الجـــمـــهـــورية الجزائريـــــة الديمقراطيـــــة الشعـــبيـــــة
REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE
وزارة السكـــــن و التعميـــــر و المدينة
MINISTERE DE L'HABITAT, DE L'URBANISME ET DE LA VILLE

المركز الوطني للبحث المطبق في هندسة مقاومة الزلازل
CENTRE NATIONAL DE RECHERCHE APPLIQUEE EN GENIE PARASISMIQUE
(CGS)

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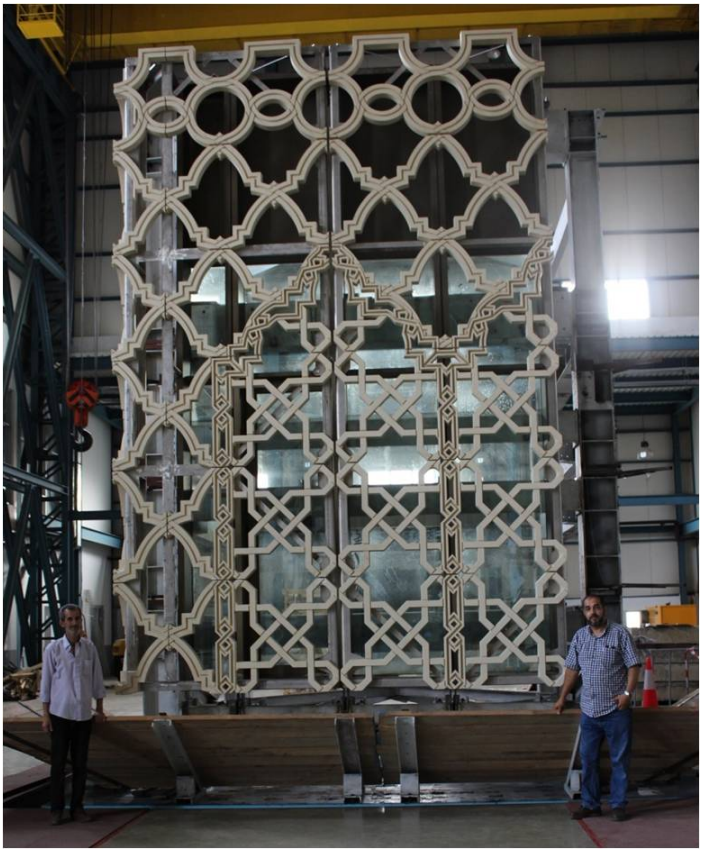
Services Offered by the National Center for Applied Research in Earthquake Engineering

- CGS -



April 2021

In addition to his daily mission, devoted particularly to research, the national center for applied research in earthquake engineering, CGS, offers services in several areas. In this booklet 22 sheets are presented representing the services offered by the 4 research divisions and the 2 technical departments of our center, which are organized as follows:

Seismic Hazard Division (S.H.D)

- Engineering seismology
- Seismotectonics,
- Neotectonics and quaternary geology,
- Paleosismicity,
- Seismology and Earthquake hazard modeling.

Seismic Microzoning Division (S.M.D)

- Geophysics,
- Soil dynamics
- Site effects,
- Dynamics of soil-structure systems.

Earthquake Engineering Division (E.E.D)

- Vulnerability and static and dynamic behavior of building structures,
- Bridge vulnerability,
- Water works vulnerability,
- Steel structures,
- Materials and Construction technologies.

Regulations and Seismic Risk Reduction Division (S.R.D)

- Technical regulations,
- Construction standardization,
- Lifelines and equipments;
- Urban vulnerability and seismic risk,
- Seismic risk reduction and planning in seismic zones.

Department of Scientific Equipment and Tests and Measurements (D.E.S.E.M)

- Maintenance and operation of scientific equipment,
- Design and implementation of technological processes for the needs of the divisions,
- Management, programming and execution of tests and measurements of experimental research projects.

Department of Scientific Information, External Relations and the Promotion of Research Results (D.I.S).

- Computer service,
- Training , publications and valorization service,
- External relations and communication.

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Ministère de l'Habitat de l'Urbanisme et de la Ville (MHUV)

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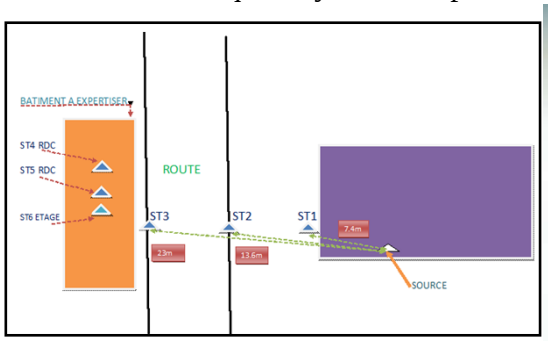
SERVICES PROVIDED BY CGS
SEISMIC HAZARD DIVISION (DAS)

BLAST IMPACT ASSESSMENT

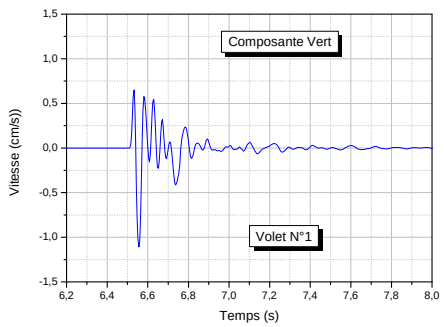
Impact study of blast works on surrounding constructions and infrastructures (Effect of the vibrations due to the use of explosive during mining works). The study is used to fix the quantity of the explosive not to be exceeded.



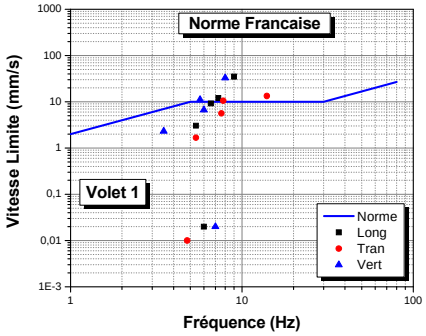
Instrumentation plan

Example of used recorders (Etna2)

Results example



Example of obtained results



Example of obtained results

APPLICATION DOMAINS

MINING WORKS, PUBLIC WORKS? YDRAULIC WORKS

POTENTIAL USERS

SECTORS OF MINING, PUBLIC WORKS, HYDRAULIC...ETC

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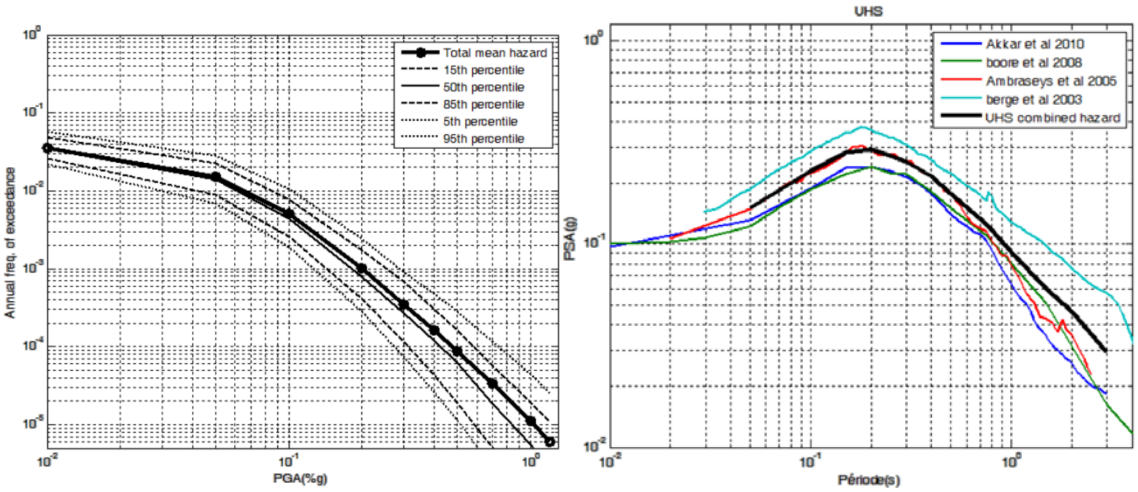
SEISMIC HAZARD DIVISION

SEISMIC HAZARD ASSESSMENT OF STRATEGIC SITES

Seismic hazard assessment of strategic sites (Dams, refineries, power stations, nuclear sites ....etc).

