural damage or instability.

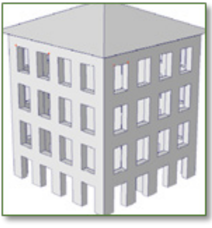
iv. **Damage from seismic activity:**

Seismic activity is the major factor. Total or partial collapse of the masonry structure due to severe damage, such as from an earthquake, extreme weather, or other catastrophic event.

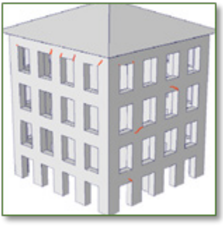
5. LEVEL FOR DAMAGE ASSESSMENT OF BUILDING STRUCTURES

Various methodologies already exist at national and international level for damage assessment of building structures (e.g. EMS-98).

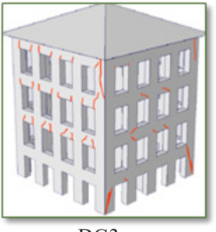
Analytical assessment of building damage (European Macro seismic Scale Grünthal, 1998)



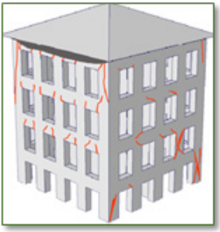
DG1



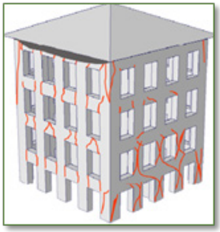
DG2



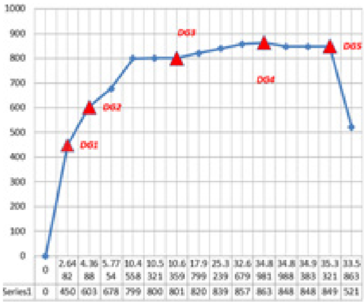
DG3



DG4



DG5



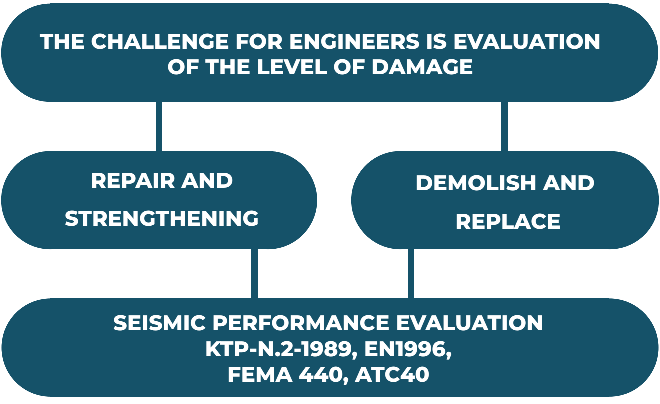
Damage Grade1- There is no destruction of any part of the building under the action of biaxial stresses, or very small cracks at the corners of the building cracks or at the top of the walls.

Damage Grade 2- Small destruction under the action of biaxial stresses at the top of the walls or at the corners of the building or in some of its cracks.

Damage Grade 3- Destruction under the action of biaxial stresses at the top of the walls or at the corners of the building or at most of the architraves

Damage Grade 4- Destruction under the action of biaxial stresses at the top of the walls or at the corners of the building or at the bulk of the architraves and between the openings of the building.

Damage Grade 5- Destruction under the action of biaxial stresses in more than 50% of the wall surface and between cracks. These classifications can help engineers and building professionals assess the nature and extent of structural damage to masonry structures and determine the appropriate repair or replacement strategies to ensure the safety and stability of the building.



Seismic Performance Evaluation of damage level with empirical and analytical methods. Empirical methods can be useful for assessing damages to masonry buildings. These methods rely on observations and measurements of the building's condition, and can help identify the extent and severity of damage. Here are some common empirical methods for assessing damages to masonry buildings:

Crack mapping: This involves mapping out the location and extent of cracks in the masonry walls. This can be done using a variety of methods, such as visual inspection or using a crack gauge to measure the width and depth of the crack.

Moisture mapping: This involves identifying areas of the building that are prone to moisture or water infiltration, such as around windows, doors, or roof edges. This can be done using a moisture meter or by visually inspecting the building for signs of water damage, such as stains or efflorescence.

Non-destructive testing: This involves using various techniques to test the strength and stability of the masonry walls without causing damage. For example, ultrasonic testing can be used to measure the thickness and density of the masonry, while ground-penetrating radar can be used to detect voids or anomalies in the structure.

Load testing: This involves applying a load to a specific area of the building, such as a wall or column, to test its strength and stability. This can be done using hydraulic jacks or other specialized equipment.

It is important to note that while empirical methods can be useful for assessing damages to masonry buildings, they should be used in conjunction with other methods, such as visual inspection and expert analysis, to ensure a comprehensive understanding of the building's condition. Visual inspection of damaged masonry buildings can provide valuable information about the extent and severity of damage, as well as potential causes. Here are some general steps to follow when conducting a visual inspection of a damaged masonry building:

Start by examining the exterior of the building, paying close attention to any cracks, bulges, or other signs of damage in the masonry walls. Look for signs of water damage, such as stains or efflorescence (white crystalline deposits), which may indicate the presence of water infiltration. Check the condition of the roof and gutters, as these can contribute to water damage and other structural issues.

Look for missing or damaged roof tiles, as well as clogged or damaged gutters and downspouts. Inspect the foundation and basement walls for cracks or signs of settling.

Look for evidence of moisture or water infiltration, such as damp or mouldy areas.

Check the condition of any chimneys, particularly if they are made of masonry.

Look for cracks or other signs of damage, and make sure the chimney is properly capped to prevent water infiltration. Finally, inspect the interior of the building, paying close attention to any cracks or bulges in the walls or ceilings.

Look for signs of water damage or mould, particularly in areas that are prone to moisture, such as bathrooms and kitchens. If you notice any significant damage or potential structural issues, it is important to consult with a professional engineer or contractor before making any repairs or modifications to the building.

Calculation method proposed by authors:

Seismic assessment of masonry buildings involves evaluating the structural integrity and seismic resistance of buildings constructed primarily of brick, stone, or concrete masonry units. Masonry buildings are generally more susceptible susceptible to earthquake damage compared to buildings made of reinforced concrete or steel. The assessment process typically involves a combination of visual inspection, non-destructive testing, and structural analysis. Visual inspection involves assessing the condition of the building, including its foundation, walls, roof, and any additional features such as balconies or parapets. Non-destructive testing methods such as ground penetrating radar and ultrasonic testing can be used to assess the integrity of masonry walls and identify any hidden defects. Structural analysis involves using computer models to simulate the behaviour of the building under seismic loads. The assessment results are used to determine the seismic vulnerability of the building and identify any necessary retrofits or repairs to improve its seismic resistance. These retrofits may include adding

EVALUATION OF DAMAGE LEVEL WITH EMPIRICAL AND ANALYTICAL METHODS

DEFINE INTERVENTION STEPS FOR REINFORCING THE BUILDING:

THE URGENCY OF THE INTERVENTION TECHNIQUES / TECHNOLOGY MATERIALS COST OF INTERVENTION

APPLICATION AND ANALYSIS FOR REINFORCEMENT TECHNIQUES COMPUTER ANALYSIS COMPATIBLE CALCULATIONS WITH KTP OR EC-6, EC-8

TECHNICAL ANALYSIS (RESISTANCE, DUCTILITY, STIFFNESS) FOR THE METHODS USED CONCLUSIONS

REDESIGN STRENGTHENING

reinforcment, strengthening walls, or adding seismic dampers or base isolation systems. It is important to note that seismic assessment of masonry buildings should be conducted by qualified engineers with expertise in seismic design and retrofitting of masonry structures. Building owners should also be aware of any local building codes and regulations related to seismic safety, and take appropriate measures to ensure the safety of occupants in the event of an earthquake. The authors propose this working method for identify any necessary retrofits or repairs to improve its seismic resistance of the masonry structure:

