EUROPEAN CENTRE ON PREVENTION
AND FORECASTING OF EARTHQUAKES (ECPFE)

EARTHQUAKE PLANNING AND PROTECTION ORGANIZATION (OASP)

EMERGENCY EVACUATION OF THE POPULATION IN CASE OF AN EARTHQUAKE

Handbook No 3

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FOREWARD BY ECPFE AND OASP

Information, training and education of all parties involved are a corner stone for an effective emergency response. Holding this view, European Centre on Prevention and Forecasting of Earthquakes (ECPFE) and Earthquake Planning and Protection Organization (OASP) continue the publication of the series of handbooks on various matters concerning earthquake emergency planning and response.

This third handbook refers to the process of emergency building evacuation and taking to safe spaces of the population in the case of an earthquake.

After a strong earthquake people tend to evacuate the buildings and to take refuge in open spaces, even in cases when the building has not suffered any damage. The fear of forthcoming shocks, the psychological condition of the population and experience transferred from generation to generation, enhance this behaviour especially in earthquake prone areas.

The process takes place on impulse, yet there is much room for planning and interventions for a safer, faster and more effective emergency evacuation. A number of issues need to be tackled:

- What are the actions to be taken before the earthquake occurs in order to select, design, signal and equip with facilities the escape routes and refuge spaces in the city
- Which are the specific guidelines for planning emergency evacuation in areas of different land uses such as residential areas, schools and welfare institutions, shopping centres and office buildings, hotels and recreation areas, industries and small business
- Which are the operational aspects of the evacuation procedure
- What information the population and the agencies involved, should be given before and after the earthquake

Safe and rapid refuge of the population in safe spaces after an earthquake has to do mainly with the characteristics of the built environment. It is also associated with the preparedness and training of agencies involved in emergency planning and response.

It should be underlined though that technical and operational measures taken by the administration are not sufficient. The active, positive participation of the population is also required and for this information and awareness of the population is of prime importance. In this respect, the constructive involvement of the media and of volunteers should be aimed at.

The handbook targets mainly the administration at local and national level, as well as the people accountable for the safety of multi-occupancy buildings, schools and welfare institutions, business and industry, recreation facilities and the tourist industry. It can be used for the training of volunteers to be involved in emergency response and aid provision. It is also of the interest of the population who should respond to an earthquake without panic, keeping in mind that in crisis situations the actions of every single one of us affect greatly the safety of the others.

Extended damages in the city of Rhodes (Greece) from the May 3rd, 1481 earthquake (woodcut, 1496, Ulm, Germany).
(Source: National Information Service for Earthquake Engineering, University of California, Berkeley, Kozak Collection, http://www.berkeley.edu/cgi-bin/kozak).

Ansei Edo, (Tokyo), Japan, 11/11/1855 earthquake: destructed and burnt houses. The living creature on the sky carries a stone to fight the «catfish», the kind of fish that causes the earthquake. (19th century woodcut). (Source: National Information Service for Earthquake Engineering, University of California, Berkeley, Kozak Collection, http://www.eerc.berkeley.edu/cgi-bin/kozak).

AN INTRODUCTION BY THE AUTHOR

The European Centre on Prevention and Forecasting of Earthquakes and the Earthquake Planning and Protection Organization have jointly decided to co-finance the compilation and publication of the present manual entitled **«Emergency evacuation of the population in case of an earthquake»** in order to prevent and mitigate the earthquake disasters in our country.

TThis manual incorparates elements from the limited existing bibliography and makes use of the greek fire safety regulations. Furthermore, it takes into consideration the reports and the experiences from past earthquake disasters in Greece. It also develops and incorporates, among the abundance of earthquake protection guides and manuals being in use in the USA and Canada, those elements that are compatible with greek particularities.

The immediate post-erthquake emergency phase, within which the evacuation and population refuge procedure takes place, is very short. It is a period lasting a few hours up to three or five days. But, what happens in these few hours or days is of crucial importance to the final losses. In spite of the fact that human societies have not, up to now, managed to eliminate the "fatality" of earthquake disasters, the final losses depend a great deal on how each one of us will react, how he will experience and face the disastrous event, at the moment of the tremours -and immediately afterwards. This means that the pre-disaster planning of evacuation and refuge requires not only the participation of the central and local state, of the administration and the emergency mechanism, but also some kind of self-organization and "self- planning" from the side of the individual citizen and household.

That is exactly the difficulty of the respective pre- and post- earthquake planning. In this context, the present manual attepmts to place each one of us within the discipline axes of an emergency plan, taking into consideration his/her particularity. Success will depend on how Local and Prefectural Authorities, and the administration in general, as well as the individual citizen of the country (which happens to be earthquake prone) will be convinced of the necessity of a responsible attitude towards self-protection.

The evacuation of indoor spaces, escape and refuge of the population towards spaces providing safety immediately after the shock, is not simply an emergency operation whose success depends exclusively on operational planning principles. A combination of "preventive-precautionary" spatial planning and operational preparedness of the evacuation-refuge procedure -as the prelude of the rehabilitation phase- is indispensable. The aim and the philosophy of this manual is a composite consideration of all planing levels (precautionary-preventive, operational, rehabilitating). The manual suggests measures and practical solutions to all the potentialities and queries that could possibly arise during this short-termed, but complex and delicate operation, up to its completion and transition of the stricken community to the rehabilitation phase.

This manual targets all levels of administration (**Central Administration, Prefectural Governement and Municipalities**) and in particular the departments and services with responsibilities relevant to earthquake protection. It incorporates, however, all the necessary material wich should reach the population in the form of brochures, posters, cartoons, signs, guides, informative television and radio shows, seminars and earthquake preparedness drills, in order to convince them that the danger is not about the "others", far from us, but hereby, threatening us.

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Harokopeion University

1. INTRODUCTION: A FEW WORDS ON THE EVACUATION PROCEDURE, THE REFUGE SPACE AND THE EMERGENCY FAMILY PLAN

Immediately after a disastrous earthquake, the population rushes to evacuate all indoor premises seeking refuge in squares, streets and private cars. These instinctive evacuation actions are usually characterised by:

- *Panic;* under its effect, people move around without a particular destination.
- *Traffic congestion;* due to simultaneous movement of pedestrians and vehicles towards various directions.
- *Ignorance about places and spaces providing safety;* as a result, innappropriate open spaces, possibly more dangerous than the evacuated indoor ones, are used as refuge places.
- *Ignorance about safe evacuation routes* leading up to the open spaces of refuge.
- *Uncertainty concerning the term of stay* at the refuge spaces and the next destination.

In order to mitigate all these problems, it is necessary to define and localize (prior to the disaster) those open spaces providing safety to all the people who will evacuate homes, office buildings, department stores, industrial sites, hotels and clubs, during the day, but also at night, in small towns, as well as in large cities. In addition to that, the population shoud be aware **of the most appropriate time to start evacuation, of the safer routes to follow, of the most reliable means to approach (on foot or by car), what they should bring along, how much time they are going to stay at the refuge space, how to contact their family, etc**. Alternative answers are given to all these queries in the following paragraphs. The predisaster planning solutions, however, are not unique and unequivocal. These solutions are tested at the time of crisis. The manual considers real time feedback processes as well. It points out ways of testing and possibly reconsidering and reforming of the pre-disaster provisions, as well as methods to make crucial decisions on the spot, depending on the situation. It is all about the precautions taken and the decisions made not only by the emergency administration mechanism, but also by the individual "family plan". It is also about the many small scale decisions that will have to be made by the individual evacuee at the time of the crisis.

It should be pointed out that the **"emergency family plan"** is a necessary stage and level of the operational planning. The initiative for its establishment and well-keeping belongs to the family alone, the unit of the household, which will inevitably be activated for self-help and self-defense.

2. ACTIONS TO BE TAKEN BEFORE AN EARTHQUAKE

2.1 Pre-disaster localization of escape routes and refuge spaces - Infrastructure provisions

A. The case of residential areas

Criteria to select a refuge space

The main objective is to find the maximum possible number and size of open spaces providing safe short-term stay to the population immediately after the first tremours. The offer of alternative spaces is not simply welcome, it is an essential prerequisite for a successful escape and refuge procedure. The more spaces found and properly equipped, the better chance for those who will, reasonably or not, leave their homes to protect themselves. **Pedestrian access of refuge places is preferable over all the other modes of access** (maximum walking distance 200-300m), especially in the central densely populated districts of metropolitan agglomerations, where the use of private cars may prove to be a pointless and dangerous choice.

The use of private cars is scarcely recommended. However, it cannot be excluded as a second phase choice (a few hours after the earthquake) to approach the most remote, isolated and peripheral open spaces. It is an alternative possibility, maybe the only one, for the vulnerable and difficult to move groups of the population. It is also a strong choice to make in the case of bad weather conditions. As a consequence, the maximum acceptable distance to be covered on foot cannot be a criterion excluding certain open spaces from being used as refuge during emergency post-earthquake period.

The population taking refuge in a central square in the city of Charleston after the 1886 earthquake.
(source: http://stargate.jpl.nasa.gov:1080/cgi-bin/lay).

On the contrary, reliable criteria **to reject a space as refuge** are: **the risky conditions** that could result from secondary or indirect effects and post-earthquake tremours, **the restrictions concerning their land use and safekeeping**, their ownership status and the lack of elementary infrastructure. Nevertheless, no matter how detailed and sophisticated pre-disaster preparedness and prevention planning of refuge spaces is, the temporal, spatial and modal details of the actual refuge process depend a great deal on the warnings and the consulting information that will be broadcasted by the media at the crucial moments (see also 3.1). The same stands for the advisable, according to the circumstances, means to approach the refuge spaces. Below, there is an analysis concerning the criteria for their pre-disaster selection (see also OASP, 1992 and OASP, 1994):

I. Land use under normal conditions

Squares are usually a very good solution for a safe refuge.

Guarded open sport fields are not recommended, despite the fact that they are reliable from the safety point of view. Finding the keys to unlock them might be difficult. They are only recommended if operating at the moment of the eartquake.

- Squares and vacant plots
- Urban greenery areas (parks, playgrounds)
- Open sport centres (impossible to be used in case they are locked up)
- Church yards and in general open spaces surrounding public or communal facilities (sport fields, gymnasiums, education and welfare institutions, cultural clubs etc)
- Peri-urban greenery areas

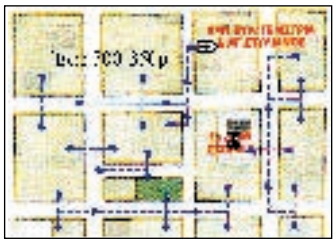
Access limitations are of crucial importance. Guarded places sould be avoided because of the difficulty of immediate access at the critical time and also because they are favorable to be used as refuge places for the most vulnerable groups of the population or for other emergency operations. (School yards, for instance, are recommended for pupil refuge or for installing tents for the homeless).

II. Location

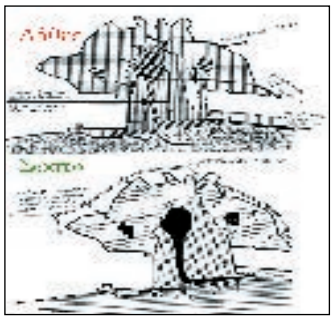
- Within the inner urban area, **on locations within walking distance from residential buildings**.
- In the peripheral zone, accessible either to **pedestrians** or by **private car users (a few hours after the quake**). This second case will prove to be important in case of seismic events during the winter, during the night, or under rainy weather conditions. Of course,

peripheral spaces will inevitably be used by people who will happen to be in their cars at the time of the event and who will not be able to reach the refuge places of their neighbourhoods or who will not be willing to abandon their private cars.