- Seismicity analysis (historical and instrumental seismicity and historical maximum intensities of earthquakes.
- Seismic source models including active faults and seismic source zones.
- Active Fault surface rupture hazard assessment.
- Determination of seismotectonic parameters of faults such as SMHV.
- Calculation of acceleration on hard rock for different return periods 100, 200, 500, 1000, 2500, et 10 000 using probabilistic and deterministic approaches.
- Assessment of hazard scenario (UHS and deaggregation).



APPLICATION DOMAINS

RISK REDUCTION, DESIGN AND SECURITY OF STRATEGIC INFRASTRUCTURES

POTENTIAL USERS

SECTORS OF ENERGY, PUBLIC WORKS, HYDRAULIC, MAJOR RISKS...ETC

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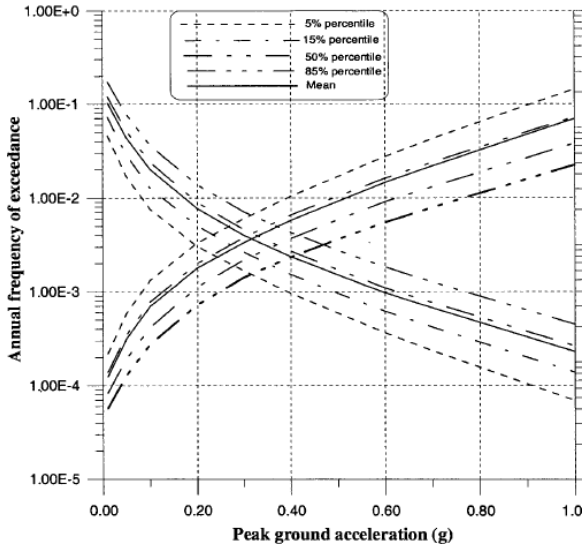
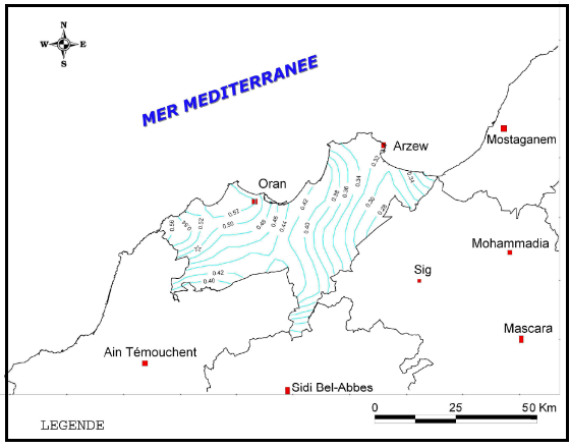
SEISMIC HAZARD DIVISION

ASSESSMENT AND MAPPING OF REGIONAL SEISMIC HAZARD

Assessment and mapping of seismic hazard in the aim of seismic risk reduction. The results are presented as annual frequency of exceedance of acceleration at a specific site as well as iso-accelartion maps for different return periods (Below example of obtained results in western Algeria).



Seismic hazard curves



Iso-acceleration map

APPLICATION DOMAINS

LAND USE, URBANISME/HOUSING, SEISMIC RISK REDUCTION, PER/PPR

POTENTIAL USERS

HOUSING SECTOR, LAND USE, MAJOR HAZARDS ...ETC

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SEISMIC MICROZONING DIVISION

SITE-SPECIFIC SEISMIC STUDY

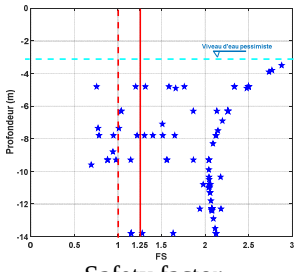
Projects of vital importance in the sense of the Algerian Seismic Regulations require a site-specific seismic study for the definition of seismic action. This study consists of a detailed analysis of the site from a geological, hydrogeological and geotechnical point of view in order to build its model as detailed as possible. For the site and from its model, a variety of results in map or GIS format will be determined:

- Seismic scenario definition (Magnitude, recorded and synthetic accelerograms)
- Amplification potential, fundamental frequency and site classification according to RPA99
- Seismic responses at the surface and at different depths
- Liquefaction potential and landslide potential maps
- Site response spectrum

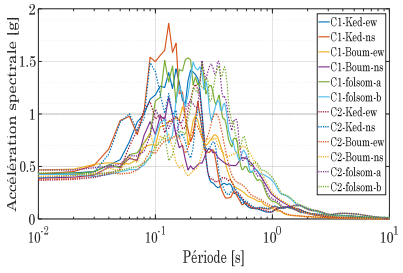
Example study

El Taref Electric Power Plant site

Liquefaction cone,



Safety factor,



Response spectra

SCOPE

Seismic risk, Constructions of vital importance, Electric Power Plant, Dams, Palaces, Hospital

POTENTIAL BENEFICIARIES

Housing Sector, Industry, Energy, Public works, Hydraulics

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SEISMIC MICROZONING DIVISION

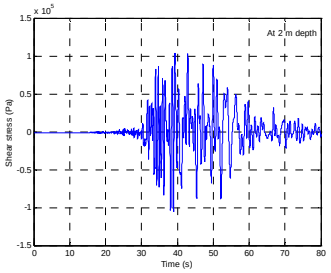
SOIL LIQUEFACTION POTENTIAL ANALYSIS

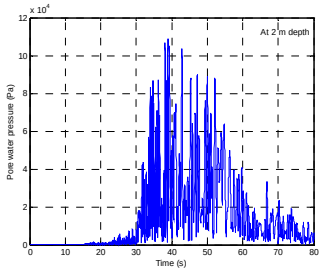
Soil liquefaction during an earthquake is a process that leads to loss of strength or stiffness of the loose saturated sand deposits with a grain size within a certain critical range. Liquefaction can have a significant and sometimes devastating effect on buildings without consideration of the consequences of liquefaction. At such site, in an active seismic zone, soil liquefaction potential analysis is important in the design of structures.

Example study

Mostaghanem Electric Power Plant site

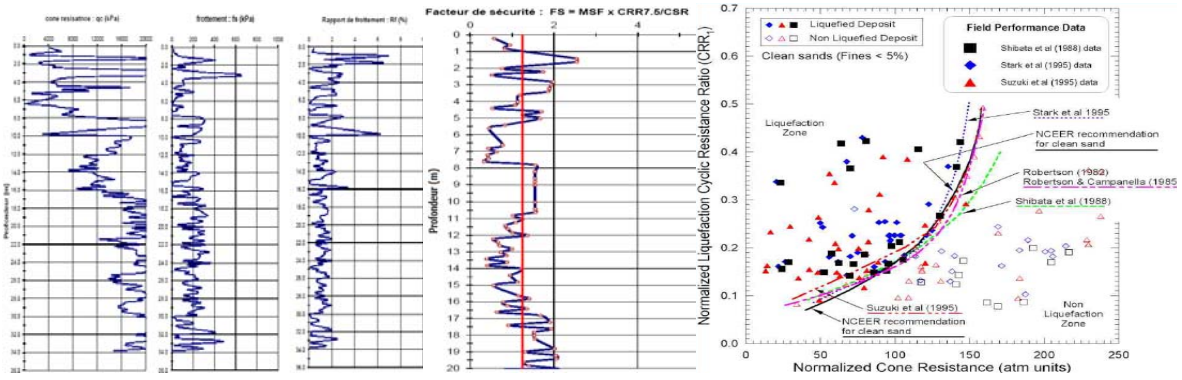
"Sand boils" appearing during the 2003 Boumerdes earthquake





	z	zw	σ_{v0}	u	σ'_{v0}	σ_{v0}/σ'_{v0}	r_d	CSR	$CRR_{7.5}$ /CSR	FSf	Plf
	7.3	2.8	142.	28	114.	1.2441	0.8964	0.2247	1.0240	1.5258	
M	10.	5.8	7	58	7	1.4093	0.8372	0.2378	0.7485	1.1153	
N	3	8.8	199.	88	141.	1.5216	0.7766	0.2381	1.1554	1.7215	
B	13.	11.8	7	118	7	1.6030	0.7182	0.2320	1.1164	1.6634	0.65
1	3		256.		168.						3
	16.		7		7						
	3		313.		195.						
			7		7						