STRATEGY

1. **Legal Requirements:** Competent authorities; organization of inspection groups;
2. **Selection of qualified professionals:** structural engineer; architect
3. **Setting Performance Goals: Usable:** Unsure;

CONCEPT

4. **Building Inspection:** Inspection; structure; Existing projects; materials;
5. **Seismic Capacity Assessment:** Modeling; Capacity curve;
6. **Determination seismic Demand:** Seismic Risk; Target displacement;
7. **Seismic Performance Verification:** Global Response Limits; State of service;
8. **Reinforcement Determination:** Techniques / Technology; Materials;

DETAIL

9. **Compilation of constructive documentation:** Constructive Projects;
10. **Monitoring the quality of implementation:** Inspection; Verification; Supervision of works;

6. CONCLUSIONS

If a masonry building is damaged due to an earthquake or any other reason, a proper assessment must be conducted to determine the extent of the damage and the required repairs or retrofits. The assessment will involve a thorough inspection of the building by a qualified structural engineer or architect.

Based on the assessment, the conclusions may vary depending on the severity of the damage. If the damage is minor, repairs may be sufficient to restore the building to its original condition. However, if the damage is severe, a more extensive retrofit or even a complete reconstruction may be necessary to ensure the building's structural integrity and seismic resistance. In some cases, if the building is deemed unsafe or irreparable, it may need to be demolished. It is important to note that demolishing a historic or culturally significant masonry building may not always be the best option and alternatives should be explored. Ultimately, the conclusions of the assessment will depend on the specific conditions and characteristics of the masonry building, as well as the local building codes and regulations. Proper maintenance and regular inspections can help prevent damage to masonry buildings and ensure their long-term safety and stability. Improved design code and national annexes, after the recent earthquake, in accordance with national codes,

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3.3

MANAGEMENT OF THE SITUATION AFTER THE NATURAL DISASTERS

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EXTENDED ABSTRACT

In our laboratory we have students from all three levels of studies: bachelor, masters and doctorate. Our interests and backgrounds are from various fields including architecture, urban planning and design, social studies, geography, anthropology etc. What makes all of us work together, is our mutual interest in long-term planning and city-recovery after natural disasters. Therefore, here today in front of you, please allow us to talk only for matters that fall within our expertise, that of recovery and long-term planning. Having visited the affected sites and families from the very first day, having met government officials, experts and philanthropists, I have been asked countless times what we think the best solution is. The reason I disapprove of this question is because I think it is unpractical to think of the solution, when we still do not understand the problem clearly. We therefore propose to have a different approach. We think that a pre-survey is necessary, from what we could evaluate the situation and have a few initial conclusions. Having the conclusions, we would be able to see what the problem is, and only then should we gather t and think about the solution. As University of Tokyo, we are aiming to contribute to Albania by creating or enhancing, three different laws. The first law, is the pre-disaster law, which would minimize the number of causalities and spatial and architectural damages. The second law is the post-disaster law, which would help Albania to consolidate itself and better manage the situation. And finally, we hope our work will also help to enhance the building code and standard in Albania. Japan, having been hit by countless earthquakes and other disasters, has managed to become very resilient through long-term planning. A very good example is school-yard project, after the 1923`s earthquake.

The government decided to invest in schools' yards so they become evacuation zones in case of disasters, at the same time, increasing their public-space quality. We think a similar approach would be very important at this stage in Albania. Our laboratory is part of a movement in Japan, known as `Matchitsukuri`, which translates to English as `participatory planning`. The goal of this movement has been to maximize the participation of people in the process of design, which has had satisfactory results in various projects past few decades.
I think one of the concerning consequences of the last earthquake in Albania, is the people`s trauma. Since as humans we feel hopeless whenever we have the feeling that we do not have our fate in our hands, I believe the involvement of people in the design would help people recover and feel better throughout the process. Moreover, it would be easier for us to design and research as academics, but also to implement for the government.
-It has been very heartwarming to see how good willing the Albanian Community and Diaspora has been from very early on. However, we have also seen how unorganized the action and relief has been, due to the lack of a single mechanism who would integrate and coordinate all teams. Together we also need to address this issue. Many ideas come to our mind, such as the volunteering engineers and architects. We propose the idea that when an architect is licensed, she should also be asked if she is willing to volunteer in case of national disasters. A database then should be created with those who chose to volunteer. In case of need, they could automatically be let known of the place and time of gathering, where they could coordinate the zones of action.
I believe that we as architect and planners are the only academics that could possibly give meaning to this calamity. It is us who can initiate better laws based on the lessons learned. Therefore, I call for joint action so we can make Albania Resilient and a better place to be.

3.4

RECONSTRUCTION OF THE CITY AFTER A NATURAL DISASTER

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Expert in Urban and Environmental Management Co-Plan Institute for Habitat Development

ANALYSIS AND SUGGESTIONS

Reconstructing the city following a natural disaster post-earthquake urban resilience. The events of the end of November 2019 triggered a foretold crisis regarding safety, quality of planning and construction, and administration and governance of territories in Albania, which were manifested on all levels and dimensions. This happening stands now as an undeniable proof of our failure in city making, despite the efforts mobilized in some sectors, or institutions. It is altogether more evident that institutions and the society are unprepared to handle, mitigate or prevent major crises of a destructive nature. We are currently still under emergency circumstances, and it is natural that all of the energy and financial resources are allocated to address the immediate post-crisis phase. However, on the other hand, it is important to start drawing lessons for the future; to raise awareness on how to plan and, most importantly, develop the territory in Albania; and to immediately start taking actions that address disaster prevention, mitigation and management in the long run. It is crucial that, while managing the emergency situation, we begin a process of thorough analysis and reflection, in preparation for potential future disasters. This event is also a warning act of nature for the phenomena that are expected to emerge as a result of climate change. The UN Climate Change Reports and other international reports clearly define that Albania will bear significant effect by these phenomena. The issue of post-disaster, resilient reconstruction in Albanian cities is complex and calls for an integrated, comprehensive and transparent approach. In order for cities to perform successfully and make citizens feel safe and comfortable in their urban environment, it is necessary to plan for resilience. This applies to both the overall planning processes and post-crisis reconstruction, regardless of the nature of the disaster. The concept of [urban] resilience has been widely discussed in scientific and professional domains, and there is a general agreement that it will become a dominant theory in the governance and development of the territory. It still remains a relatively new concept, and is significantly different from the concepts of sustainability, or vulnerability, though doubtfully related to them. 'Resilience' as a concept needs to be contextualized in relation to the territorial and socio-economic characteristics of a place, hence it is place-based. Following the change of planning legislation in the last decade, significant efforts were made in Albania to integrate resilience into territorial planning and development, especially through the strategic environmental assessment documents for local and national territorial plans. However, there still is a substantial lack of understanding and contextualization, especially in implementation, where it is either regarded as something theoretical, unrealistic and difficult to apply, or in some other cases it is completely neglected. This is exactly where our failure lies: we have not realized that planning and building for resilience is not out of touch with our reality. It is instead a necessity that requires capacities, knowledge, dedication and financial resources. It is not a one-time project, but rather a continuous, life-long process. The concept of urban resilience, as mentioned above, does not have a unified definition, but rather it is adapted to the specific context. Thus, recognizing the fact that urban resilience has a broad meaning, and is dependent on the type of crisis (earthquake, flood, fire, terrorist activity, wars, financial or economic bankruptcy, etc.) we can define it as follows. 'Urban resilience is the capacity or capability of the urban system, including the infrastructure and natural environment with which it coalesces, and all social interaction within it, to withstand external stresses, crises, disasters, and to adapt after the crisis, as rapidly as possible, achieving consequently a new state of physical, natural, socio-economic and institutional equilibrium. It is a different equilibrium from the pre-crisis condition, but nevertheless, it is a healthy new balance, that is fast to achieve". During our normal daily life and routine, free of disaster events, we forget that crises and devastating catastrophes may lie just ahead of us. They do not happen daily, cannot be anticipated, and have local features, but their impact extends to a very large geographical scale, lasts for a long time, and affects almost all of society. Thus, our preparedness at the community and institutional level must take place on a daily basis, so that when a crisis occurs, we are institutionally and socially prepared to provide a systemic solution in the immediate emergency response, as well as for the medium to long term reconstruction. Being prepared means establishing a multi-level and well-functioning system of institutional, financial and psycho-social preparedness, where citizens are continuously educated about co-living and facing disaster situations. What do we need to do in Albania after the tragic event of November 2019, in order to respond, plan, develop, and build with a focus on resilient cities, or urban resilience? In this specific case, in Albania, we went through a system shock caused by a natural disaster (the earthquake) and we need to talk about resilience planning, or urban resilience following this crisis. What could we have done differently, and what should we do differently in the future? Following is as a modest contribution to steps that could be taken now (immediately) and in the long-run regarding natural disaster management and the development of resilient cities, society and governance in Albania. As part of this reality, we believe that we, as a society, need to take such steps at all levels, from the institutional to the individual and community level. Firstly, the national and local territorial plans: it is recommended that plans be analysed, and equipped (where necessary) with policies and actions on resilience. Anyhow, this does not avoid the fact that local and national disaster management plans need to be prepared as well. The territorial and disaster management plans, albeit separate instruments, should be strongly interlinked, reinforcing one-another, and building upon each-others proposals. The second problem is related to information and its public access:

