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ADRISEISMIC

OUTPUT 2.2:
ACTION PLAN
FOR THE REGION OF CRETE

WPT2 – Establishing the ADRISEISMIC methodology for the reduction of seismic vulnerability

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Definitions & Acronyms

Acronym	Full name
CA	Consortium Agreement
PP	Project Partner
LP	Lead Partner
WPT	Technical Work Package

Executive summary

Earthquakes severely threaten the Adriatic-Ionian region. Each nation has created policies, guidelines, tools, and knowledge to address earthquake risks and lessen the built environment's seismic vulnerability. However, they continue to be high in metropolitan regions, especially in historical centers.

An earthquake is a natural disaster brought on by a natural occurrence and is likely the main factor in human fatalities and material object destruction. Disasters with a swift onset, frequent occurrence, and no previous warning are brought on by earthquakes. The preservation of cultural heritage and the sustainable development of the historical-socio-economic core of the settlements, therefore, suggest that the protection of cultural assets of historic urban centers is required and essential.
The remarkable density of cultural heritage components is Region of Crete's settlements defining characteristic. All the major cities of Crete, as well as a large percentage of the inland settlements (villages etc) each have preserved ancient urban cores that serve as markers of the region's identity and as the backbones of its local economies. Having said that, the breadth of effects of potential seismic activity would be catastrophic on numerous levels. The execution of steps to lessen the consequences of earthquakes and to improve community readiness in the event of their occurrence are of the utmost importance because earthquakes cannot be prevented.

The Local Action Plan is the result of the effort done to share information with local stakeholders and highlight best practices through three rounds of local workshops. Based on their knowledge, the participants engaged in a thorough conversation and offered helpful comments, proposals, and counsel. Additionally, workshop attendees acknowledged a high level of satisfaction with the demonstrated techniques and newly given material. All of the feedback will be used as motivation to improve methods for addressing and securing the decrease of seismic vulnerability of the Region of Crete's historic centers and historic settlements

The goal of this Local Action Plan (LAP) is to compile information already available and feedback from community workshops into concrete steps that will effectively protect and conserve cultural items located in the Region of Crete ancient urban areas. To address the protection and preservation of cultural heritage in times of crisis through an integrated approach, it is crucial that all stakeholders continuously communicate with one another and work together during the activities' definition, implementation, and subsequent monitoring of implementation. This multi-sectoral approach helped the LAP be successfully drafted, and it will have a positive impact on activities to enhance knowledge in the relevant field and reduce seismic risks through decentralized disaster management organizations.

The Local Action Plan is the outcome of the work done on transferring the knowledge and highlighting good practices to local stakeholders achieved through three series of local workshops. Based on their expertise, the stakeholders engaged in a substantive discussion providing invaluable suggestions, proposals and advice. Stakeholders expressed their satisfaction about the displayed methods and presented content of the workshop. Good Practises of other Adriseismic partners will also be presented in the Local Action Plan.. In defining the activities, their implementation and subsequent monitoring of implementation, it is important to continuously communicate between all stakeholders and to cooperate together in order to deal with the protection and preservation of cultural heritage in crisis situations through an integrated approach. Such multi-sectoral approach contributed to successful drafting of the Action Plan and will result in a pro-active reduction

of seismic risks through decentralized disaster management institutions and in boosting activities on developing new knowledge and making advancements in the respective field

1 Introduction and methodology

The ADRION area is heavily subject to natural hazards and Europe, in particular, is the area with the highest seismic vulnerability. It is due not only to the severity of earthquake events, but also to the high level of exposure and to the important value of the Cultural and Natural Heritage, confirmed by a large number of UNESCO World Heritage Sites and UNESCO Geoparks. When it comes to the seismic vulnerability assessment and risk management, the area lacks homogeneous and comparable normative and policies as well as shared methods for the expeditious assessment of buildings. In addition, the skills and knowledge of all the actors involved in the seismic retrofitting process are not enough detailed and comprehensive to face the complexity of the thematic. Facing all these challenges is in general important in order to tackle seismic vulnerability, but it is especially urgent if the focus is about cultural heritage and historic centres since these areas are particularly prone to seismic risk and, at the same time, they are the socio-economic cores and symbols of identity of the ADRION area.

Given all the considerations above, ADRISEISMIC project aims at developing new integrated approaches to innovate and harmonize the normative, technical and training frameworks in the ADRION area, providing ready-to-use methods, tools and procedures that will be integrated into the existing policies and practices, thus strengthening local responses and reducing vulnerability to natural hazards.

Within WPT1, relevant seismic norms, urban planning laws, building regulations, incentives, post-earthquake planning, and insurances policies have been collected in the six countries partner of the project and analysed in depth (Activity T1.1). The detailed knowledge has been systematized in order to identify good practices for reducing seismic vulnerability and enhancing resilience of historic areas. Good practices have been described through a factsheet with the aim to describe it in detail and let all the partners understand whether and how it is possible to replicate the good practices in their countries.

Besides the work carried out in WPT1, in the second WPT (Activity T2.2) the ADRISEISMIC expeditious assessment methodology has been developed for both masonry and reinforced concrete buildings. The two factsheets have been conceived to be compiled by a technician in less than ten minutes after the collection of the basic information necessary for the assessment of the building.

In WPT3 efforts have been made to improve the knowledge and skills of all the actors involved in the seismic retrofitting process and three training packages have been developed addressing the target groups of practitioners, building workers and civil servants. A toolkit for volunteers has been also conceived and developed. In fact, in the initial part of the project a lack of targeted training courses has been detected in all the project partners countries.

All the above-mentioned activities generate knowledge at project level. A first step towards the tailorization of the general knowledge to the various local context is represented by the roadmaps. These are strategic documents conceived within the activity T1.2.2 as a step-by-step procedure to undertake in order to improve the seismic norms, urban planning laws, building regulations, post-earthquake planning documents and procedures, incentives and insurance framework in respect to seismic vulnerability of the built environment and historical centres. Each country involved in the project has drafted its own roadmap, besides the institutional role of the representing partners (e.g. public authorities, higher education, private companies) aiming at identifying a strategic pathway to increase its resilience towards the seismic risk.

