CURTEA DE CONTURI A ROMÂNIEI

DEPARTAMENTUL XI

Synthesis

of the main findings, conclusions and recommendations resulting from the performance audit regarding earthquake risk management in the Municipality of Bucharest

The VIII-th Meeting and the Seminar of the EUROSAI Working Group on the Audit of Funds Allocated to Disasters and Catastrophes,
22-23 November 2022

The more governments, UN agencies, organizations, institutions, business environment and civil society understand risk and vulnerability, the better prepared they will be to mitigate disasters when they strike and save more lives.

(*Ban Ki-moon, Secretary General of the United Nations 2007-2016)*

Scope of the audit mission and justification of the chosen topic

- The initiation of the audit mission was motivated by the fact that, according to the history of earthquakes that have occured in Romania, a major earthquake in Vrancea can generate catastrophic effects in Bucharest, and the institutions with responsibilities in this field must be as well prepared as possible to face this challenge.
- **Citizens, must be constantly informed, trained and aware of the characteristics of this type of risk.**
- Existing data indicate a certain cyclicity of major seismic phenomena in the Vrancea area, and the location of Bucharest on the seismic map in the proximity of the rupture zone and the fact that it is also the most crowded urban settlements in the country are the two factors that make the municipality highly exposed to the potential destructive effect.
- *The ability to manage earthquake risk in Bucharest depends on how the management system strives to ensure the framework, tools, resources and conditions so that the devastating effects can be largely prevented and optimally managed, and afterwards, based on some correct assessments, to ensure effective recovery measures.*
- **The performance audit, through the formulated recommendations, supports the improvement of the earthquake risk management system.**
- In 2017, during the Meeting of the EUROSAI Working Group on the Audit of Funds Allocated to Disasters and Catastrophes, the Romanian Court of Accounts signed a joint position with the supreme audit institutions of Turkey and Italy regarding cooperation during the conduct of audit actions related earthquake risk management.
- Seismic risk assessment is a sub-objective of the sustainable development objective - SDG 11 "Sustainable cities and communities" provided by the National Sustainable Development Strategy of Romania 2030.

The imminence of such a phenomenon, the high degree of exposure of the municipality and the need to prevent potentially destructive effects are key points in justifying the audit of the seismic risk management system for the municipality of Bucharest.

The general objective of the mission was the evaluation of the efficiency and effectiveness of the programs and measures undertaken in order to prevent, intervene and remove the effects of a major earthquake in the Municipality of Bucharest, and the period analyzed was 2014-2020

The performance audit was carried out by Directorate 1 of Department XI of the Romanian Court of Accounts and took place, between 11.09.2017 and 01.04.2021, at the Ministry of Internal Affairs (MAI) - Department for Emergency Situations (DSU).

In order to fulfill the specific objectives of the performance audit, the action also extended to 19 other public entities with attributions in the field of emergency situations and seismic risk management

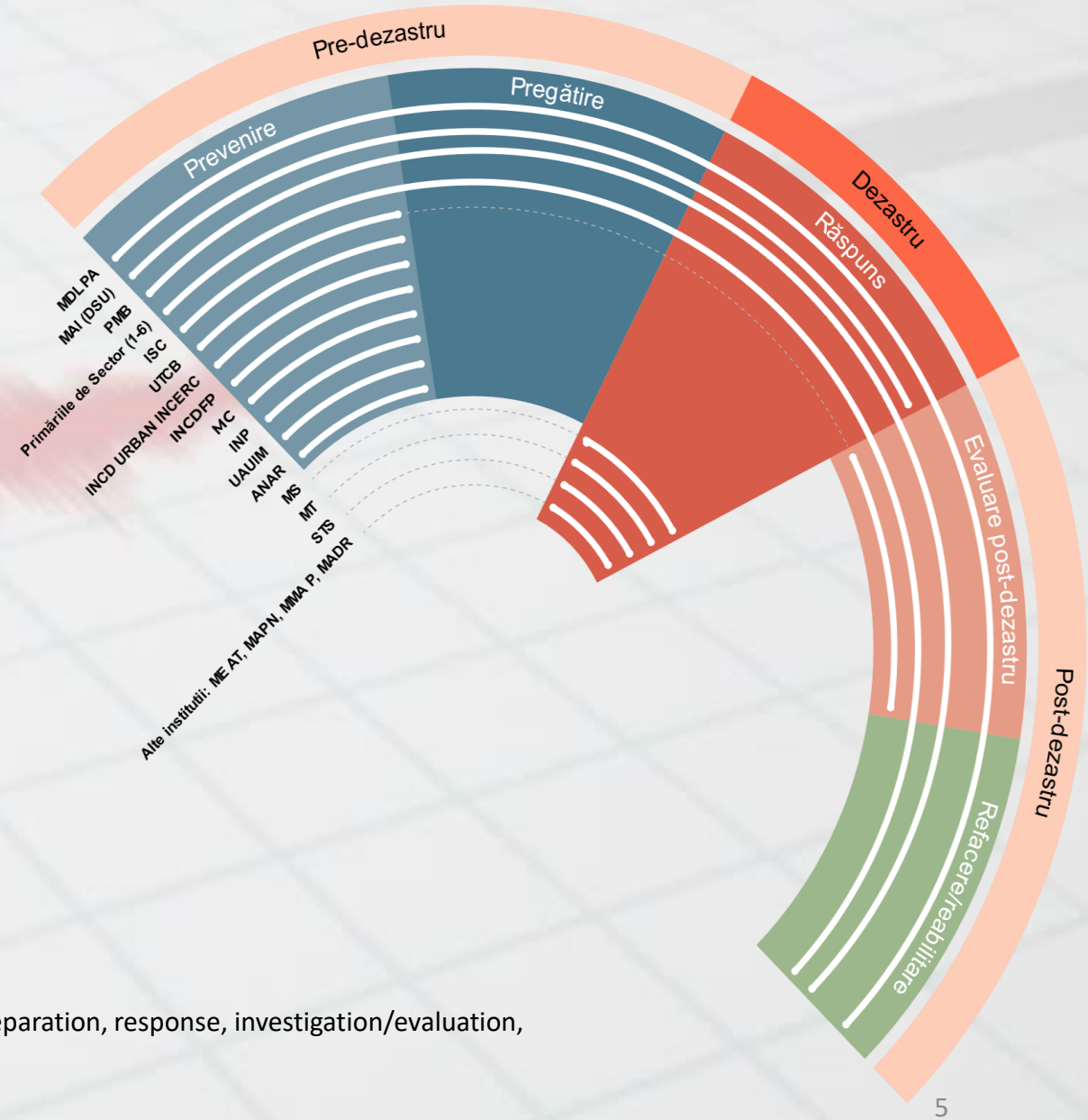
Within the entire earthquake risk management system are identified:

-227 findings resulting from performance audit actions

-216 deficiencies resulting from documentation actions

Public institutions audited

Auditing/documentation activity	Leading authorities	Secondary authorities/support functions
Performance audit	Ministry of Development, Public Works and Administration (MDLPA)	Ministry of Internal Affairs (MAI) Bucharest City Hall (PMB) Bucharest District City Halls (6)
Documentation action		Ministry of Health (MOH) Ministry of Transport, Infrastructure and Communications (MTIC) Ministry of Culture (MC) National Research Development Institute for Earth Physics (INCDFP) Institute for Research and Development in Construction, Urbanism and Sustainable Territorial Development (INCD URBAN INCERC) State Construction Inspectorate (ISC) "Romanian Waters" National Administration (ANAR) Technical University of Construction Bucharest UTCB) National Heritage Institute (INP) "Ion Mincu" University of Architecture and Urbanism (UAUIM) Special Telecommunications Service (STS)



Some public institutions have duties in all fields of action (prevention, preparation, response, investigation/evaluation, restoration/rehabilitation), such as: MDLPA, MAI, district town halls.

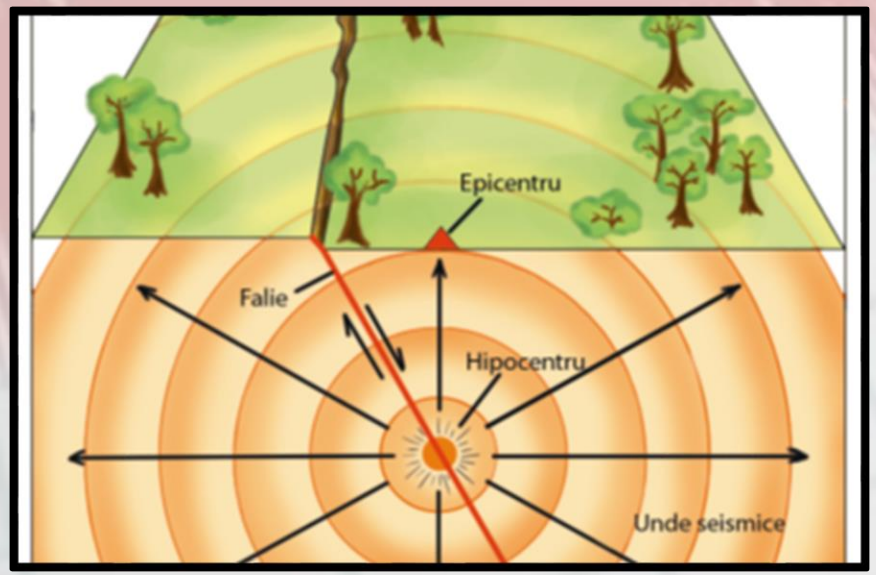
What are earthquakes?

An earthquake (or seismic activity) is a natural phenomenon characterized by the sudden release of energy accumulated in rocks, energy that is transmitted in the form of seismic waves that cause, among other things, ground movement.