All of the plans that were drafted in the last 30 years have taken into account maps of seismic hazard regionalization and seismic risk, as a legal requirement for the (land use) zoning process, and as dictated by the professional and moral responsibility of planning experts. These are both are macrozoning maps, not micro-level, and both are outdated in the past 40 years. The conservative nature of the data makes them in a position to be used even now days. Yet, during four decades, the zoning has changed, as confirmed by a comparison between these maps and the seismic macro-zoning map of the Western Balkans, drafted in 2015. Moreover, planners have been using maps drafted in the early 1980s, since the more recent maps of 2003 and 2015 are not public and/or officially accessible. Even though it has always been necessary and occasionally even a legal requirement, to have a seismic microzoning map, the latter has not been and is not yet provided by the respective institutions.

Similarly, geological and hydrogeological maps and geomorphological risk maps are at best available at 1: 100,000 scale at qark level. These maps are produced as part of studies that were published 5 years ago. The studies were offered to qark authorities as a legal requirement stemming from the fact that they were drafted on a project basis, but never made public to a wide audience. Moreover, the maps are not updated, constituting merely old information represented in a new way and at a more adequate scale, which still fails to meet the needs for this type of information at local planning scale, and even more so for detailed planning, although, still used by planners.

Information on city metabolism and ecosystem services is altogether lacking in Albania. For example, information on water resources and their role in the urban system is not produced, or available at any level. There is no information about the consumption of water by different categories of users, on the quantity of the inflow and outflow, and its final drainage destination. This estimation and quantification is not feasible, not because of lack of technical knowledge, but because there is no any information systematically generated on these issues. Similarly, there is no information on the carrying capacity of the Tirana lake park, Lana River and 'Rinia' park, and their potential (ecosystem services) to protect the city against flood caused. Nowadays, in Albania, it is extremely difficult to access technical, scientific and quantitative information, unless it is generated individually. Information continues being kept isolated by a limited number of experts, although by law it should be public and accessible to all. Semi-independent institutions that produce and own this information, should guarantee its dissemination, taking into consideration that its quality and accessibility affect public safety and peoples' lives. A capable institution performs both public and private activity without using one at the expense of the other. Perhaps, it is time to revise their operational scheme, which should not be left to survive in the market from the revenues generated by the information they give for public interest, and for that reason perhaps they should receive full public funding. This will guarantee the end of the currently established monopoly on information. Information is a public good, and supporting science with appropriate funding is one of the key actions for the preparation, planning and establishment of resilient urban systems. Allocating funding of up to 5% of GDP to scientific research would be a significant step forward in this regard, turning into reality what has so far remained an electoral and political speculation. It is also important that scientific content be supported by public funding, without discrimination among public and private institutions, becoming accessible to all and free of charge, especially for public interests, such as drafting plans and public safety
The third problem is related to the analysis and proposed interventions in the plans that take into account urban resilience, such as infrastructure, buildings, and public spaces and, in general, open spaces, the ability of the community to adapt and the ability of institutions to govern crisis and post-crisis. These analyses and proposals have been deprived of resilience actions in general, and pre or post-seismic situations in particular. This comes undoubtedly as a result of lack of information, the novelty of the concept per se, and the insufficient knowledge in this regard. But, most importantly, it comes as a result of decision-making which favours high-rise development at the expense of safety; and gives into the pressure of construction, without considering the soil or development conditions of specific locations.