A further step is then undertaken by local and regional authorities involved in the consortium. They have the role to embed it in their policy instruments some of the project results, establishing priorities among the possible actions and based on the specific territorial needs. To this aim, the Municipality of Gjirokaster and the

City of Kaštela developed a local action plan, while the Region of Crete and the RDA Bačka are responsible for the action plan at regional scale.
Action plans represent instruments for public authorities to clearly define and explain the way to integrate and adapt some of the promising good practices and/or the new expeditious seismic vulnerability assessment methodology into the current local practices, thus enhancing their replicability and scalability in the Countries involved in the project but also beyond. The structure of the action plans reflects a process to be followed by municipalities and regions in order to identify priorities among all the possible strategies identified at project level to increase the resilience of the historical areas and provide as much details as possible in this regard. In this way it is possible to verify the effective concreteness and feasibility of the actions selected by the authorities in charge of the implementation. The methodology also foresees a series of local workshops to involve key stakeholders to take decisions on what to insert in the action plan.
The process starts from the identification of the territorial context and the specific needs of the region/municipality, followed by the presentation of the overall and specific objectives of the plan. A specific chapter has been then dedicated to the identification of the key stakeholders that was involved in the above-mentioned workshops and their specific role in the process. The last part of the document is about the description of the specific actions identified as priority to improve resilience of historical areas while reducing the vulnerability of the existing assets, together with the timeframe of implementation and the identification of possible risks and the corresponding mitigation actions to undertake. Each measure is described in detail, starting from the identification of specific objectives and specific activities foreseen for the implementation, the timeframe, main stakeholders to involve and beneficiaries of the action. Attention is also paid to the means for monitoring of the implementation phase.
In the following chapters the action plan for the Region of Crete is presented.

2 Territorial context

Crete is the largest and most popular of the Greek islands, the 88th largest island in the world and the 5th largest island in the Mediterranean Sea, after Sicily, Sardinia, Cyprus, and Corsica. Crete rests approximately 160 km (99 mi) southern of the Greek mainland. It has an area of 8,336 km2 and a coastline of 1,046 km (650 mi). It bounds the southern border of the Aegean Sea, with the Sea of Crete (or North Cretan Sea) to the north and the Libyan Sea (or South Cretan Sea) to the south. Crete and a number of islands and islets that surround it constitute the Region of Crete which is the southernmost of the 13 top-level administrative units of Greece, and the fifth most populous of Greece's regions

The island has an elongated shape: it spans 260 km (160 mi) from east to west, is 60 km (37 mi) at its widest point, and narrows to as little as 12 km (7.5 mi) (close to Ierapetra). Crete covers an area of 8,336 km2 (3,219 sq mi), with a coastline of 1,046 km (650 mi); to the north, it broaches the Sea of Crete ; to the south, the Libyan Sea in the west, the Myrtoan Sea, and toward the east the Carpathian Sea. It lies approximately 160 km (99 mi) south of the Greek mainland.

Crete is mountainous, and its character is defined by a high mountain range crossing from west to east, formed by the following groups of mountains: The White Mountains or Lefka Ori 2,454 m , the Idi Range (Psiloritis) 2,456 m , Asterousia Mountains 1,231 m , the Dikti Mountains 2,148 m

The island has a number of gorges, as well as three large plains. A large number of islands, islets, and rocks hug the coast of Crete. Many are visited by tourists, some are only visited by archaeologists and biologists. Some are environmentally protected.

Crete lays between two climatic zones, the Mediterranean and the North African, mainly falling within the former. As such, the climate in Crete is primarily Mediterranean. The atmosphere can be quite humid, depending on the proximity to the sea, while winter is fairly mild. Snowfall is common on the mountains between November and May, but rare in the low-lying areas. While some mountain tops are snow-capped for most of the year, near the coast snow only stays on the ground for a few minutes or hours. The south coast, falls in the North African climatic zone, and thus enjoys significantly more sunny days and high temperatures throughout the year. There, date palms bear fruit, and swallows remain year-round rather than migrate to Africa.

Region of Crete is based at Heraklion, the capital city of Crete, and is divided into four regional units From west to east these are: Chania, Rethymno, Heraklion, and Lasithi. These are further subdivided into 24 municipalities. Heraklion is the largest city and capital of Crete, holding more than a fourth of the island's population.

Figure 1: Map of Crete

2.1 Regional factsheet

2.1.1 Socio-demographic indicators

According to the 2021 Census, there are 617.360 inhabitants in the area of the Region of Crete. These are distributed between the major cities of the island, according to the following (expressed in Population - population density)

- Heraklion : 177.064 inhabitants – 115 ps/km2
- Chania :53.910 inhabitants – 65 ps/km2
- Rethymno :32.468 inhabitants – 56 ps/km2
- Ierapetra :16.139 inhabitants – 29 ps/km2
- Agios Nikolaos 12.638 inhabitants – 42 ps/km2
- Sitia : 14.338 inhabitants – 23 ps/km2

The above-mentioned population is mainly concentrated near the islands coast, where are the above cities are located. The inland is characterized by a large network of small villages with a small number of inhabitants, that fluctuates around the year.

The permanent population of Crete was 623.000 inhabitants according to the 2011 census, thus causing a decrease in the island's population.
Tourism offers a vast fluctuation in the islands population, since during the touristic season (April – October) the population of the island increases rapidly due to overseas and native visitors. The large number of visitors brings out the necessity of developing infrastructure that can meet their needs (road network, etc). On the other hand a large number of the visitors, as opposed to the natives, has never experienced a large earthquake, making their briefing concerning the threat of earthquakes a necessity.

