HELLENIC MINISTRY FOR CLIMATE CHANGE AND CIVIL PROTECTION

Earthquake Planning and Protection Organization (E.P.P.O.)

Pre-earthquake vulnerability assessment of public use buildings in Greece

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Earthquake Planning & Protection Organization

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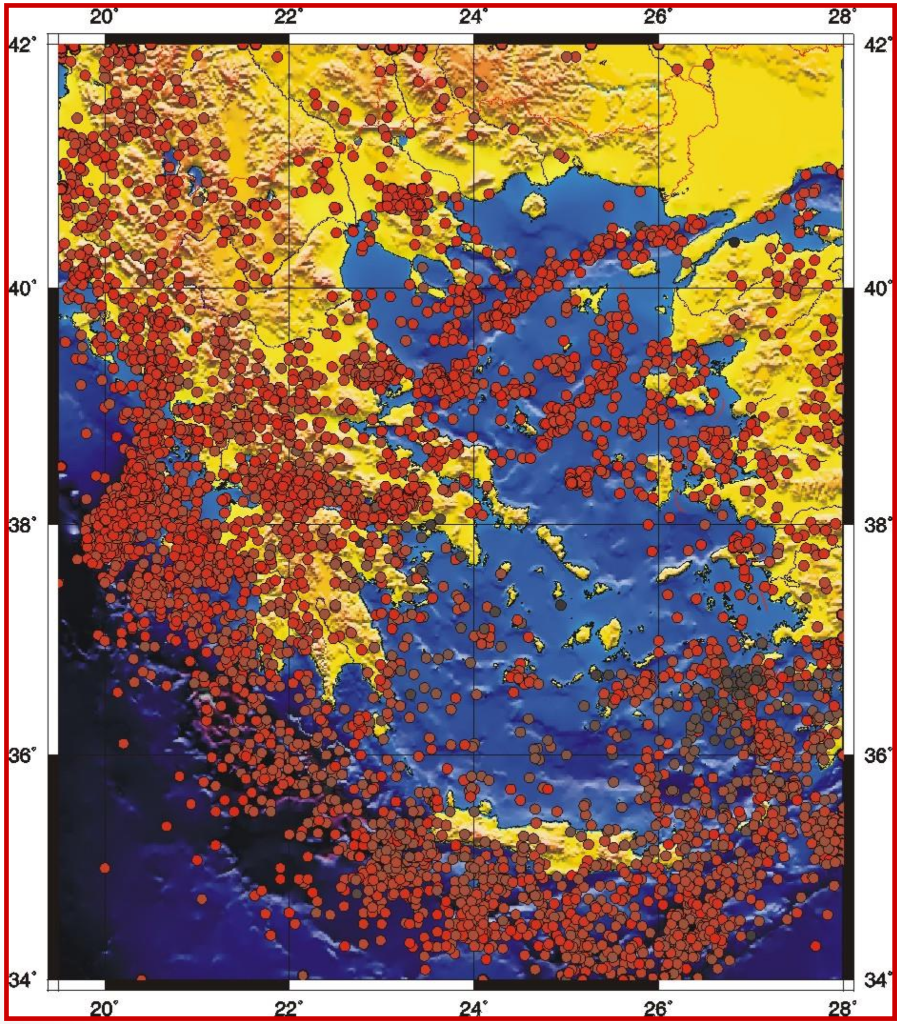
BEF 2021

Seismicity in Greece



The seismicity of Greece is the highest in Europe and the 6th globally.

Protection of structures against earthquakes

Strengthening seismic capacity of structures through Seismic Design Codes

EPPO assigns to relevant scientific committees the enactment of earthquake safety regulations and Seismic Design Codes harmonized with modern data in the sector of manufacturing of buildings, as well as the processing of special subjects relevant to seismic technology.

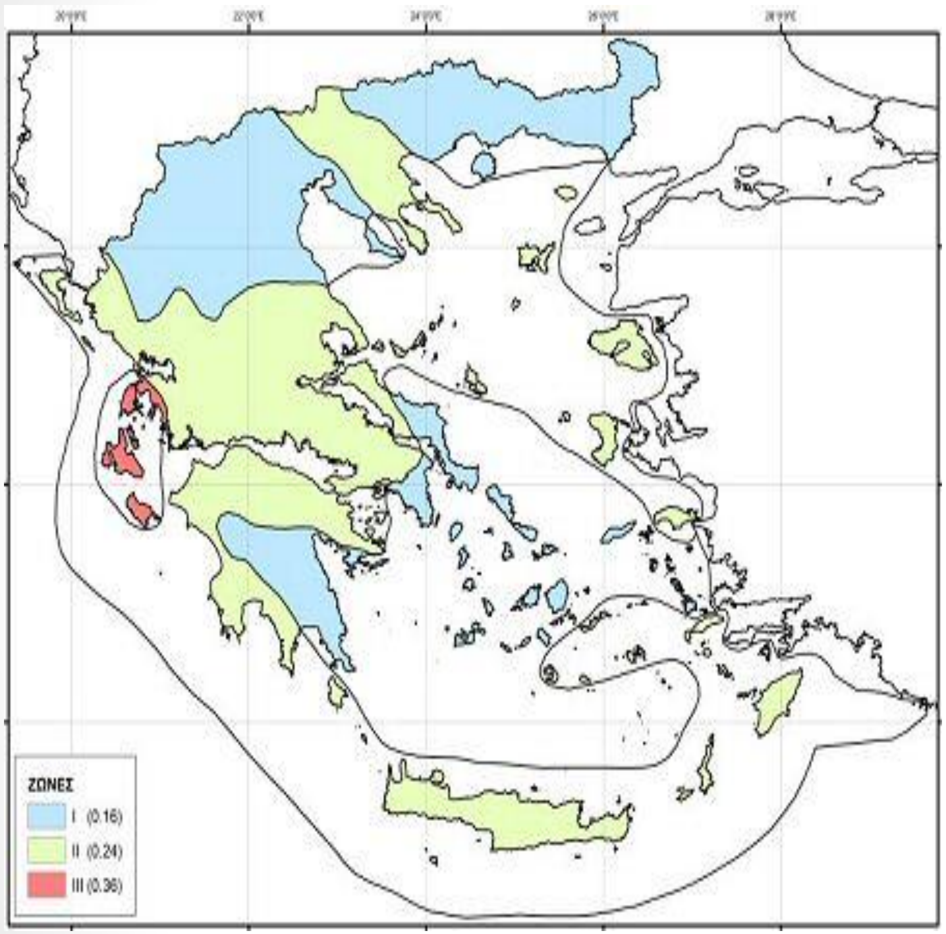
Seismic Design Code History in Greece

Years with significant updates in the seismic design

- **1959** First complete Seismic Design Code in Greece
  (Before 1959, regional seismic provisions)
- **1985** Updated version (taking into consideration soft story)
- **1995** New Greek Seismic Design Code (NEAK)
- **2000** Greek Seismic Design Code (EAK 2000)
- **2001** The Regulation of Concrete was replaced from the new "Greek Code of Reinforced Concrete EKOS - 2000"
- **2003** The Seismic Hazard map was replaced with a New Seismic Hazard Map
  (Reduction of the 4 Seismic Zones in 3)

Existing buildings are categorized in 5 main Construction Code Periods

New Seismic Hazard Map



p=10% T=50years

The Seismic Hazard Map of Greece is a result of the active faulting and the seismicity of the country that is continuously reassessed every time a strong EQ happens.

The new Seismic Hazard Map is part of the Greek Seismic Design Code (EAK 2000) updated in 2003 and the Greek National Annex of EC8-Part 1.