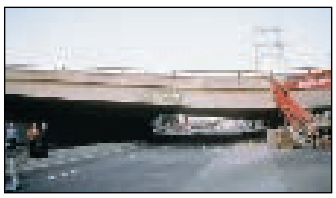
III. Accessibility and means to approach



Moshato neighborhood: the arrows indicate the routes that the residents should follow to reach the refuge areas (source: OASP, 1999).



The regulation of the flow of traffic in Kalamata city on the sketch above is not favorable to the evacuation because of the only exit/entrance to the city. On the contrary, the sketch below offers multiple exits and entrances (source: G. Diamantopulos/ KEPAME, 1991).



Collapse of a flyover part of a highway (Northridge earthquake, California 1994)

- The spaces within the densely built and populated urban districts should be located within walking distances (max. 300-350 m.) via alternative pedestrian evacuation routes, which make up the **pedestrian evacuation network**. The use of private cars for this purpose should be discouraged, not only because parking on these locations would be irrealisable, but also because emergency crews should be able to obtain easy access to the refuge spaces. Consequently, the connection of all the candidate spaces with the pedestrian evacuation network, but also the road axe allowing easy access to the emergency vehicles, are essential.
- The spaces in the peripheral zone should be accessible by car via **alternative evacuation roads**. Hence, these spaces should be located along the main road network leading up to exits of the city. This network should not include flyovers or crossings with natural or manmade obstacles (rivers, train rails, etc). In addition, it should not be endangered by tsunami waves or pass by or through facilities prone to explosions and fires. In the case of two-way road axes, a traffic islet is desirable. The routes to evacuate the city should not pass by hospitals and other emergency facilities. There must be **multiple exit routes from the centre towards the peripheral open spaces**. In the case of medium-sized cities, it is possible to later transform these places into temporary accomodation sites for the homeless, as long as they are equipped with the necessary infrastructure.

IV. Safety standards of the pedestrian evacuation network

The space around buildings is not safe.

Safe evacuation routes are considered the pedestrian ways meeting the following standards:

- The presence of a frontage space beside and along the pedestrian way, (equal to one third of the building's height) at least, as well as the presence of rows of trees alongside and/or sheds.
- The absence of crossings with natural or manmade obstacles (roads, train rails etc) and flyovers.
- The absence of elements and installations prone to explosions and fires (along the pedestrian ways).
- Location away from emergency facilities and overcrowded areas.
- The absence of walls, glass panelligs and electric power posts alongside or in contact to the pedestrian way.

V. Safety standards of the refuge spaces

Collapse of a fence in Menidi caused by the 1999 Parnitha earthquake.

Rock fall after the 1994 Lefkada (Greece) earthquake.

Safe refuge spaces are considered the open spaces meeting the following standards:

- Location away from dangerous soils (from the geological aspect of view), prone to landslides, subsidences, rock falls, etc, and away from large mounds or underground galleries.
- In seaside areas, location on altitudes excluding the potential danger of tsunamis.
- Distance from the surrounding buildings at least equal to the half of their height.
- Location away from large technical works (bridges, groundworks, dams etc).
- Location away from electric power lines or where there is a danger of fallen elements (posts, traffic lights etc).
- Distant location from areas threatened by the destruction of other facilities (fuel tanks etc).
- Location at a distance of at least 5 m. from walls, glass panellings, balusters etc.

VI. Ownership status

It is desirable for refuge spaces to have a public ownership status. If this is not the case, then the maintenance and the management of such spaces should preferably lay on the hands of institutions which have the authority, the financial capability, but also the interest to invest on the necessary emergency facilities and infrastructure.

VII. Infrastructure and equipment

Spaces appropriate for population refuge are those that already have or will obtain in the immediate future the following infrastructure and equipment:

- Electrical lighting from the city network and, for the case of a post-disaster blackout, backup generator or portable hurricane lamps.
- Water supply by means of a pre-disaster installation of a tap per 50 persons. The exigible water amount is 3 litres per person daily. There should be arrangements for transporting water by water wagons or distributing bottled water in the post-disaster phase and in case the water supply is cut off.
- Sanitation facilities and connection to the city's sewage system. 1 WC per 40 persons is recommended.
- A small shed for storage.
- Garbage buckets.
- Signalling of the spaces and of the evacuation routes.
- In the case of peripheral spaces, additional parking areas, either around or inside the refuge spaces. They will be indispensable under bad weather conditions.

Except all of the above, in the refuge spaces, information dissemination, food distribution, provision of medical care and psychological support, protection of valuable items etc, will probably become a necessity, especially if the spaces are meant to accomodate earthquake victims for more than 24 hours.

Typical in the USA signs marking the evacuation routes and the emergancy parking areas.

Hygiene conditions are very important.

Water distribution to earthquake victims.

Criteria for checking the adequacy of refuge spaces

The refuge spaces (a) those within walking distances, inside the city and (b) those in the periphery, accessible by car, are considered adequate, literally and practically, if and when they suffice for the total of the population of the city or the urban area under consideration.

This adequacy definition derives from the likelyhood of utmost conditions with respect to the use of cars: private carstock will either be useless (roads and evacuation routes will be blocked by debris or by imposed traffic restrictions) or fully activated a few hours after the earthquake, due to hard weather conditions, etc.

In reality, and despite prior information campaigns, as well as posterior advice given to the public, there will be reactions in both directions: others will make use of their private means of transportation and others will not. The success of prior planning and posterior guidance lays on the extent to which all various potentialities and different post-earthquake conditions will be taken into consideration. Two basic principles can be adopted: (a) the districts of the basic urban fabric (by inference those incorporated in the statutory Town Plan) of the large cities and metropolitan agglomerations should have spaces **within walking distances** from the residential buildings and indeed via routes providing safety for the **totality of their inhabitants,** and, (b) the available capacities of the peripheral spaces will be judged according to their capacity in private cars, which constitute the basic medium of accessibility.

Depending on the level of adequacy of **the existing refuge spaces located within walking distances -the first priority in all evacuation plans**- pre-disaster decisions have to be made concerning the proper evacuation policies to be followed, if an emergency arises. If the spaces located within walking distances are not sufficient, then, the more isolated and remote peripheral spaces should be exploited. The procedure of the additional evacuation of people inside cars (or the vulnerable groups of the population who will be transported by vehicles reserved to this purpose) should be well organized, without prohibiting the emergency crews from reaching the areas of destruction. In this case, charts will be required to regulate the circulation of the evacuation, which, of course, should be clearly separated from the circulation of the emergency crews. If the peripheral spaces too are not enough or inaccessible, then the earthquake victims should be encouraged **to seek refuge in their holiday residencies**. The prevailing conditions in each case of town/city or Municipality dictate the adoption of one or the other of the above scenarios, which, in turn, affect the pre-disaster planning and post-disaster instructions to be broadcasted to the public.

The criteria for checking the adequacy of the refuge spaces are elaborated as follows (see also OASP, 1992 and OASP, 1994):

VIII. The required capacity and the available

Square "Psila Alonia" in Patra -Area appropriate for refuge
(source: EC/ OASP, 1998).

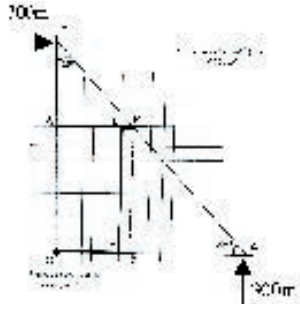
"Liberty Square", Patra. Area appropriate for refuge
(source: EC/OASP, 1998).

- **The existing capacity of the spaces available inside the city fabric** is calculated on the basis of the proportion of $2m^2$/person and the size of the spaces selected for each urban area. Inspections on the spot have to be carried out resulting in delimitation of the **"active" surfaces**. This means to exclude those surfaces covered with fountains or other elements, those that do not comply with the standards of safety distances (for instance, 5m at least from building sides, walls, balusters, safety distances from electric power lines and posts etc) or those that will be used for parking emergency vehicles.
- **The required capacity of spaces inside the city fabric** is calculated on the basis of the maximum population density of the residential area under consideration, from which the area's total maximum population is extracted. Extra care must be taken when setting the limits of these areas. Routine urban planning criteria should not be followed then. An inseparate residential area should not be crossed by natural or manmade obstacles, even if they are of emergency character (for instance, a two-way avenue used by emergency crews). If the available capacities of the open spaces inside the delimited urban districts fall shorter than the required ones, then the additional prospects of using the traffic islets as parking spots, as well as activating a car evacuation network a few hours later, via a series of alternative roads leading up to the peripheral refuge spaces, must be examined. This network must be clearly separated from the network used by emergency vehicles.
- **The available capacity of the peripheral spaces** equipped with the necessary infrastructure (criterion VII, p. 14) is calculated on the basis of the number of the available parking spots, inside or around the refuge space.
- The evaluation of the available capacity of the peripheral spaces (based on the parking spots) will give the opportunity to those responsible for the evacuation to guide the evacuating population either to the peripheral

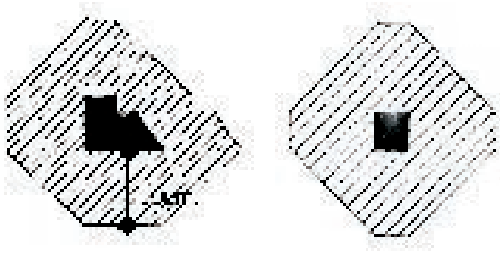
zone, or to the individualized solution of the holiday residencies, which, in the case of large urban agglomerations, is a major alternative possibility.

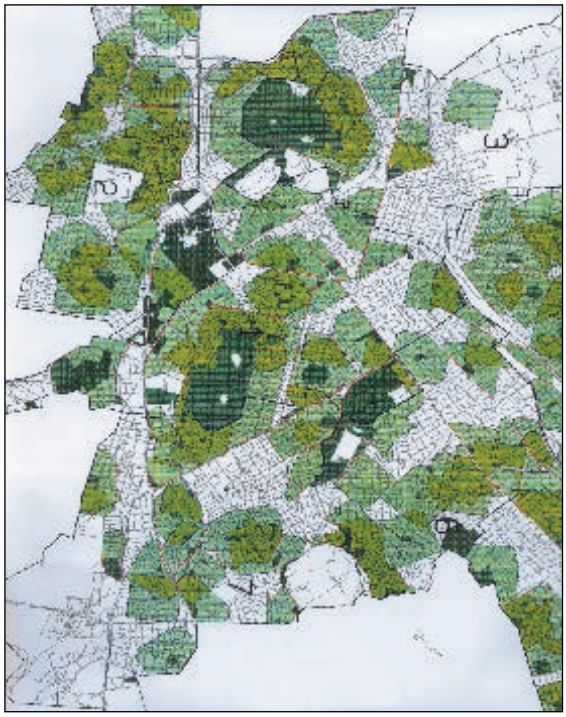
IX. Maximum distance from residential buildings

The maximum acceptable walking distance of the spaces inside the dense urban structure varies. In any case, a distance between 300-400m is considered to be the maximum, since it is equal to 5'-6' of intense walking. In densely populated areas, lacking safe pedestrian ways to reach the refuge spaces, the acceptable distance is shorter than 250m. (see sketch).



The areas serviced by the refuge spaces and how to set their limits in the case of a gridiron pattern of the network (source: Ministry of Environment Planning and Public Works/ OASP, 1985).





The refuge spaces in the Municipality of Athens and the areas served. On the map, the district areas having alternative choices are clearly distinguished from those having only one possibility or no service at all (source: NTUA, OASP, 1997, «Emergency Operational Plan of the Municipaltiy of Athens»).

Who is responsible for locating, signalling and equipping the refuge spaces with the appropriate infrastructure?