2.1.2 Traffic connections

Crete is connected to the rest of Greece via plane and ships. There are three significant airports ,Heraklion, Chania and Sitia, with the first two to be the largest and more popular. A new airport is currently being constructed in the province of Heraklion, with the intention to replace the Heraklion airport.
The main ports are those of Heraklion and Chania (Suda Bay) Via these, most of the goods and people are transferred to the rest of the country. Smaller ports (e.g. Rethymno, Agios Nikolaos and Sitia) also exist, with lesser naval movement.
In the inner part of the island, a large road network exists in order to connect all the cities villages and other settlements or touristic sites. The quality of the road network is characterized as medium to low. The main national highway that crosses the island from east (Sitia) to the west (Chania) was designed decades ago, and currently it cannot withstand the traffic load necessary especially during the summer period. A new highway is planned to be constructed in the near future
Railway service is absent in Crete.

2.1.3 Economy

The regional economy is specialized in economic activities linked to the agricultural sector (19.4% of employment), tourism and trade (35.4% of employment). Based on Gross Production Value, tourism and trade account for 35% of economic activity, agriculture 9%, manufacturing/energy and construction 9% with real estate management approaching 10% (up from 8% in 2005). Tourism and a significant part of agricultural and manufacturing production are aimed at international markets.
The structure of exports confirms the sectoral specializations of the regional economy with some significant differences. Crete's exports consist mainly of primary products (59%) while manufacturing (30%) strengthens its position mainly due to the strong local plastics industry (15%). In addition to the aforementioned economic activities in which Crete specializes, Research and Technology is a strong pillar of development, as the Region has significant educational and research potential, which contributed substantially to its economic development and can enhance to a greater extent the development of productive areas of the island. During the period 2000 – 2008, the region accounted for 7.8% of the national GERD. Regional GERD represented 0.95% of regional GDP, a percentage that exceeds the national average (0.6%) and is one of the highest in Greece.

2.1.4 Cultural and natural heritage

The strategic position of Crete at the crossroads of the ancient Mediterranean civilizations was the main reason for the constant claim of the island by various occupiers. Traces of each occupier are scattered everywhere on the island and are deeply engraved in the customs of the Cretans.
Crete is the birthplace of the first European civilization, the Minoan, which flourished between 3000 BC and 1200 BC mainly in Central and Eastern Crete. Even today, the majestic palaces of Knossos, Phaestus, Malia,

Zakros, Tylissos, Arhanes, Monastiraki, Galatas, Kydonia and the luxurious mansions at Agia Triada, Zominthos, Amnisos, Makrigialos, Vathipetro and Nerokouros reflect the splendor of the Minoan civilization through architectural, pottery, jewelry and painting masterpieces.

The imposing Minoan palaces and the rest of the constructions developed between 2000 BC and 1400 BC. Around 1700 BC, the Minoan cities were levelled by an unverified factor, probably the eruption of Santorini volcano. The palaces were rebuilt, but the destruction of the large Minoan centers by the Mycenaeans around 1400 BC was the starting point for the decline.

During the classical and Greco-Roman empire

the "island of a hundred cities", as recorded by Homer, gradually came to the fore. Knossos became the administrative center again and new impressive cities were developed, such as Hierapytna, Itanos, Axos, Praesus, Sivrytos, Dreros, Rizinia, Tripitos, and many others.

When the Roman Quintus Caecilius Metellus undertook the conquest of Crete in 69 AD, the capital of the island was moved to Gortys, which later became the capital of the senatorial province of Crete and Cyrenaica. The city still impresses with the remains of the baths, theaters, stadium, hippodrome, citadel and temples. It was served by the ports of Matala, Lassea and Levena (current Lendas).

The prosperity of Christian Crete under the protection of the Byzantine Empire was fiercely interrupted by the Arabs in 824 AD. The new occupiers of the island converted Candia, today's Heraklion, to a base for their pirate raids in the Mediterranean Sea.The Byzantines eventually managed to liberate Crete in 961 AD.

After the Occupation of Constantinople by the Fourth Crusade in 1204, Venetians became the new masters of Crete until 1669. During this that period, Crete experienced a great economic and spiritual development, despite the revolutionary activities of local population. Large cities were reconstructed, adorned with imposing monuments and fortified with massive walls.

In the 17th century, after the Ottomans stabilized the possession of Constantinople, they targeted new conquests. Crete soon came to the center of their expansionist policies, because of its strategic position in the Mediterranean.The Ottomans managed to occupy the cities of Chania in 1645 and Rethymnon in 1646.

On December 1st, 1913, Crete officially united with Greece, fulfilling the century-long dream of Cretans. The political personality of Eleftherios Venizelos from Chania, who was later to become the Prime Minister of Greece, came to the fore.

All the above have left their architectural footprint in Crete, with many historic buildings, old parts of cities bearing evidence of the civilizations that affected them

2.2 Description of the need(s) to be addressed

As well known, Greece is located to the edge between two lithospheric plates , the Eurasian and the African plate. The collision of the two plates and the subduction of the African plate under the Eurasian plate, thus giving birth to a large number of earthquakes of significant magnitude