Max seismic ground acceleration:

A=a g

Zone I (a=0,16)
Zone II (a=0,24)
Zone III (a=0,36)

Seismic capacity of existing buildings

- ✓The seismic capacity of existing (old) buildings could never satisfy the requirements of modern Seismic Codes.
- ✓The fact that existing (old) buildings will inevitably show poor seismic behaviour when a major EQ strikes is a **big social problem**.
- ✓**Quantification of the problem is a necessity!**
- ✓The only way to quantify the problem is through numbers and statistics regarding the technical characteristics and the seismic performance parameters of the existing building stock.

Statistics on existing buildings

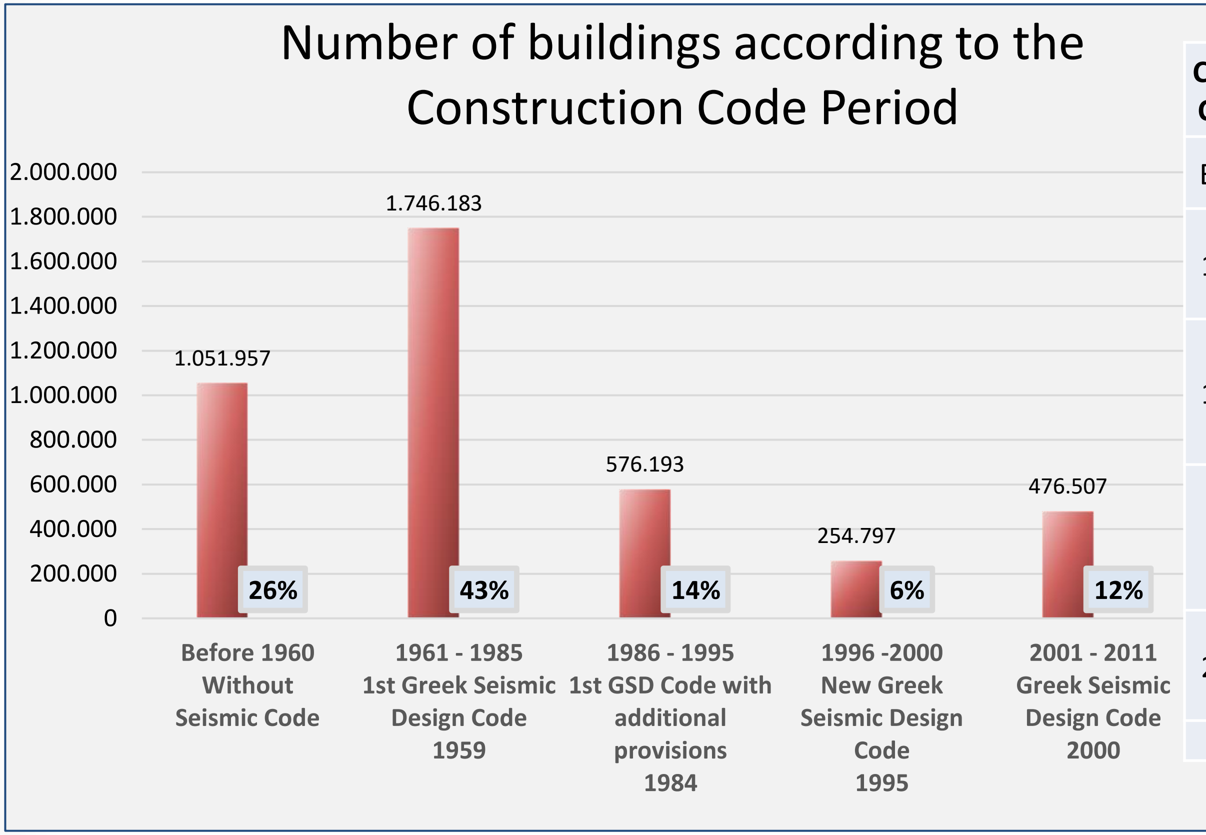
Statistical information acquired from the General Census of Buildings 2011 of the Hellenic Statistical Authority gives a general outline of the existing building stock.

Statistical parameters related to seismic performance of a building are:

- ✓ Construction period depicting the general technical know-how (construction techniques, scientific knowledge) at the time of construction
- ✓ Construction material of the structural system depicting the structural type of buildings
- ✓ Way of usage relating to the importance of its integrity during an earthquake for civil protection

Existing building stock

Hellenic Statistical Authority (ELSTAT) / General Census of Buildings 2011

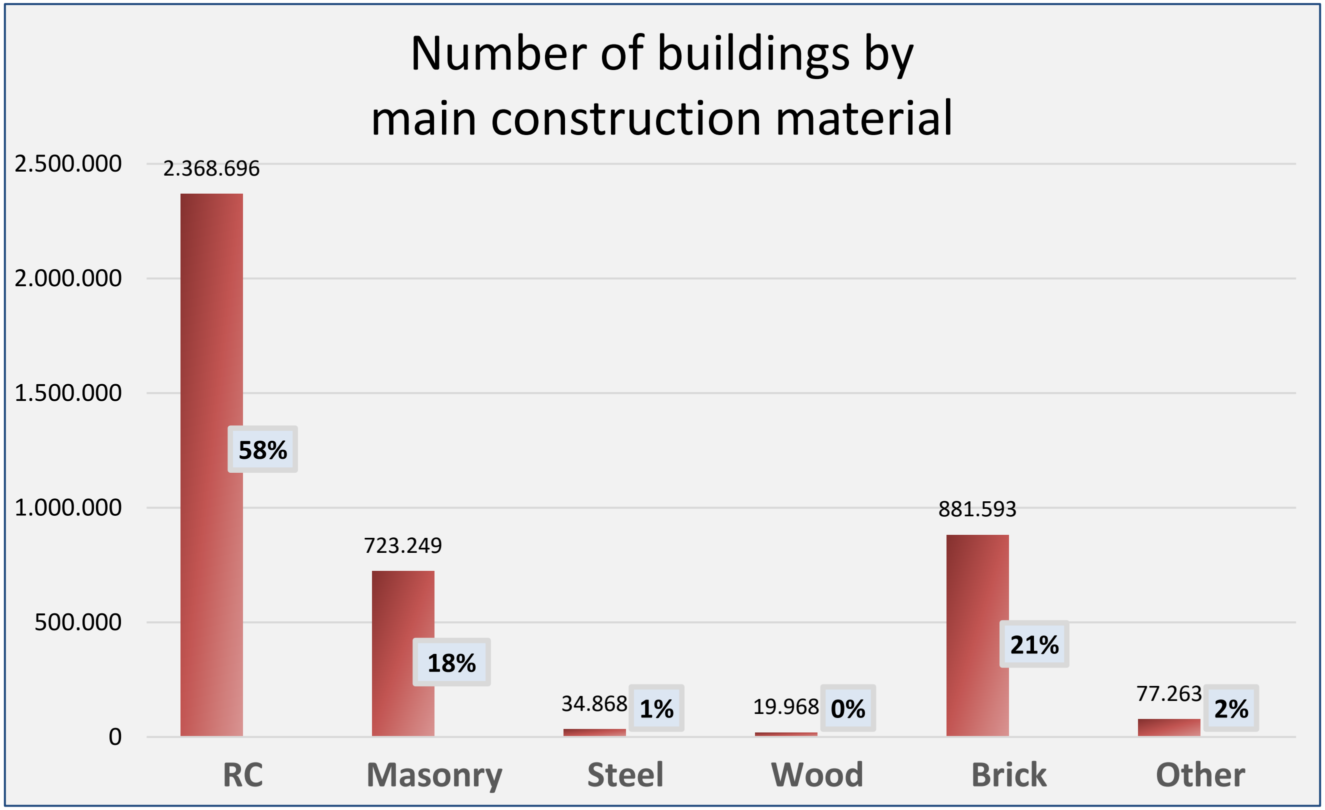


Construction Code Period	Seismic Design Code	Number of buildings
Before 1960	Without Seismic Code	1.051.957
1961 - 1985	1st Greek Seismic Design Code **1959**	1.746.183
1986 - 1995	1st GSD Code with additional provisions **1984**	576.193
1996 -2000	New Greek Seismic Design Code **1995**	254.797
2001 - 2011	Greek Seismic Design Code **2000**	476.507
	TOTAL:	**4.105.637**

The vast majority (**69%**) of the existing Greek building stock is built without modern Seismic Design Code.