The responsibility to declare an open space inside the urban fabric as a potential refuge space lays on the **town-planning and technical services** of the Municipality or the Prefectural Government. This declaration should be made after an inspection on the spot and the fulfiling of a specific card comprising details on the features of the site that justify its emergency use after the quake, but also details about the interventions necessary for the refuge space standards to be covered. The form of the cards of the open spaces, which will make up the **open space record** of each town/city, a record extremely useful to multiple management and town-planning purposes, is advisable to be as follows [see also EC, DG XI, OASP,1998] :

ELEMENTS TO IDENTIFY AN OPEN SPACE		**EXISTING FEATURES OF THE OPEN SPACE**
1. Code		5. Ownership and management status …….
2. Name		6. Total size and "active" surface …….
3. Location		7. Normal land use …….
4. Site map No		8. Available public utility services …….
		9. Other Infrastructure and services ……. (parking, sanitation etc)

DEFICIENCIES AND POSSIBILITIES OF POST-EARTHQUAKE USE

A. As a refuge area

A.1 Available capacity ……

A.2 Necessary projects and interventions ……

B. For emergency shelter

B.1 Available capacity ……

B.2 Necessary projects and interventions ……

Who should be informed about the selected spaces and who should be charged with the signalling and the establishment of the equipment and the infrastructure?

The public utility services (electricity, water, sewage) and the responsible **technical services** (Municipal or Prefectural), but also the **environment and urban landscape services**, where available, should be the primary receivers of the cards of the spaces which have been designated as refuge spaces, so that they can provide for the execution of the necessary works. The priorities concerning infrastructure projects will be based on cost-benefit analyses criteria referring of course not only to emergency needs and aspects, but also to normal period requirements. Thus, infrastructure requirements of large spaces are bound to be favoured by this type of analysis, at the expense of smaller spaces. It is most likely then that the small spaces in the neighbourhoods (squares etc) will be appropriate only for a few hours' stay and for reuniting families, according to the family emergency plan. On the other hand, large parks and organised spaces in the peri-urban zone are most probably going to be appropriate for a several days stay. These spaces are however favorable for the smooth transition of the harassed community from the stage of refuge to the stage of temporary emergency sheltering.

The concerned population must be informed about the refuge spaces of the neighbourhoods. This can be accomplished by using especially designed brochures slipped in the electricity or phone bills, by special signs and informative pannels and plans in the refuge spaces, informational radio and television shows,by distributing brochures in schools and kindergartens, and so on.

People gathering at the Congress square in Loubliana, Slovenia, on the 14th of April 1895 (source: National Information Service for Earthquake Engineering, University of California, Berkeley, Kozak Collection, http://www.eerc.berkeley.edu/cgi-bin/kozak)

B. The case of schools and welfare institutions

Criteria to select a refuge space

Should the earthquake happen at a time that schools and kindergartens are in operation, then the school or the institution community is the one to seek the maximum safety and protection of the pupils and the children. It is almost certain that the school communities themselves will be forced to undertake the responsibilities of the precaution procedures during the tremours; of the first aid rendering to the injured children; of the evacuation process towards a safe refuge place and of the protection of the pupils/children there until they are picked up by their parents or they are accompanied to other, larger refuge spaces. This fact calls for evacuation plans well-elaborated and more detailed than the family plans, but also for routes, procedures, escape and refuge spaces safer than those destined to the rest of the population.

Each school unit should have its own special evacuation plan, divided into two separate sections, one about the evacuation procedure up to the exit of the school, and another one referring to the approach to and staying at a safe, open space. It is important to point out that the individual evacuation plans of the educational and welfare units should be compatible and mutually supported.

Below there is an analysis concerning the criteria of the predisaster selection of the escape routes and the refuge spaces for schools and welfare institutions (see also OASP, 1999 and OASP, 1994):

I. Land use under normal condition

- School and welfare institution yards
- Squares, playgrounds, open sport fields, church yards, parks, vacant plots, etc, adjacent to the schools and welfare institutions.

The ownership and safeguarding status of the space is of crucial importance. Large, unguarded spaces, those which are most likely to be used also by the general population, should be avoided. These spaces are expected to be inadequate and inconvenient for the children population groups, among other reasons because supervising and helping the pupils there will become a difficult task indeed.

II. Location

- In the schoolyard or near the school/welfare facilities. If a road which is likely to receive evacuation traffic or emergency vehicles lies between the school and the candidate

Schoolyards are the first priority refuge spaces, as long as they comply with safety regulations.

space, then this should not be used, even if it is just opposite to the school.

- In the case of unsafe schoolyards and neighboring open spaces, then there should be arrangements with the other school units of the district concerning the emergency transportation of the pupils to safer schoolyards or other open, yet controlled spaces, sport fields for instance.

III. Accessibility and means to approach

- On foot, in case of adjecent schoolyards, nearby areas, or other school yards in the vicinity.

In case of new school plans, extra attention must be paid to the design of their exits to the schoolyards and the refuge spaces. The possibility of a direct opening must be assured. The exits must be free of potential obstacles blocking either the approach to the exits or the access to the refuge spaces. The sufficiency of the effective door-width in order to avoid accidents during jostle is of crucial importance too.

IV. Safety standards of the pedestrian ways giving access to the refuge spaces

Inside the school building, the width of the escape routes in general should not in any case be diminished on the course to the exit.

Windows in general are not regarded as parts of escape routes. Glass panellings could become dangerous during the tremours. Nevertheless, in the case of groundfloor spaces, and under the condition of a fire event in the premise, they could be used as alternative exits, as far as the openings are at least 0,60-0,85 m and the window-sill height is no more than 1m from the floor.

The lighting of the escape routes (natural or artificial) must be continuous during the operation hours of the school units. When the

Drawings by V. Pavlides from a poster for children published by OASP.

school building is operating exclusively during evening hours, or during both day and evening hours, then a safety lighting must be installed.

The signalling of the evacuation routes must be made with easy to read sings. Signalling is imperative, especially when the exit or the evacuation route is not directly visible.

The safety standards of the pedestrian ways giving access to the refuge spaces are as in the case of refuge spaces for the residential areas.

V. Safety standards of the refuge spaces

The safety standards of the refuge spaces for the rest of the population are also applicable in the case of spaces for the children population groups. **An additional demand is for the safeguarding or fencing of the refuge space**.

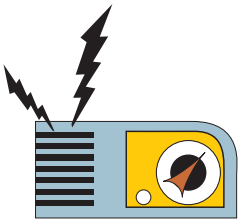
VI. Ownership status

Spaces belonging to or managed by educational or welfare institutions are preferable.

VII. Infrastructure and equipment

In addition to the infrastructure requirements of the other refuge spaces destined to the general population, schools or welfare units must outfit with first aid material, potable water, sanitation items, tools, foodstuff, communication equipment and accessories stored in a safe and easily -via the schoolyard- accessible area. A detailed list is reported below (see also American Red Cross, 1994).

– First aid material.
– Bottled water supplies and paper cups to last at least for three days (half a gallon per person daily).
– 1 portable WC/ 100 pupils, along with toilet rolls.
– Soap and garbage bags.
– Hurricane lamps.
– Whistles.
– Flashlights.



– Portable radio and batteries or other communication system.
– Various tools, among others pincers, hammers, screwdrivers, spades, spanners and openers, iron bars, knives, etc.
– Office stationery (papers, pencils, etc).
– Pupil lists.

It is most likely that several students will stay for several hours at this first and transitional refuge space, before they are picked up by their parents, or before a temporary accomodation is arranged for them and their families. (See also American Red Cross, 1994).

Criteria for checking the adequacy of the refuge spaces for schools and welfare institutions

The degree of adequacy of the available refuge spaces within walking distances from the school and welfare communities is the critical issue upon which the decisions on the necessity of mutual agreements between school units will be based. The objective is to protect the totality of the children population, if the need to evacuate and refuge comes up.

However, the educational and welfare institutions, especially those lacking a safe and large schoolyard or an adjecent appropriate open space, should be inspected on the spot and secured against earthquakes, before they become operational.

The transportation of the children groups to safe spaces outside the school, even when accompanied and in cases of high level of preparedness, is a hazardous and difficult operation.

Such a procedure takes time and presupposes the prior localization of relatively safe spaces inside the school premises.

Below there is an analysis of the criteria to check on the adequacy of the refuge spaces for schools and welfare institutions:

VIII. The required capacity, compared to the available one

After the 1986 Kalamata (Greece) earthquake. The elderly are a vulnerable population group in need of special care.

- The schoolyards' available capacity or the capacity of the neighboring spaces can be estimated on the basis of the ratio of 2m^2 per person and the size of the "active" surfaces (that is, after excluding the surfaces which do not comply with the acceptable safety distances from the surrounding buildings or other dangerous elements).
- The required capacity must be estimated for each school separately. This is the only way to define the space surplus in some schoolyard cases and the space deficit in others, so that the predisaster agreements for emergency transportation of certain children groups can be arranged.

IX. Maximum distance from the education/welfare insitutions

The schoolyard is preferable. If it is inadequate, then the spaces adjacent to the school facilities or the spaces in the vicinity are a second priority selection. The best way to approach is on foot; the teachers should accompany the groups. If such spaces do not exist, then, instead of searching for more distant places, it is advisable to transport the pupils in other distant but collective and safeguarded spaces.

Who is responsible of locating the evacuation routes and the refuge spaces for schools and welfare institutions? Who is responsible of their signalling and equipment?

The responsibility of locating of the evacuation routes for schools and welfare institutions lies in the hands **of the school and institutions authorities, in cooperation with the technical services** of the Municipality or the Prefectural Self-Government and the Fire Department.

The responsibility of declaring an open space as a potential refuge space for schools or welfare institutions lies in the hands of the **official town-planning or technical services of the Municipality or the Prefectural Government, in**

cooperation with the education services. This declaration should be made after the on the spot inspection of each schoolyard or the candidate neighboring spaces and the fulfilling of a relevant card, on which the features of the site that justify its emergency utilization are recorded. Other details to be recorded are the active surface of the site and its population capacity, in relation to the population of the school in question.

The format of the cards for the refuge spaces of schools and welfare institutions is advisable to be as follows (see also EC DG XI OASP, 1998):

IDENTIFICATION ELEMENTS		**EXISTING FEATURES OF THE OPEN SPACE**
1. Code		5. Ownership and management status …….
2. Name		6. Total size and "active" surface …….
3. Location		7. Normal land use and safeguarding …….
4. Topography diagram No		8. Available public utility services …….
		9. Other infrastructure and services ……. (Parking, sanitation, storage of first aid material)

CAPACITY AND POTENTIAL POST-EARTHQUAKE USE

1. Available capacity in relation to the population of the school or the welfare facility serviced ……

2.1 In case of space surplus, reference to the school units that could be serviced in addition ……

2.2 In case of deficit, reference to other open spaces that could cover the extra needs to refuge of the school ……

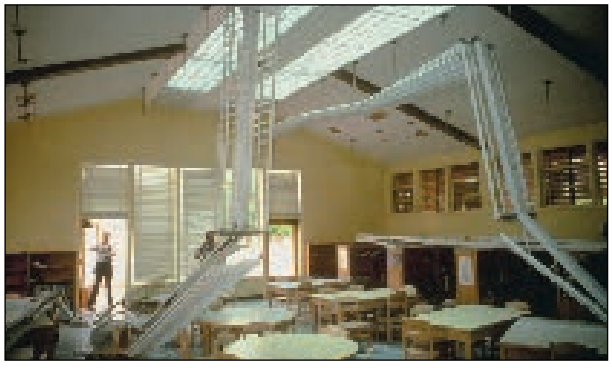
Who should be informed about the selected refuge spaces and the escape and evacuation routes giving access to the selected spaces?

The schoolmasters, the teachers and the rest of the school staff should be informed about the evacuation routes and the refuge spaces. They should not only be informed, they also **have to participate** in the making of the evacuation plans, they have to improve their aptitude in responding to the children's and their own stress and panic, to obtain knowledge about first aid provision and to be ready to help pupils and staff with special needs.