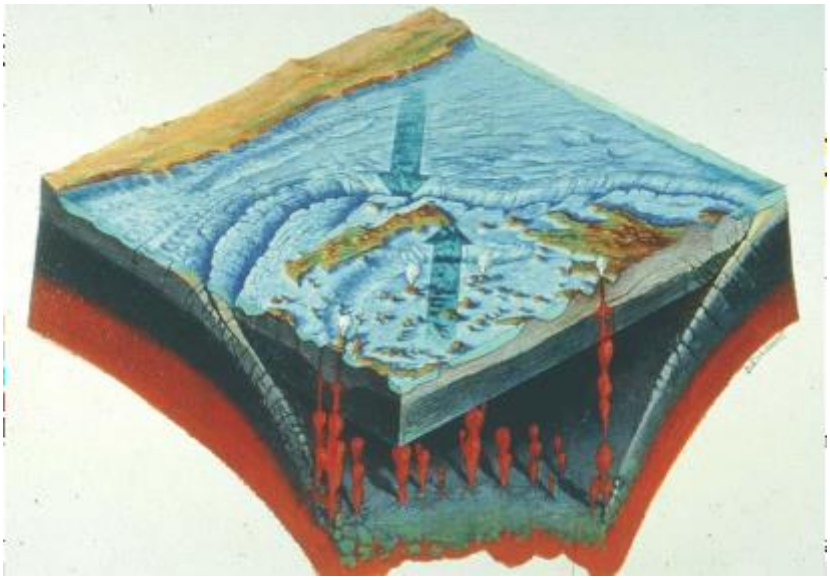

Figure 2: Subduction zone east of Crete

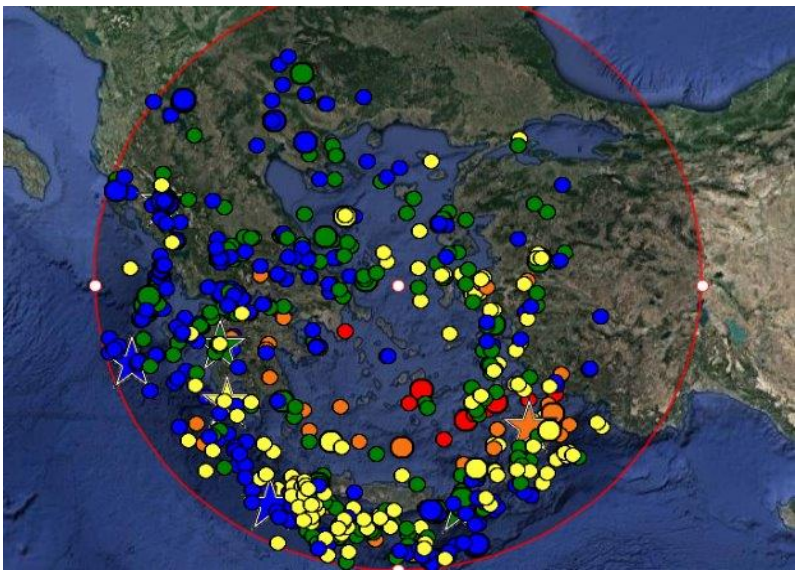

Figure 3: Earthquake epicenters of the past 20 years in the area of Greece

Greece is first between EU countries and sixth in the world regarding the seismic energy released annually Below is a table that demonstrates the highest magnitude earthquakes in history around Crete.

- 62-66 AD Western Crete, M=7
- 365 AD Western Crete, M=8,3
- 448 AD South Crete, M=7,2
- 1236 AD Western Crete, M=7
- 1303 AD Rhodes, M=8
- 1494 AD Heraklion, M=7,2
- 1508 AD Ierapetra, M=7,5
- 1604, 1612 AD Heraklion, M=7
- 1665, 1673 AD Heraklion, M=7
- 1780 AD Ierapetra, M=7
- 1810 AD Heraklion, M=7,1
- 1856 AD NE Crete, M=7,8
- 1926 AD Rhodes, M=8
- 1956 AD Amorgos, M=7,5

From the above table it is easily conducted that the whole of Crete is highly threatened by a high magnitude earthquake. Even recently, in September 2021 an earthquake of M:6,0 occurred in Arkalochori, Heraklion with significant damages in buildings infrastructure and 1 death. The earthquake was preceded by a long series of pre earthquake shocks during the summer 2021 and was also followed by a large number of after shocks till today (see Figure 4 below).

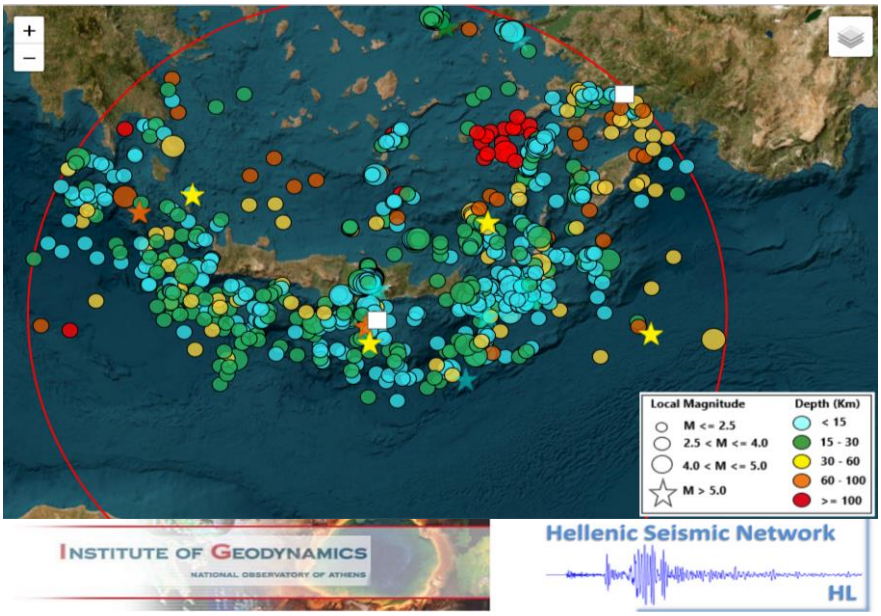

Figure 4: Greek seismic risk map (according to the expected ground acceleration)

The above situation has led the Greek state to form a very high level anti-seismic code for building construction, thus making modern buildings able to withstand a large earthquake finding a link between earthquake magnitude and the spatial distribution of the sensed ground movement (ie intensity) and mechanical vulnerability on buildings is essential. The initial stage is to assess the potential extent of damage to various building types at various earthquake magnitude levels. The degree of damage can be estimated by taking into account the mechanical resistance and the extent of damage to buildings.
Since the history of Greece though the ancient years till today is connected to earthquakes, the Greek state has imposed preliminary anti – earthquake actions, in three axes:

1. Civil protection preparation
2. Construction guidelines against earthquake,
3. Short-, medium- and long-term rehabilitation of people and infrastructure affected by an earthquake.

Greek Earthquake Planning and Protection Organization (EPPO) has issued a map depicting the foreseen ground acceleration due to an earthquake in the whole of Greece. Crete lays in zone II, where the expected ground acceleration during an earthquake is 0.24g.