This is also due to the lack of a unified methodology for harmonizing these aspects. This problem is further extended to the use of planning standards. The discussion about Eurocodes, technical design and building norms, etc. has caught considerable public attention recently. It is for a fact that we base our design on very outdated norms and have not yet institutionally adopted the Eurocodes for construction activities. This makes us fall into a legislative vacuum of construction and design in terms of quality and safety. Undoubtedly, these standards are very important and directly related to the disaster that happened. But, in order to prevent a second disaster, aside from the above, we need to design appropriate planning standards as soon as possible. Significant efforts were made in this regard, but they did not conclude into a legal act. Implementing planning standards in Albania has not been easy. It seemed unrealistic to think about such standards that include, for instance minimum plot size for public uses, such as kindergarden or nursery, building setbacks, coefficients for public and green spaces, etc., in the context of the socioeconomic transition the country is going through. This transition has led to people misunderstanding property rights, and perceiving them as absolute rights. As a result, the real estate market has been a high profit margin resource, in comparison to other European countries: landowners have received and continue to receive over 30% of the development value, while developers aim for more than 12-20% return on investment, which would otherwise be a normal rate in European countries. These issues, combined with the corruption of the legal and administrative system in issuing building permits, exacerbate the development cost and its impact on citizens and livelihood in the city. This is a moment for profound reflection and action. World experience has shown that, aside from buildings, the greatest fatalities in disaster situations are caused by the city itself, when it is developed against livability standards and it lacks adequate infrastructures. An extremely important component of urban resilience, both related to planning standards and the whole process of building permits and land management, is the public space, open (unconstructed) space, and the road network. The open space can be considered as an "Achilles' heel" in managing the crisis and the emergency phase following it. The public open space, aside from a common good in terms of city livability, is the first emergency evacuation space in disaster situations. In Durrës, or even in Tirana people were often forced to stay outside just below the high-rise buildings, unsafe, in the absence of public space. In Tirana, many self-evacuated towards the lake, even though rules of conduct during an earthquake advice against staying near trees or by a dyke wall. So, it is important to understand that public space, aside from aesthetic and environmental benefits, plays an important role in public safety as well. It is a well-known fact that because of densification, our cities have lost many open spaces, even sports areas, such as the case of the football fields. So, the lake park was the only solution in the absence of squares, or wide roads, where people could initially be settled during the afterschocks, or where they could be safe from possible debris, and keep the streets free for evacuation and emergency vehicles. The legal definitions for public spaces, roads, squares and parks are present in the Albanian legislation. There is even a dedicated bylaw approved with a decision of the Council of Ministers for the management and creation of public space. This bylaw in particular has not been used de facto by the implementing stakeholders, because it encourages the use of market instruments to guarantee the necessary public space, which requires more energy and involvement from both the municipality and the developers, in order to be implemented. The proposals of this bylaw capitalize on well-acclaimed world experience and can be further improved to adapt to the local context. The problem is that we, as a society, need to raise our own awareness that the collective benefit from public space is, in fact, an individual benefit as well. Disastrous events have an impact on everyone, starting from the property owner, the developer, and the residents who buy the apartments, to the municipality that is supposed to guarantee safety for all and to harmonize public and private interests. Over 10 football fields and 90% of the open space we inherited after 1990s is today occupied by buildings and the city is made only of built space and narrow streets. Hence, instead of ignoring the legal frame that we have in place, we need to make an effort to implement and improve it, shifting the focus from simplifying the work of stakeholders, to actually solving the problems that this legal framework aims to address – the need for public space. Clearly, the reconstruction of the city should begin by critically reconsidering the creation of public space, at city level and in every residential unit, block, or neighbourhood. However, this should not be done hurriedly, with "ad-hoc" decision making, but in a well thought manner, providing an integrated approach, and implemented at an intense pace. We should also take measures that are considerate and integral across the natural disasters spectrum. For example, an urban park on a former alluvial field is a solution for post-earthquake situations, but not appropriate at all to withstand floods. In the meantime, people cannot move to the forest in the event of an earthquake, but in the event of climate change the forest is the rescue place. Therefore, the solutions should be tailor-made and cannot replace one-another. Seismic resilience should be closely matched to climate change resilience. The construction of new neighbourhoods should take into account the quality of the soil and the creation of public space. Surely new housing is needed, but it is necessary to define carefully the location of these new settlements, so that in 20 or 30 years, when the seismic cycle repeats, the new settlements are safe from risk. We need sustainable, secure secure neighbourhoods and safe buildings, adapted to the and geology, and public spaces. Before the reconstruction phase starts, a series of qualitative feasibility assessments should be undertaken, to quantify the socio-economic and financial costs of the interventions and of the disaster. These costs will affect our society, in the present and in the long term. Moreover, an important element of urban resilience is the mix of land uses to avoid negative social impacts. It is necessary to discourage gated communities, whether of poor or rich ghettos. Urban segregation is an adverse factor in post-disaster situations. After all, we are dealing with people and communities belonging to different social groups, whose segregation and unequal treatment only deepens the social catastrophe. In this case, it is important to analyse through feasibility studies different solutions to address the housing problem. These solutions may range from using existing housing stock through social policies, building new neighbourhood, social housing, or reflecting on the property tax and its collection. However, all physical and financial aspects should take into consideration the social and psychological implications of these interventions. The solution is only viable if it does not destroy the balance and livability of communities, and does not impose unfair costs to the society. Another element that relates to public space are setback regulations. Historically and until recently, in Albania, these regulations have been subjected to constant reduction. Narrow spaces prevent people from being evacuated and impede ambulances and firefighting vehicles to enter and provide their services. Moreover, because of narrow setbacks, there are well constructed buildings in optimal conditions that are currently endangered by the deteriorated ones adjacent to them and declared inhabitable. In these conditions, instead of looking for solutions (even extra-legal ones) to reduce distances and increase profitability, we need to realize that the setback regulations are extremely important and should be enforced as such. The third element to be considered regarding space is the infrastructure and the open space. First of all, we need wide roads for evacuation and protection during the disaster event. The straight path is crucial for rapid evacuation. Perhaps, we may not guarantee it in the organic (historic) city, but in the new city, with high-rise buildings, it is a necessity. Furthermore, the urban territory needs to be serviced with a road network throughout the whole area, and, where possible, of orthogonal typology. Every building must have access to roads, and the road network must respect the principle of hierarchy. The problems of access to infrastructure could be witnessed even during the September 21 earthquake, when people came out panicked and confused from the shopping mall on the highway, some even running to get their cars in the underground parking garage, to then unavoidably create a 5-kilometer traffic line at the entrance to the city of Tirana. Most of them, stuck in this congestion, had to stop right below high voltage wires and poles – an other dangerous space for evacuation. This situation mirrors both a cultural and institutional problem. Citizens in Albania are completely unprepared on a personal level to properly manage a crisis; but, clearly, we also have an infrastructure problem that impedes or delays evacuation, which should be addressed critically at an institutional level. A resilient urban system needs a road network consisting of highways, arteries and local roads, as determined by the Road Code, with the respective setback rules and parameters, accessible from any building and with various alternative routes that create options in case of emergency. Technically the latter is known as the concept of redundancy in road infrastructure. But this does not suggest that the solution should lead to more concrete and asphalt paving. On the contrary, this would be dangerous for flood prevention and climate change resilience. Today we can make use of the technology to build permeable and porous roads. This applies to parking spaces and the entire mobility network, especially outdoor recreation areas, parks, etc. Finally, to implement steps in both of the above vectors, some important aspects of urban resilience and city planning/reconstruction that we need in Albania can be summarized as follows:

Resilience in technology, quality and safety of construction and of housing.

A national methodology for the assessment, reinforcement and rehabilitation/retrofitting of earthquake damaged structures needs to be established. This methodology can be unified and should be applied rigorously; the findings of the evaluation should be transparent and accessible. Decision making regarding reconstructions should be strongly based on this evaluation. The engineering evaluation of the sustainability and quality of structures should be urgently initiated, not only in cities and in the affected areas, but also in informal and rural areas. In the latter cases, residents built their houses independently and without a project, so their safety is unknown and uncertain. The legislation on legalization contains such indications, but they have been overlooked and pre-legalization analysis has not been properly conducted. Based on international experience, in particular the case of New Zealand, we recommend the establishment of a national and local building monitoring system regarding buildings performance, safety, and deterioration and design housing policies on this basis. This system should be transparent and accessible to all. This national database on the structural data of buildings, seismic and geophysical data, will be of service not only to construction experts, but also to citizens. Information should be open and accessible to everyone. Many buildings may have damages which are not visible at first sight. This is why it is necessary for this database to serve as a type of structural-engineering certification. People need to be informed about the quality of their housing and the safety they ensure. Beyond monitoring, the system should be supported institutionally and financially, in order to improve the situation and reduce the risk emerging from problematic buildings. Moreover, a much more detailed monitoring system is needed for specific public and private institutions, which accommodate a considerable number of users for a long time. It is important that this database protects the real estate market against speculation, therefore it should be considered as an instrument for citizens to make more informed decision-making on housing. In the case of buildings that need to be demolished, we suggest that the emerging plot is used as open public space. Professional technical controls should be enforced throughout the entire construction cycle until the issuance of the occupancy certificate. Beyond raising awareness for the private sector, which exercises a variety of obligations during the construction, municipalities must clearly assume the legal responsibility for the safety of citizens. If the legislation is ambiguous or unclear in this regard, then it is the time for clarity to be established legally over the responsibility of public institutions, and municipalities in particular. Resilient planning and governance. Above all implementation and monitoring mechanisms need to be established accordingly. Information on geotectonics, hydrogeology, seismicity, soil, natural hazards and risks must be up-to date, accessible in real-time to institutions and experts, and available online to all. Today we operate under the conditions of irresponsibility or even withheld information. This has created monopolies that endanger people's lives. After all, everyone has the right to know if the soil under their property has a tectonic vault, is a sliding hazard, has high radon content, or other similar issues. We need to carry out an assessment of the socio-economic impact of the crisis. This comprises not only the value of damage and the cost of reconstruction, but the external costs that derive from the domino effect as well – banks that have given loans, businesses that have gone bankrupt, increased unemployment, difficulty of many families to send their children to school this year, the tax burden on those within the system and the increased number of the ones out of the system, and so on. There is no room for panic, but for rational, technical thinking and thoughtful steps in decision-making. Assessments and a good strategy based on them, would also enable us to access and absorb more efficiently funding for redevelopment from external, European sources.