The parents and guardians, on the other hand, must also be aware of the selected refuge spaces and of the evacuation plans (the teaching staff is responsible of informing them on paper), they must encourage the compilation of such plans, in the case they do not already exist, they must offer voluntary services and material to improve the preparedness standards, encourage the coordination of the school communities with the officials in the Municipalities and the Prefectural Self-Government with respect to emergency planning and, finally, encourage discussion at home about the plans and the proper precautionary actions that their children are tought of at school.

Every school and welfare community must keep its own planning and update it. However, these plans should be complemented by mutual aid agreements, because mutual support and complementarity of the capacities of the individual institutions in infrastructure, instruments, spaces and personnel is of vital importance.

School class after the 1995 Grevena - Kozani (Greece) earthquake.



Coalinga earthquake, California, 1983, internal damages in a school.

C. The case of shopping centres and office buildings

Criteria to select a refuge space

If the earthquake strikes at working hours, then the counter jumpers and consumers, employers and employees in private or public posts should, **after the first tremours stop, seek refuge on foot to nearby open safe spaces**, since they will probably be away from their homes, public transport will be off and since they will not be able to move their cars.

These **"transitional" refuge spaces** should be selected to be inside the central areas and the historic centres fo medium-sized towns and large cities, close to department stores, multi-storeyed private office buildings, shopping centres, busy shopping malls, public office buildings, etc. The problem with such crowded areas is that it is hard to find within open spaces large enough to accomodate the overall population potential, and it is even harder to find safe access routes connecting these spaces to office, service and commercial buildings.

The aim is to find such spaces as closer as possible to the working and transaction places of all these people, even if the infrastructure or the ownership status of these outdoor spaces do not justify their selection for a potential emergency use. The distances from the served buildings must be shorter than those of the refuge spaces serving the residential areas (not more than 200-250m). **The stay of the earthquake victims at these spaces will last only a few hours** (they are not going to be transformed into spaces for temporary sheltering), and, as a consequence, the prerequisite infrastructure is minimal. **But safety standards are important**.

Downtown Kobe, Japan, 1994 earthquake

Several historic centres of greek towns amd cities are extremely vulnerable. Their structure is characterised by scant open spaces and poor standards along road and pedestrian ways, problems which are not easy to deal with in a few months' time. That's because employees and customers ought to be aware of the safer locations inside buildings, where, if staying, they are more likely to avoid being injured than if evacuating.

Below there is an analysis of the criteria for pre-disaster selection of the evacuation routes and the refuge spaces serving department stores, office buildings and generally central areas of medium-sized towns and large cities (see also OASP,1992 and OASP,1994):

I. Land use under normal conditions

In supermarkets, the most dangerous spots are beside the liquor and detergent shelves

- Squares and vacant plots.
- Urban greenery areas (parks, etc).
- Public buildings' courtyards and in general open spaces surrounding multi-storeyed office buildings or public service buildings.
- Open parking areas

Accesss restrictions are of crucial importance. Restricted or locked spaces, during working hours, must be avoided. Public buildings' courtyards should be accessible on a 24hours' basis to improve safety standards of the central areas of greek towns and cities, which are suffering from high densities, excess traffic loads, congestion and lack of open spaces.

II. Location

- Inside central areas, at the courtyards in front of large, public buildings, if any, and provided that these spaces meet the prerequisite safety standards.
- At the open spaces (plots, squares, etc), where access from stores and office buildings can be obtained immediately, on foot, within a few minutes, via safe pedestrian ways and where the stay will last a few hours only.

III. Accessibility and means to approach

Typical case of unfastened bookshelves falling in offices after an earthquake.

- Within a few minutes (less than 5min), on foot.
- The spaces must be accessible by emergency crews and vehicles.

Fallen, scattered books in a downtown bookshop, Loma Prieta earthquake, Los Gatos, California

When constructing a new office or store's building, extra attention must be paid to the emergency exits (lobbies, stairwells, passages) leading up to courtyards and refuge spaces. The possibility of a direct opening must not be hampered by obstacles. The effective door width must be enough so as accidents will be avoided while jostling. Alternative routes to the exit or exits are helpful and these should not be via the cashier's desks, so that massive evacuation will not be obstructed.

IV. Safety standards of the pedestrian ways giving access to the refuge spaces

At Kalamata commercial centre, 1986 earthquake

The evacuation routes of all office buildings and stores must be equipped with safety lighting and signs, as in the case of educational institutions.

The safety standards of the pedestrian ways leading to the refuge spaces are as in the case of residential areas. The population should be very careful of falling decorative panels and fascias and glass debris from glass windows.

V. Safety standards of refuge spaces

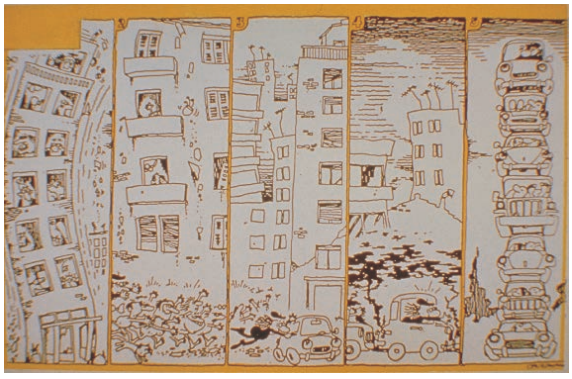
As in the case of refuge spaces serving residential areas.

VI. Ownership status

Spaces belonging to or being managed by public or municipal institutions are preferable. Private spaces can be used as well, such as parking areas, provided that they are open during working hours.

VII. Infrastructure and equipment

The demands in infrastructure are limited. What is essential is electrical lighting and signalling of the pedestrian ways of access and of the refuge spaces.

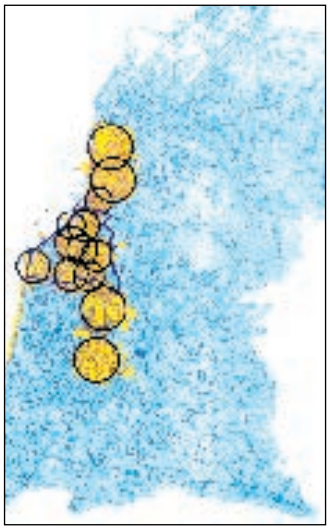


Imediately after the earthquake, evacuating using cars is impossible within the densely populated districts. In addition to that, there are hazards threatening the passengers of the congested cars, which impede significantly the circulation of the emergency vehicles.
(source: Cartoon by D. Mitropoulos regarding the situation in Athens after the 1981 Alkyonides earthquake)

Criteria to check the adequacy of central area refuge spaces

Guaranteeing sufficiency of refuge spaces at the central areas of greek towns and cities is the most **tricky problem** of a potential emergency period. In **downtown areas, taking refuge in cars will be irrealizable and the relevant tensions must be discouraged**. On the other hand, several central areas, if inspected on the field, will prove to be innadequate, as far as the probability of an on foot evacuation is concerned. Under the circumstances, a crucial question emerges: what can be done on a short- or mid-termed basis? Safety standards of city centres must be of first priority. Removing dangerous elements from building facades (panels, air-conditioners, etc) and implementing interventions enlarging the effective surfaces of the open spaces, are examples of policy measures towards the above direction of improving safety standards. Safe spaces must be found everywhere; on the pavements, on clear backyards of private buildings, etc. The slightest possibility of safe spaces to be approached on foot must be explored. Below, there is an analysis of the criteria to check the adequacy of the refuge spaces of the central areas of towns and cities:

VIII. The required capacity compared to the available



The distances of the location and buildings served by the refuge spaces in the city centres (200-250m) should be considered shorter than in the cases of other urban areas (up to 300-400m) (source: EC DG XI OASP, 1992)

- **The available capacity of the refuge spaces within city centres** is estimated as in the case of residential areas. This estimation is based on the ratio of $2m^2$/person, where, of course, only the "active" surfaces of the open spaces count (as in the case of residential areas).
- **The required capacity** is estimated on the basis **of peak hours' population** of the central areas, including the population of office buildings and stores, the population moving along roads and pedestrian ways, as well as the local residents. Attention should be paid to setting the limits of these central areas; highways which are going to facilitate emergency traffic should not cut across the delimited areas. If the available capacity of the open spaces falls short of the required one (after the next criterion of the maximum acceptable distance has been taken into consideration, then, either additional spaces have to be found, or intervantions to extend "effective" surfaces have to be implemented. **Taking refuge in private cars should be avoided at any cost, because, even if the**

Menidi, (Greece) after the 1999 Parnitha earthquake.

cars are somewhere nearby; such decisions could result to self-entrapment of the eartquake victims.

IX. Maximum distance from office and other central use buildings

The distance of 200-250m is the maximum acceptable, given the unsafe conditions in the centres of greek towns and cities.

Who is responsible for defining the escape routes from central use buildings and also for setting the limits, signalling and equipping the refuge spaces and the pedestrian network giving access to them?

Safety divisions of department stores and large office companies (in cooperation with the **technical services and the Fire Department**) are responsible for the working personnel and customers' evacuation up to the point they reach the exits of the buildings.

The responsibility to declare an open space in the city centre as a potential refuge space and to define the routes giving access to it lies on the hands of the competent urban planning authorities or the technical services of the Municipality or the Prefectural Government. The designation will take place after an on the spot inspection of the space, but also of the roads and the pedestrian ways leading to it and after the filling in of a special card, as in the other cases. On these forms, the safer ways towards the spaces and\or the necessary interventions to improve the safety conditions of these spaces and routes should also appear. It should be emphasized that, if the balance of the refuge spaces in central areas is adverse, that is, if the suitable spaces are not enough to accomodate the totality of the population, then, the competent officials in the Municipality or the Prefectural Government should decide on additional policy measures and inform the employees and businesspersons respectively. A representative example of such policy measures is the establishement of staggering working hours for the various commercial and other central uses.

ELEMENTS TO IDENTIFY AN OPEN SPACE		EXISTING FEATURES OF THE OPEN SCAPE
1. Code		5. Ownership and management …….
2. Name		6. Total size and "active surface" …….
3. Location		7. Normal land use …….
4. Topography diagram No		8. Available public utility services …….
		9. Other infrastructures and services

CAPACITY AND POTENTIAL POST-EARTHQUAKE USE

A. As a refuge space

A.1 Available capacity

…….

A.2 Safer access routes and necessary interventions for improving safety

…….

Who should be informed about the selected pedestrian ways, the refuge spaces and the emergency building evacuation plans?

The management departments of companies and organizations whose building premises are situated along the pedestrian ways giving access to the refuge spaces of the city centres should be informed about the necessary interventions on the building facades, to minimize possibilities of detachment and accidental falls of facias and panellings. In addition to that, **shopkeepers, office personnel and business staff** must be informed about refuge spaces and evacuation routes corresponding to their working places.

D. The case of hotels, tourist and recreation areas

Criteria to select a refuge space

Should an earthquake strike at a moment when city hotels and/or recreation and cultural centres are at their peak hours and the maximum intensity of use, then there is a high risk of injuries, due to squeezing during building evacuation or even due to ignorance of the routes to follow and the spaces offering protection. Guaranteeing the conditions for a smooth and fast evacuation of hotels, cinemas, theatres, stadiums, clubs and for giving reliable guidance to tourists, spectators and clubbers about safe routes and refuge spaces constitutes one of the most important issues of earthquake preparedness planning. This is true for two reasons: first, because these type of facilities are usually situated in the city centres, forming groups with other kindred uses which attract population during the night (being therefore very vulnerable **at night time**) and secondly because the respective population groups - especially tourists- **are not familiar** with the urban landscape around.