The mechanism for producing earthquakes is explained by the fact that when rocks begin to come under pressure, they initially bend like a spring, resisting the force from the opposite direction. When the pressure becomes too great, the rocks yield and break at the most vulnerable point, and the rest of the bent rocks return to their original shape.

The rupture zone becomes a fault and the suddenly released energy generates an earthquake.

According to the United States Geological Survey, more than three million earthquakes occur on Earth each year, resulting in more than 8,000 earthquakes per day, or one every 11 seconds. While some earthquakes are not felt by humans, others have devastating effects.



The causes that lead to earthquakes

The causes that lead to the occurrence of earthquakes can be:

- ***natural***:
  - **tectonic: due to the tensions inside the Earth (90% of earthquakes on the Globe);;**
  - **volcanic activity (7% of earthquakes on the globe);**
  - **meteorite impact;**
  - **the collapse of underground caverns;**
- ***artificial***:
  - **explosions;**
  - **mining operations (mining, excavations, etc.)**
  - **filling of reservoirs.**

Internal causes (from inside the Earth) are the most common, the movement of tectonic plates being the main cause of earthquakes and they occur especially at the separation limits between them (plate margins).

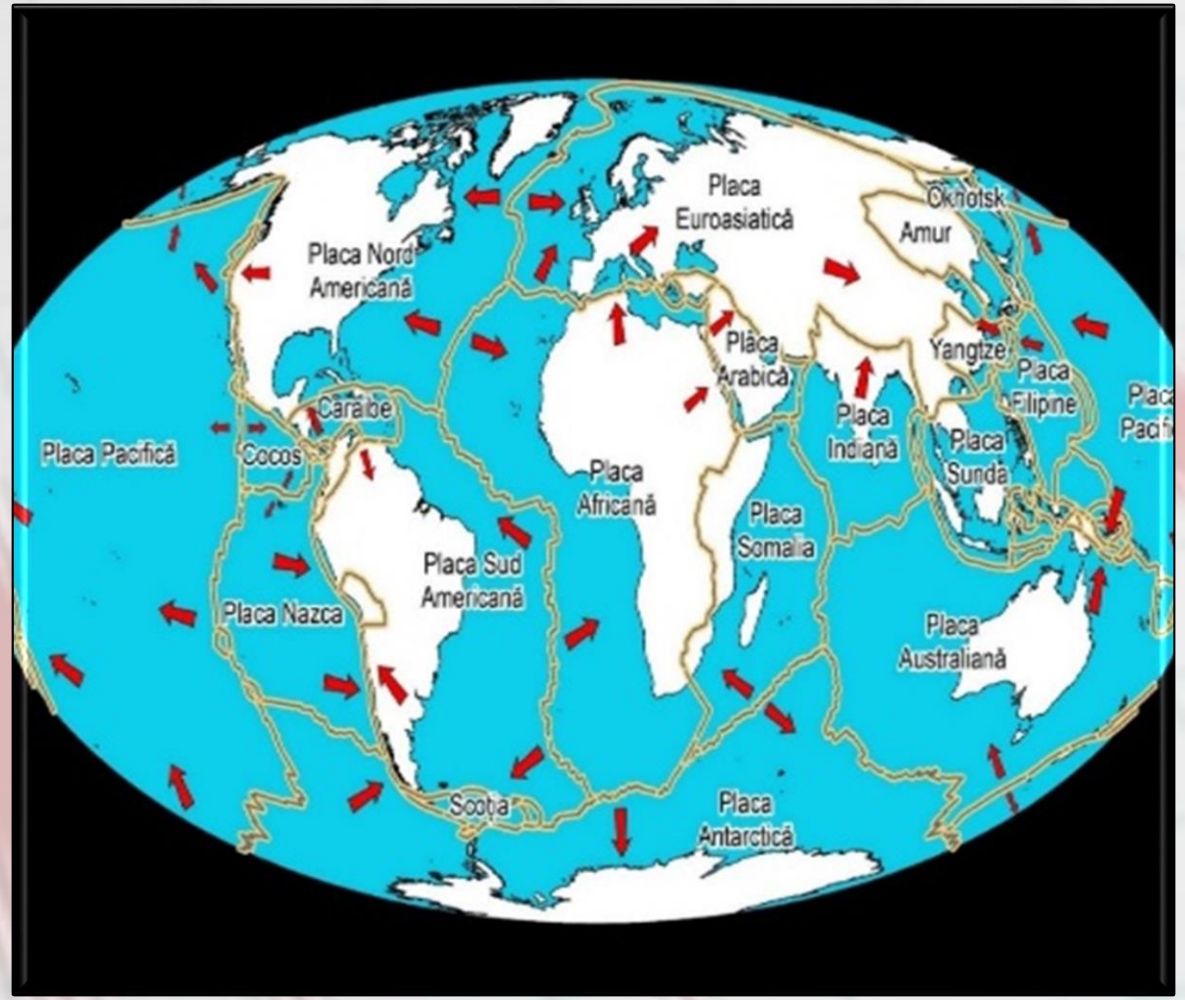
In the case of convergent movements of two tectonic plates and especially in subduction processes, enormous stresses are created. When stress relief occurs, earthquakes occur.