We also need to turn our eyes to regional development. We have always underestimated and overlooked this issue. When the crisis happened, people found their solutions everywhere in the country but in Tirana and Durrës. The existing pattern of development, the concentration of population, the economic activity and increasing migration to this region, which is at high seismic risk, are only adding to the probability of even greater damages and hazards in the event of other disasters. This also applies to a part of the Western Low-land of Albania, and not just for seismic events. The projections of impacts from climate change on the territory in Albania suggest that this region will be affected the most. Hence, it is necessary to immediately start implementing a well-balanced approach to regional development. Albania's resilience, but also sustainable development as a whole, should not be concentrated solely in the Tirana-Durrës region.Resilience and sustainable development are achieved by taking into account the whole territory, and by increasing the potential of each region. After all, we must understand that resilience is not just a technical concept. It is planning and governance leading to physical intervention to the territory. The discussion during the Forum highlighted once again that without a resilient governance, without resilient institutions, many of these proposals would be difficult to achieve. It is important that this crisis serves to re-dimension our governing mentality, by increasing citizen participation in governance, and by creating systems that are capable of self-adaptation and self-recovery in times of crisis. It is of utmost importance that we start improving plans, developing disaster and emergency management plans, with a focus on resilience. Internationally, there are well-defined methodologies in this regard. They have to be understood and then contextualized. Municipalities do not have to wait for support from the central government; they should become proactive, allocate a share of the budget, apply for funds, and act accordingly. We should start implementing the law on condominiums, everywhere in Albania. There is a need for wide awareness among residents now on the benefits of this law. Citizens now have a concrete case where they can draw lessons. Part of the safety issues in buildings comes from their depreciation and lack of maintenance throughout their lifetime. The use of the entire plot area for construction should finally be brought to an end. Coverage coefficients (plot cover ratio) defined in plans should be implemented rigorously, allowing for more public spaces and increased setbacks. The bylaw on public space should receive priority, should be improved (where necessary), and implemented and monitored accordingly. We need to promote good practices in creating public spaces, and turn them into our new reality of urban development. Cities in Albania must urgently be provided with emergency accommodation facilities, regardless of the crisis or disaster. It is necessary to identify which typology of crises can affect what territory and act accordingly. Our cities need alarm systems. We once had them, though used with for a different purpose. Nevertheless, such systems are valuable regardless of the reason behind, and in today's Albanian cities they are entirely absent. The systems must be properly maintained and the respective management authorities should provide training and systematic simulations for citizens. We need every municipality to create a Voluntary Rapid Response Team, that must be trained and train their fellow citizens on how to act in the event of fires, floods, earthquakes, and other disasters. Citizens must be provided with information and receive the basic culture for this purpose. What happened in November 2019, shows that a lot remains to be done in Albania. Individual rationality did not fail, even though individual knowledge often led us towards wrong personal decisions. What failed is social rationality, institutions that guarantee the protection of the public realm, and the regulatory system of common or collective interests. And it is precisely there, where we need to take actions for the reconstruction of the city post-crisis and for the recovery of the society.

TECHNICAL REPORT

GEOTECHNICAL ASPECTS OF DURRES EARTHQUAKE

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EXTENDED ABSTRACT

Albania is a country characterized by high seismicity levels, as such the possibility of facing an earthquake is high. For this reason, many studies by the Institute of Seismology are conducted, through which the seismic map of Albania is developed. From this map results that 40% of the Albanian territory has a Modified Mercalli Scale of 7, the other 40 % of 8 and the remaining 20% has a value of 9. The studies also show that in the Albanian territory may be found three tectonic faults: the first in the direction North-South in the Adriatic and Ionian Sea, the second passes through Skopje and ends in Tepelenë and the third is located in the area Korçë- Pogradec with an end in Greece. The latest earthquakes in Durrës region, firstly the one in September and later on the strongest one in November with a magnitude 6.4 of Richter scale clearly showed that these areas are the most dangerous due to their geographical position just above one of the faults mentioned above. Geological and geotechnical studies show that a part of Durrës area lays above ex-marshes zones (typical example that of “Lagja Nr. 18” which had the most serious problems), other parts in weak soil deposits and a third part in fine sands like Hamallaj and Golem area. For these reasons in Durrës and surrounding areas in case of an earthquake many dangerous geotechnical problems are observed like: liquefaction, lateral spreading, slides and also

amplification of the ground acceleration from the base rock that is directly connected with the structural damages of the buildings. Engineers in Albania and worldwide for years are having a special interest in the liquefaction phenomenon because of the complexity and dangerousness of the phenomenon that causes many problems like: heavy damage of objects, loss of slope stability, deformation of the soil layers etc. Liquefaction is a phenomenon in which the strength of a saturated cohesion less soil is reduced due to the rapid load (earthquake). The water pressure is increased, reducing the effective pressure and therefore the contact between particles is lost. To understand the phenomenon better, an analogy with a visit on a beach can be done, where it may be easily observed that if you walk the sand has the strength to keep your weight up, but if you had to stay in one place shaking your legs a little, causing in this way a vibration, the water will begin to go up in the surface and the legs would start to "sink" in the sand. In estimating the potential, a soil has to liquefy, many factors are considered where the most important one is the type of soil and the water table. Studies have shown that different areas in Durrës have the potential of liquefaction as shown in the map below:

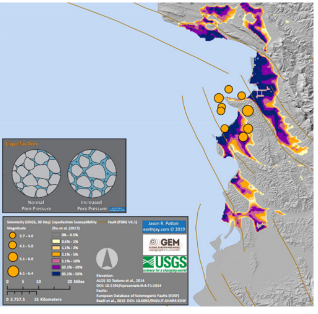

Fig 1. *Liquefaction Potential in Durrës area (source: EDSF)*

Fig 2. *Points in Durrës area where the liquefaction was observed during the earthquake.*

After the earthquake of the 26 November, thanks to the many inspections from students and the staff, it was proven that the earthquake, in specific areas shown in Fig.18 has caused the liquefaction phenomenon. Comparing both figures it can be easily observed that the phenomenon appeared exactly in the areas that had the highest potential. Site photos below show depict in a clear way the phenomenon:

Fig 3. *Liquefaction phenomenon in Durrës (Source: Olgert Gjuzi)*

The damages of liquefaction in structures are observed in the case of Lubjana Hotel, where it can be seen that the rear side due to the liquefaction has settled and caused in this building the problem of differential settlement which is accompanied with cracks in the vertical elements:

Fig 4. *Lubjana Hotel after the earthquake of 26 November (Source: Klodjan Dervishi)*

If there is a potential of liquefaction, different engineering interventions can be designed in order to reduce the effects of the phenomenon, and these interventions can be classified as:

- Interventions that raise the relative density of the sands.

This is achieved using a superficial compaction with blows, vibration and hidrovibration, with a compacted layer from 50-150 cm, or by compacting the soil using sand piles.

- Interventions that improve the drainage conditions

Since the cause of liquefaction is the immediate increase in the water pressure, vertical drainage systems can be used in the form of gravel piles, which beside drainage help in the compaction.

- Interventions that raise the effective stress

Since the cyclic shear resistance is proportional to the vertical stress in soils, the soil layer can be loaded building an embankment and in doing so the vertical stress due to the load transmitted from the embankment will increase.

- Interventions to modify the mechanical properties of the soil.