Below there is an analysis of the criteria for the pre-disaster selection of the evacuation routes and the refuge spaces. The cases of the hotels and the recreation places are considered separately. This segregated analysis pivots on the dissimilar behaviours of the population groups in tourism and recration facilities, but also on the distinctive architectural structure of these facilities:

I. Land use in normal conditions

Imaginary depiction of a woman in a hotel room during the 1895 earthquake in Loubliana, Slovenia (source: National Information Service for Earthquake Engineering, University of California, Berkeley, Kozak Collection, http://www.eerc.berkeley.edu/cgi-bin/kozak).

IA. Hotels' refuge spaces

- Courtyards and open spaces surrounding the hotel premises.
- Squares, churchyards, parks and vacant plots or open parking areas in the hotel vicinity (preferably, in nearby blocks).

The case of foreign tourists staying in hotel rooms is very important. They have to be guided in such a way that their later contact with the competent tourism services of Municipalities and Prefectures (to procure for their safe and comfortable transportation back to their countries) will be attainable.
Disorientation of tourists is also a considerable probability, especially if their hotels are hit during the night, when an electricity cut off is an eventuality. Under these conditions, the proximity of the evacuated building to the refuge space becomes essential. It is obvious that tourists have, in general, no other alternative than walking.

IB. Refuge spaces for cultural and recreation facilities

- Courtyards and open spaces in front of cinemas, theatres, cultural centres, etc.
- Squares, churchyards, parks and vacant plots or open parking areas in the vicinity (preferably, in nearby blocks).

II. Location

After the 1999 Parnitha earthquake. Taking refuge in cars may be advisable only in cases of stationary cars in nearby open parking areas parked in places complaying with the safety standards.

IIA. Hotel refuge spaces

- In proximity to the hotels, or within the nearby blocks.

IIB. Refuge spaces for recreation and cultural facilities

- In proximity to the facilities.
- If such spaces are lacking, the population, under the state of panic, will seek refuge at any cost in cars. The fact will have **disastrous effects** and obstruct evacuation of the recreation and cultural precints as well as the access of rescue crews. If a nearby safe parking space exists, it would be helpful, provided that the cars stay still at a safe distance from buildings, walls, stone fences, etc.

III. Accessibility and means to approach

- On foot.

The final exits of newly-built hotels and recreation facilities to courtyards and refuge spaces must be designed carefully.

IV. Safety standards of the escape routes up to the building exits and the pedestrian ways leading to the refuge spaces

IVA. For hotels

The escape routes within the hotels should not be edged by glass panellings, except if they are made of safety glass.

The hotel building should be equipped with safety lighting, operating during the necessary time for full evacuation. All the sections of the evacuation routes (corridors, doors, stairs, emergency exits, final exits) must bear suitable signs, visible during both day and night hours, to guide the public to the final exit, in the case of a fire.

IVB. Recreational and cultural facilities

The escape routes within the recreation facilities should not be edged by glass panellings, except if they are made of safety glass.

As far as the safety lighting systems are concerned, the standards are the same as in the case of hotels.

The safety standards of the pedestrian ways giving access to the refuge spaces are as in the case of refuge spaces for the residential areas. It is however wise to make sure that the exits from the buildings lead directly to a safe refuge space and that there are no intervening narrow, dark pavements, which may prove to be more dangerous than the evacuated buildings.

V. Safety standards of the refuge spaces

The safety standards of the refuge spaces aimed at serving the residential areas are also applicable in the case of recreation and cultural precints.

VI. Ownership status

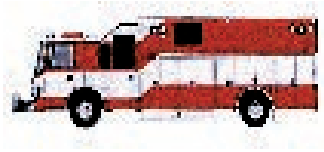
Preferably, spaces belonging to or managed by public or municipal institutions, or by the respective hotel enterprises.

VII. Infrastructure and equipment

VIIA. Hotells

In the cases of hotels, the refuge spaces should satisfy the needs of the tourists for several hours; it is consequently advisable to be well

Hurricane lamp



Rescue vehicle of the Fire Service

First Aid Centre Ambulance (source: First Aid Centre)

equipped. The infrastructure and equipment needed are as in the case of residential areas.

VIIB. Recreational and cultural facilities

The needs of the spaces serving recreation facilities are limited, because, as in the case of commercial precints, **they are transitional refuge spaces**. They accomodate the earthquake victims up to the time they are transported by their own or by public means to their neighborhoods. An additional requirement is for emergency lighting (hurricane lamps etc).

Sign informing about the escape roots in a touristic place in Barcelona.

Criteria to check the adequacy of refuge spaces for hotels and recreation facilities

The level of adequacy and safety of the spaces for the hotels and the recreation facilities of crucial importance for the toll among population groups hit by the quake while resting in hotel rooms or being amused in recreation clubs. The location of these facilities, often within central precints, the high population concentration and densities characterizing their operation (mostly clubs), and the fact that their peak hours of operation happen during the night, all of the above unfavorable conditions make the available "expansion" open spaces a real "lifebelt". Hotels and recreation centres lacking this type of "expansion" spaces may turn out to be deadly traps during earthquakes. In such cases, either relocation or structural interventions, or rearrangements of the surrounding spaces to receive refugees, become unavoidable tasks. It should be emphasized that several of these facilities are vulnerable to secondary effects as well (mostly fires). Below there is an anlysis of the criteria to check the adequacy of the refuge spaces serving such facilities:

VIII. The required capacity compared to the available

- The **available** is estimated on the basis of the ratio of 2m^2/person and the size of the "active" surfaces of the existing "expansion" spaces.
- The **required** capacity coincides with the peak period population potential of the hotels and recreation centres.

IX. Maximum distance from the hotel locations and the recreation facilities

Open spaces adjacent to the facilities are preferable. The acceptable distance of 250m, which applies for commercial stores and office buildings is also applicable in the presumed case. Nevertheless, the tourists or the club habitues will not be able to find the refuge spaces at night, if they are not clearly visible from the buildings' exits or if they are not guided towards them, given the fact that they are probably unfamiliar with the surrounding territory.

Zagreb, Kroatia, 9.11.1880 earthquake. People are camping on Jelacic square (source: National Information Service for Earthquake Engineering, University of California, Berkeley, Kozak Collection, http://www.eerc.berkeley.edu/cgi-bin/kozak).

Who is responsible for defining the evacuation routes, as well as for setting the limits, signalling and equipping the open refuge spaces?

The evacuation plans of the already existing hotels and large recreation facilities **is a responsibility of the security departments of the respective companies, which for this purpose should cooperate with the urban planning departments and technical services of the Municipality or the Prefecture, as well as with the Fire Service**. These same institutions are responsible for setting the limits of the refuge spaces and their "active" surfaces, given that in most cases these spaces are in direct contact with facilities prone to fires, and, therefore, the fire safety regulations should be taken into account. On the spot inspections of the facilities and their "expansion" spaces and filling in of the relevant forms is therefore essential, as in the other cases of evacuation and refuge. These forms should

record information data concerning not only the refuge space, but also the serviced facility. Thus, the persons in charge will be aware of the most vulnerable facilities to take care of in order of priority when the emergency crisis appears.

ELEMENTS TO IDENTIFY THE TOURISM RECREATION FACILITY AND THE RESPECTIVE SPACE OF REFUGE	**EXISTING FEATURES OF THE OPEN SPACE**
1. Code	5. Ownership and management status of the open space …….
2. Name	6. Total size and "active" surface …….
3. Location of the refuge space and of the serviced facility	7. Land use under normal conditions …….
4. Topography Diagram No	8. Maximum population of serviced facility …….
	9. Distance of the selected space from the facility Direct visibility? …….
	10. Infrastructure and utilities of the space

Available space capacity …….

Interventions to develop alternative possibilities …….

Who should be informed about the selected spaces and building evacuation plans?

The hotels' and recreation facilities' management departments should be informed about the problems of their premises, if any, and the measures they should implement with respect to a potential post-earthquake evacuation procedure. They are obliged (especially the large units) to inform accordingly employees and clients (in the case of hotels), either by means of brochures hang in the rooms, or other ways. Finally, **the tourism and transportation authorities** of Prefectures and/or Municipalities should also be aware of the refuge spaces aimed for tourists and foreigners, because these authorities are competent of planning and facilitating the departure of foreigners from the disaster area.

E. The case of small and medium industrial enterprises

Criteria to select a refuge space

The following precautions and planning principles concern the small and medium low hazard industrial and storage facilities lacking fire protection groups. Besides, this type of companies is the only one located within the urban structure, with the exception maybe of the cases of industrial parks or institutionalized industrial areas at the urban fringe.

I. Land use under normal conditions

- Squares and vacant plots at distances guaranteeing protection from secondary fires.
- Areas of urban greenery (parks, etc).
- Courtyards and in general spaces surrounding the industrial premises, which, of course, meet the fire safety standards.
- Open parking spaces.
- Spaces in the peri-urban zone, if the industrial building is located within.

II. Location

- At the inside of the central or the industrial areas, or in nearby peripheral areas.

III. Accessibility and means to approach

- On foot and in a few minutes' time.
- The spaces must be easily accessible by the rescue teams and vehicles, for the transportation of workers, if necessary, to their residencies or the corresponding refuge spaces.

The exits of the newly-built industries and storage facilities to the courtyards and the refuge spaces must be given the proper attention. The possibility of immediate exit must be secured. Obstacles blocking the access to the refuge space may cause injuries.

IV. Safety standards of the pedestrian ways leading to the refuge spaces

The pedestrian ways' safety standards are as in the case of residential areas. Extra attention should be paid to the potentiality of falling signs and panelling elements as well as broken glass from glass windows.

V. Safety standards of the refuge spaces

The same standards apply as for the refuge spaces aimed for the residential areas. However, there may be some additional hazards due to secondary impact factors (dangerous gas emission, fires, etc). The security staff should decide on the safety distances.

VI. Ownership status

Preferably, spaces belonging to or managed by public or municipal institutions, or spaces under the management and control of the industrial companies. Other private spaces may be used as well, provided that they are open during working hours.

VII. Intrastructure and equipment

The infrastructure requirements are limited.The only necessary utilities are electrical lighting, water supply and signalling of the pedestrian ways giving access to the refuge spaces and of the spaces themselves.

Criteria to check the adequacy of the refuge spaces

The level of adequacy of the refuge spaces aimed at servicing the industrial buildings located within central areas will be judged by taking into parallel account the demands of offices, department stores and other central use buildings situated in the respective areas. The requirements of indoor spaces should be co-estimated as well as the numbers of people moving along vehicle roads and pedestrian ways. If the demands exceed the availabilities, then those who make the decisions in the coordination centre should be concious of the fact that they will have to take supplementary actions and policies for an effective population refuge in case of an earthquake at a peak hour. The workers of industrial and storage facilities which are located in the peripheral districts are not expected to meet difficulty in finding a safe open space.

VIII. The required capacity compared to the available

From the Greek Fire Service calendar

- The **available capacity** is estimated, once more, on the basis of the ratio of 2m^2/person, where, of course, only the "active" surfaces of the open spaces are taken into consideration.
- The **required capacity** offerring full service of industrial buildings is estimated on the basis of peak hours' population of these premises. The solution of the car in the peripheral districts, under unfavorable circumstances, (if it rains, for instance) may be the only chance. In such a case, it is not discouraged, provided that the "cars-refuge shelters" will not move away from safe nearby open spaces. However, in the central areas, the evacuees and the emergency mechanism in charge should not rely on the private car as a safe refuge shelter.

IX. Maximum distance from the industrial facilities

The distance of 200-250m is the maximum acceptable for the central areas, given the risky circumstances there. In the case of facilities prone to explosions or fires, the minimum acceptable fire safety distances must be kept.

The facilities in the peripheral districts can be serviced by spaces within distances of more than 300-400m. For those with cars somewhere nearby their workplace, even the most remote refuge spaces may prove to be useful.

Who is responsible for defining the escape routes from the industrial and storage facilities, but also for setting the limits, signalling and equipping the refuge spaces and the ways giving access to them?