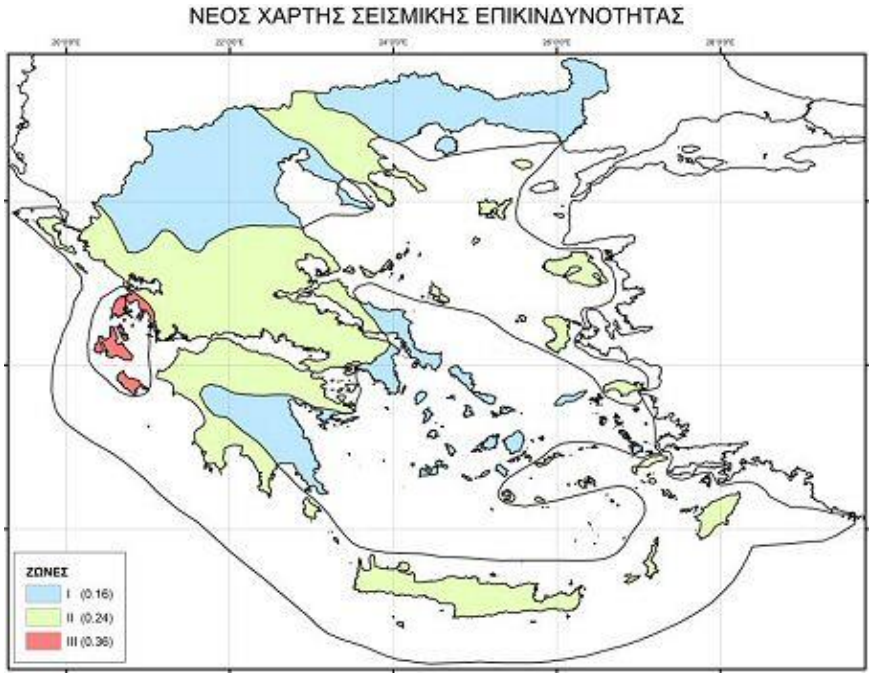

Figure 5: Greek seismic risk map (according to the expected ground acceleration)

Thus, civil engineers and civil protection official possess many tools against earthquakes.

The implementation of measures to lessen the effects of earthquakes and of those connected to the community's readiness in the event of its occurrence are of the utmost importance because earthquakes cannot be prevented.

The vulnerability of a settlement is determined by the style of residential building construction and the density of the people. Is it possible to make a preliminary assessment of a set of buildings' seismic resistance by knowing when they were built, since according to their age of construction, different materials appear in their skeleton, like timber, wooden beams, concrete, mansonry etc.

Historic buildings may sustain damage from earthquakes for a variety of reasons, but in most of the cases, these reasons and circumstances are related to the original architectural features, alterations made to the building, prior negative events, lack of maintenance, improper interventions, etc. The effects of earthquakes on cultural heritage items are severe, especially when it comes to damage to the inside of preserved cultural heritage items as well as to the physical state and look of buildings, timber and metal structures, and artifacts. Along with the state and type of the foundation soil, the position or orientation of the building with respect to seismic wave direction is also crucial. Then, seismic activity of any kind can lead to issues with a building's construction, including relocating specific components, weakening retaining walls due to the potential for plaster to fall off the walls, rising floors and other units, and decreasing the stability of the entire building.

The needs of Region of Crete to be addressed in this Action Plan, and in the future are:

- Better knowledge of the total seismic vulnerability of a historic settlement (city or village). By the term “total” what is meant is the ground expected movement during an earthquake, as well as the specific seismic vulnerability of the building, according to its building material and characteristics;
- The economic assessment of the seismic rehabilitation process, preferably focused on each historic building block, so as the municipality can have an estimate of the total rehabilitation cost of the area, and forward it to the central state;
- Higher awareness of the historic building owners / managers, ie the knowledge of the risk of using a historic building that has not been seismically reinforced, and to produce emergency plans tailored to the specific building.

2.3 Overall and specific objectives of the plan

The above mentioned conditions, create a very demanding action plan, including the following main objectives:

- Provide an expeditious assessment method in historic buildings, combine it with existing methods, and validate it by testing in construction industry
- Raise state awareness regarding financing private historic building restoration against earthquake impact.
- Raise public awareness regarding the necessity of seismic reinforce of heritage monuments in urban areas.
- Enhance the importance of earthquake civil protection plans in historic urban areas.
- Incorporate outcomes of ADRISEISMIC in State's official norms/ guidelines
- Inform all the scientific unions (engineers, contractors, construction workers) about the project's outcomes

3 Stakeholders involved through the workshops

While developing the Local Action Plan, four local workshops with significant local stakeholders were arranged, with the objective to engage relevant stakeholders and obtain their feedback related to different project components.

The stakeholders involved through the workshops come from the public, private, and civil sectors. These are mostly the administrators or managers of a specific cultural heritage item, who are responsible for, among other things, organizing protection and rescue operations and promptly contacting all pertinent services that must be involved. Rescue efforts for cultural heritage should involve operational forces operating in the City as well as managers of cultural assets, since they are outfitted with the equipment and tools required to carry out specific operational actions. The civil protection headquarters, firefighting operational forces, associations crucial to the civil protection system, civil protection units and commissioners, and site coordinators are the most crucial operational forces for saving cultural heritage

The main stakeholders involved in the project are:

Type of stakeholders involved in the event	Municipality of Rethymnon
	Municipality of Heraklion
	Municipality of Chania
	Municipality of Agios Nikolaos
	Red Cross
	Technical Chamber of Greece, Easter Crete branch
	Technical Chamber of Greece, Western Crete branch
	Civil protection of the Region of Crete
	Fire Departments
	Hellenic Police
	Polytechnic University of Crete, Chania
	Earthquake Planning and Protection Organization