Depending on the direction of movement and the density of the tectonic plates, the edges between them can have very different characteristics, being:

- **divergent edges - encountered at the interaction between two plates moving away from each other;**
- **convergent edges - where two plates collide: example of the Himalayas, formed by folding:**:

- **transformed edges - found in areas where plates slide past each other (subduction zones);**
- **transition zones - regions of interaction between the plates, for which it is not possible to clearly define the type of movement of the plates that separate them, nor can the surface on which it lies be clearly defined.**

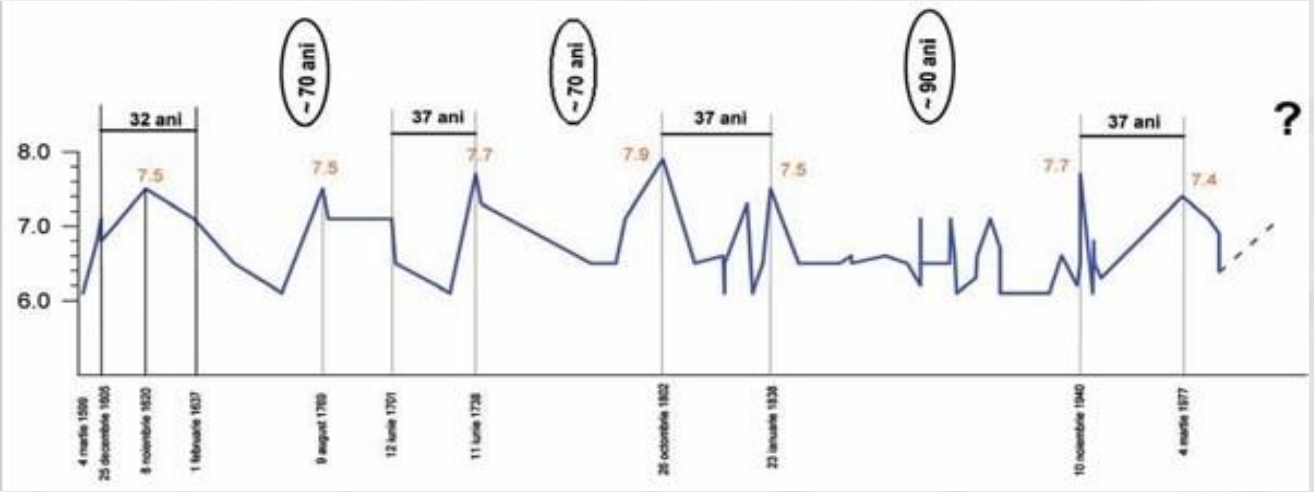
Given the positioning of our country at the intersection of three continental tectonic plates, the risk of earthquakes is an element of vulnerability for Romania.



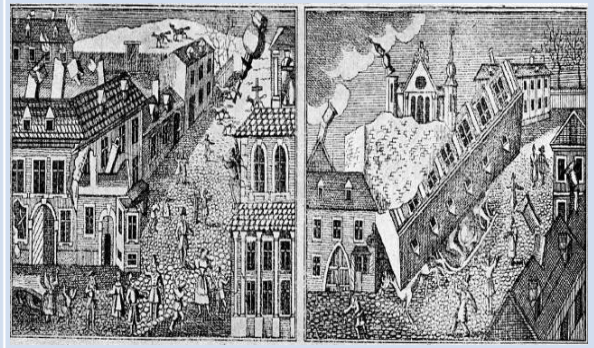
The Vrancea area in Romania is the intersection of three tectonic plates, out of the 7 globally – the Eastern European plate, the Intra-Alpina sub-plate and the Moesic sub-plate.
Because of this and given the way seismic waves propagate, the possible effects are not uniformly felt throughout Romania. They are stronger in Moldova and the Romanian Plain, while the areas affected by shallow earthquakes are in Banat, Crisana, Maramureș, Făgăraș, Târnave.

Earthquake risk affects our country unevenly.

Statistical data and the history of earthquakes in Romania prove a certain cyclicity of major seismic phenomena in the Vrancea area, which may indicate that there is a risk of a large earthquake occurring in the near future.
The history of earthquakes in the Vrancea area shows that high-intensity earthquakes in Romania have occurred, on average, about 3 times per century.
The seismic history of the country was marked by 4 major earthquakes, which occurred in 1802, 1838, 1940, 1977.