Existing building stock

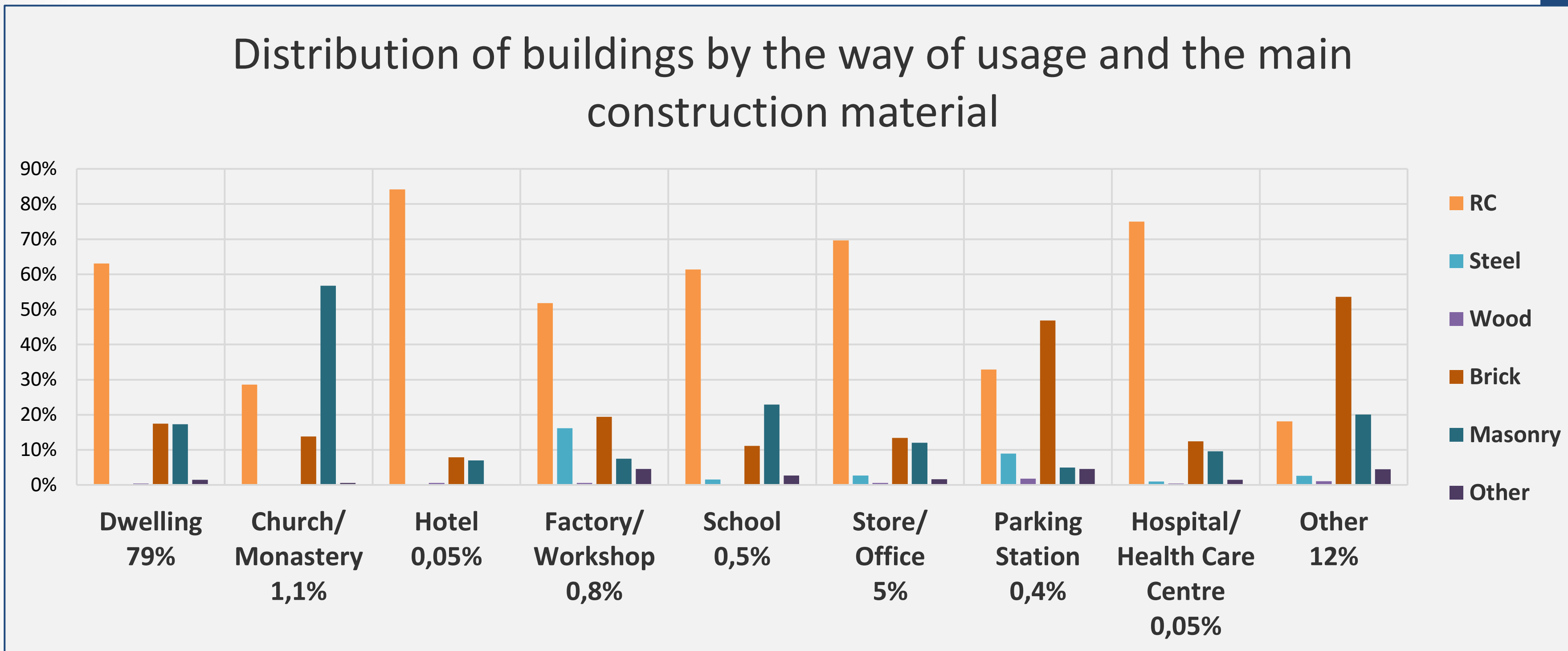
Hellenic Statistical Authority (ELSTAT) / General Census of Buildings 2011



The structural system of buildings in Greece is mainly of Reinforced Concrete (58%) and Stone or Brick Masonry (39%)

Existing building stock

Hellenic Statistical Authority (ELSTAT) / General Census of Buildings 2011

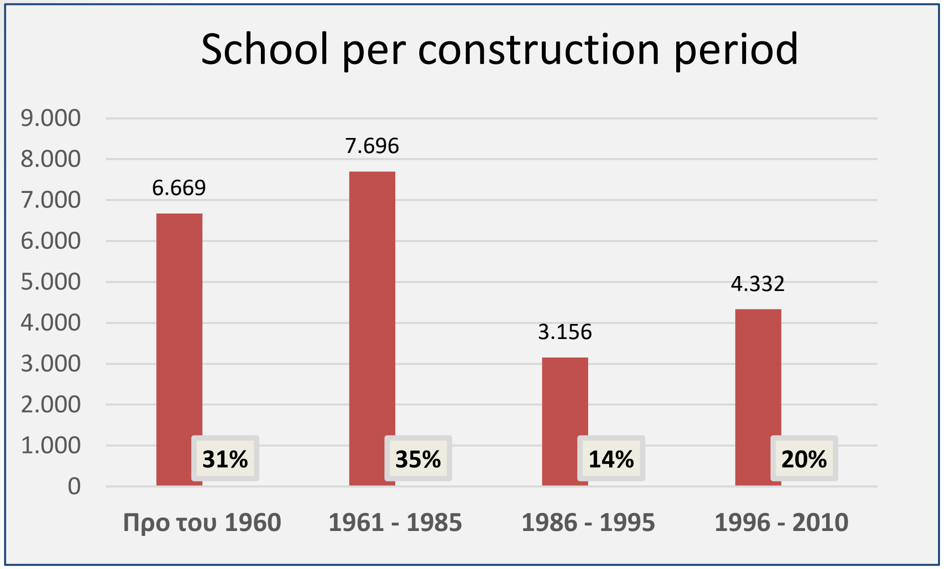


Small deviations of material used relatively to the use of buildings

79% of the existing building stock in Greece is used exclusively or mainly as a dwelling

Existing building stock

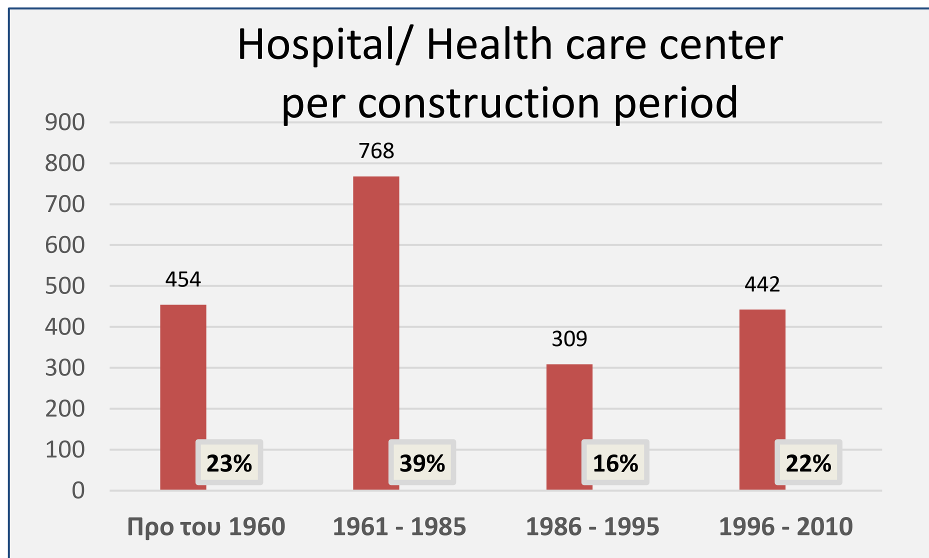
Buildings with Public Use



Seismic safety of public buildings and critical infrastructures should be a matter of highest priority for the State and the Authorities

Hellenic Statistical Authority (ELSTAT)/ General Census of Buildings 2011

More than **60%** of buildings with exclusive or main public use have been built without modern Seismic Design Code or without any seismic design at all.