Stakeholders specific involvement in the project	
Municipalities of Chania, Rethymno, Heraklion, Agios Nikolaos	The municipalities are decision makers in matters like the emergency plans and affected local communities by an earthquake. They are also beneficiaries of central government decisions, like urban and special planning rules. They can also form and perform their own tactics regarding earthquake consequences anticipation policy i.e local emergency plans, finance local microzonation study etc
First Responders: Local Fire Department, Hellenic Police	First responders are crucial to the elaboration of emergency plans conducted by the other local entities
Volunteers: Red Cross	Volunteers also play a crucial role in the anticipation of earthquake consequences in the pre earthquake stage, as well as during the post earthquake stage.
Non-Governmental Institutes: Technical Chamber of Greece, Easter and Western Crete branch, Earthquake Planning and Protection Organization	Technical Chamber of Greece, as o consultant of the Greek State in technical matters, plays a key role in the formation of the anti-seismic policy in terms of building, urban and special planning Laws and regulations, as well as in terms of formation of emergency plans and local municipality actions and policies.
Scientific Institutions: Polytechnic University of Crete	The Polytechnic University of Crete, Chania and especially the School of Architecture can offer significant assistance to the scientific results of the project

Table 1: Stakeholders involved in the local workshops and their role in the project

4 Actions and timeframe

4.1 Actions

4.1.1 Action N. 1

Action name	Common Seismic Vulnerability estimation tool
Specific objective of the action	The specific objective of the action is to produce the most suitable seismic vulnerability estimation tool,
Brief description of the action	The specific objective of the action is to produce the most suitable seismic vulnerability estimation tool, so as an engineer can rapidly evaluate the seismic vulnerability of a building. Greek Earthquake Planning and Protection Organization has produced a procedure named "*Framework for pre-earthquake monitoring of public utility buildings*" It can also be applied on private buildings. The objective is to combine this tool with the ADRISEISMIC methodology of rapid seismic vulnerability assessment of RC and mansonry buildings, thus producing a valid seismic vulnerability estimating tool available for field engineers
Specific activities foreseen for the implementation of the action	1. To compare this tool with existing tools, like the primary earthquake vulnerability estimation method of EPPO (Earthquake Planning and Protection Organization). EPPO is currently comparing the ADRISEISMIC method with its own evaluation method, though testing it in school buildings that have already been evaluated by EPPO 2. To provide the existing tool to relevant scientific groups(Universities, Institutes etc) for their opinion 2. To validate this tool by testing it in the field, via selected applications 3.To form a widely accepted seismic vulnerability estimation tool, which, via the above steps, will be audited for its applicability on every (or certain) type of buildings 4. To make it available among stakeholders, practitioners and the rest relevant experts
Reference to the policy instruments in WPT1	**Seismic norms** - Eurocode 6, 8 **Building regulations** - KANEPE, KADET **Seismic incentive framework** Framework for pre-earthquake monitoring of public utility buildings
Reference to the Good Practice in WPT1	**Guidelines for the evaluation of seismic vulnerability of buildings (**GP_14-SIF_5.2_IT.pptx)
Implementation timeframe	2023 - 2028
Means for monitoring the implementation	Presenting the field scanning results to the stakeholders through organized lectures/workshops
Main stakeholders involved and their roles and contribution	**Region of Crete and/or Local Municipality**: application of the experimental tool on public building **Technical Chamber of Greece:** coordination and expert support
Beneficiaries	Governmental entities and governmental – nongovernmental institutions
Indicative funding sources	EU, Recovery and Resilience Facility, This European Territorial Cooperation), Multiannual Financial Framework

4.1.2 Action No2

Action name	Economic incentives for historic building restoration
Specific objective of the action	The specific objective of the action is to provide financial incentives to the historic building managers to renovate and seismically reinforce their building
Brief description of the action	A major problem for Greece and particularly for Region of Crete is the costs involved in the process of renovating and reinforcing a historic building. Many such buildings are left to collapse due to the lack of economic ability of the owners. Such buildings also have a large vulnerability due to an earthquake. Economic incentives towards that direction on behalf of the state would form a framework in which, the managers of historic buildings would be able to finance the restoration process. The economic incentive could be in the form of bank loan with low or no interest rate, tax reduction, etc. This action could also solve another problem anticipated in historic building restoration: ownership. It is often the case that a historic building is under the ownership of numerous units – people, making it difficult to agree on a certain plan and offer financial participation on a conventional retrofitting process (by own economic means)
Specific activities foreseen for the implementation of the action	Greece is devided (by EPPO) into three (3) seismic risk zones, according to the ground acceleration expected during the earthquake. Moreover, microzonation studies (where performed) should give the state a clear picture of ground behaviour and possible risks (acceleration, liquefaction etc). According to the above results, the Greek State should decide which areas should be more affected after an earthquake, and define the zones in which buildings should be initially eligible. Further conditions to be taken into account, are: type and age of buildings, building importance (public or private), as well as maximum amount of finance per building. In order to obtain the aforementioned goals, it would be more effective, if primary data was collected through regional / local scale. **Downscaling** the analysis of seismic vulnerability (along with action 5), allows the clarification of geotectonic circumstances and the adaptation of intervention measures, to the particular needs of each territory. After having collected the required data, and having defined the local vulnerability zones, Regional Governance will upscale seismic protection demands officially to the national government. This way, priority to restoration incentives will be given to specific areas, following the local documented vulnerability research.
Reference to the policy instruments in WPT1	**Seismic norms** - Eurocode 8 **Building regulations** - KANEPE, KADET **Concrete and Steel Building Regulation**
Reference to the Good Practice in WPT1	**Sismabonus - national incentives for seismic retrofit of buildings** (GP_13-SIF_5.1_IT.pptx) – developed for cultural buildings as well
Implementation timeframe	2023 - 2028
Means for monitoring the implementation	Presenting the field scanning results to the stakeholders through organized lectures/workshops. Actions will be held firstly at regional / municipal level, and conclusions from such interaction will be addressed subsequently at national level.

Main stakeholders involved and their roles and contribution	**Greek State** – coordination, monitoring and financing of the progress **Region of Crete and/or Local Municipalities**: applications **Technical Chamber of Greece:** coordination and expert support **Banks** **Association of insurance agencies of Greece**
Beneficiaries	Historic building owners, inhabitants being threatened by security and Civil Protection issues
Indicative funding sources	EU, Recovery and Resilience Facility, European Territorial Cooperation), Multiannual Financial Framework NOTE: a financial tool called "PRESERVE" is already designed by the Ministry of Environment, to save the country's preserved building stock from being abandoned. The action will be financed from the Recovery Fund with a budget of **200 million €.** The program, ensures public safety since many of the buildings are outdated and dangerous, due to financial inability of their owners to maintain them. For the 9.300 cases recorded all over the country, hopefully the ADRISEISMIC outcomes, will be of high importance, when implementing interventions within this framework.