The evacuation plans of the industries and storage facilities, concerning escape procedures up to the exits are the responsibility of **each enterprise in cooperation with the technical services and the Fire Service** according to the submitted fire safety plans.

The local urban planning services or the technical services of the Municipality or the Prefectural Government have the authority to declare an open space as a potential refuge space of a central area and to define the routes to approach. This declaration will follow an on the spot inspection of each space (in cooperation with the Fire Service), and of the pedestrian ways leading to it as well as the filling of an appropriate form,as in the case of offices and commercial uses. Attention should be paid to the minimum distance between the selected spaces and warehouses or installations with flammable or explosive materials.

Who should be informed about the selected pedestrian ways, the refuge spaces and the building evacuation plans?

The management departments of the industrial companies should be informed about any necessary interventions to their facilities, because of the fact that the nature of their productive lines or the stored raw materials and products may endanger the wider area by potential secondary effects. Beyond that, **businesspersons and workers** should be informed about the evacuation routes and refuge spaces corresponding to their working places.

As for the employees in private companies, an important query arises: does the existing legislation provide for their evacuation immediately after the earthquake and the fact that they will not return until the completion of building usability assessment? With respect to these issues, the Greek General Confederation of Labour and the Workers' Centre of Athens, have published after the Parnitha earthquake (1999) a brochure referring to the relevant legislative provision. The brochure reads that, according to the PD 17/96 «Measures to improve safety and health of employees during working hours, conforming to the 89/391/ EU and 91/383/EU directives», «the employee who, in the case of a serious, immediate and inevitable hazard evacuates his workplace and/or a dangerous zone should not undergo any adverse effects. Furthermore, he should be protected from any harmful and unjustified consequence, according to the laws in force».

Finally, **the transport department** of the Prefecture and/or the Municipality should also be aware of the refuge spaces. It is a probability that these spaces will have to be serviced by public transportation means.

2.2 Operational planning of the procedures

A. Materials and means

The necessary materials and means for carrying out the evacuation and refuge procedures concern **the appropriate means of transportation, the communication systems and the infrastructure and equipment of the refuge spaces** and the ways to approach them.

Means of transportation:

A few weeks after the 1986 Kalamata (Greece) earthquake, buses were used to transport pupils of damaged schools to safe schools everyday.

Once the refuge spaces and the ways leading to them have been defined, it must be guaranteed that the population groups concerned will, if necessary, be able to reach them. However, it is a certainty that several groups will not manage to reach refuge spaces, either due to reasons related to the disaster itself, or due to physical inabilities of the specific groups, or, even due to the restrictive status of the facilities accomodating them. The children groups in school and kindergarten buildings of low safety standards, but also the inmates of prisons, old people's homes and orphan asylums, etc, the patients in hospitals and the tourists willing to evacuate the area are representative examples of the groups which will probably need emergency transportation a few hours after the event. These groups will be carried (from the "transitional" refuge space) to either the refuge spaces of their neighborhoods or to railway stations, ports, airports, etc.

The transport authority of the Municipality or the Prefecture should record **the capacity of their jurisdiction area in schoolbuses and emergency vehicles**. In addition, they should estimate the maximum needs in transportation means and establish agreements or suggest procedures for the requisition of vehicles belonging to private companies.

This type of agreements or requisition procedures, should be supported by a record of the companies', owners' and drivers' data (names, addresses, phone numbers, capacity in vehicles, etc). These records should also refer to the preselected collection points and destinations of the specific population groups.

Communication systems:

The main necessary devices for communication (a) between the commanding officers of the evacuation operations and their teams, performing the actual operation on the field, and, (b) between the coordination centre and the earthquake victims, either evacuating buildings or already being at the refuge space, are **alarm systems, sirens, loudspeakers, battery transistors, CBs, radios, flashlights, whistles, but also mobile and wired telephones**, (even if they cannot be used immediately after the event). The transport and communication department of the Municipality or the Prefecture should record the suppliers of such devices and also of the necessary ground equipment. The radioamateurs equipment will be valuable at the immediate post-earthquake time period and there should be agreements in advance. The **courrier network** might also be utilized on the basis of pre-disaster voluntary agreements. The creation of a **phone bank** could also help, as far as the non-urgent messages are concerned. The **mass media** could also contribute to the relief of the crisis, after the lapse of a critical period, and provided that the broadcasted information is controlled by the coordination centre and the emergency mechanism.

The infrastructure and equipment of the refuge spaces

Mobile emergency care unit on the spot after the 1986 Kalamata (Greece) earthquake.

The respective public utility services are responsible for the fixed infrastructure of the refuge spaces. The relevant requirements are mentioned in the VII criterion referring separately to the various types of refuge spaces. The establishment of signs that read EVACUATION PEDESTRIAN WAY, REFUGE SPACE, EMERGENCY PARKING, EMERGENCY EXITS, etc, depends on the initiatives of the technical services of the Municipalities and the Prefectures.

Finally, emergency contact with suppliers of bottled water and first need materials should be arranged in advance.

B. Staff

As far as the administration mechanism is concerned (Central Administration, Prefectural and Local authorities), the staff of the education, health, social security and transportation services,as well as the police and Fire Service personnel will have to contribute to the evacuation procedure during an emergency. Except the public administration and local authorities, the teachers, the welfare employees, the doctors, the social workers, the schoolbus and public bus drivers, and other civilians, will also have to help, either as volunteers, or by means of their occupation status. Finally, volunteer organisations could play an equally important role.

Earthquake in Istanbul, 10/5/1556 (coloured woodcut, Nyremberg, 1556). The woodcut depicts the damage in the city and on the Aghia Sofia dome (source: National Information Service for Earthquake Engineering, University of California, Berkeley, Kozak Collection, http://www.berkeley.edu/cgi-bin/kozak)

2.3 Population information

The policies and actions of declaring, checking the safety, signalling and supplying the refuge spaces with the necessary infrastructure or equipment do not guarantee alone the operational success of an evacuation and transportation procedure of the vulnerable population groups to spaces providing safety from aftershocks, or secondary effects (fires, flood, etc). The population, before the earthquake hits, should learn, be well-drilled and become familiar with issues concerning:

- The most appropriate time to start building evacuation, and the best reactions in case of outdoor locations.
- Precautionary actions before evacuating and the survival items to be prepared to take along when evacuating.
- The pre-disaster arrangements and agreements with neighbors and family members.
- The ways and the procedures of mutual help and support during evacuation.
- The locations of the escape routes, emergency exits, external evacuation routes and refuge spaces and the suitable means to approach.
- The actions to avoid during their stay at the refuge space and how and when to depart.

The guidance, drills and in general the methods to transmit and consolidate this information and the preparedness skills and knowledge for properly evacuating, should reach the following groups of population:

- The general population (the instructions should include the indicated actions in the household, the working place and the recreation facilities).
- The elderly, the disabled and the groups facing mobility problems (pregnent women, etc).
- The teaching staff of schools and kindergartens, since they will be responsible for the evacuation of education and welfare institutions.
- The executives and the managers of commercial and industrial companies and utility services.
- The executives of hospitals, elderly and orphan homes.
- Tourists and foreigners.

What should the general population do?

A. Before the earthquake hits

A survival kit, as suggested by the American Red Cross: hammer, adhesive tape, flashlight, batteries, water, instructions for first aid supply, hurricane lamps, first aid kit, food supplies for an emergency.

- ✔ They should take particular care to removing any hazards in the household.
- ✔ They should establish an emergency family plan (see also Wellington City Council Emergency Management Office, 1999, but also American Red Cross et al 1999).
- ✔ They should prepare an emergency kit for the household and another one for the car containing:
  - ✔ **first aid kit and necessary medicines**
  - ✔ **cans and can opener**
  - ✔ **at least two litres of water for each person for at least three days**
  - ✔ **protective clothes, rain coats, blanket or sleeping bag**
  - ✔ **necessary things for babies (eg. nappies, bottles, etc), elderly people (medicines, walking sticks, etc), for disabled persons and for persons with mobility problems**
  - ✔ **written instructions on where the gas, water and electricity master switches are and how to turn them off**
  - ✔ **a flashlight and a pair of stout shoes should be kept near the bed in case the earthquake happens during the night**.
- ✔ They have to choose a safe spot in each room of the house: under a strong table, or desk or another piece of strong furniture.
- ✔ Decide on a relative or a friend in another town/city as a connection to contact. In a disaster, it is usually easier to call at another town/city. The members of the family that are not going to be at home when the earthquake strikes, will probably be unable to contact the others, who will be evacuating. All the family members will have to call their "contact".
- ✔ They have to take first aid lessons.
- ✔ They have to show to all the members of the

family how to turn off the supplies of water, gas, and the master electricity switch.

- ✔ They have to get used to locating and remembering the emergency exits in supermarkets and work places (office buildings, commercial stores, industrial buildings).
- ✔ They have to make arrangements with the other family members concerning the meeting place, after the earthquake, which will probably be the refuge space of their neighborhood.
- ✔ If they have children at a school age or in kindergarten, they will have to demand via the parents' school council for an emergency plan to be established.
- ✔ If they work in a large company (industrial, commercial, etc) or an organisation, they will have to ask for information about the existing evacuation plan, the emergency exits, and the refuge space.

B. As soon as the earthquake starts....

- ✔ **«FALL DOWN, TAKE COVER, HOLD ON».** They should move just a few steps to the nearest safe spot. They should remain indoors until the quakes stop and until they are sure that it is safe to go outside. Stay away from windows. Under no circumstances should they rush towards their cars.
- ✔ If they are in a department store or in an office building, it is possible that the fire alarm goes off and that the fire extinguisher is set off. During the quakes, they should take cover under a desk or hold on to an internal wall, away from glass panellings, shelves with heavy objects and bookcases. They should also stay away from elevators and, if they are in a stairwell, they should remain there and crouch to cover their heads. In the supermarkets, the most dangerous spots are next to the liquors and detergent sections

because of the probability that the bottles break and the chemical liquids spilled. If they have a trolley, they should take cover under it (see Wellington City Council Emergency Management Office, 1999, American Red Cross et al, 1999 and Los Angeles City Fire Service, 2000).

- ✔ If they are in a restaurant, they should take cover under the table, and if they are in a cinema, a stadium or a theatre, they should take cover between the seats. They should stay away from the area of flow of the panic-stricken crowd.
- ✔ If they are in bed, they should remain there and protect their head with a pillow.
- ✔ If they are outside, they should find on foot an open space away from buildings, trees and electricity posts and fall on the ground.
- ✔ If they are in a car, they should reduce speed and drive it in an open space, away from buildings, trees and electricity posts. After that, it is advisable to stay inside the car until the quakes stop.
- ✔ If they have children, they should not run in panic to find them. Children need their parents after the earthquake, and if they are injured, they will not be able to help them. It is preferable to call them, give guidance and relieve their anxiety without rushing towards them.
- ✔ If a parent is with his/her child, at the time of the earthquake, then he/she should take cover with the child until the quakes stop. Then, if they should evacuate, do so carefully, taking along the supplies (emergency kit).

C. As soon as the quakes stop... and if they are at home

- ✔ They should not run outside for their cars, especially if they are or live in a densely populated area, because in many similar cases, cars become deadly traps.

- ✔ They should check themselves for injuries. They should protect themselves from further hazards by wearing trousers, long sleeved shirts and stout shoes.
- ✔ They should check other peole around for injuries and assist with first aid supply those who are seriously injured.
- ✔ Look around for small fires and if possible, extinguish them. Turn off the gas supply, if a smell exists or if gas leek is suspected. (ATTENTION:only the technician of the gas company can turn it back on).
- ✔ They should turn on the portable radio and listen for directions.
- ✔ They should inspect their home for damage. If electrical appliances (television, stereos, lamps, computers, etc) have fallen on the floor, or if cables have cracked the plaster and are hanging out of the walls, they will have to turn down the electric power. In other cases, they should just unplug the appliances.
- ✔ They should leave their homes by using the stairs, no matter on which floor they are, so that they will not be trapped in an elevator during an aftershock.
- ✔ They should use their phone only to report an emergency situation (Emergency number in the European Union: 112).