Can we cope the problem of upgrading the existing building stock?

Statistics show that a significant number of existing buildings require pre-earthquake strengthening.

Seismic upgrade of the building stock and the subsequent **mitigation of seismic risk** is a necessity and it may be performed either:

- through a gradual replacement of the under-designed (old) buildings with more seismic resistant ones, or
- through detailed assessment of the structural capacity of all individual buildings and seismic strengthening of the inefficient ones.

Both approaches demand a lot of time and are inevitably associated with **enormous cost**, which is **unbearable** even in the most developed countries.

Strategy for Seismic Upgrade/Strengthening – Vulnerability reduction of building

Therefore, it is time a long-term strategy for **Seismic Upgrade** is planned, optimizing available resources through a more reasonable and realistic approach, aiming at the **vulnerability reduction of buildings**.

Different approach is needed for private and public buildings which can be affordable socially and economically:

- ✓ **Partial seismic upgrade**

  More suitable for private building

- ✓ **Selective intervention through prioritization**

  The only solution for public buildings

Partial Seismic Upgrade – Seismic classification Lack of legislative framework

Given the European Community policy on improving the energy performance of buildings and the renovation wave, it is imperative that energy and seismic upgrade are combined.

There is a need for developing a national policy for seismic upgrading of the country's structural wealth, alongside with environmental upgrade, following the example of Italy who has already developed a methodology for assessing and calibrating the seismic risk of buildings, in addition to the methodology of energy calibration.

Policies and actions which target all public buildings should enforce the assessment of seismic capacity according to the national codes, before energy upgrading and major renovation works. If the structural studies indicate inefficiency, then appropriate measures should be taken to ensure safety. The necessary actions should upgrade the seismic capacity to the minimum acceptable level.

Selective intervention through prioritization in terms of seismic risk

- When the scope is to assess and upgrade a particular building, it seems that the Codes can give a rather reasonable answer.
- When the question is to locate those buildings which have a **priority on intervention**, the problem is quite complex. The problem is complex not only in Greece but also in all countries prone to earthquakes.
- EPPO has adopted a 3-degree procedure for the pre-earthquake evaluation of seismic risk of public buildings, in agreement with international practice for the inventory and the hierarchical evaluation of the existing building stock.
- Scientific committees have standardized Methodologies with detailed instructions for the structural systems commonly used in Greece

State policy on pre-earthquake evaluation

- **Pre-earthquake assessment** of bearing capacity of existing buildings **is enforced only in cases of interventions** (change of use, additions, modifications) which may affect the seismic behaviour (Government Gazette 350/17-2-16).
- The Civil Protection of Greece according to the General Contingency Plan "Xenokratis" implemented through the 1st edition of the **General Emergency Plan for Earthquakes** with the code name “**Egelados**” (30-1-2020) defines the implementation of the **first-degree pre-earthquake inspection** of public buildings, conducting by the bodies responsible for the operation and safety of the buildings.

Pre-earthquake vulnerability assessment of public buildings procedure

PRE-EARTHQUAKE ASSESSMENT

EPPO is responsible for the implementation and validation of the vulnerability assessment procedure of buildings of public use (hospitals, schools, telelecommunication buildings, power plants etc.)

The vulnerability assessment of public buildings is carried out at **national level** in Greece and includes **three steps of inspection**.

First degree inspection
Rapid Visual Screening Procedure
A first estimation of bearing capacity of the building (A,B,Γ)

↓

Second degree inspection
Approximate Seismic Evaluation
based on simplified calculations and non-destructive methods for insufficient buildings (A) from the first-degree inspection.

↓

Third degree inspection
Detailed assessment of seismic performance of buildings with local or general inefficient seismic performance.
According to Greek Intervention Codes: KAN.EPE, KADET or EC8-3.

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Detailed assessment of seismic performance of buildings with local or general inefficient seismic performance.
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Pre-earthquake vulnerability assessment of public buildings procedure

- EPPO's 1st and 2nd Pre-earthquake vulnerability assessment is a simplified method for estimating the seismic capacity of existing buildings, in the scope of setting priorities.
- There are a lot of factors that affect the seismic behavior of a building:
  - ✓ Year of construction
  - ✓ Structural analysis of the building
  - ✓ Application of the structural analysis of the building
  - ✓ Materials of construction
  - ✓ Expected seismic risk
  - ✓ Vulnerability factors
- **Knowledge of certain data** is required in order to quantify the above-mentioned factors.

Pre-earthquake vulnerability assessment of public buildings procedure – 1st degree Inspection

Knowledge of the following data is required

- **Data to identify the building**
  Section A: Identification of the building
  Section B: Technical Characteristics of the building
- **Data to identify seismic action on the building**
  Section C: Seismological and Geotechnical parameters of the region
- **Data to identify the type of the structural system**
  Section D: Structural Type of the building
  13 structural types representatives of the common building constructions in Greece
- **Data to identify seismic vulnerability of the building**
  Section E: Vulnerability factors
  13 vulnerability factors related to the most common causes of failure

Inspection Form for the 1st degree pre-earthquake assessment

MINISTRY OF CLIMATE CHANGE & CIVIL PROTECTION

FIRST DEGREE PRE-EARTHQUAKE ASSESSMENT OF PUBLIC BUILDINGS

INSPECTION FORM (*5th Edition, 2020*)

SECTION A: BUILDING IDENTITY

1. REGIONAL UNITY: ……
2. MUNICIPALITY: ……
3. ADDRESS: …… POSTCODE: ……
   GEOGRAPHIC COORDINATES Latitude: …… Longitude: ……
4. BUILDING NAME: …… Tel: ……
5. BUILDING USE: ……
6. BUILDING USER: ……
7. BUILDING OWNER: ……
8. RESPONSIBLE PUBLIC ENTITY: ……
9. DEPARTMENT OPERATING THE INSPECTION: ……
10. MAX NUMBER OF PERSONS GATHERED IN THE BUILDING: UP TO 10 ☐ 10 – 100 ☐ > 100 ☐

SECTION B: TECHNICAL CHARACTERISTICS OF THE BUILDING

11. NUMBER OF STORIES (ABOVE GROUND): …… UNDERGROUND: ……
12. FLOOR AREA: ……
13. TOTAL FLOOR AREA: ……
14. YEAR OF CONSTRUCTION: ……
15. YEAR OF LAST ADDITION: ……
16. IS THE STRUCTURAL ANALYSIS OF THE BUILDING AVAILABLE: YES ☐ NO ☐
17. HAS THE STRUCTURAL ANALYSIS OF THE BUILDING BEEN USED FOR THE INSPECTION: YES ☐ NO ☐
18. HAS THE BUILDING BEEN DECLARED AS CULTURAL BUILT HERITAGE: YES ☐ NO ☐
19. PREVIOUS REPAIR / STRENGTHENING: YES ☐ NO ☐
20. IF YES WHY, WHEN AND HOW: ……
21. IMPORTANCE CLAA (E.A.K-2000) Σ1 Σ2 Σ3 Σ4
22. COMMENTS: ……
23. INSPECTORS IDENTITY:
    1. NAME: …… SPECIALISATION: …… TEL: ……
    2. NAME: …… SPECIALISATION: …… TEL: ……
24. DATE OF INSPECTION: ……