Results of numerical (shear stress and pore pressure) and empirical (table) analysis



Some results of the liquefaction safety factor analysis from the CPT tests

SCOPE

Seismic risk, Constructions of vital importance, Electric Power Plant, Dams, Palaces, Hospital

POTENTIAL BENEFICIARIES

Housing Sector, Industry, Energy, Public works, Hydraulics

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SEISMIC MICROZONING DIVISION

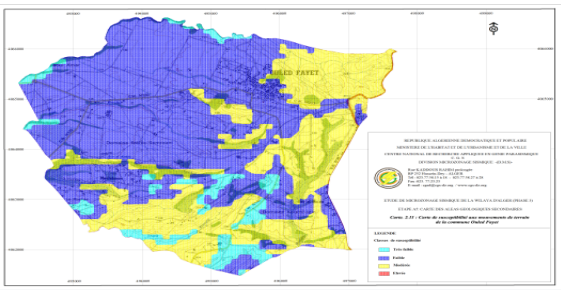
SEISMIC MICROZONING STUDY OF URBAN SITES

As part of MHUV's major risk assessment and reduction concerns, seismic microzoning studies of an area (PDAU scale) involve a detailed field study to assess the seismic risk by producing a variety of maps where geological hazards will be mentioned (potential for surface faults to appear, landslides, liquefaction), and site effects (Amplification, classification, vibration frequency, etc.)

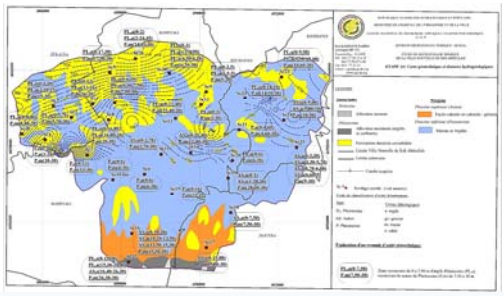
Results are provided under a geographic information system, these are:

- Geological mapping taking into account active faults
- The mapping of iso-peak ground accelerations at bedrock
- Geotechnical and hydrogeological mapping
- Assessment and mapping of site effects (frequency map, amplification map, classification map according to earthquake regulations) from a background noise measurement campaign using 3-component seismographs, combined with geotechnical data
- Assessment and mapping of induced site effects (liquefaction, settlement, landslides)

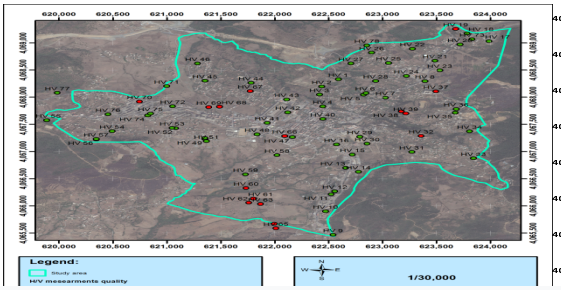
Exemple de résultats



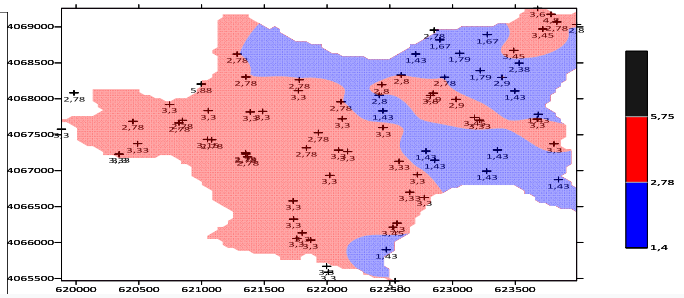
Map of susceptibility to ground movements



Geotechnical and hydrogeological map



Map of background noise measurements



Classification map of an Urban site (Blue Soft Soil, Red FirmSoil)

APPLICATION DOMAIN

Seismic microzoning, Land use planning, Seismic risk, Housing and Urban planning,

POTENTIAL BENEFICIARIES

HOUSING SECTORS, LAND USE PLANNING, PUBLIC WORKS, HYDRAULIC ... ETC.

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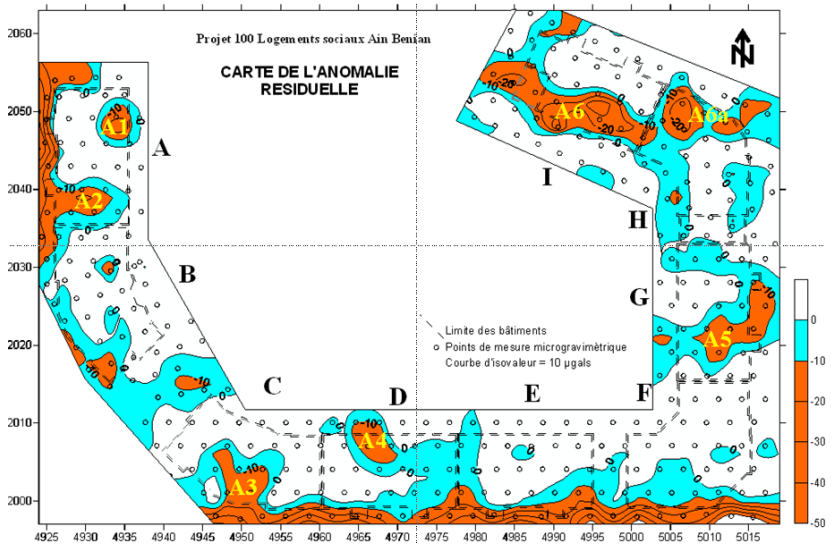
SEISMIC MICROZONING DIVISION

UNDERGROUND CAVITES INVESTIGATION

The search for cavities is part of a natural risk prevention policy. The presence of underground cavities represents a real danger for the sustainability of a structure in general, and threatens the safety of people and property located directly above them. Considering this hazard must be a major concern for project owners and contractors. The objective is to come up with solutions for identifying voids and securing sites. The objective of the search for cavities is to determine the areas where underground cavities are likely to cause damage to the surface. The research methodology recommends preliminary studies, a geophysical measurement campaign and a drilling campaign. The results of this methodology should lead to technical treatment solutions.

Example of result



Residual anomaly map showing anomalies likely to correspond to cavities

APPLICATION DOMAIN

Planning and town planning, Seismic risk, Seismic microzoning, Prevention policy natural risks, search for underground cavities

POTENTIAL BENEFICIARIES

HOUSING SECTORS, LAND USE PLANNING, PUBLIC WORKS, HYDRAULIC ... ETC.