26 octombrie 1802 (14 octombrie pe stil vechi) - magnitudinea cuprinsă între **7,9 și 8,2 grade pe scara Richter**. Cutremurul a ținut **2 minute și 30 de secunde** și a fost resimțit intens pe o arie geografică extrem de vastă, de la Sankt Petersburg până în insulele grecești din Marea Egee (Insula Creta), de la Belgrad până la Moscova. Cutremurul principal a fost urmat de o **serie de replici**, cea mai mare având o **magnitudine de 5.5 grade**.	Este cel mai puternic seism vrâncean, considerat cel mai puternic cutremur consemnat vreodată în România și unul dintre cele mai puternice din istoria europeană. Seismul a avut loc *cam la o oră după prânz* (12.55 ora locală), când lumea tocmai ieșise de la slujbe din biserici. În București multe clădiri au căzut. Celebră a fost prăbușirea Turnului Colței, ridicat cu peste 8 decenii înainte, care s-a rupt de la mijloc, iar partea superioară a căzut pe caldarâm, cauzând moartea unui negustor ambulant. A răsturnat turle de biserici și a cauzat prăbușirea mănăstirii Cotroceni. În Bulgaria, orașele Ruse, Varna și Vidin au fost aproape complet distruse. Forța cutremurului a crăpat ziduri până în nordul îndepărtat, în Moscova.
23 ianuarie 1838 **ora locala 20h45min**, a avut loc un cutremur vrâncean major cu efecte catastrofale mai ales în centrul, Sudul și Estul Munteniei, dar și în regiunea Buzău-Râmnicu Sărat-Focșani (unde s-au constatat fenomene geomorfologice specifice, crăpături, țâșniri de apă etc.). Seismul este cotat ca **al doilea cutremur major catastrofal** produs în Vrancea în cursul secolului al XIX-lea; magnitudinea estimată a fost de **7,3 grade pe scara Richter**, iar intensitatea maximă a fost de **IX** grade pe scara Mercalli. Cutremurul a fost urmat de mai multe replici moderate, resimțite inclusiv la București. Cutremurul din **1838** a fost un seism major cu focar la **90-110 km** adâncime și a fost resimțit pe o arie foarte largă, dar cele mai mari distrugeri au fost consemnate în Muntenia.	La București, cutremurul a avut o **manifestare de tip multi-șoc**, cu cel puțin 3 mișcări consecutive însoțite de zgomote ca niște "șuierături". Numeroase case au fost distruse sau avariate, mai ales cele șubrezite de cutremurul vrâncean anterior din **1829**. Se menționează zeci de victime (bilanț oficial). Numeroși oameni au fost surprinși în case de sobele prăbușite. Cutremurul s-a produs într-o seară foarte geroasă. În Moldova, **în urma unei alunecări de teren produse în Carpații Orientali în regiunea Bicazului, s-a format Lacul Roșu (lac de baraj natural).** Alunecarea de teren a fost declanșată de acest cutremur vrâncean major. Mișcarea seismică a mai fost resimțită și în afara României, inclusiv în Ucraina, Peninsula Balcanică, Turcia.



On November 10, 1940, the strongest earthquake in Romania's recent history occurred, at 3:39 a.m., with a magnitude of 7.4 on the Richter scale. The earthquake had its epicenter in the Vrancea area, at a depth of 133 kilometers. The earthquake had devastating effects in the center and south of Moldova, but also in Muntenia and caused over 1,000 dead and 4,000 injured, most of them in Moldova.
Because of the context in which it occurred, the number of victims was never known precisely, as the information was censored during the war.
The earthquake was also felt in Bucharest, where it caused the death of approximately 300 people, most of them due to the collapse of the Carlton block, an 8-story reinforced concrete structure, very modern at the time. Many other blocks in Bucharest were considerably damaged.

After the earthquake, the General Association of Romanian Engineers undertook a detailed study of the effect of the earthquake on reinforced concrete buildings, reaching the conclusion that the calculation rules for the construction of reinforced concrete buildings, practically copied from the German ones, did not provide for the calculation of seismic forces, Germany not being located in a seismic risk zone.

Bucharest – earthquake from 04 March 1977

✓ The earthquake of March 4, 1977 with a magnitude of 7.2 degrees on the Richter scale occurred at 9:22 p.m., had devastating effects on Romania in approximately 56 seconds, its violence being recorded both vertically and horizontally, in the direction north-south and east-west.

✓ The epicenter was in the Vrancea area, at a depth of about 110 km. All seismic stations around the globe, on reception, detected the earthquake, the first to catch, process and analyze the information received following the earthquake was the one from Golden - Colorado (United States).

✓ The destructive energy released by the earthquake was equal to that emitted by 10 atomic bombs of the type dropped on Hiroshima.

✓ Post-earthquake studies have shown that the earthquake was multi-shock in nature: there were at least 4 main shocks at different depths along the rupture plane, which is estimated to have a perimeter of 30 by 60 km.

✓ Although there were several seismometers in Romania at the time of the earthquake, only one of them was able to correctly record the entire seismic movement - the one at the INCERC station in Bucharest (Pantelimon district); the maximum acceleration value recorded at ground level was 2.069 m/s.