This modification can be done using reinforcing chemical methods like cementation and silicate grouting. In doing so the ability of the soil to resist deformation is highly improved. In countries like Japan and Turkey, which are known for their high seismicity levels, the mentioned methods are used in many cases, on the other hand in Albania the usage of these interventions is slightly limited. The most typical case is that of the Oil Plant in Porto Romano. From the initial field tests (CPTU) it was observed that the soil conditions were not good and in the case of a seismic force serious problems could appear. For this reason, some ground improvement techniques were used consisting on:

- Gravel piles under each implant to a depth of 12m to avoid the liquefaction problem.
- Pre- loading using embankment to reduce settlements.
- Vertical drainage in a depth of around 24m to accelerate the effect of the pre-loading (rapid drainage and reducing the time of consolidation settlement).

Fig 5. *Porto Romano Oil Plant after construction*

Fig 6. *Drilling of boreholes for vertical drainage system*
(Source: Luljeta Bozo)

In conclusion it can be said that the Durrës area seen from the geotechnical aspect is a week site with high potential of developing dangerous geotechnical hazards like, slidings, liquefaction and shaking amplification. For these reasons detailed and serious studies together with engineering measures are necessary to reduce and avoid problems related with these phenomena's which, it must be said, were numerous in the occasion of the two recent earthquakes that hit our country.

4.2

STRUCTURAL ENGINEERING OBSERVATION FROM 26 NOLVEMBER 2019 M_w 6.4 ALBANIAN EARTHQUAKE

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ILLUSTRATIVE IMAGES	ANALYSIS
 *Fig.1 Collapsed structure*	**Structure Characteristics 1:** 5-storey masonry building with retaining walls and anti-seismic floor beams, design code “KTP-2-89”, Location Durres. **Collapse mechanism:** Total collapse of the structure. The collapse is due to the "soft story" phenomenon. Soft-story phenomenon: The phenomenon occurs mainly when the floors are higher and are completely open (ie, the floors have only concrete skeleton, without the presence of dividing or perimeter walls), while the other floors above them are partially or completely constricted to the outer masonry. This alters the behavior of the structure and damages these "soft floors". **Causes that have brought about the total collapse of the structure:** Intrusion into the retaining walls of the building mainly on the ground floors (removal, shifting and thinning of the walls. Also geometric modifications to the other floors and closure of the balcony consoles) Destruction of the stair cage as a result of placing water deposits on the cage suite. This extra load, unaccounted for by the designer, under seismic action has caused loss of stability and has helped the global collapse of the entire structure. Degradation of masonry constituent materials, reduction of physical-mechanical parameters of bricks and mortar, also is reduced the retaining capacity of the walls.

ILLUSTRATIVE IMAGES	ANALYSIS

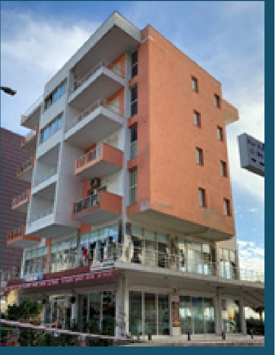


Fig 2. Building near collapse

Characteristics of the structure:
6-storey building, concreted gun construction, 2-way frame system, design code “ktp-2-89”, Location Durres.

Collapse mechanism: Local Collapse of the first floor. The collapse is due to the phenomenon, the "soft story", and it endangers the structure's stability. (Object hit by explosives from IKMT).

Causes that have brought about the total collapse of the structure: Creating a rigid mass has changed the behavior of the structure and damaging the first-floor columns.
Inappropriate configuration and orientation of the column plane judging by the geometry of the height structure, also the structural detail, shows insufficient stirrups to withstand seismic force.

ILLUSTRATIVE IMAGES	ANALYSIS

Fig.3 Structural damages, plastic hinges on columns.

Structure Characteristics: 3 storey private villa, with reinforced concrete “frame system” structure, design code "unidentified". Location “Shkozet, Durrës”

Collapse mechanism: Maximum damage to columns due to poor design (out of standard) and poor quality concrete and steel.
Creation of plastic areas (areas of residual deformation that cannot be retrofitted or repaired) at the edges of columns, exposed of steel bars to air.

Causes that have led to the total collapse of the structure:
Column design out of standards. We have identified a section-cut detail of the column in dimensions of 20x20cm.
Non-compact concrete in very low grade. Column damage in large scale.
Low grade, fully corroded steel that increases its volume.
Lack of longitudinal and transverse reinforcement.
Failure to respect the critical areas, at the corner of the columns, for the staff density to be increased in these areas.

ILLUSTRATIVE IMAGES	ANALYSIS
 *Fig.4 – Structural damages, plastic hinges on columns*	**Structure Characteristics:** 3 storey private villa, with reinforced concrete "frame system" structure, design code "unidentified". Location "Shkozet, Durrës" **Collapse mechanism:** Maximum damage to columns due to poor design (out of standard) and poor quality concrete and steel. Creation of plastic areas (areas of residual deformation that cannot be retrofitted or repaired) at the edges of columns, exposed of steel bars to air. **Causes that have led to the total collapse of the structure:** Column design out of standards. We have identified a section-cut detail of the column in dimensions of 20x20cm. Non-compact concrete in very low grade. Column damage in large scale. Low grade, fully corroded steel that increases its volume. Lack of longitudinal and transverse reinforcement. Failure to respect the critical areas, at the corner of the columns, for the staff density to be increased in these areas

ILLUSTRATIVE IMAGES	ANALYSIS

Fig.5 Significant damage to the building with high flexibility

Structure Characteristics: 12-storey building with reinforced concrete frame system, design code “unidentified”. Location Durres

Damage analysis: Significant local damage to the perimeter walls and divided walls of the building (large cracks and destruction of walls in many areas). Significant damage to the beams mainly on the ground and first floor. Damage to the cage and stair ramps, also damage to the elevator cage

The causes that led to the total collapse of the structure: The absence deep beams at the structure, not even on the perimeter of the object, so those beams that absorb more seismic force are missing.

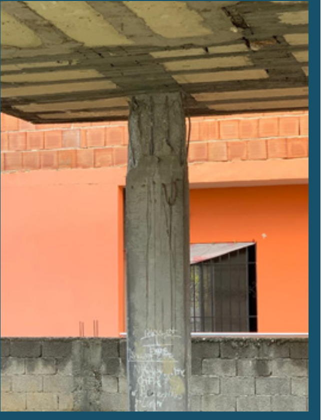
Not using structural rc shear walls.

An nonregular configuration of the structure in the plan, which causes the center of mass of the structure to shift. The structure is vulnerable to torsion.

ILLUSTRATIVE IMAGES	ANALYSIS
	**Consequences:** Non-structural damages. High cracks in infill walls. **Reason:** Lack of concrete strip in walls. High inter-story drifts. **Measures to be taken:** Replacements of damaged. infill walls.
	**Consequences:** Structural damages High cracks in infill walls Damage of concrete cover on columns. **Reason:** Lack of concrete strip in walls. Small concrete cover Large stirrups spacing in critical regions of columns **Measures to be taken:** Replacements of damaged infill walls. Concrete jacketing of columns.

ILLUSTRATIVE IMAGES	ANALYSIS
	**Consequences:** Non-structural damages. High cracks in infill walls. Fallen infill walls. **Reason:** Lack of concrete strip in walls. High inter-story drifts. **Measures to be taken:** Replacements of damaged infill walls.
	**Consequences:** Non-structural damages. High cracks in infill walls. **Reason:** Lack of concrete strip in walls. High inter-story drifts. **Measures to be taken:** Replacements of damaged infill walls.