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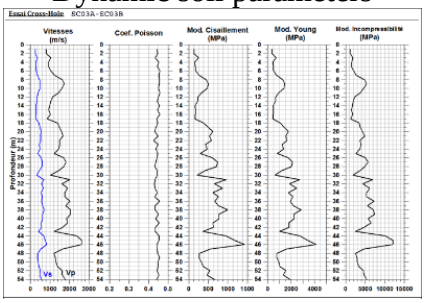
SEISMIC MICROZONING DIVISION

DYNAMIC CHARACTERIZATION OF SOILS IN SITU

Determination of seismic profiles (speed of shear waves as a function of depth) is essential for the classification and assessment of site effects, where different seismic prospecting methods can be used:

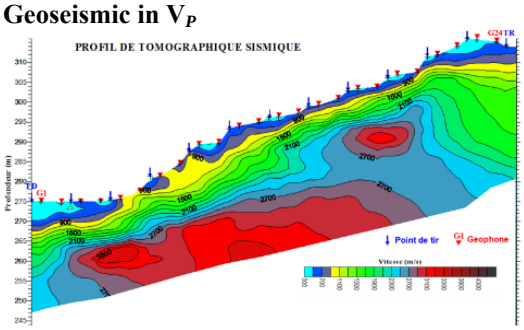
- Well seismic, downhole (1 borehole) and cross-hole (2 boreholes minimum, search for anisotropy) are used to determine lithology, V_P compression and V_S shear wave velocities;
- Surface seismic tomography is used for the determination of the lithology of geological formations and V_P compression rates with very good resolution;
- MASW (Multistation Analysis of Surface Waves) used for the determination of VS shear wave velocities from surface wave recordings, (maximum depth is 30 m).
- Ambient vibration network methods are passive and inexpensive techniques, based on recording ambient vibration noise. The depth of investigation can reach hundreds of meters.

Dynamic soil parameters



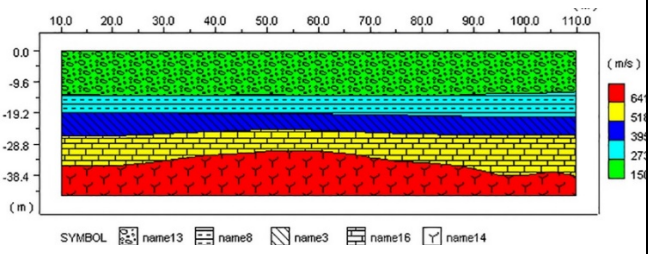
(Cross-hole and down-hole tests)

Geoseismic in V_P



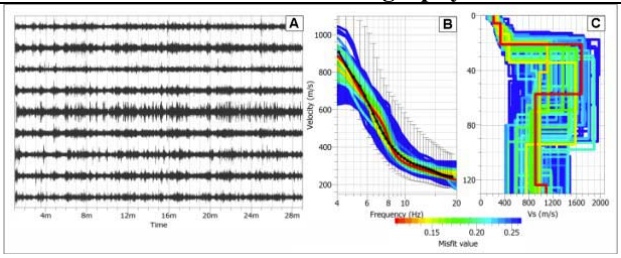
Seismic Tomography

Geoseismic in V_S



Results of several MASW profiles

(Geogica 2018)



Result of an ambient vibratory noise network (2D), (a) recorded ambient vibratory noise, (b) Rayleigh wave dispersion curve, (c) velocity models obtained by inversion. The depth of investigation in this study case exceeds 120 m.

APPLICATION DOMAIN

Seismic risk, Seismic hazard, Seismic microzoning, Natural risk prevention policy; determination of soils dynamic parameters in-situ and assessment of site effects

POTENTIAL BENEFICIARIES

HOUSING SECTORS, LAND USE PLANNING, PUBLIC WORKS, HYDRAULIC ... ETC.

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SEISMIC MICROZONING DIVISION

ASSESSMENT AND MAPPING OF HAZARD "GROUND MOVEMENTS"

Study of the assessment and mapping of the susceptibility and hazard of landslides for different scales (local, large, medium and regional) under a GIS Geographic Information System:

- Specific study of landslides at the local scale of a slope (1/5000 to 1/1000) by geophysical prospecting (seismic, electrical imaging, etc.)
- Development of slope movement inventory maps (scale 1 / 10,000, 1 / 25,000 and 1 / 50,000)
- Development of slope movement hazard factor maps (scale 1 / 10,000, 1 / 25,000 and 1 / 50,000)
- Assessment of the susceptibility and hazard of slope movements by different methodologies (Expert, probabilistic and deterministic modeling)
- Development of susceptibility and terrain movement hazard maps by GIS at 1: 10,000, 1: 25,000 and 1: 50,000 scales.

Example of results

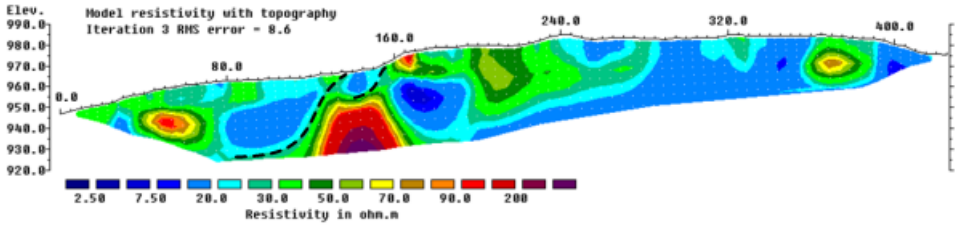

Fig.1- Landslide study by electrical imaging identifying landslide surfaces at the local scale

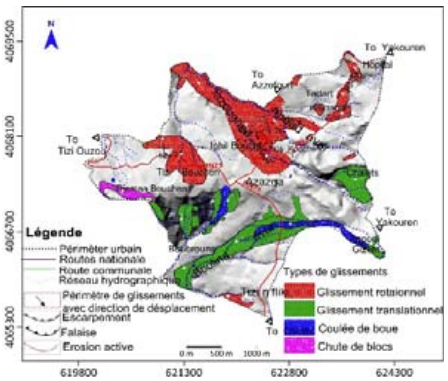

Fig.2- Inventory maps of slope movements.

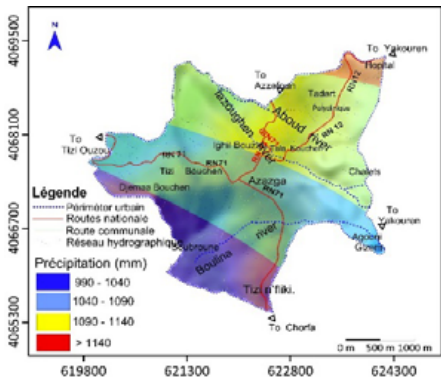

Fig. 3- Map of hazard factors.

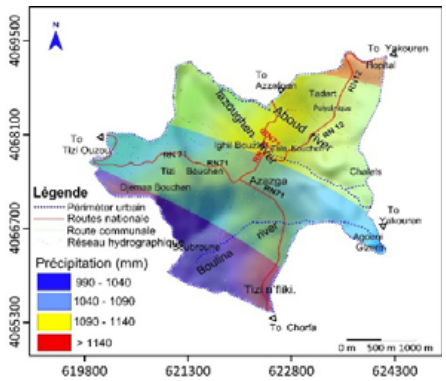

Fig. 4- Slope movement hazard map.

APPLICATION DOMAIN

Seismic microzoning, Land use planning, Seismic risk, Housing and Urban planning, ...etc.

POTENTIAL BENEFICIARIES

HOUSING SECTORS, LAND USE PLANNING, PUBLIC WORKS, HYDRAULIC ... ETC.

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SEISMIC MICROZONING DIVISION

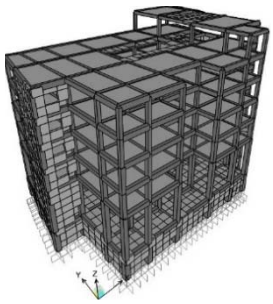
DYNAMIC ANALYSIS OF STRUCTURES CONSIDERING SOIL-STRUCTURE INTERACTION (SSI)

The current practice, as reflected in the standards, is to estimate the forces transmitted to the foundation without any interaction with the soil. This approach, which may be considered adequate for common structures, may be too conservative for important structures such as: rigid structures founded on loose soil or foundations for vibrating machines.