✓ The worst consequences were recorded in the southern part of the country, especially in the Capital, where 33 buildings and blocks of high or medium height were destroyed, among them being old buildings built in the pre-war period, but also three new buildings (block OD16 in the Militari neighborhood, the block on Ștefan cel Mare-Lizeanu and the Computing Center of the Ministry of Transport).

The earthquake of March 4, 1977 was the most destructive earthquake on the territory of Romania in the 20th century, according to INCD specialists for Earth Physics, it caused 1,578 victims, of which 1,391 were in Bucharest alone.

Across the country, there were approximately 11,300 injuries, 32,900 homes collapsed or were severely damaged, and 35,000 families were affected.

Most of the material damage was concentrated in Bucharest, where more than 33 buildings and large blocks collapsed.

The disaster produced by the earthquake in Romania generated losses estimated by the World Bank at 2.048 billion USD.

More than half of the losses were in housing, the equivalent of 5% of GDP at the level of 1977.

70% were in Bucharest (1.4 billion USD).

Blocul OD 16 – Cartierul Militari

Blocul Dunărea

The strategic and public policy framework (1)

As a member of the UN, Romania has undertaken the implementation of the objectives in the field of disaster risk management established at the level of the United Nations Organization, as well as the policies and programs on this line developed at the level of NATO, the European Union and other international or regional bodies and organizations to which it is a part. However:

The implementation at the national level of the obligations assumed at the international level, especially through the Hyogo Framework for Action (for the period 2005-2015) and that of Sendai (the period 2015-2030) has only been partially achieved during the last 10 years.

There are **significant gaps in the strategic planning process and deficiencies in inter-agency coordination** in the application of the main strategies affecting the entire earthquake risk management system.

The strategic and public policy framework (2)

The activity of the National Platform aims at the following directions of action:

- ❑ knowledge and awareness of the types of risk and their effects;
- ❑ increasing the risk management capacity of public administration authorities by supporting inter-institutional collaboration and the involvement of all interested factors;
- ❑ encouraging investments in structural and non-structural measures to reduce the risk of disasters and increase resilience;
- ❑ strengthening the training of the intervention forces, in order to ensure an effective response at all levels.

- ❑ The Sendai Framework for Action is also in line with the targets set under SDG 11 "Sustainable cities and communities" for reducing seismic risk and building resilient cities.

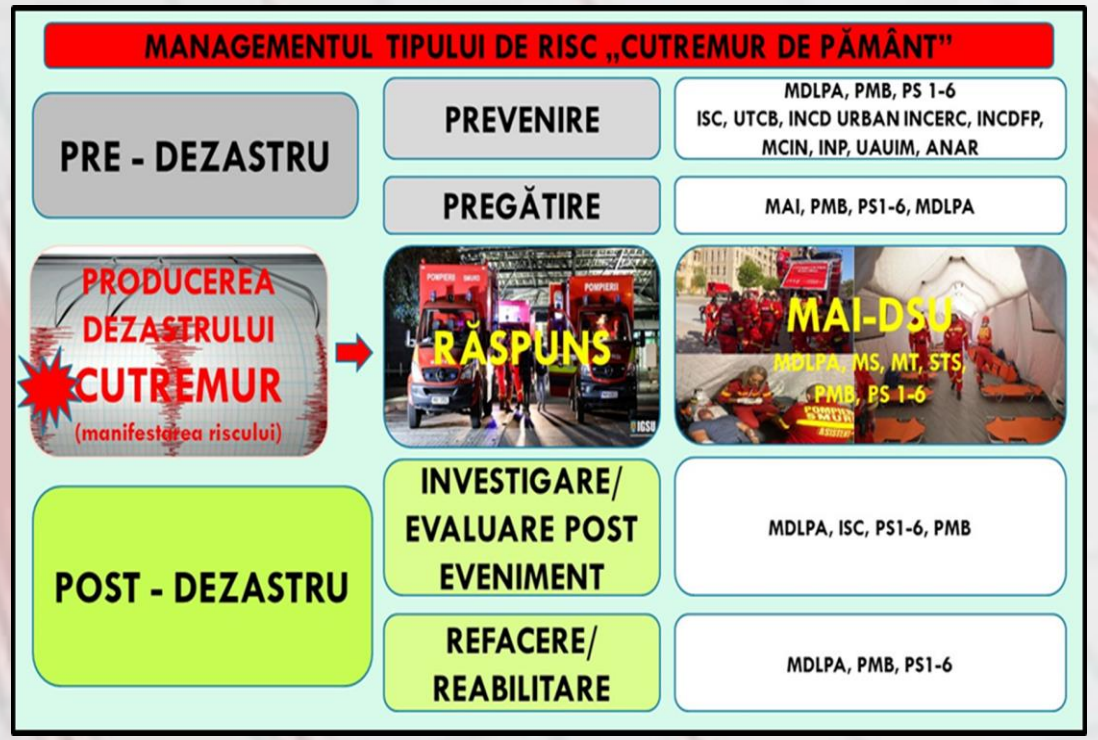
The implementation of the Sendai Action Framework is carried out through the National Platform for Disaster Risk Reduction (PNRRD)