4.1.3 Action no. 3

Action name	Seismic microzonation survey
Specific objective of the action	The specific objective of the action is to perform a thorough microzonation survey
Brief description of the action	Seismic microzonation surveys can detect ground characteristics and performance during an earthquake, thus defining down to very detailed scale, the ground seismic performance, and transferring it to the type of buildings located in the specific area. Seismic microzonation uses geophysical, geotechnical and geological methods and surveys to survey the ground in which the buildings are founded, and resemble the earthquake movement. Seismic microzonation surveys should be obligatory to municipality level, mostly in the cities located in zone III and II of the Greek seismic vulnerability map. To date, such surveys have been performed in various cities, but are not obligatory by law to the municipalities.
Specific activities foreseen for the implementation of the action	- Performing field scanning (geological, geophysical geotechnical investigation and data collection, seismic scenarios, seismic vulnerability assessment of buildings according to their importance, seismic vulnerability assessment of building blogs in of a city, formation of emergency scenarios according to the city's peculiarities and population density etc) - These are usually conducted by universities, and the specific plan of the survey and the deliverables are formed in conjunction with the owner and beneficiary of the study - Presentation of the results to the local brunch of the Technical Chamber of Greece and the possible related stakeholders (state and/or local administration entities)
Reference to the policy instruments in WPT1	**Seismic norms** - Eurocode 8 **Building regulations**

	- KANEPE, KADET, EAK 2000, Steel And Concrete Manual
Reference to the Good Practice in WPT1	**Analysis of the local seismic risk as part of the Urban Plan Baseline Framework** (GP_09-UPR_4.1a_IT.pptx) **Seismic Microzonation (SM) foreseen in the Urban Planning Baseline Framework** (GP_11-UPR_4.1a_IT.pptx)
Implementation timeframe	2023 - 2028
Means for monitoring the implementation	Presenting the field scanning results to the stakeholders through organized lectures/workshops. Since some of the stakeholders (state central or local public administration entities) are also decision makers, they can adjust their seismic, urban and special planning policies according to the results of the microzonation study. The results can also be transferred to the Ministry of Infrastructure as well as the Ministry of Environment, in order to issue special urban and special planning provisions for certain areas of the specific city
Main stakeholders involved and their roles and contribution	**Greek State** – make seismic microzonation obligatory for a municipality **Local Municipality**: applications **Technical Chamber of Greece:** coordination and expert support / difuse the results among its members – engineers.
Beneficiaries	Local administration entities
Indicative funding sources	EU, Recovery and Resilience Facility, European Regional development Financial Framework

4.1.4 Action No 4

Action name	Raising public awareness
Specific objective of the action	The specific objective of the action is increase public awareness against earthquakes and their consequences.
Brief description of the action	The specific objective of the action is to inform various groups of the Greek society, especially the more vulnerable ones (Erdely, Disabled, under temporary medical treatment etc) about the direct and indirect consequences of an intense earthquake that may affect their province. The action should be offered at various levels of education providers (schools, civil protections entities, first responders etc) so as to be available to every societal group (disabled, schools, elderly, public and private companies stuff etc)
Specific activities foreseen for the implementation of the action	1. to access the needs for education on certain societal groups, as well as on general society. Certain groups may be the elderly, disabled, schools, special health care institutes (hospitals, private clinics etc). Also public and private companies employees, general public. 2. to locate possible educators (civil protection certified educators, school teachers, etc) 3. to form the education material and validate it in terms of quality and quantity 4. to define the education process (location, modality (face to face or distance) duration, education material, attendees) 5. to finance the procedure 6. to implement the education procedure and validate it through que questionnaires

	In the above procedure, existing platforms like the ADRISEISMIC Moodle Platform or other similar existing ones (EVANDE, CP Risk etc)
Reference to the policy instruments in WPT1	**Seismic incentive framework** - Guidelines for planning and execution of civil protection drills (2nd edition) - General Civil Protection Plan concerning earthquakes 1st edition, code name Engelados. - Law 4662/2020 "National Disaster Management Mechanism, reformation of General Secretary of Civil Protection, CP voluntary system and reform of the Fire Unit"
Reference to the Good Practice in WPT1	**"I don't take risks" - national awareness campaign for risk prevention and preparedness** (GP_14-SIF_5.3_IT.pptx)
Implementation timeframe	2023 - 2028
Means for monitoring the implementation	Monitoring of actions, evaluation of emergency drills, questionnaires
Main stakeholders involved and their roles and contribution	**Region of Crete and/or Local Municipality**: public campaign First Responders: school visits and demonstration of emergency actions **Ministry of Education:** incorporate natural disasters in school program **Universities**
Beneficiaries	General public, special groups, schools
Indicative funding sources	Greek State, Recovery and Resilience Facility,

4.1.5 Action No 5

Action name	**Providing Seismic Vulnerability Maps, through Crete Region's Geospatial Infrastructure (GIS Crete)**
Specific objective of the action	The specific objective of the action is to increase public awareness against earthquakes, as well as professional knowledge about regional seismicity.
Brief description of the action	The aim of the action is to inform any target group which is interested, about the recent seismicity in the island territory. This will be feasible, by providing shakemaps in several regional units, after every incident of low or high magnitude. This way, there can be produced (if needed) direct and indirect conclusions about the vulnerability of particular areas, contributing to the planning ahead The maps will be available to everyone who is interested, not yet defined if in an "open data" form, or provided on demand only to professionals and policy makers (in order to avoid citizens' anxiety deriving from data misinterpretation).
Specific activities foreseen for the implementation of the action	- Through a dynamic geospatial platform already developed by RoC, local shakemaps are provided, with data collected through a **seismological network of 14 stations**, installed in the main cities. - Shakemaps can be the baseline of creating new seismic **vulnerability maps** of cities of Crete and demarcate high risk areas, with historic buildings in them.