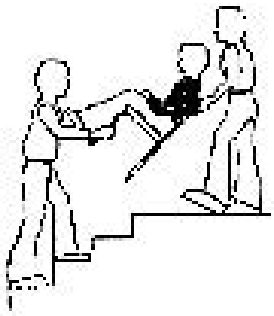
D. At the refuge space

- ✔ They should wait for instructions from the emergency crew, listen to the radio for information concerning the post-earthquake situation or information originating from persons trying to inform their families on their condition. They should not leave the refuge space until further notice.

What should the elderly and the disabled do?

(See also Wellington City Council Emergency Management Office,1999)

A. Before the earthquake hits



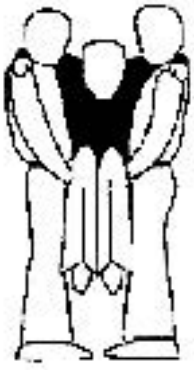
- ✔ If it is difficult for them to take cover, due to mobility problems, they should make sure in advance that all objects that could fall and hit them are firmly fixed. This stands for the home, the bed, the office, the workplace. Except for the possibility of being injured, the fallen objects will make it harder for them to walk or to move on a wheelchair in order to evacuate.
- ✔ They should get and retain additional suplies compared to the rest of the population, at least those guaranteeing or improving their safety and comfort (extra medicines, batteries, hearing aids, medicine prescriptions and elements concerning their personal health, etc).
- ✔ If they rely on an elevator in order to reach their workplace, then evacuating might be a difficult task for them. They will have to make sure that the existing evacuation plans have taken under consideration disabled people and persons with mobility problems.

B. As soon as the earthquake starts....

- ✔ They should first seek cover. It is yet necessary that they are later transported to safer places. Hence, if it is hard for them or impossible to move after the earthquake from under a desk or table, they should avoid to take cover under them.
- ✔ If they are on a wheelchair, they should remain on it and remove themselves with the chair away from windows. They should move to a position under a door or away from bookcases. They should pull the brakes of the chair, and, if possible, crouch and hold a pillow or book or other protective object over their head and neck.

- ✔ If they have mobility problems, but are not on a wheelchair, they should assess the situation. Remaining where they are is usually the safer thing to do. If they are in bed or if they are sitting, they should remain at their positions until the earthquake stops. If they are standing, they should sit down on the floor or on a chair, if one is nearby.

C. As soon as the earthquake stops... and if they are home or at thier workplace



- ✔ They should check themselves for injuries and use the phone if only there is a serious need for help. If they are trapped, they should try to use a flashlight, bell or whistle, knock on beams, windows, walls or pipes.
- ✔ Making the decision to evacuate needs thinking. If evacuating is easy and there is a possibility of fire or building damage, then, they should try to evacuate to an open space. If evacuating is difficult and there is no fire, gas leak or important damage to the building, then, they should avoid evacuation.
- ✔ If the evacuation is necessary, the people with disabilities should be the last ones to evacuate, so that they will not be injured from the crowd. If they are on a wheelchair, or if they use a walking stick, they should ask for help and give information to their rescuers about the things they are going to need at the refuge space.

D. At the refuge space

- ✔ As the general population. If they have health problems, they should request first aid and they should wait to be transported to a place where medical care is being provided.

What should corporate executives of industrial and commercial companies and tertiary sector services do?

(See also Wellington City Council Emergency Management Office, 1999)

A. Before the earthquake strikes

- ✔ They should make sure that all hazardous elements are removed from the workplace.
- ✔ All companies are responsible of their employees' security and they have the obligation to establish and keep an evacuation plan, in cooperation with the competent urban planning or technical services of the Municipality or the Prefectural Government. This plan will determine a safe open space for employees emergency gathering after the earthquake or a secondary effect, such as a fire.
- ✔ This plan should also mention the operational aspects of the evacuation procedure, taking into consideration all emlpoyee groups. If there is a list or a record of the employees, someone will have to take it along during the evacuation procedure. This plan should also include a scenario of delay of the arrival of external aid for up to three days.
- ✔ The companies' administrations should make sure that the evacuation routes, the emergency exits and their alternatives are free of obstacles and that they are equipped with safety lighting. The fire alarm and extinguisher systems should be maintained from time to time. Each company's plan should appoint persons responsible for facilitating the evacuation of employees, disabled persons, visitors, etc. It is advisable that the company organises or participates to drills.
- ✔ It is necessary that, especially in industrial companies, groups of employees are appointed and trained to handle simple first aid situations, fire extinguishments, rescues, damage assessions, etc. At last, the guardians of the companies should be trained to take leadership duties during the evacuation procedure.

- ✔ It is the company's responsibility (in the case of industrial sector, in particular) to inform each employee about the hazards (related to the equipment and the stock of raw materials and products), the warning signals and the alarm systems, the evacuation plans and the emergency supplies.
- ✔ It is the responibility of the industrial companies to secure properly the containers of chemicals or detergents, to keep toxic materials in suitable containers labelled properly and to make sure that acid, toxic or dangerous fluids are covered in order to avoid overflow during the earthquake.
- ✔ A power generator is necessary for an emergency, especially in the case of large companies.
- ✔ The company is responsible for equipping the industrial premises with alarm systems, as well as with visual and audible signs.
- ✔ The phone numbers, but also the other means and codes of communication with the emergency services, the Police and Fire Service, the First Aid Station, hospitals, etc, should be immediately available during the crisis.

B. As soon as the earthquake starts....

- ✔ The alarm systems should go off and the employees should act according to the preparedness drills and the provisions for the first stage of the evacuation plans. During the quakes, self-protection is the main concern.

C. As soon as the quakes stop....

✔ There should be a quick assessment of the situation, small fires should be dealt with, if possible, the supplies should be cut off and instructions concerning the evacuation should be given (it is possible that the pre-disaster selected spaces present safety problems). The employees should be well trained so that they will not run to the stairs and elevators, unless they are instructed to do so. The guardians-in head of the evacuation procedure should take action. The employees lists should also be found.

D. At the refuge space

✔ According to the lists, the presence or the absence of employees should be confirmed, including the visitors and the clients. These presences and absences should be made known to the coordination centre, which by being in contact with the local radio stations, can pass the relevant information to the emergency services, to the relatives and the employees' families.

What should the staff in schools and welfare institutions do?

(See also OASP, 1999, American Red Cross, 1994, Washington State Emergency Management Division in partnership with Kitsap County Emergency Management, 1998 and Davis School District Emergency Policy)

A. Before the earthquake starts

Bookshelves, blackboards, lamp shades, fans: school objects that should be taken into consideration in order to prevent hazardous situations.

- ✔ They should make sure that all hazardous elements are removed from the classrooms, the teachers' offices, the corridors and the schoolyards.
- ✔ The school staff should take the initiative to make out, establish and keep evacuation plans (with sketches), including procedures to cut off the supplies, the order according to which the classrooms are going to be evacuated, the alternative evacuation routes, the refuge spaces, the potentially dangerous spots inside and outside the building, the alternative alarm systems and ways to give out instructions (in case of electricity cut off), the alternative systems of contact and communication with the coordination centre, the mutual aid agreements with other educational and welfare units referring to the common use of infrastructure, if needed. The plan should also read the existing conditions of the school spaces, both indoor and outdoor, and point out any hazardous elements, those which have not been removed (eg, theatres with one exit, toilets in the basement, external power cords, open shelves containing dangerous chemical materials, etc). The actions before, after and during the quake should be explicitly reported, taking into consideration that the catastrophic event could happen during either class hours or break. Copies of the plan should be given to the parents' councils.
- ✔ The evacuation plan should also assign several duties and roles to the school staff so as to satisfy the full range of the emergency needs (yet trivial duties, for instance, who is responsible for unlocking the main entrance, in case of evacuation). It should be emphasized that the teaching staff is fully and

exclusively responsible of protecting the pupils in the school premises. This responsibility starts at the onset of the tremours and finishes with the delivery of the last pupil to his/her parents or guardians. In particular, the evacuation plan should define the following roles and duties: the person in charge of the plan, who is responsible for organizing, training, preparing and coordinating the staff, the person in charge of the rescue operations, the person in charge of the fire extinguishing operations, the person responsible for recording presences or absences and the person responsible for checking the supply networks. These plans should be flexible and easily understandable from the pupils and their parents.

✔ The school staff should procure for the provision of the school or the kindergarten with the emergency supplies (see paragraph 2.1.B, criterion VII). These supplies should include fire extinguishers, loudspeakers and lists of the school staff, as well as of the schoolbus drivers. These lists should incorporate data such as addresses, phone numbers, etc. The supplies should be stored in safe places easily accessible.

✔ They should learn, train and be well-drilled on issues concerning the alarm and warning systems, the locations and the potential obstacles of the evacuation routes up to the refuge spaces, simple cases of first aid assistance, as well as the reactions of children under the condition of panic.

B. As soon as the quakes begin... and if they are at school or the kindergarten

✔ The school staff should guide the children, in case they are within the classroom to seek immediate self protection, according to the instructions **«FALL, TAKE COVER, HOLD ON»** and to guidelines already known by means of earthquake drills. They should be prevented from running to the exits. If they are in the schoolyard, they should remain there and stay away from fence walls, balconies,

electric power cords, etc. If they are in corridors without desks or tables, they should go away from dangerous spots, fall on the ground and remain there in a face-down position, covering their heads with whatever is available.

C. As soon as the quakes stop... and if they are at school or the kindergarten

- ✔ First of all, there should be an assessment of the situation. Then, should the schoolyard or the surrounding spaces be found safe and secure, the instruction to evacuate is given. The teachers should take along the pupils' lists, they should check the corridors, kitchens, classrooms and sanitary facilities, they should cut off the supplies of water and electricity and guide the pupils to the preselected spaces. The school's emergency supplies should be either brought along or reachable from the refuge space.
- ✔ If the outdoor spaces of the school cannot provide for the required safety standards, then, the teachers should direct the pupils, towards the-out of the schoolsite- pre-selected neighboring refuge space. The safer and shorter way up to it should be examined and selected. If there is not such a possibility, then there should be arrangements, through the coordination centre, for the transportation of the pupils to school sites with surplus of safe outdoor spaces.

D. At the refuge space

- ✔ The teachers, with the help of the lists, pin-point the missing children and notify the headmaster or his/her deputy. It might be wise to group the pupils according to their districts or neighborhoods. The headmaster or his deputy notify the coordination centre, the Fire Service or the Police about the absents.
- ✔ At the refuge space, the teachers are receiveng information through the loudspeakers or with a

signal and they supervise the children, in order to prevent them from leaving unescorted or without parents and guardians. For the following hours and days, the children must be well taken care of by their teachers, until the time that the school building has been looked up and down and assessed usable, or until they are escorted back to their homes or until they are picked up by buses and transported to their home refuge spaces.

What should the tourists and the foreign population staying at hotels do?

A. Before the earthquake begins

- ✔ They should be informed at the hotel reception about the emergency exits or they should look for themselves and find the according signs.
- ✔ They should make sure to always keep along their necessary personal belongings (identification cards, glasses, medicines, etc).

B. As soon as the tremours start....

- ✔ They should act as the indigenous population.

C. As soon as the quake stops... and they are at the hotel

- ✔ They should evacuate the building following the evacuation route and the emergency exit signs, after making sure that they have taken along their necessary personal belongings.