SECTION C: SEISMOLOGICAL AND GEOTECHNICAL PARAMETERS OF THE REGION

25. SEISMIC HAZARD ZONE
    (E.A.K. 2000 - Greek Seismic Design Code–according to the 2003 amendment)
    I ☐ II ☐ III ☐
26. SEISMIC HAZARD ZONE
    (According to Greek Seismic Design Code valid during the construction year)
    Before 1995: I ☐ II ☐ III ☐
    Between 1995 και 2003: I ☐ II ☐ III ☐ IV ☐
    After 2004: I ☐ II ☐ III ☐
27. SOIL CLASSIFICATION
    (Classes according to E.A.K. 2000 - Greek Seismic Design Code)
    A ☐ B ☐ C ☐ D ☐ X ☐
    Unknown Soil Type ☐

SECTION D: BUILDING STRUCTURAL TYPE

28. BUILDING STRUCTURAL TYPE
    (according to attached Table 1)

RC1 ☐	RC2 ☐	RC3 ☐	
PRE-CAST RC1 ☐	PRE-CAST RC2 ☐		
UNREINFORCED MASONRY ☐	COMBINED MASONRY & RC ☐	REINFORCED MASONRY ☐	REPAIRED/ STRENGTHENED MASONRY ☐
STEEL1a ☐	STEEL1b ☐	STEEL2a ☐	STEEL2b ☐

SECTION E : VULNERABILITY FACTORS

Check only the positive answers

29. Study without Seismic Design Code ☐
30. The importance class has increased due to change of use ☐
31. Previous seismic damages ☐
32. Bad condition due to poor maintenance/ subsidence/ construction defects ☐
33. Danger of pounding ☐
34. Soft Story ☐
35. Plan irregularity of infill walls ☐
36. High rise ☐
37. Vertical Building Irregularity ☐
38. Plan Building Irregularity ☐
39. Torsion ☐
40. Short Columns ☐

EARTHQUAKE PLANNING & PROTECTION ORGANIZATION
Xanthou 32 15451, N. Psychiko Tel: 210 6728000, 210 6725255, e-Mail info@oasp.gr

Inspection Form for the 1st degree pre-earthquake assessment

SECTION A: BUILDING IDENTITY

1. REGIONAL UNITY:
2. MUNICIPALITY:
3. ADDRESS: POSTCODE:
   GEOGRAPHIC COORDINATES Latitude: Longitude:
4. BUILDING NAME: Tel:
5. BUILDING USE:
6. BUILDING USER:
7. BUILDING OWNER:
8. RESPONSIBLE PUBLIC ENTITY:
9. DEPARTMENT OPERATING THE INSPECTION:
10. MAX NUMBER OF PERSONS GATHERED IN THE BUILDING: UP TO 10 ☐ 10 – 100 ☐ > 100 ☐

SECTION B: TECHNICAL CHARACTERISTICS OF THE BUILDING

11. NUMBER OF STORIES (ABOVE GROUND): UNDERGROUND:
12. FLOOR AREA:
13. TOTAL FLOOR AREA:
14. YEAR OF CONSTRUCTION:
15. YEAR OF LAST ADDITION:
16. IS THE STRUCTURAL ANALYSIS OF THE BUILDING AVAILABLE: YES ☐ NO ☐
17. HAS THE STRUCTURAL ANALYSIS OF THE BUILDING BEEN USED FOR THE INSPECTION: YES ☐ NO ☐
18. HAS THE BUILDING BEEN DECLARED AS CULTURAL BUILT HERITAGE: YES ☐ NO ☐
19. PREVIOUS REPAIR / STRENGTHENING: YES ☐ NO ☐
20. IF YES WHY, WHEN AND HOW:
21. IMPORTANCE CLASS (E.A.K-2000) Σ1 ☐ Σ2 ☐ Σ3 ☐ Σ4 ☐
22. COMMENTS:
23. INSPECTORS IDENTITY:

E.P.P.O. Earthquake Planning & Protection Organization

Inspection Form for the 1st degree pre-earthquake assessment

SECTION C: SEISMOLOGICAL AND GEOTECHNICAL PARAMETERS OF THE REGION

25. SEISMIC HAZARD ZONE
(E.A.K. 2000 - Greek Seismic Design Code–according to the 2003 amendment)
I ☐ II ☐ III ☐

26. SEISMIC HAZARD ZONE
(According to Greek Seismic Design Code valid during the construction year)
Before 1995: I ☐ II ☐ III ☐
Between 1995 και 2003: I ☐ II ☐ III ☐ IV ☐
III ☐

ign Code)
D ☐ X ☐

SECTION D: BUILDING STRUCTURAL TYPE

28. BUILDING STRUCTURAL TYPE
(according to attached Table 1)

RC1	☐	RC2	
PRE-CAST RC1	☐	PRE-CA	
UNREINFORCED MASONRY	☐	COMBI MASON	
STEEL1a	☐	STEEL1	

SECTION E : VULNERABILITY FACTORS

Check only the positive answers

29.	Study without Seismic Design Code	☐
30.	The importance class has increased due to change of use	☐
31.	Previous seismic damages	☐
32.	Bad condition due to poor maintenance/ subsidence/ construction defects	☐
33.	Danger of pounding	☐
34.	Soft Story	☐
35.	Plan irregularity of infill walls	☐
36.	High rise	☐
37.	Vertical Building Irregularity	☐
38.	Plan Building Irregularity	☐
39.	Torsion	☐
40.	Short Columns	☐

E.P.P.O.
Earthquake Planning & Protection Organization

Pre-earthquake vulnerability assessment of public buildings procedure – 2nd degree Inspection

- Structural factors and parameters which **affect the seismic performance** of a building are quantified through simplified calculations. The result of such an assessment is a "score" called the "**priority index for further inspection λ**" of the building.
- This index does not indicate the level of seismic capacity. It **determines the priority order** of each building for the 3rd level pre-earthquake detailed assessment, compared to other buildings **in a group that are similarly subjected to the process**.
- Whereas 1st degree pre-earthquake assessment method concerns all structural types, 2nd degree differs for RC and Masonry.

Pre-earthquake assessment
2nd degree Inspection for RC buildings

Knowledge of the following data is required

- Data to identify the building
- Data to assess the **Seismic Demand**,
  in terms of design base shear: $V_{req} = M \cdot S_d(T)$
  considering the EC8-1 design spectrum
- Data to assess the **Seismic Resistance** of the building,
  in terms of base shear: $V_R = \beta \cdot V_{R0}$
  - ✓ V_{R0} : Base Shear, approximately calculated
  - ✓ 13 Seismic Resistance reduce Parameters ranked (β_i) in a 5-degree scale
  - ✓ β: Seismic Resistance reduce factor/ coefficient (weighted mean value of β_i)
- Calculation of **Priority Index** for further control

$$\lambda = \frac{V_{req}}{V_R}$$

Pre-earthquake assessment
2nd degree Inspection for RC buildings

EARTHQUAKE PLANNING & PROTECTION ORGANIZATION
INSPECTION FORM 2nd DEGREE PRE-EARTHQUAKE ASSESSMENT
FOR PUBLIC BUILDINGS OF REINFORCED CONCRETE [1st Edition 2018]

A. BUILDING IDENTITY

1. REGIONAL UNITY:
2. MUNICIPALITY:
3. ADDRESS:
   TK: THΛ :
4. BUILDING NAME :
5. BUILDING USE :
6. BUILDING OWNER:
7. BUILDING USER:

B. TECHNICAL CHARACTERISTICS OF THE BUILDING

1. NUMBER OF STORIES (ABOVE GROUND): UNDERGROUND :
2. FLOOR AREA:
3. TOTAL FLOOR AREA :
4. YEAR OF CONSTRUCTION :
5. YEAR OF LAST INTERVENTION: ADDITION? :
6. INFORMATION ABOUT THE ADDITION :
7. HAS THE BUILDING BEEN DECLARED AS CULTURAL BUILT HERITAGE: NAI ☐ NO ☐
8. PREVIOUS REPAIR / STRENGTHENING NAI ☐ NO ☐
9. IF YES WHY, WHEN AND HOW :
10. ADDITIONAL INFORMATION :

C. SEISMOLOGICAL AND GEOTECHNICAL PARAMETERS

1. SEISMIC HAZARD ZONE Z1 ☐ Z2 ☐ Z3 ☐
2. SOIL CLASS (according EC-8): A ☐ B ☐ C ☐ D ☐ E ☐ S ☐
3. POSSIBLE DANGER FOR LOCAL SOIL AMPLIFICATION OF SEISMIC ACTION: YES ☐ NO ☐

D. CALCULATION OF SEISMIC DEMAND

1. $V_{req}=M\times S_d(T)$ according EC-8
2. BEHAVIOUR FACTOR $q_x=$ $q_y=$
3. $V_{req,x}=$ $V_{req,y}=$

E. CALCULATION OF SEISMIC RESISTANCE V_R ($V_{R,x}$ - $V_{R,y}$) $V_R=\beta V_{R0}$

1.	STRUCTURAL DAMAGES	$\beta_{1x}=$	$\beta_{1y}=$
2.	CORROSION	$\beta_{2x}=$	$\beta_{2y}=$
3.	HIGH COMPRESSION FROM VERTICAL LOADS	$\beta_{3x}=$	$\beta_{3y}=$
4.	PLAN BUILDING IRREGULARITY	$\beta_{4x}=$	$\beta_{4y}=$
5.	PLAN STIFFNESS DISTRIBUTION - TORSION	$\beta_{5x}=$	$\beta_{5y}=$
6.	VERTICAL BUILDING IRREGULARITY	$\beta_{6x}=$	$\beta_{6y}=$
7.	VERTICAL STIFFNESS DISTRIBUTION - TORSION	$\beta_{7x}=$	$\beta_{7y}=$
8.	VERTICAL MASS DISTRIBUTION	$\beta_{8x}=$	$\beta_{8y}=$
9.	SHORT COLUMNS	$\beta_{9x}=$	$\beta_{9y}=$
10.	VERTICAL DISCONTINUITIES	$\beta_{10x}=$	$\beta_{10y}=$
11.	VERTICAL FORCES TRANSFER SYSTEM	$\beta_{11x}=$	$\beta_{11y}=$
12.	ADJACENT BUILDINGS	$\beta_{12x}=$	$\beta_{12y}=$
13.	DEFECTS, STRUCTURALS INJURIES	$\beta_{13x}=$	$\beta_{13y}=$
14.	$\beta=\sum\frac{\sigma_i\beta_i}{5}$	$\beta x=$	$\beta y=$
15.		$V_{R0,X}=$	$V_{R0,Y}=$
16.		$V_{RX}=\beta_X V_{R0,X}=$	$V_{RY}=\beta_Y V_{R0,Y}=$

F. PRIORITY INDEX FOR FURTHER INSPECTION "λ"

λ_X = λ_Y =

PRIORITY INDEX FOR FURTHER INSPECTION $\lambda=$

G. INSPECTORS IDENTITY

1. NAME:	2. NAME:
SPECIALISATION:	SPECIALISATION:
PHONE NUMBER:	PHONE NUMBER:
SIGNATURE	SIGNATURE

INSPECTION DATE :

COMMENTS:

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Earthquake Planning & Protection Organization

Pre-earthquake assessment
2nd degree Inspection for Masonry buildings

Knowledge of the following data is required

- Data to identify the building
- Data to classify the **Seismic action** on the building (Hazard: H) (according to EC8-1)
- Data to classify the **Seismic Resistance** of the building (Resistance: R)
  - ✓ 10 Seismic Resistance indexes (R_i), determined by a qualitative approach
  - ✓ Seismic Resistance estimator (R) (weighted mean value of R_i)

Pre-earthquake assessment
2nd degree Inspection for Masonry buildings

EARTHQUAKE PLANNING & PROTECTION ORGANIZATION
INSPECTION FORM 2nd DEGREE PRE-EARTHQUAKE ASSESSMENT
FOR PUBLIC BUILDINGS OF MASONRY [2nd Edition 2018]

A. BUILDING IDENTITY

1. REGIONAL UNITY:
2. MUNICIPALITY:
3. ADDRESS:
   POSTCODE: TEL :
4. BUILDING NAME :
5. BUILDING USE :
6. BUILDING OWNER:
7. BUILDING USER:

B. TECHNICAL CHARACTERISTICS OF THE BUILDING

1. NUMBER OF LEVELS: BASEMENT :
2. FLOOR AREA:
3. TOTAL FLOOR AREA :
4. YEAR OF CONSTRUCTION :
5. YEAR OF LAST ADDITION:
6. DETAILS OF ADDITION :
7. IS IT A LISTED BUILDING? NAI ☐ OXI ☐
8. HAS THE BUILDING BEEN REPAIRED/ STRENGTHENED? NAI ☐ OXI ☐
9. IF YES FOR WHAT REASON AND WHEN? :
10. ADDITIONAL GENERAL INFORMATION:

C. SEISMOLOGICAL AND GEOTECHNICAL PARAMETERS

1. SEISMIC HAZARD ZONE Z1 ☐ Z2 ☐ Z3 ☐
2. SOIL CLASS (according to EC-8): A ☐ B ☐ C ☐ D ☐ E ☐ S ☐
3. POSSIBLE DANGER FOR LOCAL SOIL AMPLIFICATION OF SEISMIC ACTION: NAI ☐ OXI ☐

D. ASSESSMENT OF THE SEISMIC ACTION OF THE BUILDING (Hazard: H)

1. SEISMIC ACTION INDEX (H1) : ☐
2. INFLUENCE OF ADJACENT BUILDINGS INDEX (H2) : ☐
3. ESTIMATE OF SEISMIC ACTION (H) : *H=0,75H1+0,25H2* H= ☐

E. EASSESSMENT OF THE SEISMIC RESISTANCE (Resistance: R)

1. GROUND FLOOR SHEAR RESISTANCE INDEX (R1) : ☐
2. LOAD BEARING WALL OPENINGS INDEX (R2) : ☐
3. RING BEAM INDEX (R3) : ☐
4. DIAPHRAGM INDEX (R4) : ☐
5. OPENINGS NEAR CORNER INDEX (R5) : ☐
6. MASONRY DAMAGE INDEX (R6) : ☐
7. CONNECTION BETWEEN TRANSVERSE WALLS INDEX (R7) : ☐
8. PERIMETER WALL OUT OF PLANE STRESS INDEX (R8): ☐
9. GROUND FLOOR PLAN REGULARITY INDEX (R9) : ☐
10. HEIGHT REGULARITY INDEX (R10) : ☐
11. BUILDING'S EARTHQUAKE RESISTANCE ESTIMATE (R) :
    R=0,20R1+0,15(R3+R5)+0,10(R4+R7+R8)+0,05(R2+R6+R9+R10) R= ☐

F. PRIORITY INDEX FOR FURTHER INSPECTION

PRIORITY INDEX FOR FURTHER INSPECTION λ=100(H/R) **λ=** ☐

G. INSPECTORS IDENTITY

1. NAME: 2. NAME:
   SPECIALISATION: SPECIALISATION:
   TELEPHONE: TELEPHONE:
   SIGNATURE SIGNATURE

INSPECTION DATE :

E.P.P.O.
Earthquake Planning & Protection Organization

Pre-earthquake assessment – Mitigating seismic risk
Identification of potential worst seismic performance

Pre-earthquake evaluation of seismic risk aims to identify **those buildings which may present more inefficient earthquake performance** and might pose a risk of loss or injury, or severe interruption of community services in the event of a damaging earthquake, comparatively to similar others.