ILLUSTRATIVE IMAGES	ANALYSIS
	**Consequences:** Structural damages Soft story Collapse of columns **Reason:** Columns with small dimensions (20x25) cm. Insufficient longitudinal reinforcement bars. Large stirrups spacing in critical regions of columns. **Measures to be taken:** To be demolished
	**Consequences:** Structural damages Soft story. Collapse of columns **Reason:** Large stirrups spacing in critical regions of columns **Measures to be taken:** Demolished

ILLUSTRATIVE IMAGES	ANALYSIS
	**Consequences:** Structural damages Forming of plastic hinge Damage of column **Reason:** Lack of stirrups The beam has no continuity **Measures to be taken:** To be demolished
	**Consequences:** Structural damages Short columns phenomenon Damage of column **Reason:** Large stirr ups spacing in critical regions of columns.

ILLUSTRATIVE IMAGES	ANALYSIS
	**Consequences:** Structural damages Forming of plastic hinge Damage of column **Reason:** Large stirr ups spacing in critical regions of columns. Small overlap length
	**Consequences:** Structural damages High damages of retaining masonry walls. Damage of mortar **Reason:** Low thickness of walls Deterioration of bricks and mortar because of atmospheric agents
	**Consequences:** Structural damages High damages of retaining masonry walls. Damage of mortar **Reason:** Low thickness of walls. Deterioration of bricks and mortar because of atmospheric agents.

4.3

STRUCTURAL ENGINEERING OBSERVATION FROM 26 NOLVEMBER 2019 M_W 6.4 ALBANIAN EARTHQUAKE

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ABSTRACT

Masonry buildings occupy a considerable place of construction in our country. They are built in different time periods but mainly before 1990. In our country masonry buildings built before the '90s make up most of the residential buildings, which are designed in accordance with the codes [KTP-63, 1963; KTP-78, 1978; KTP-89, 1989], and after 90s are bearing masonry with two to three storey that were mainly built by private investors for residential purpose. These buildings also serve for many different businesses and companies as work environments. Most of these constructions are built on private initiatives, based on traditional construction techniques, with no engineering projects supported by codes of design. Risks that affect the security of buildings with bearing masonry.

1. Damages due to their age (material degradation) and non-criteria human interventions

- Chemical degradations
- Carbonization
- Sulfate degradation
- Erosion
- Freeze-thaw degradation
- The effects of strain
- Degradation by seniority, atmospheric agents and human activity.

Masonry is an inhomogeneous material consisting of bricks and bonding mortar between them. Usually the old buildings have been plastered on the outside which has played a protective role towards atmospheric impacts. Over the years this plaster has been damaged by rainfall or frost allowing moisture to penetrate the masonry building. This moisture also associated with micro-organisms like mold has in many cases damaged the bond between mortar and brick creating weak areas in the building. This phenomenon is even more evident in those buildings where the external plastering is completely absent. In the most extreme cases degradation of masonry by the age can lead to local or even total demolition of the building. An significative influence to the masonry bulding also have the humans. His interventions to restructure the masonry buildings are considerable. Here we can mention creating gaps for doors, partial or total breakdown of retaining walls on the first floors, or water deposit tank installations or various equipment on the perimeter wall. Also in a few cases floor extensions have been noted on the terrace as well as the creation of new balconies. Such interventions may damage the initial scheme of load transmission and cause serious damage to the building. An significative influence to the masonry buildings also have the humans. His interventions to restructure the masonry buildings are considerable. Here we can mention creating gaps for doors, partial or total breakdown of retaining walls on the first floors, or water deposit tank installations or various equipment on the perimeter wall. Also in a few cases floor extensions have been noted on the terrace as well as the creation of new balconies. Such interventions may damage the initial scheme of load transmission and cause serious damage to the building.

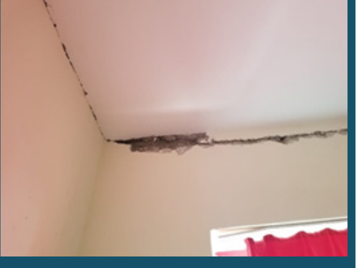
2. Damage due to basement

Damage from foundation settlement. Old buildings with masonry have extended foundations of stone masonry. They are in the form of continuous supports that extend below the retaining walls. On the whole, such buildings are quite stiff but at the same time sensitive to foundation settlement. Since the tensile strength of the masonry is negligible, the cracks caused by settlement of the foundations will appear in areas where tensile stresses arise. Settlement can occur when the groundwater level is near the surface and the soil contains fine particles (clay dust). These particles rinse over time from the soil, increasing its porosity and reducing bearing ability. In the moment when bearing capacity become less then the pressure coming from the building, settlement occurs. Depending on the size of the foundation that has settled the evaluation of the possibility of repair is made. Although in many cases it is possible to repair a building, it has many implementation difficulties and uncertainty about the outcome. It is recommended that the buildings at risk from this phenomenon to take preventive measures before settlement happened on the foundation. Measures include drainage of groundwater near the building and injection of cement mortar under the foundations.

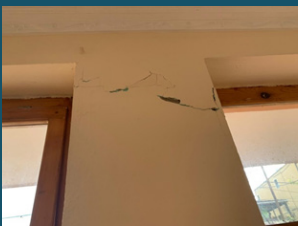
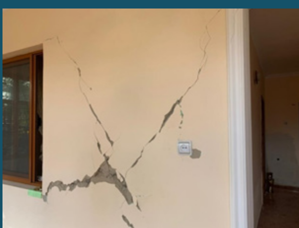
3. Damages due to static and seismic loads

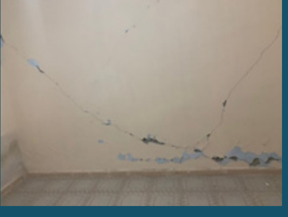
Damage from seismic activity. Seismic activity in countries such as Albania is one of the biggest risks for multi-storey buildings, this proved the November earthquake that hit our country. It is proven that seismic is the main factor affecting the dimensioning of structural elements, therefore it is of utmost importance to design these structures. Seismicity is represented by the elastic design spectrum, which according to the Albanian standard KTP-N2-89 many structures are designed with TIP masonry. To build these spectra are using such parameters that represent seismic risk in most part of Albania. In the current situation the main damage to these structures are the seismic loads. In order for buildings to resist this force, it is necessary to have ductile behavior to absorb seismic energy and shoot. In reinforced concrete buildings that ductility obtained by iron. In older buildings with load bearing masonry, we do not have proper ductile elements, so they are more at risk. They are capable to face small earthquakes as a result of the high stiffness of the large working section. Their global ductility is also ensured by the gradual detachment of mortar-brick bonding in the most stressed areas. The old Albanian design codes do not provide sufficient measures for the seismic safety of these buildings. This situation becomes even more serious when we consider degradation over the years and structural interventions. For these reasons, these structures do not meet the utilization requirements and new technical building codes. In Europe, most countries have incorporated the design practice of "Structural Eurocodes", which reflect a high level of knowledge in the field of Structural Engineering. These codes are now part of the design practice in Albania as well, and work about this has been going on for several years, either with official initiatives of the responsible institutions so too with individual initiatives of Albanian engineers. The seismic design of structures according to Eurocodes, summarized in Eurocode 8 is more advanced than the one based on our country's Technical Design Conditions (KTP). The last update of KTPs was made in 1989 with the approval of KTP-N.2-89 (Academy of Sciences, Ministry of Construction, 1989). On the other hand, many existing buildings were completed before this year, based on even older design codes. Structures designed with previous codes have suffered severe damage due to insufficient capacity to withstand seismic load and limited ductility.