- ➢ **The National Platform for Disaster Risk Reduction** was created by GD no. 768/2016 as a multi-sectoral national body with an advisory role in establishing strategies and programs regarding disaster risk reduction
- ➢ **The national emergency prevention strategy (**developed by the Ministry of Internal Affairs and approved by GD no. 762/2008) constitutes the main policy document that defines public order and safety and formulates the priority directions of action for emergency situations.
- ➢ **The national civil protection strategy,** approved by GD no. 547/2005, defines the strategic directions, but has not approved a Plan of measures for implementation**.**

General operational framework

In 2016, the Government of Romania adopted a Government Decision by which it regulated the management of risk types, which implies:
- identification of risk types and associated risks,
- establishing the responsible authorities, by risk type,
- establishing the areas of action of the responsible authorities, for prevention, preparation and response to the event and restoration/rehabilitation of the situation, as well as
- distribution of support functions.

The operationalization of the policy in the field of seismic risk management is carried out in 5 levels, also regulated in the national legislation, structured on the 3 phases of a disaster.



1. Prevention - Measures to identify, evaluate and reduce risks in case of emergency situations

2. Preparedness - Prior measures and actions to ensure response and recovery capacity

3. Answer - Operative intervention actions to limit and remove the negative effects of the emergency situation, until the provisional state of normality is restored

4. Investigation/evaluation - Establishing and quantifying the effects, causes and circumstances that led to the occurrence of the emergency. Assessment of the safety level of buildings.

5. Restoration/rehabilitation - Measures and actions to restore the state of normality planned, prioritized and carried out following the investigation/evaluation stage and urban reconstruction according to the restoration plans developed in the preparation stage

General distribution of findings

Most of the findings focus on the stages of prevention and preparation drawing attention to their deficient character.

Most findings are related to the record of the built fund.

In the case of the response, investigation/assessment, and recovery/rehabilitation stages, most findings are related to the resources required for operationalization and the functioning of alert and warning systems.

The strategic framework related to restoration/rehabilitation is the key point for returning to the state of normality. The effects of strategic deficiencies are in this case amplified by the deficiencies of the general legislative and institutional frameworks.