Elementary school of Damassi, Larissa. Severely damaged by the earthquake in March 2021, during operation. Fortunately, with no injuries!

If it had been inspected, the "score" would have been "**A**"

Pre-earthquake assessment – Mitigating seismic risk

Identification of potential worst seismic performance

Elementary school of Damassi, Larissa, was built in 1938. During German occupation, the school suffered from severe damages and was declared as inappropriate of use.

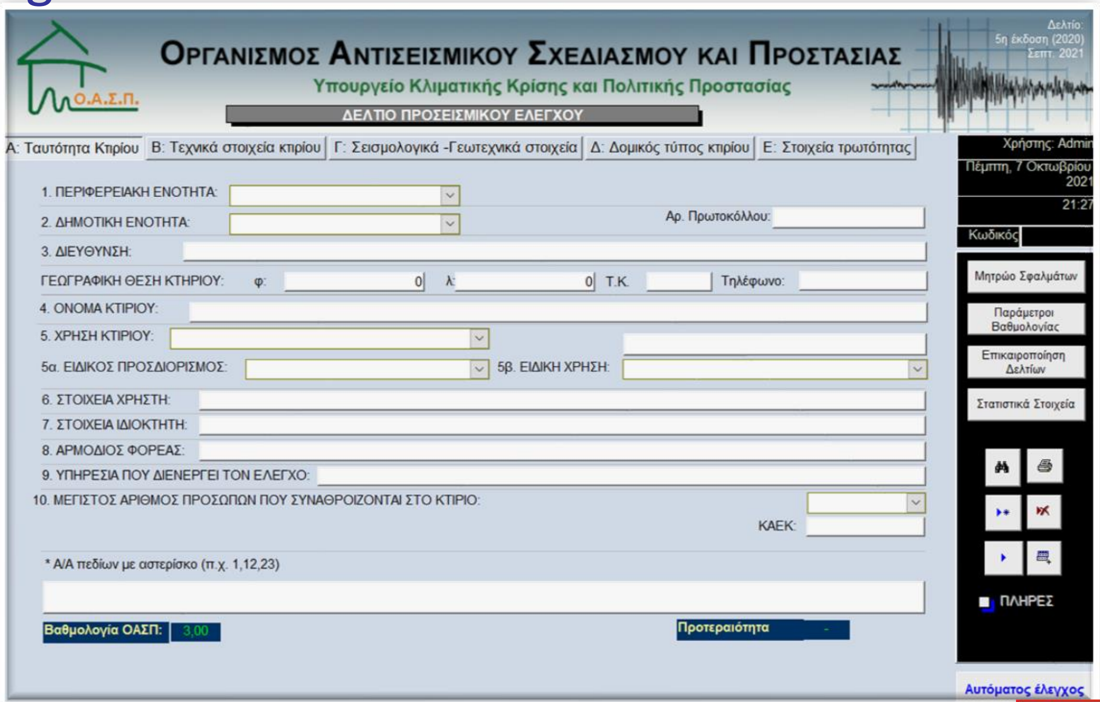
Finally, it was retrofitted in 1952 and had been operated as a school until 03-03-2021.

Source: www.gak.gr

Pre-earthquake assessment of public buildings
1st degree Inspection Data Base

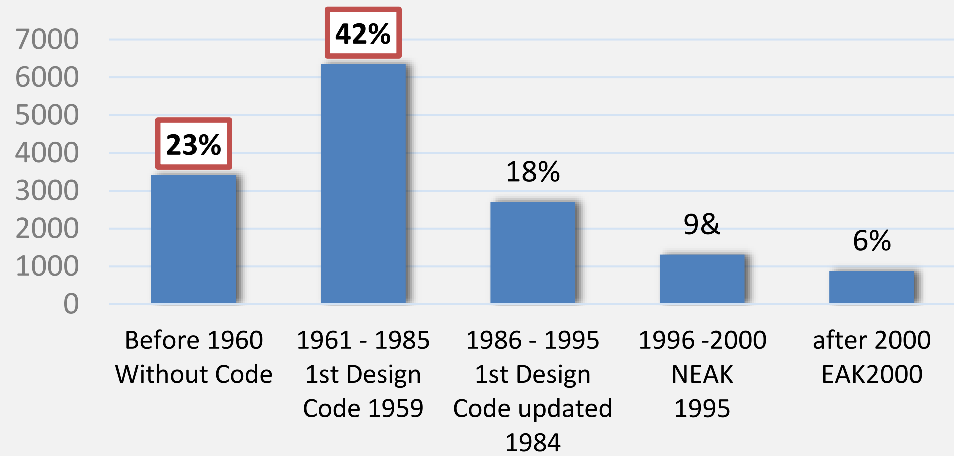
- The implementation of this procedure started in 2001.
- Till today 16.000 public buildings have been inspected and classified according to EPPO's vulnerability assessment procedure.
- The progress of the program is slow, but the data are enough for statistical processing

Data base entry form filled by EPPO according to the technical sheets sent from competent authorities

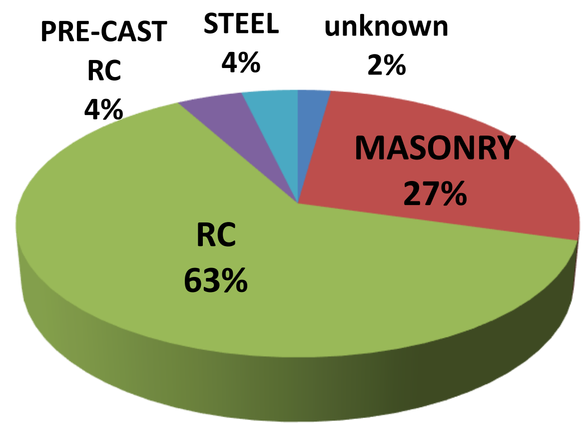


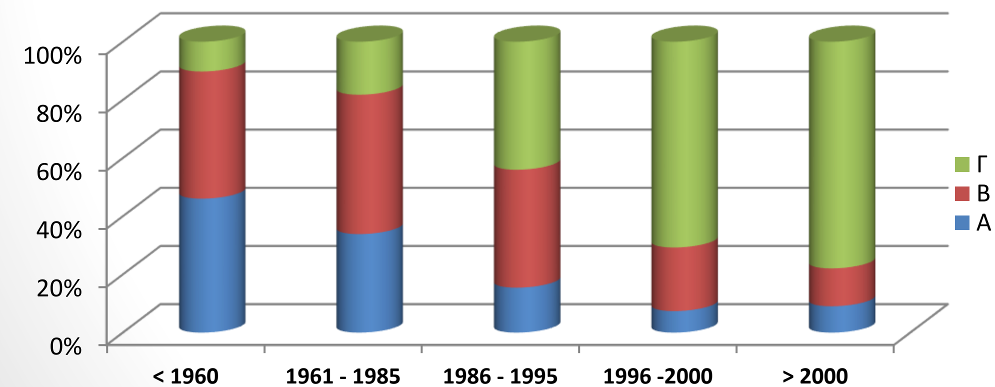
Statistical Processing of National Data Base for pre-earthquake assessment of public buildings