Example study

Nuclear Power Plant

Electric Power Plant



Massive Structure

The CGS deals with the problem in its generality. A structural seismic study, taking into account the SSI, generally consists of the following steps:

1. Geotechnical soil model and geophysical survey;
2. Analysis of the amplification of the seismic motion
3. Evaluation of dynamic impedance functions as representative as possible;
4. Evaluation of the seismic action loading the soil-foundation system;
5. Calculation of the seismic response of the soil-foundation-structure system.

Technical assistance is provided to the client to ensure better understanding and applicability.

APPLICATION DOMAIN
Structural design, Foundations of Special Equipment, Massive foundations

POTENTIAL BENEFICIARIES
Housing Sector, Industry, Energy, Public works, Hydraulics

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SEISMIC MICROZONING DIVISION

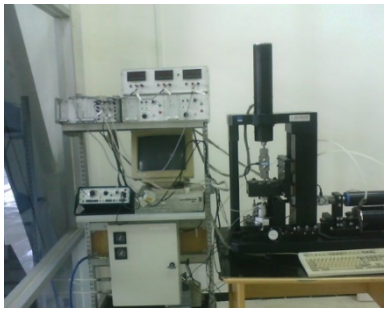
LABORATORY DYNAMIC CHARACTERIZATION OF SOILS

Structural damage caused by earthquakes is mainly influenced by the soil's behavior under cyclic loading. Post-seismic observations revealed that site effects induce, among other, an irreversible subsurface settlement. The study of these effects requires a good knowledge of dynamic soils properties as well as their variation with levels of distortions.

One of the fundamental aspects of soil dynamics is the measurement of these properties. Their variation with distortion, especially in strong seismicity area, is non-linear. This behavior can be characterized by curves giving the evolution of the shear modulus and damping as a function of the distortion.

The devices of the soil dynamics laboratory of the CGS (Cyclic simple shear, Cyclic triaxial) can be/are used for the measurement of the dynamic soils properties.

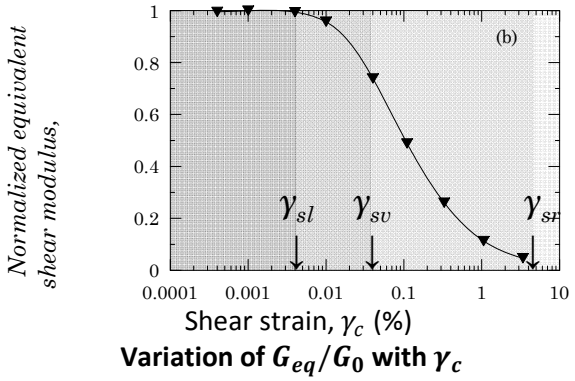
Used apparatus



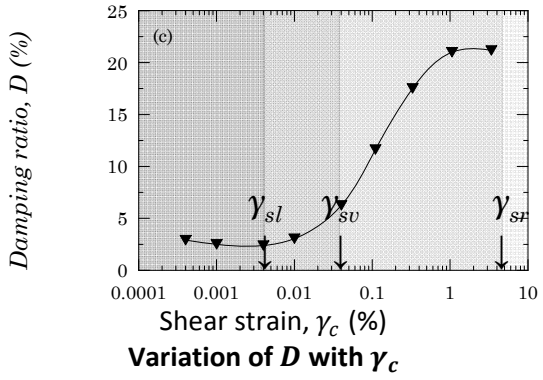
Cyclic simple shear Apparatus

Cyclic triaxial Apparatus

Example of results



Variation of G_{eq}/G_0 with γ_c



Variation of D with γ_c

APPLICATION DOMAIN

Seismic microzoning, Land use planning, Housing and Town planning,

POTENTIAL BENEFICIARIES

Housing sector, Land use planning, Public works, Hydraulics, etc.

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SEISMIC MICROZONING DIVISION

MAPPING OF ACTIVE FAULTS

Development projects and building new cities or strengthening buildings must take into account active faults neighboring these sites. Doing so, need a thorough knowledge of the faults traces, lateral extension and their recent activity. A combined geological and geophysical approach allows the mapping, at metric scale, of these potentially dangerous faults.

Fig. 1- Surface ruptures related to active fault.

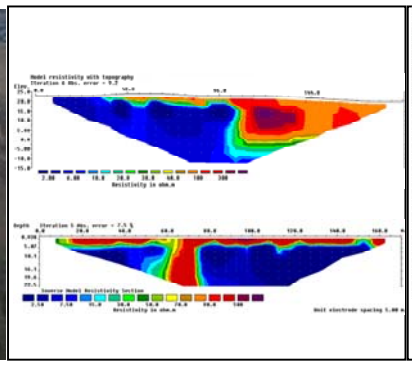

Fig. 2- Imaging of the Thénia active fault by Electrical Resistivity Tomography (ERT).

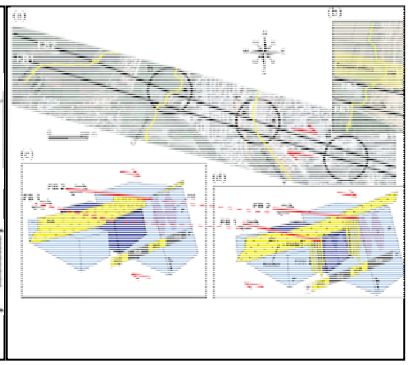

Fig. 3- Mapping of the Thénia fault trace at local scale (Boumerdes city).

APPLICATION DOMAINS

Geological mapping, Natural hazard, Seismic microzonation, Housing and territory planning, Seismic hazard.

POTENTIAL BENEFICIARIES

Housing Sector, Industry, Energy, Public works, Hydraulics

Ministry of Housing Urbanism and Town (MHUV)

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EARTHQUAKE ENGINEERING DIVISION

SEISMIC VULNERABILITY STUDY OF EXISTING REINFORCED CONCRETE BUILDINGS

The National Earthquake Engineering Research Center has adopted a methodology to analyze the seismic vulnerability assessment of strategic existing reinforced concrete buildings in form of a flowchart with certain seismic safety criteria to be respected.

In a first step, the capacity of the building is analyzed in terms of shear forces versus lateral displacements using capacity methods with a computer program Ultimate Analysis of Rectangular Cross Sections (UARCS).

A nonlinear dynamic analysis using real accelerograms is used in a second step to compare the demand to the capacity in terms of lateral displacements and ductility with a computer program Dynamic Response Analysis of Building Structures (DRABS).

Finally, according we compare the obtain results of the demand to those of the capacity in terms of lateral displacements and ductility to make a decision to keep the building as it is because it is safe, to propose a retrofitting or to change the use of the building.

