Earthquake preparedness of school students and population using scientific knowledge for public multimedia information

DURATION : 2012 – 2013

TARGET COUNTRIES: Romania, Moldova, Ukraine, Bulgaria

PARTNERS INVOLVED:
Coordinating Centre : ECBR Bucharest, Romania
Other Centres: ECMNR Chisinau, Moldova, ECRP Sofia, Bulgaria , TESEC Kiev, Ukraine
Other Partners : ECPFE Athens, BE-SAFE-NET Cyprus

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013:
Dissemination of earthquake preparedness knowledge for school students and population using public multimedia information in areas shaken by Vrancea, romania, intermediate seismogenic source.

Specific yearly objectives:

2012:
Gathering knowledge on specific damage and vulnerability of buildings after past great Vrancea earthquakes and lessons for earthquake protection of students and citizens. Comparison with the experience of Greece and Cyprus.

2013:
Study of contents and dissemination means required for earthquake preparedness and education materials, to take into account the local conditions of each country affected by Vrancea source and validation according to experience of Greece and Cyprus.

EXPECTED RESULTS

2012:
Reports about damage and vulnerability of buildings and population in Romania, Moldova, Ukraine and Bulgaria

2013:
Preparation of materials for earthquake education od students and citizens, to be posted on websites of EUR-OPA Specialized Centres of partner countries and dissemination of other materials. Evaluation and improvement based on experience of Greece and Cyprus.

RESULTS OBTAINED PREVIOUSLY

Research and dissemination activities in support of rehabilitation programs, earthquake education seminars and courses in Romania, R. Moldova, Bulgaria and Ukraine

RESULTS OBTAINED IN 2012

Work package 1 (prepared by ECBR, ECMNR, ECRP, TESEC)*:*

Description:
Organize a working committee with experts from partner countries and set-up a content for a preliminary report on the scientific, technical and management issues and tasks of each centre. The Committee works by INTERNET.

Associated deliverables:
D1-Committee tasks and content of a report with scientific, technical and management issues.
D2 Kick-off Meeting of all partners at ECBR Bucharest to discuss the tasks

Work package 2 (prepared by ECBR, ECMNR, ECRP, TESEC):

Description:
Gathering data on specific damage and vulnerability of buildings after past great Vrancea earthquakes and lessons for earthquake protection of students and citizens in Romania, R. Moldova, Bulgaria and Ukraine.

Associated deliverables:
Report with scientific, technical and management issues from Romania, R. Moldova, Bulgaria and Ukraine.

ECBR

ECMNR

For project fulfilment for the period of the year 2012 we laid stress on:

- short-term objectives ;
- promotion of the project involving Centres, (more frequently CSLT Sofia, Bulgaria) and other central and local authorities from the Republic of Moldova;
- development of a policy of active communication

During activity fulfilment, taking into account the common aim, we have carried out these activities in a way that would allow us collecting as many as possible ideas, ensuring communication and an exchange of experience in this respect as to scientific and technical information about hazards and vulnerability, the identification of solutions for improving society's survivability against earthquakes.

In this respect, the selected information related to risk mitigation has been analysed and developed with the participation of the scientists from this field, of the experts and of the central and local decision-making authorities.
In result of the earthquakes with the epicentre in Vrancea in 1977, 1986 and 1990 and with the amplitude of 9 on the Richter scale the most affected buildings were those from Chisinau. We contributed to risk area identification and map elaboration according to the mutual consent of the municipal authorities. We worked upon concrete proposals and measures for mitigating the vulnerability of these areas of risk. In result of the polls made at different social levels, we found out that both the population and the persons in charge had scanty knowledge about this. In regard thereto, we sensitized the improvement of comprehension of the seismic risk by people and society, pursuing the aim of focusing the political attention on risk control. We proceeded to training improvement through a correct and attentive examination of the social and ethical aspects, paying attention to the vulnerable population from Chisinau and from the republic. With this object in mind, we organized and fulfilled training courses related to risk management within university classes for students. Considering the fact that we planned to use the knowledge with the aim of mitigating vulnerability, we proceeded to gathering information and to carrying out a round table. We should mention that Centre's initiatives sensitized both municipal authorities and a great part of the public opinion.
The Centre gathered as well information connected to the effects and damages provoked to the Republic of Moldova in the past by the earthquakes from Vrancea region.

The Centre has investigated the reports on the damages caused to the Republic of Moldova by the earthquakes from Vrancea region in the past and the current state of knowledge, training classes and needs concerning population's preparedness to an earthquake as well.

Round Table: ANTI-RISK EDUCATION IN THE EVENT OF AN EARTHQUAKE
Chisinau, Moldova, 26-27 December 2012

Conclusions
The round table was fulfilled with the aim of performing the project *,,Earthquake preparedness of school students+population using scientific knowledge for public multimedia information in areas shaken by Vrancea, Romania, intermediate seismogenic source (case studies on buildings in Moldova, Ukraine, Bulgaria)"* regarding the promotion of the earthquake risk prevention culture and the application of anti-risk education activities in schools. The earthquakes with the epicentre in Vrancea are still a situation of risk. The analysis of the earthquakes from 1977, 1986 and 1990 with the amplitude of 9 on the Richter scale, with the epicentre in Vrancea, shows that they destroyed in a catastrophic way the buildings form Chisinau. In this regard, Centre's contribution made it possible for the local public authorities and scientific institutions to make common efforts for mitigating the seismic risk in Chisinau city.