D. At the refuge space

- ✔ They should remain there until further notice to return back to the hotel or up to their transportation to other hotels or to major ports, airports and terminals for leaving definitively the disaster area.

3. POST-EARTHQUAKE ACTIONS

3.1 Informing the population

Giving information to the public, and, in general, the communication of the emergency mechanism with the disaster victims is an essential prerequisite of a successful evacuation process. Even in cases of high level of prepardness, several problems, contingencies, uncertainties and dilemmas may come up:

- An industry's courtyard has been selected for the employees' refuge, yet the nearby industry cought fire after the earthquke. Where to should the employees be moved?
- For a school, the predefined refuge space was the park of the next block, yet the street giving access to the park is closed due to debris. What should the school community do?
- The refuge space of my neighborhood is at a 7 minutes walk distance, but it is pouring outside and some of my family members are aged with mobility problems. Will my car offer us safety?- And where should I go?
- I didn't take particular care to get pre-disaster information about the refuge spaces of my neighborhood and the safer ways to get there. How to get relevant information without losing precious time?

Some of these answers are bound to be given by the earthquake victims themselves, forced to make decisions without adequate information. The fact may result into awkward, undesirable effects. Hence, the quicker the situation is assessed and the capability of transmitting instructions to the population groups is secured, the smaller the toll during evacuation will be.

Disseminating information to the public in a post-earthquake emergency situation could take the following forms:

- It could be informative, that is to give information about the latest course of the situation and the actions taken to protect life, health and property.
- It could be consulting, that is to give advice to the public on actions to avoid or others to pay attention to.
- It could be information promoting alertness and readiness. Life and safety are threatened (for instance, by post-earthquake secondary hazards). The public has to be cautious and alert.
- It could be warning: the situations imposing alertness are now a reality. The public is warned, they should prepare themselves to implement protection measures.
- It could be guiding: the public receives instructions to act immediately.

The coordination centre should communicate with the evacuees by broadcasting information of various content, as mentioned above. Particularly, there will be a need of broadcasting:

Updating information:	➲ How serious the earthquake disaster is and which measures are taken to assess the situation. ➲ Are there any districts, areas or locations inaccessible at first sight via helicopter view, due to fire or extended damages? ➲ Which of the refuge spaces are accessible (urban and periurban), which evacuation routes (roads, pedestrian ways) are hazardous? ➲Are the children at schools or schoolyards safe and for how long should they remain there? How are the relatives and generally the familiar persons? ➲ Are there any buses available to transport the children of the school to the preselected refuge space?
Consulting information:	➲ What should the persons inside cars do? Should they abandon them, should they pull over or move towards a specific direction? Where to? ➲ Is it wise to return home, a few hours after evacuation, and under which circumstances? ➲ Is tap water drinkable or not? ➲ Is it wise for parents to attempt to approach the schools by car in order to pick up their children?
Information promoting alertness:	➲ After-shocks are expected! Keep away from trees, posts, bending vertical constructions, downtown streets with hanging panels, etc! ➲ Be careful of fallen electricity cords! ➲ Be careful with children when crossing roads used by emergency vehicles.
Warning information:	➲ Do not attempt to cross any flyovers of the town/city, they are seriously damaged by the earthquake! ➲ Do not enter in houses declared as hazardous or non-usable! ➲...
Guiding information:	➲ If you have a summer residence, leave the town/city... ➲ The refuge spaces downtown are innaccessible, congested or hazardous

due to fire. Make use of your private cars to move away towards the periurban refuge spaces... ➲ To obtain information about your relatives' health condition, call the following number... ➲ The tourists and foreigners being in refuge spaces can receive information concerning departure arrangements by calling the following numbers... and getting in contact with the competent officials of the tourist authorities.

There are many possibilities to transmit the above mentioned messages. Indicative examples are: **message systems making use of the radio or the phone (if operating), phone banks, news flashes, press conferences**. As far as warning messages and guiding information are concerned, other important information sources are **the intra-personal contacts with the persons in charge of the emergency mechanism and the mobile units of the municipal and public services**. The announcements to the public should clarify from the beginning their content and purpose, whether informative, warning or instructive.

The first messages to the public should come from services involved in the emergency mechanism, such as the civil protection, the police and the Fire Service, the minicipal and prefectural technical services, the education, health, transport and welfare services. These first messages wil be broadcasted by the radio or the telephone and they will be addressed to specific groups of the population.

Phone banks, if created after the earthquake to absorb the increased demand in communication could be extremely useful, especially in the field of transmitting individualized information. These banks could be staffed by employees of the phone company and volunteers. The relevant numbers will be made known to the public. The phone banks will relieve the emergency phone numbers from excess load and the administrative services from non-urgent calls that do not require immediate attention.

It should be emphasized that the efforts of the population to **communicate by phone**, mobile or wired, with the authorities, the relatives or the emergency services, **will be in vain**, at least during the first hours after the quake. The population should not rely on the telephone. They should use instead a portable radio to get information. After destructive earthquakes, telecommunication systems are out of operation due to overloading of the networks, beyond the possibility of being seriously damaged.

It is however important for the public to know that the number **112**, is the number for emergencies in the countries of the European Union. 112 can be dialed by all mobile telephones without an access code and without dialing the PIN first, which activates the phone and which might be unknown to the occasional user. In addition to that, this call is a priority call and it can therefore pass through other than the user's phone company network.

3.2 Operations' conduct

Knowledge and the aquisition of information concerning the location and the signs of escape routes, emergency exits and refuge spaces, awareness and preparation of the survival kits and emergency supplies, even the conciousness of the responsibilities assigned to each one of us at the workplace, are not enough for the operational success of an evacuation and refuge procedure. The correct order and succession of the necessary steps is essential so that the prerequisits of each action are secured and that the synergies between them are attained leading finally to the ultimate end that is safe refuge.

By way of example the following paragraphs analyse the successive steps to take when evacuating a school, so that it becomes understandable where and when obstacles might come up and how they can be dealt with:

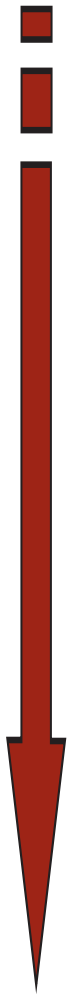
Some of the steps to evacuate school buildings and welfare institutions. -Pictures from preparedness drills (source: OASP, 2001, «Memorandum of actions for the protection of schools against earthquakes»).

Step 0:

➵ When the tremours start and the pupils are in the classroom, the teachers induce the children to immediately cover themselves by barely taking a few steps and not running to the exits of the building. After they have taken cover under the desks or tables, they should remain calm, and wait, without panic, for the instructions that are going to be given by their teachers. They do not evacuate the building during the eathquake. They do not go out on balconies and terraces. They do not approach windows or glass panellings. They do not try to evacuate through the windows.

➵ When the tremours start and some of the pupils are in the schoolyard, they should remain there, keeping themselves away from the buildings.

Step 1:



When the alarm goes off, or when instructions are given to evacuate the building, they all move calmly and orderly towards the signalled or nearest clear exit. The sections and the wings which are closest to the exits, the escape routes and stairwells are the first to evacuate:

1a) The headmaster or the keeper open as quickly as possible the school's main entrance and the person in charge cuts off the electricity and water supply.

✚

1b). The teachers open carefully the classroom doors, assess the situation along the evacuation routes, remind the pupils of the whreabouts of the refuge space and guide them following orderly the prearranged succession, to avoid jostling.

✚

1c). The teachers take along the pupils' lists and guide them out of the building.

✚

1d). All the staff should be well trained and familiar with the alternative evacuation routes.

✚

1e). The pupils do not take along any of their personal belongings.

✚

1f). The teachers follow the prearranged procedures in order to help any disabled pupils to evacuate.

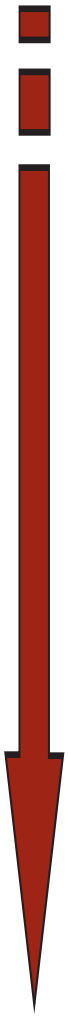
✚

1g). The staff assigned with particular duties checks during evacuation the areas of common use, the kitchen, the classrooms, etc, and makes sure that they are all fully evacuated.

✚

1h). The persons in charge take the school's emergency supplies to the preselected refuge space.

Step 2:



As soon as the building is evacuated, the teachers guide their pupils to the prearranged and signalled on the ground area of the schoolyard, or another, in the same or a nearby block, according to the pre-disaster arrangements. For this purpose, a teacher goes to the preselected refuge space and decides on the safest and quickest way to approach. Then, the children are guided there divided in accompanied groups. If the stay at a nearby refuge space is unreccommended, then, the teachers, according to the prearranged plan, accompany the children in other schools of the neighborhood.

2a). The preselected refuge space aimed to serving the pupils and the teachers should not be endangered by any electrical power lines, gas pipes or vehicle traffic.

✚

2b). The pupils should remain there calmly and orderly.

✚

2c). The teachers, by making use of the lists, establish pupil's absences and report them to the headmaster or his deputy. It might be necessary once more to group the children according to their districts of residence. If there are missing pupils, the teachers have to go back and look for any injured persons.

✚

2d). Some teachers handle small fires, if any.

✚

2e). The pupils who, at the moment of the earthquake are not with the rest of their class, evacuate the building via the nearest clear exit and move to where the rest of their class is.

✚

2f). The pupils remain away from the building at a distance equal to at least the half of its height and away from the fences. They do not drink tap water.

Step 3:

The vehicle traffic and parking areas should remain clear and the pupils should stay away from them, unless they are accompanied by an adult.

Step 4:

The headmaster or his deputy report any absents to the Coordination Centre, to the Police and the Fire Service. If communication is impossible by interpersonal contact, then someone from the school staff should undertake the mission to do so.

Step 5:

The teachers get information through loudspeaker announcements, signals or even through personal contacts with the representatives of the Coordination Centre carrying messages. The electric bell should not be used as it might as well be off. The pupils and the teachers should remain at the refuge space until they are informed about the existing conditions from a reliable source. Depending on the disater circumstances, the teachers should take care of the pupils' physical and mental health until they are delivered to their parents.

INSTEAD OF AN AFTERWORD

An extract from an article by the Greek writer Gregorios Xenopoulos is quoted, instead of an afterword. The article was published in an issue of the magazine «Diaplasis ton Pedon», dated May 5th 1928. It is titled «SEISMOS»which is EARTHQUAKE in Greek and it was written on the occasion of the 1928 earthquake disaster in Korinthos:

«..... But what can you do about it! Even the shadow of the earthquake frightens us. When one feels the most solid, the most unshakable thing in the whole world -the earth- trembling under his feet, dancing, waving like the sea, he loses his trust in everything, he thinks that he no longer has a safe refuge. Even the slightest tremours are enough to madden him. And, besides, who can vouch for no stronger tremours later on? Who is to guarantee that the earth will not shake more vividly, and that the houses will not collapse? And there is neither forecasting, nor the possibility of taking precautions!

... The earthquake, you see, is an inevitable thing. Because, in order to live on the earth, the earth has to be alive. And, in order to be alive, the earth generates earthquakes...

... But mankind can defend itself with its mind, even against earthquakes. Humans cannot, of course, cancel or eliminate earthquakes altogether, but they can indeed mitigate its impacts by the available means. Fear however remains as the greater evil. But even fear can be fought down by the mind, the mind telling us we shouldn't be affraid of sudden and random disasters... Because, when they arrive, in all inevitability, our brothers are here to help us, as the great disaster awakes in their souls benevolence and solidarity; and we' ve just seen these attitudes after the Korinthos earthquakes, in all their beauty and emotiveness.

I embrace you
PHAEDON»

If nothing else, this manual attempts to mitigate the fear of earthquakes.

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C. Drawings and photographs

- All images belong to the archive of OASP unless another source is mentioned.

A BRIEF CURRICULUM VITAE OF THE AUTHOR

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