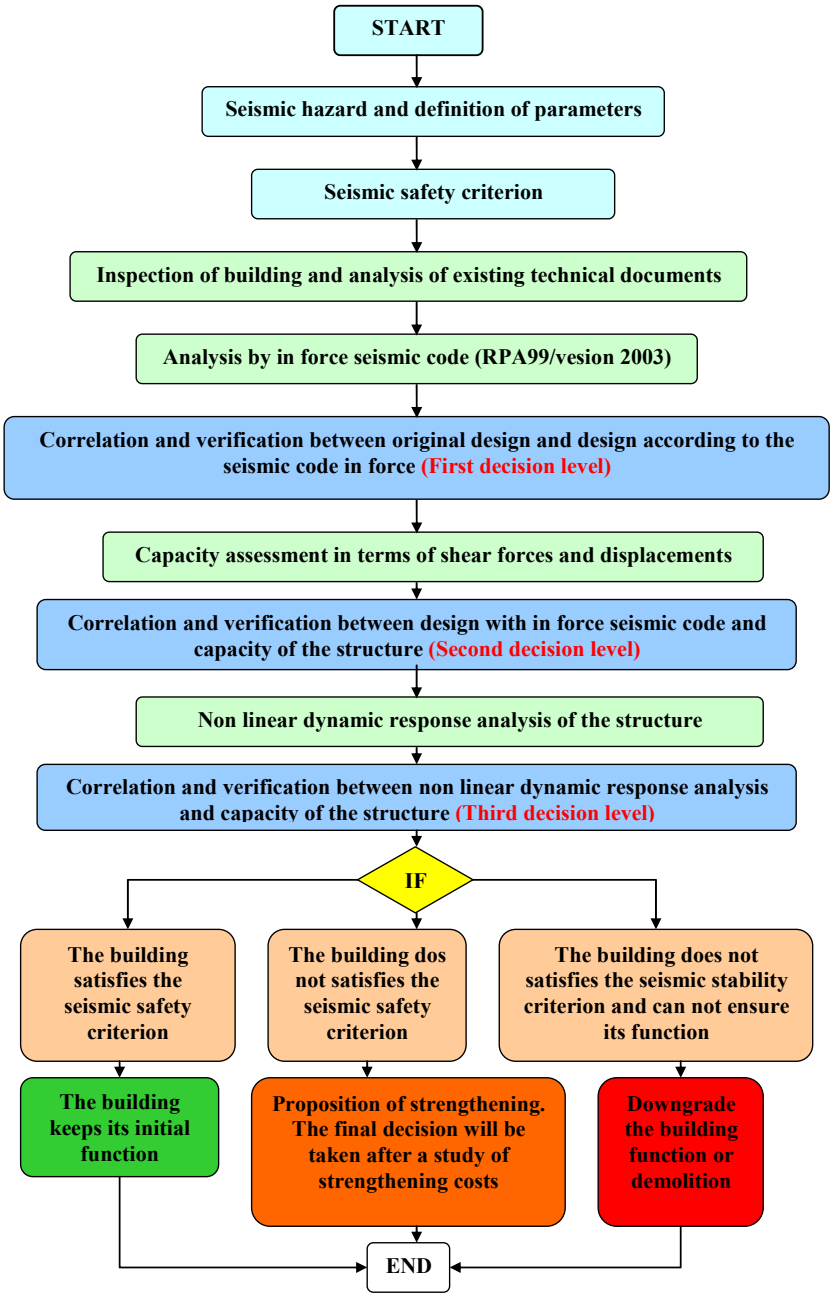
APPLICATION DOMAIN

Capacity method, Nonlinear dynamic analysis.

ECONOMIC BENEFICIARY

Housing sector, Public fittings, Sanitary fittings, etc.

FLOWCHART OF THE METHODOLOGY



Example of a strategic building (Popular National Assembly or parliament in left and telecommunication center in right)

Ministry of Housing Urbanism and Town (MHUV)

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EARTHQUAKE ENGINEERING DIVISION

SEISMIC VULNERABILITY STUDY OF EXISTING UNREINFORCED MASONRY BUILDINGS

The National Earthquake Engineering Research Center has adopted a methodology to analyze the seismic vulnerability assessment of strategic existing reinforced concrete buildings in form of a flowchart with certain seismic safety criteria to be respected.

In a first step, the capacity of the building is analyzed in terms of shear forces versus lateral displacements using capacity methods with a computer program Ultimate Analysis of Rectangular Cross Sections (UARCS).

A nonlinear dynamic analysis using real accelerograms is used in a second step to compare the demand to the capacity in terms of lateral displacements and ductility with a computer program Structural Dynamic Ultimate Analysis of Masonry Buildings (SDUAMB).

Finally, according we compare the obtain results of the demand to those of the capacity in terms of lateral displacements and ductility to make a decision to keep the building as it is because it is safe, to propose a retrofitting or to change the use of the building.

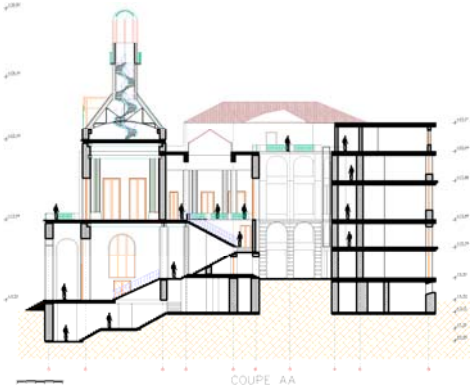
APPLICATION DOMAIN

Capacity method, Nonlinear dynamic analysis.

ECONOMIC BENEFICIARY

Housing sector, Public fittings, Sanitary fittings, etc.

Example of a strategic existing building (Town Hotel Constantine)



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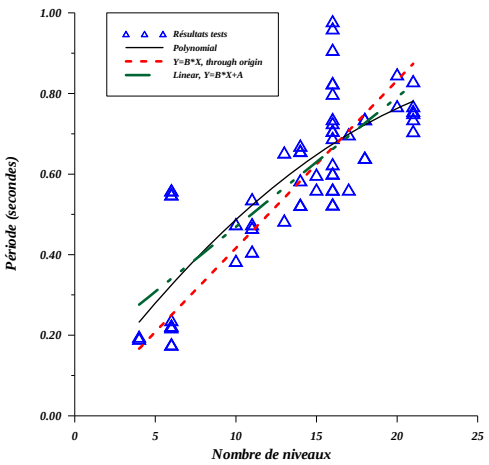
EARTHQUAKE ENGINEERING DIVISION

DETERMINATION OF DYNAMIC CHARACTERISTICS OF STRUCTURES BY AMBIENT VIBRATION MEASUREMENTS

Study of the intrinsic dynamic characteristics of real structures (natural periods and mode shapes) on site, using ambient vibration measurements with an equipment composed of seismometers Lennartz 5s with three components (vertical, NS and EW) and CityShark II measurement stations. It is a technique that captures the vibrations of the structure, which is excited by regular service loads and by climatic conditions (sensitive noises such as wind and which is then amplified up to 5000 times. Then, a specialized algorithm makes it possible to extract the modal properties contained in the signals recorded on the site.

Example of equipment used for ambient vibration measurements and results.

Cityshark II, station



Period variation with number of stories

APPLICATION DOMAIN
Ambient vibrations, signal processing, mode shapes.

POTENTIAL BENEFICIARIES
Building fields for all uses (Housing, public facilities, etc.)

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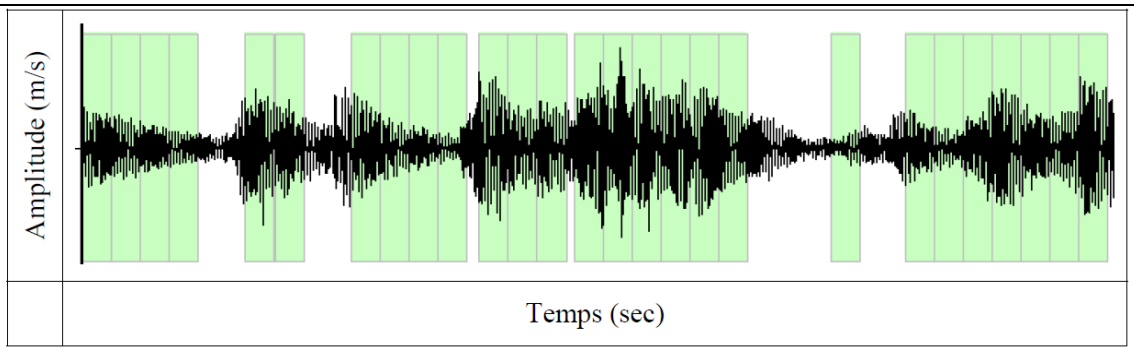
EARTHQUAKE ENGINEERING DIVISION