Number of buildings relatively to the Construction Code Period



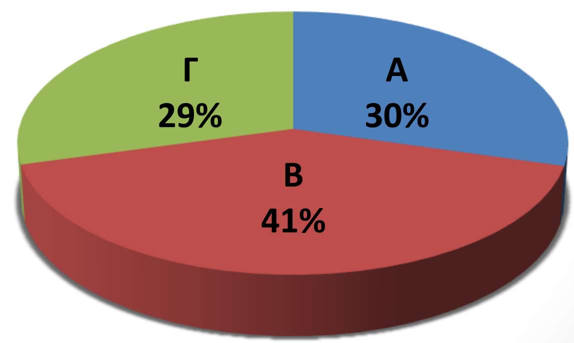
Structural types of public buildings





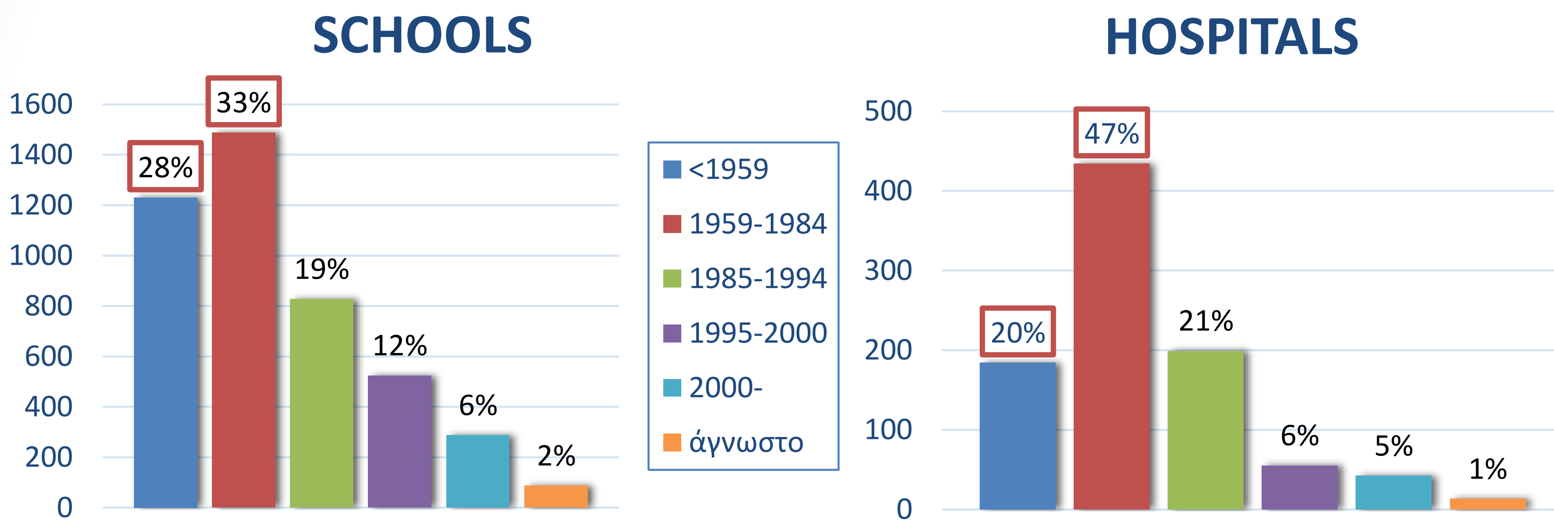
Priority of public buildings related to the construction period

Priority of public buildings for further control



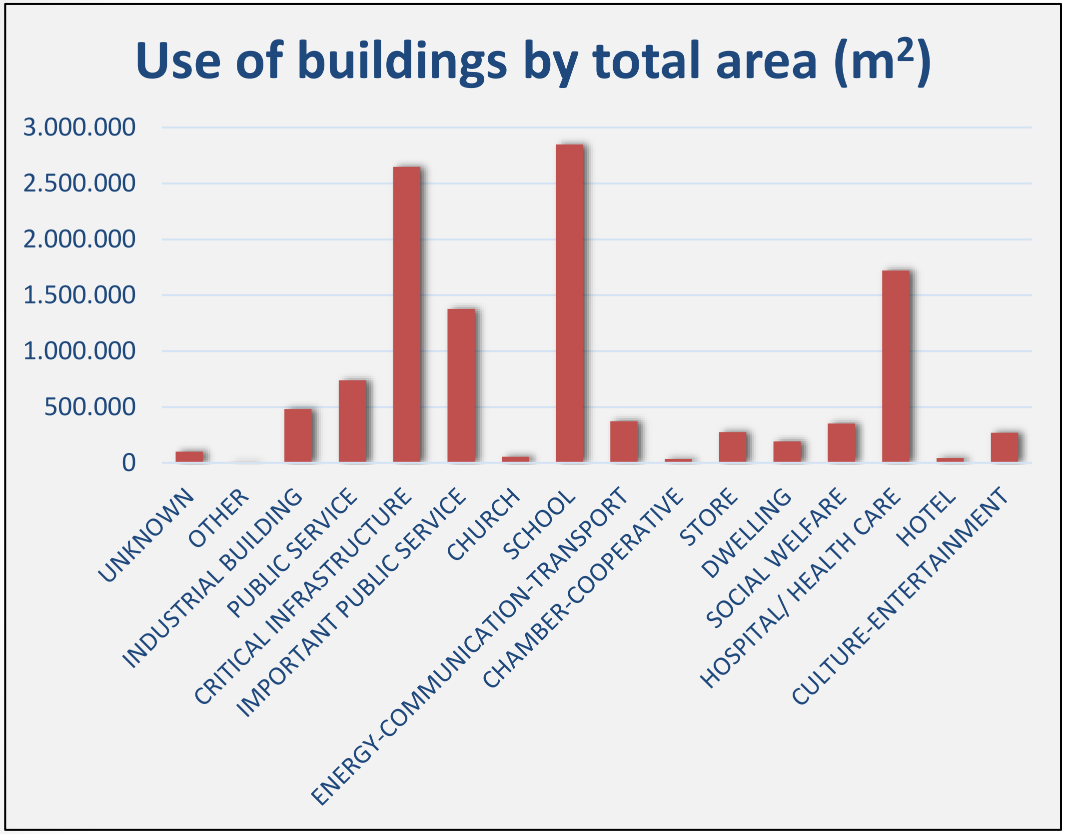
Statistical Processing of National Data Base for pre-earthquake assessment of public buildings

Distribution of Public buildings and Critical infrastructure
by Construction Code Period



- An analysis by construction code period reveals that only one third (**30%**) of the existing public buildings has been built with modern seismic codes, while the highest share (**65%**) has been built with old regulations, or without any seismic design at all.
- The results corresponds to the general census of buildings conducted by ELSTAT in 2011.

Statistical Processing of National Data Base for pre-earthquake assessment of public buildings



Extending the statistical analysis by other socio-economic factors, e.g.:

- ✓ number of people gathered
- ✓ importance of integrity, during an earthquake
- ✓ cost of repair per m^2

reveals the extent of the big socio-economic problem, an earthquake-prone country, such as Greece, is facing, which is called under-designed existing building stock.

From evaluation of seismic risk to calculation and selection of mitigation solutions

- EPPO’s National Data Base for pre-earthquake assessment of public buildings incorporates scientifically based knowledge and contains valuable information related to seismic vulnerabilities and technical characteristics of public buildings in Greece.
- Therefore, pre-earthquake assessment can be a **useful tool for mitigating seismic risk** at a national and regional level.

Objectives

EPPO seeks to update the DB into a Geospatial DB introducing geo-referencing of collected statistical data and interoperability with other national DBs concerning the public buildings in order to:

- Provide detailed information and guidance for a comprehensive approach to protect built environment against seismic hazard
- Provide information to serve authorities, security operators, practitioners, researchers and policy-makers regarding earthquake protection

Thank you

www.oasp.gr

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