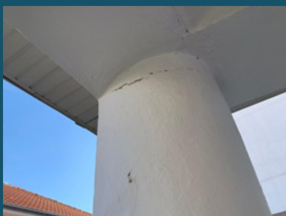
oday there are numerous attempts to include seismic assessment procedures of existing structures and rehabilitation in their design code, moreover in some developed countries (USA, Japan etc.) these "Evaluation Codes" are included in the legal framework of construction. An important challenge for engineers is to evaluate the seismic capacity of new and existing buildings as well as to evaluate their response under a ground motion. Nonlinear procedures in different country codes [ATC-40, 1996; FEMA-356, 2000; FEMA 440, 2005; N2 Method, 1996; Eurocode 8], which have been developed for the last two decades are approaches to achieve this objective. Using nonlinear analysis, it is possible to predict the capacity of the structure in the form of the capacity curve. These results should be used to alert competent authorities of the risk of an expected earthquake.

ILLUSTRATIVE IMAGES	ANALYSIS
	**Damage:** Disconnecting the connection between the red brick retaining wall and the slab. **Cause:** Lack of the anti-seismic band. Poor quality in material and working technique. Non-compliance with the rules of technical conditions of implementation (KTZ-89).
	**Damage:** Local damage to the load bearing wall and its bond to the slab. **Cause:** Lack of anti-seismic band. Poor quality in material and working technique. Non-compliance with the rules of technical conditions of implementation (KTZ-89). Plastering off standard thickness.

ILLUSTRATIVE IMAGES	ANALYSIS
 	**Damage:** Damage to the building's slab with load bearing masonry. **Cause:** Degradation of roof composite materials. Using a traditional technique with low resistance materials. Poor quality in material and working technique. Non-compliance with the rules of technical conditions of implementation (KTZ-89) Plastering off the standard thickness.

ILLUSTRATIVE IMAGES	ANALYSIS
	**Damage:** Damage to the joint between two buildings with different constructional systems one with reinforced concrete and the other with load bearing brick masonry. **Cause:** Non-compliance with the minimum distance between two objects joints. Non-compliance with the rules of technical design code (KTP - No.2-89).
	**Damage:** Damage to the part of the wall between the window spaces. **Cause:** Low load bearing masonry capacity by cutting forces. Poor quality in material and working technique. Non-compliance with the rules of technical design conditions (KTP - No.2-89, KTZ-89).
	**Damage:** Damage to the load bearing wall. **Cause:** Low masonry ability by cutting forces. Lack of anti-seismic band. Poor quality in material and working technique. Non-compliance with the rules of technical design conditions (KTP - No.2-89, KTZ-89).

ILLUSTRATIVE IMAGES	ANALYSIS
 	**Damage:** Structural damage to the load bearing masonry in all its height, between the two window spaces and between the retaining wall and the parapet. **Cause:** Low load bearing masonry capacity by cutting forces. Lack of the anti-seismic band and anti-seismic columns. Poor quality in material and working technique. Failure to comply with the rules of technical conditions of design and implementation (KTP - No.2-89, KTZ-89).
 	**Damage:** Damage to the structure with load bearing masonry due to the phenomena at the base. **Cause:** Non uniform continuous foundation settlement. Lack of field geological study.

ILLUSTRATIVE IMAGES	ANALYSIS
	**Damage:** Damage to the masonry plaster **Cause:** Poor quality in material and working technique. Non-compliance with the rules of technical conditions of implementation (KTZ-89).
	**Damage:** Structural damage to the column in individual buildings with load bearing masonry construction. **Cause:** Poor quality in material and working technique. Building structures without constructive projects based on traditional experience. Non-compliance with the rules of technical conditions of implementation (KTZ-89).
	**Damage:** Partial demolition of masonry structure built in 1980s **Cause:** Poor monolithicization of the connecting joints between prestressed concrete reinforcement slab and reinforced concrete band on the retaining wall. Poor masonry resistance outside of its plan against seismic forces

GENERAL EARTHQUAKE DAMAGE CHECK LIST

Proposed by the Department of Civil Engineering
POLIS University

A. GENERAL INFORMATION

1. Street Address of Property : ______________________

   Mulcipality:______________City:______________Zip: ______________

2. Property Owner's Name: ______________________

3. Date of inspection: ______________________

4. Inspector's Name: ______________________

B. BUILDING SITE INSPECTION

5. **Building Layout Plan**

6. **Sorrounding topography: (check one)**

   - Flat
   - Gently sloping (easily walkable)
   - Steeply sloping (difficult or impossible to walk in some areas)

B. BUILDING SITE INSPECTION (continued)

7. Geotechinical Issues (circle the identified problem)

- New cracks In the ground
- Signs of fresh cracking in or movement of retaining walls
- Liquefaction phenomenon
- Lateral spread phenomenon
- Loss of slope stability
- Loss of stability of other supporting structures (pillars,piles,etc.)

C. GENERAL BUILDING INFORMATION

8. Classification of the building:

- Residential facility
- Offices
- Warehouse
- Factory
- Hospital
- School
- Cultural heritage
- Other (specify) ____

9. Structure type

- Masonry Construction
  - Red brick (with anti-seismic band)
  - Red brick (with anti-seismic band and anti-seismic column)
  - Silicate brick (with anti-seismic band)
  - Silicate brick (with anti-seismic band and anti-seismic column)
  - Stone masonry

C. GENERAL BUILDING INFORMATION (continued)

- Reinforced concrete constructions
    - R/C Frame
    - Sheerwalls
    - Core system
    - Mixed system (frame and sheerwalls)
- Steel constructions
    - Heavy industrial steel structures
    - Light industrial steel structures
    - Multi-story steel structure with braces
    - Multi-story steel structure without braces

10. Building configuration

- Lateral floor extension
- Additional floor above the existing building
- Intervention on the first floor (specify the intervention) ______________________________

11. Foundation type

- Spread footing
- Raft foundation
- Beam foundation
- Countinious foundation
- Pile foundation
- Other (specify) _____________________________

D. EXTERIOR BUILDING INSPECTION

12. Building Facade

- Cracking at corners of door and window openings
- Fresh cracking of wall finishes at wall corners or wall/ceiling intersections
- Windows damaged, difficult to operate, or inoperable
- Wall leaning
- Plaster damage
- Pattern of cracking that extends from the floor slab through the wall
- Severe cracking, separations, or offsets at building irregularities
- Seismic joint damage
- Spaces in masonary

D. EXTERIOR BUILDING INSPECTION (continued)

13. Foundations

- Foundation cracking
- Cracking due to differential settlement
- Problems from sliding
- Other (specify) ______________________________

E. INTERIOR BUILDING INSPECTION

14. Access inside the building

- Accessible (fill in below)
- Inaccessible (specify the reason) ____

15. Seperate walls

- Cracking of plaster at joints between walls and ceiling
- Plaster cracking in the corners of doors and windows
- Cracking of the walls around the door and window spaces
- Wall leaning
- Pattern of cracking that extends from the floor slab through the wall
- Visible diagonal wall cracks
- Damage of plasterwork
- Other (specify) ________________________________

16. Ceiling

- Slight cracking of ceiling plaster
- Severe cracking of ceiling plaster
- Ceiling settlement
- Presence of cracks in the ceiling
- Slab reinforcement exposure
- Other (specify) ________________________________

E. INTERIOR BUILDING INSPECTION (continued)

17. Floors

- Light cracking on the tiles
- Broken tiles
- Visible floor slab cracking
- Other (specify)) ______________________________

F. FACILITY SECURITY ASSESSMENT

18. Safety Assessment Tag:

- **Green**
- **Yellow**
- **Red**

19. A. Year of original construction (best estimate): ____________________

B. Total square footage (best estimate):__________________

C. Have any repairs, modifications, or demolition been performed since the earthquake?

YES **NO**

If yes describe: ____

Green: *No damage to structural elements, slight cracks in plaster*
Yellow: *Cracks in structural elements (diagonal cracks in masonry buildings and cracks in columns, R/C walls for reinforced concrete systems*
Red: *Structural elements and connections between them are severely damaged. The object partially or totally collapsed Entering the facility is forbidden.*

G. PHOTO FROM FIELD INSPECTION