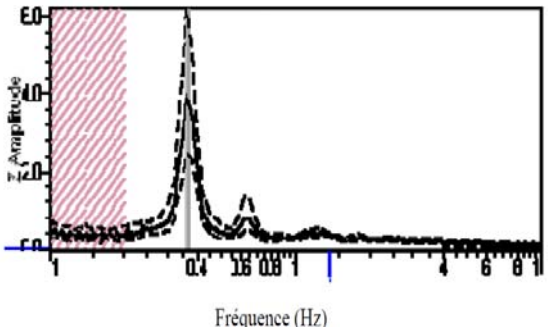
DETERMINATION OF DYNAMIC CHARACTERISTICS OF BRIDGES AND SPECIAL STRUCTURES USING AMBIENT VIBRATION MEASUREMENTS

The response of the structure to ambient vibrations is recorded for a certain time (of the order of 15 to 30 minutes) and then interpreted by processing the signals obtained. Ambient vibrations induced by human activity (industries, traffic), wind, swell, etc. have the advantage of existing anywhere and at any time, without the need to generate them. Despite their amplitude (10^{-6} to 10^{-4}), it is possible to measure the response of structures to these stresses and to deduce their dynamic characteristics (natural periods, modal damping and mode shapes) in the field of small strain (linear elastic domain).

Structures such as important (significant) bridges should be the subject of regular campaigns of ambient noise measurements in order to monitor the evolution of their behavior throughout their operation because the protection and maintenance of their functionality before and after an occurrence of a disaster (earthquake, cataclysm, etc.) are vital, not only for the evacuation and rapid delivery of relief, but also because of their socio-economic and strategic nature.

Some tests on bridges with results (recording of ambient vibration noise and fundamental frequency obtained on a reinforced concrete bridge)





Recording of ambient vibration noise and fundamental frequency obtained on a bridge.

APPLICATION DOMAIN

Ambient vibrations, signal processing, modal shapes.

POTENTIAL BENEFICIARIES

Fields of Public Works, Housing, Hydraulics, etc.

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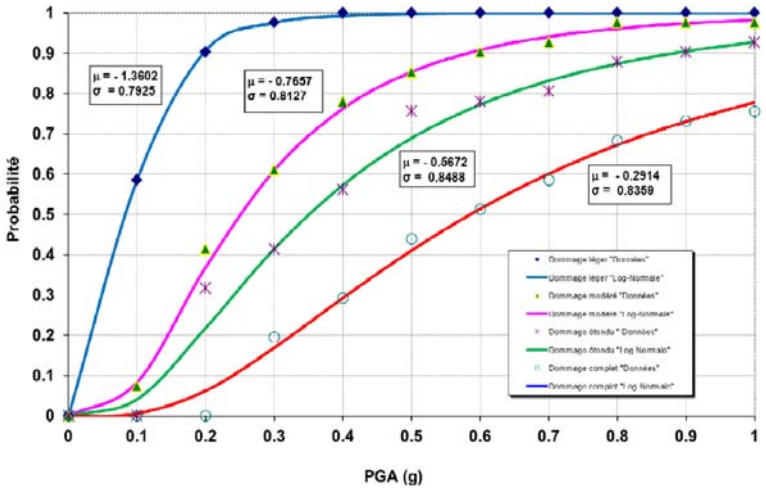
VULNERABILITY STUDY OF REINFORCED CONCRETE BRIDGES

During an earthquake, part of the loss of the road network is the result of poor performance of bridges. The losses generated can be of different kinds; we can cite the loss of human life due to the collapse of the bridges, the direct material losses due to their damage and indirect material losses resulting from the disruption of traffic and economic activities in the region struck by the earthquake. Therefore, seismic vulnerability studies of basic infrastructure such as bridges play an important role since it is from these studies that seismic risk reduction measures could be taken and an emergency plan could be drawn up (established). Assessing the seismic vulnerability of bridges is therefore a study that falls within the field of seismic risk management.

Appropriate recommendations will be formulated from the results found, thus forming a tool for managing the seismic risk from which the National Bridge Park is facing.
Bridge vulnerability studies make it possible to establish a classification of these structures according to their degree of seismic vulnerability (structural weakness) and therefore define the intervention priorities that they require. All the more so, since they would serve to establish an intervention action strategy on these structures, aiming to increase their life time and improve their behavior to face earthquakes (seismic shocks).

On the other hand, the evaluation results of this vulnerability analysis can be used on the one hand, within the field of a management policy and planning of seismic heritage protection programs, and on the other hand, for the development of seismic risk mitigation or mitigation strategies.

Example of a vulnerability study of reinforced concrete bridges with results in terms of fragility curves.



APPLICATION DOMAIN

Capacity study, non linear analysis, vulnerability of bridge piers, fragility curves.

POTENTIAL BENEFICIARIES

Public works fields.

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EARTHQUAKE ENGINEERING DIVISION

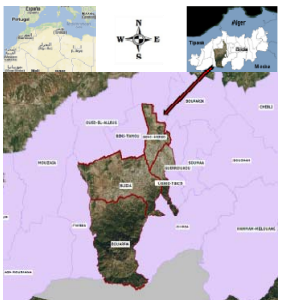
VULNERABILITY AND SEISMIC RISK ASSESSMENT STUDIES OF URBAN AREAS

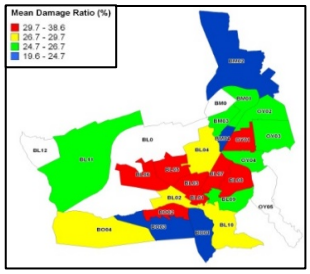
Within the framework of the national seismic risk reduction policy in Algeria, one of the privileged means consists in setting up analytical tools and carrying out actions for an effective prevention of this natural phenomenon effects. Among the most effective actions, it is appropriate to conduct studies of "**Vulnerability and seismic risk assessment of urban areas**". They consist, in a first step, to perform an "Earthquake damage scenario", which provides a first insight of the space distribution of the damage and their extent, in order to elaborate, in a second step, an action plan aiming to reduce the human and economic losses.

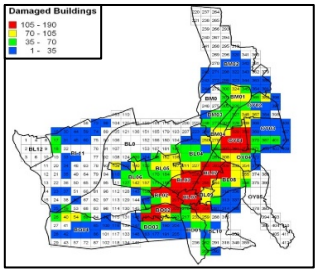
CGS has the tools and skills to carry out these studies which will lead to the following results:

- Inventory of the urban fabric (existing buildings), lifelines (electric power supply, gas supply, water supply, sewage, Telecommunications networks, etc.), road infrastructures (bridges and roads), port and airport infrastructures with implementation of their GIS database.
- Data analysis and loss estimation of the whole exposures through the performance of "Earthquake scenarios".
- Generation of GIS damage maps and identifying the urban areas and exposures that could be the most vulnerable.
- Estimation of the expected number of victims and their spatial distributions
- Recommendations and set up of an action plan.

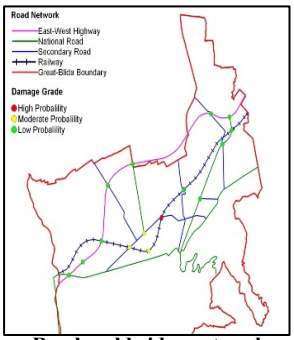
Examples of resulting GIS damage maps:







Existing building damage maps



Road and bridge networks damage map

APPLICATION DOMAIN

- Vulnerability of Building, lifelines, road, port and airport infrastructures
- Prévention et Gestion du risque sismique

POTENTIAL BENEFICIARIES

- Public authorities and local collectivities

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REGULATION AND SEISMIC RISK REDUCTION DIVISION

SCIENTIFIC AND TECHNICAL TRAINING SEMINARS

Scientific and technical training is carried out through the organization of seminars for the benefit of engineers from design offices, control offices, construction companies and any other actor in the field of civil engineering in general and seismic reduction in particular.