	- Along with the action of **register and digitize** the amount of historical buildings, there may be a combination of how many of them (and which in particular), are included in the high vulnerability zones, defined.
Reference to the policy instruments in WPT1	**Seismic Norms** - This tool will be beneficial for all of the subcategories, referring to seismic norms regulative processes.
Reference to the Good Practice in WPT1	No references in GP
Implementation timeframe	2023 - 2028
Means for monitoring the implementation	Monitoring will be feasible and constantly updated, through the Infrastructure Platform of Crete Region **GIS CRETE**. Visiting the website https://gis.crete.gov.gr/sdi/ and choosing the division of "Culture", someone can rapidly have an overview of vulnerability zones and by adding the layer of "historical buildings", can have their spatial distribution within these zones.
Main stakeholders involved and their roles and contribution	Region of Crete is the main provider of this opportunity and/or Local Municipalities that have already this infrastructure can interact and support. Ministry of Education. Ministry of Cultural heritage. Ministry of Digital Governance. Ministry of Infrastructure.
Beneficiaries	General public, professionals, special groups, schools, national and regional government, municipalities, chambers, universities, researchers, archeologists, cultural stakeholders, etc
Indicative funding sources	Greek State, Ministry of Environment, Ministry of Digital Governance, Crete Region

4.2 Risks and mitigation actions

Risk action no.	Actions involved	Description of the risk	Mitigation actions proposed
1	No. 1, 4	Insufficient finances for carrying out activities	EU funds
2	No. 1,2,5	Lack of adequate and proper IT equipment Lack of knowledge – lack of proper information about seismic vulnerability	Procurement procedure Training of citizens in targeted groups, depending on their expertise, job description or personal interests. The seismographs network will be adequately equipped and constantly updated, in order to deliver the most accurate data.
3	No. 5	If GIS Crete provides open data to general audience, there might be a false interpretation, leading to wrong decisions or increased anxiety from	Training of citizens in targeted groups, in order to acknowledge and discriminate the real danger, from false beliefs.

		citizens who live within high risk zones. It may also lead to decrease of the ….value of properties in these particular areas.	Keep data classified for internal use, only addressing to professionals or owners concerned. If anyone claims the right to access, this will be on demand.
4	No. 1, 2,4	Lack of skilled staff (operative level)	Economic incentives for experiences scientists to get involved. Attract scientists from abroad.
5	No. 1,4	Absence of public interest	Stronger and more dynamic campaign, sharing the benefits gained from such good practice and successful results
6	No. 1, 2, 3	Non-responsiveness of experts/professionals (at the level of local and regional self-government unit)	Economic incentives for experiences scientists to get involved. Attract scientists from abroad

4.3 Notes for recent Greek Regulatory evolution

Having engaged in the Greek project partners' study team, the Vice President of the Earthquake Planning and Protection Organization (EPPO) as an external partner, enables us to make a reference about the regulatory evolution actions, that have partly encountered Adriseismic considerations.
The regulatory evolution within the last year, is indicative referred below:

3.3.a. Government Gazette /3197/B/22-6-2022

The 3rd Revision of the state's Interventions Code (KAN.EPE.), is a complete legislation, scientifically modern, safe, economical, legally consistent and adapted to EC8, for interventions in existing buildings, which have been designed with older anti-seismic codes. (see table below)

$\alpha_g / \alpha_{g,ref}$	Structural performance levels			
	A "Immediate Occupancy after the earthquake" (A)	B "Life Safety" (B)	Γ "Collapse Prevention " (C)	Italian Classification
1.80	**A0**	**B0**	**Γ0**	
1.30	**$A1^+$**	**$B1^+$**	**$Γ1^+$**	
1.00	**A1**	**B1**	**Γ1**	**A^+**
0.75	**$A2^+$**	**$B2^+$**	**$Γ2^+$**	**≈A(0.80)**
0.60	**A2**	**B2**	**Γ2**	**B**
0.45	**$A3^+$**	**$B3^+$**	**$Γ3^+$**	**C**
0.35	**A3**	**B3**	**Γ3**	**≈D(0.30)**
0.25	**$A4^+$**	**$B4^+$**	**$Γ4^+$**	**≈D(0.30)**
<0.25	**A4**	**B4**	**Γ4**	**≈E(0.15)**

TABLE 3.3.a
Assessment objectives of the structure $\alpha_{g,ref}$ reference horizontal ground acceleration, defined with a probability of exceedance of seismic action of 10% within the conventional life cycle of 50 years (α_g horizontal ground acceleration)

3.3.b. Government Gazette 3134 21/06/2022

"Pre-earthquake vulnerability assessment of public use buildings" (EPPO). The program is recording the public use buildings in Greece and provides a first evaluation of their seismic risk, in order to identify priorities for further interventions.

Result of the inspection: is an "indicator" called "Priority Index λ" of the building, showing the degree of building inadequacy, and hence the priority for the 3rd phase (valuation studies, redesign & reinforcement).(www.oasp.gr).

Return Period (years)	Probability of exceedance of seismic action within the conventional lifetime of 50 years	δ	Seismic classification of Builidngs (K)
2475	2%	$1.80 \leq \delta$	K0
975	5%	$1.30 \leq \delta < 1.80$	K1+
475	10%	$1.00 \leq \delta < 1.30$	K1
225	20%	$0.75 \leq \delta < 1.00$	K2+
135	30%	$0.60 \leq \delta < 0.75$	K2
70	50%	$0.45 \leq \delta < 0.60$	K3+
40	70%	$0.35 \leq \delta < 0.45$	K3
20	90%	$0.25 \leq \delta < 0.35$	K4+
<20	>90%	$\delta < 0.25$	K4

3.3.c. The Code of assessment and retrofitting of masonry structures (KADET), was completed in 2022 by OASP Organization (https://www.oasp.gr/node/4145).

The aim is to establish assessment criteria of the structural capacity of existing masonry structures. The code regulates the redesign, after potential interventions (repairs or reinforcing), both for usual and historical buildings.

The code defines three potential performance levels of the structure:

Level A: Limited Damage

Level B: Severe Damage

Level C: Near Collapse.