CURTEA DE CONTURI A ROMÂNIEI

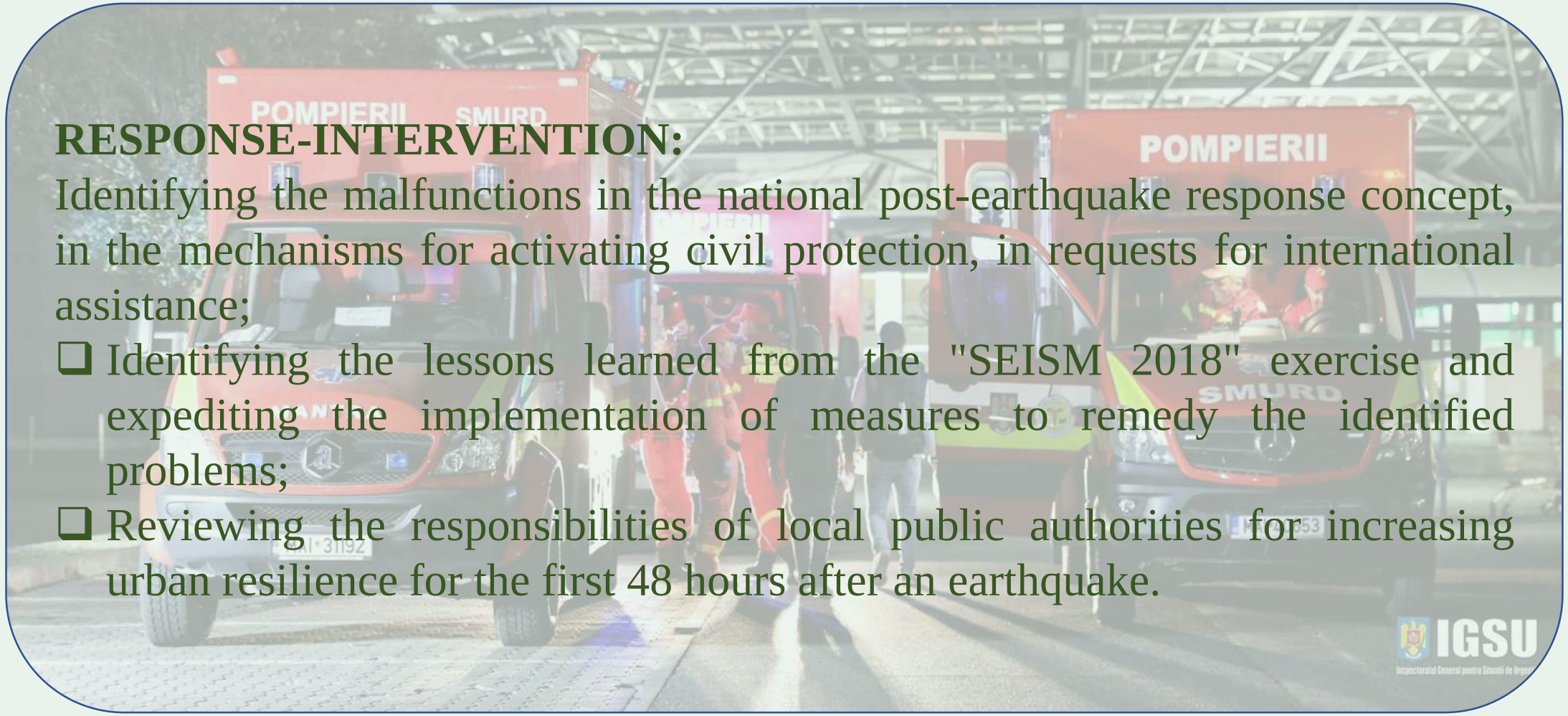
DEPARTAMENTUL XI

PREVENTION-PREPARATION:

- Large number of buildings included in seismic risk classes, especially old buildings, included in the List of historical monuments;
- The National Program for the consolidation of buildings classified in seismic risk classes was carried out with difficulty - it is necessary to identify sustainable and accelerated mechanisms to improve the performance of the seismic risk reduction program, in order to accelerate progress in the implementation of the National Program for the consolidation of buildings classified in classes of seismic risk, of railway bridges, bridges and road passages, dams;
- Reduced degree of responsibility of designers, contractors, project verifiers, technical construction experts, site managers and technical managers with construction execution;

PREVENIRE-PREGĂTIRE:

- Absența unei strategii a municipalității de reziliență seismică;
- Grad redus de conștientizare și pregătire a populației privind riscul seismic;
- Personalul autorităților responsabile cu atribuții în domeniul situațiilor de urgență este insuficient pregătit pentru situația producerii unui cutremur major;
- Resursele de intervenție sunt incomplete - este necesară asigurarea bazei materiale și tehnicii utilizate în intervenția operativă;
- **Nu există hărți de micro-zonare** a hazardului seismic în municipiul București **cu valoare normativă** benefică pentru obținerea hărților de risc seismic;
- Sistemele de monitorizare seismică sunt insuficient dezvoltate, de asemenea Rețeua Națională Seismică;



RESPONSE-INTERVENTION:

Identifying the malfunctions in the national post-earthquake response concept, in the mechanisms for activating civil protection, in requests for international assistance;

- ❑ Identifying the lessons learned from the "SEISM 2018" exercise and expediting the implementation of measures to remedy the identified problems;
- ❑ Reviewing the responsibilities of local public authorities for increasing urban resilience for the first 48 hours after an earthquake.

Response

The response stage represents 9% of the total findings.

The "National post-earthquake response concept" identifies serious effects to which the authorities and the population will have to respond, such as: :

- ✓The collapse/serious damage of homes with effects on the population (deceased, injured and injured persons) and some public utility buildings;
- ✓the overburdening of the medical system although qualified first aid will also be provided through the regional or national mobilization of SMURD crews, the problem of ensuring the necessary stocks of blood, sanitary materials and medicines;
- ✓ possible damage to IT, telecommunications and transport infrastructure;
- ✓the negative effects on essential public utilities: water, gas, energy, sewage system, communications, heating agent, possible fires/explosions; and so on.

The financial and human resources needed to ensure optimal post-earthquake response are insufficient and reduce response capacity.

Current legislation does not provide an effective framework for earthquake response in relation to requisitionable assets – it requires a high level of endorsement/approval which can cause major delays.
Starting from 2016, "SEISM" type exercises are held annually.

National exercises have a positive effect as they aim to identify the vulnerabilities and problems that the authorities could face in a disaster with the aim of solving them, to enable the institutions/authorities and all the decision makers or forces involved to work integrated or to correct malfunctions.

Conclusions and recommendations

For each stage of the seismic risk management process, from prevention to restoration, the management system in this area has numerous deficiencies.

The integrated performance audit report summarizes more than 300 findings in this regard.

160 recommendations were made for the performance audit actions.

Measures to prevent crisis situations and civil protection, anti-seismic preparation of the population and the authorities, consolidation of technically expertized constructions and classified in seismic risk categories are a national security issue.

The main deficiencies found in the seismic risk management system were also confirmed by the points of view assumed by the management of DSU and MAI.

Prevention is the weakest link in the chain of seismic risk management stages!

Preparing the population and institutions to deal with the disasters produced by a major earthquake is an area where efforts have not been made in recent years.

Responsiveness largely depends on ensuring an integrated system of collaboration between the various institutional structures.

Thank you for your attention!