Six (6) to ten (10) seminars are organized annually (at CGS headquarters) among the following topics:

1- Seismic hazard and microzoning;
2- Geotechnical tests;
3- Foundations of works (shallow foundation, deep foundations);
4- Landslides;
5- Retaining structures;
6- Soil liquefaction;
7- Soil dynamics;
8- Dynamics of structures (linear and non linear analysis);
9- Experimental methods (laboratory and in-situ);
10- Reinforced concrete structures;
11- Steel structures;
12- Masonry structures;
13- Design and seismic calculation of structures;
14- Vulnerability, rehabilitation and reinforcement of existing buildings;
15- Seismic risks of urban fabrics

For more information, it is recommended to consult the CGS website.

In addition, the CGS can organize, on request, more targeted training. This operation will then have to be the subject of an agreement between the requesting organization and the center to set the execution conditions.

APPLICATION DOMAIN

Earthquake engineering training, regulatory enforcement and seismic risk reduction

POTENTIAL BENEFICIARIES

Design offices, control offices, construction companies, public and private contractors

Ministère de l'Habitat de l'Urbanisme et de la Ville (MHUV)

المركز الوطني للبحث المطبق في هندسة مقاومة الزلازل
CENTRE NATIONAL DE RECHERCHE APPLIQUEE EN GENIE PARASISMIQUE
NATIONAL EARTHQUAKE ENGINEERING RESEARCH CENTER
(CGS)

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SERVICES PROVIDED BY CGS
TECHNICAL DEPARTMENT

ASSESSMENT OF THE SEISMIC PERFORMANCE OF INNOVATIVE STRUCTURES

Earthquake protection of structures consists in adopting specific provisions for these constituent elements, as well as their connections, in order to achieve adequate resistance and sufficient ductility for the structure. The application of the seismic codes (RPA99 / 2003) is not always sufficient to guarantee the achievement of the necessary performances. For innovative processes in particular, it is essential to use experimental investigation in order to understand all the phenomenon that may arise during a seismic event.

The CGS has a shaking table with six degrees of freedom to simulate real or synthetic earthquake records applied at the base of the specimen to be tested. A set of four static and dynamic hydraulic actuators fixed on the reaction wall and reaction floor allowing the application of various loading (forces, displacements) on real-scale structural models. This platform allows us to apply various static and dynamic actions. The test can be subjected to analyze coupled with numerical simulations using nonlinear computing software.

Our center, CGS, offers experimental technical-assessment services to support and keep company to the construction players in developing and improving their innovations.

Shaking Table

Reaction Wall

APPLICATION DOMAIN
Experimental Evaluation

POTENTIAL BENEFICIARIES
Construction sector: Housing, Public works, Hydraulics

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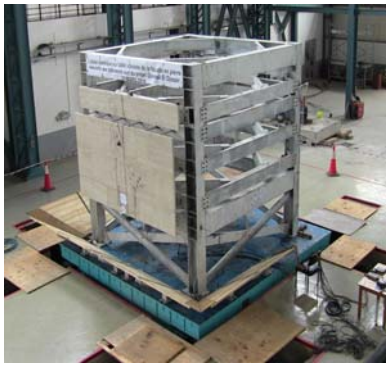
TECHNICAL DEPARTMENT

SEISMIC QUALIFICATION OF NON-STRUCTURAL COMPONENTS

Effective seismic prevention involves considering the risks induced by non-structural components of the building (chimneys, partitions, facade elements, suspended ceilings,...). During an earthquake event, non-structural elements can cause injuries to occupants and cause damage to the mechanical and electrical equipment contained in the building.
This damage can prevent continued use of the building after an earthquake. It was found from the past earthquakes that the damage to the non-structural components gives the largest contribution to the economic loss. Hence, knowing the seismic performance of nonstructural elements is very important while assessing the seismic performance of a building.
The CGS seismic engineering laboratory is equipped with various test equipments, including servo-hydraulic shaking table with six degrees of freedom, a strong floor and strong wall. The CGS laboratory provides services for seismic qualification of non structural components. These tests allow us to understand the behavior of non-structural component in the event of an earthquake.

Examples of tests carried out in the CGS laboratory



Facade system Natural stone - Moucharabieh
Seismic qualification testing of facade system of Djamaâ El-Djazair

APPLICATION DOMAIN
Experimental Evaluation

POTENTIAL BENEFICIARIES
Construction sector: Housing, Public works, Hydraulics

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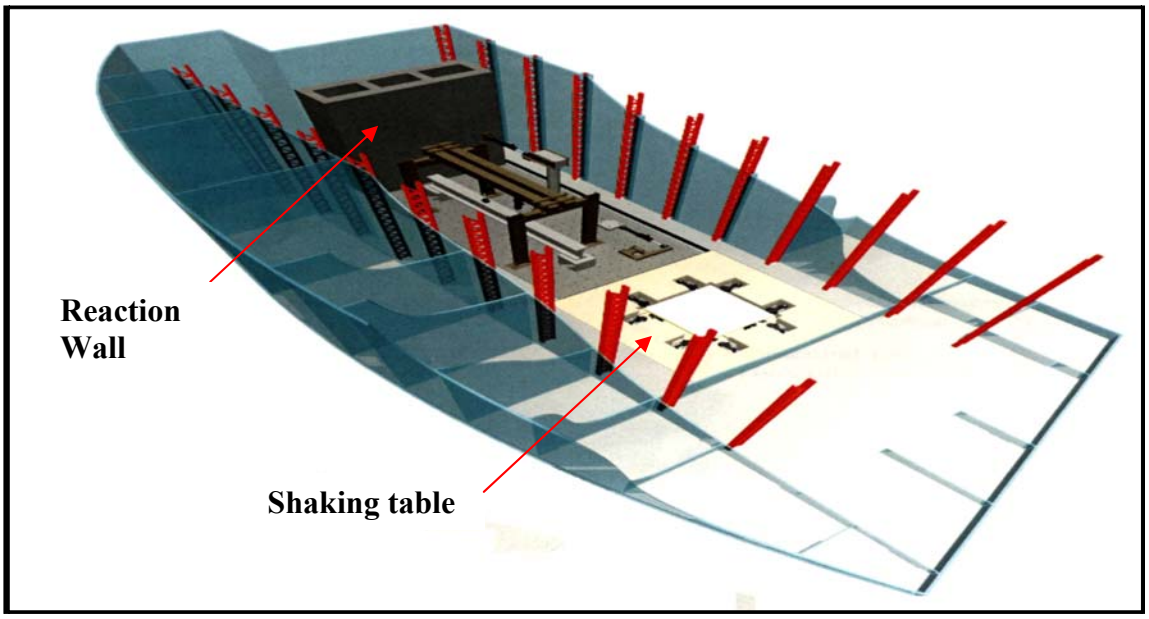
SERVICES PROVIDED BY CGS
TECHNICAL DEPARTMENT

ENDURANCE TESTS OF INDUSTRIAL EQUIPMENT

The qualification requirements for integrating vibration phenomena are gradually becoming generalized to all sectors of industrial activity**.** In many engineering applications, equipment and components are exposed to severe vibrations which may eventually, after a number of cycles, lead to component failures. To validate whether the hardware components will remain operational during the service life, they are subjected to extensive vibration tests, so-called endurance tests. This type of testing is essential for product quality assurance, new product research and development.

The CGS seismic engineering laboratory is equipped with diverse test equipments, including servo-hydraulic shaking table with six degrees of freedom, a strong floor and strong wall. The CGS laboratory provides services for seismic qualification and other endurance testing for industry clients.



APPLICATION DOMAIN
Experimental Evaluation

POTENTIAL BENEFICIARIES
Industry sector, Energy, Maritime navigation