Alexandru Boldesco, Chief Engineer of the General Department of Architecture, Urbanism and Land Relations of Chisinau Municipal Council, who was present at the round table, mentioned that the concept of a durable development determines a permanent reassessment of the relation between the human being and nature and asserted that the solidarity between generations is the only viable option for a long-term development.
For implementing this concept at a local level, the following researches have been developed through the common efforts of Chisinau Municipal Council, Chisinau City Hall, General Department of Architecture, Urbanism and Land Relations of Chisinau Municipal Council in collaboration with the Institute of Geology and Seismology at the Academy of Sciences of Moldova and the European Centre for Mitigation of Natural Risks:

1. *Feasibility Study: „ Elaboration of engineering and technical protection measures for increasing seismic security of building territories and sites from Chisinau Municipium" (under the action of penetration of water into the basement and seismic actions)*

The territory of Chisinau city has at present the total area of about 130.0 km^2, the maximal length of about 14 km., width -12 km. Chisinau is situated in the meadow of Bic River, on its left and right banks. The maximum pluvial precipitations with the probability of 1% attain 220 mm per day. The city is located on a territory with complicated geological and hydrogeological conditions and is in **the range of coverage of Vrancea seismic region.** The dwelling stock constitutes about 14,0 mln. m ^{2} (about 70% from country's stock). The most intensive building period was from 1966 up to 1989. For instance, at the end of the 80's, residential houses/blocks with the area of about 400 thousand m^2 (total area) were put in commission yearly.

This building dynamics had a negative influence on the natural and geological environment in result of the deterioration of the natural equilibrium of groundwater and of the conditions of its circulation. The greatest part of flooded territories from 1966 up to 2020 (forecasted year) amounts to 1803,1 ha. The period from 1966 until 1985 is the most intensive building period and represents 72,5% of the surface of flooded territories. The maximum increase in Botanica Sector constitutes 704,6 ha (39,1%), and the minimum increase is in Centru Sector - 174,5 ha (9,6%), where the built-up areas were minimal, fact confirmed by the priority thesis of anthropogenic loads for the flooding

processes of the urban built-up territories and of the need for forecasting and engineering preparation of territories for their distribution for building aims.

The increase of flooded territories (groundwater level up to 5,0 m), ha			Total
1966-1985	1986-2002	2002-2020	
1308,3 (72,5%)	408,2 (22,7%)	86,2 (4,8%)	1803,1 (100%)

We have made an extensive analysis within the abovementioned study as to the area of the territory of the city that was flooded in the period from 1965 up to 2002. We have elaborated the groundwater pattern and the forecast of groundwater level dynamics up to 2020.

We have developed the groundwater pattern for Chisinau city and we have made the evolution forecast for 2020, which can present an insignificant increase, and namely 0,42-0,65 m or 2,3-3,6 cm per year; in general, the statistical interval of groundwater level rise "F" changes from 0,0 up to 1 m in 15 years. The temporary and local flooding can happen only within the boundaries of small territories during the creation of a temporary horizon, especially when there are intensive precipitations. We have made the geotechnical zonation of the territory. The outlined geotechnical regions differ according to their composition and properties of the quaternary soils, as well as according to the presence of some unfavourable factors as landslips, etc. We have developed a modern database describing the geologic and hydrogeologic environment of Chisinau city. The database contains information about 2376 wells drilled in the territory of Chisinau city recently. For the operational administration of the database, we have developed the "GEOTECH" program.

On the grounds of the results of a complex analysis and of the generalization of geological, geotechnical, instrumental and calculation data, we have developed the seismic microzonation map of the territory Chisinau city at a scale of 1:10000 for an area of 122,3 sq.km. depending on the value of the forecasted seismic oscillation intensity, the studied territory being divided in two areas: of 7 and 8 degrees MSK, and namely:
The 8-degree area constitutes 37% (45,3 km) out of the total area of the city.
The 7-degree area constitutes 63%, being associated with territories having a level of more than 80-120 m.
The seismically unfavourable sectors for buildings are indicated as well on the seismic microzonation map of Chisinau city. The study concerning the seismic microzonation of the territory of Chisinau city was fulfilled through the common efforts of Chisinau Municipal Council, Chisinau City Hall, General Department of Architecture, Urbanism and Land Relations, the Institute of Geology and Seismology and the European Centre for Mitigation of Natural Risks.

2. *The development and monitoring of the geological and geotechnical database of Chisinau city.*

As shown before by the feasibility study „Elaboration of engineering and technical protection measures for increasing seismic security of building territories and sites from Chisinau Municipium" (under the action of penetration of water into the basement and seismic actions), information about 2376 wells was introduced in the database.

Within the abovementioned study, the database that had been created previously was considerably developed. Currently, this database contains data about circa 12 thousand wells and all this information is processed through Geotech program. The geological database of Chisinau city with a set of special maps represents already the data that are necessary for the development of design works in the field of urbanism and land improvements; this database allows creating a modern geotechnical service and continuous monitoring. The operation of this service has other social and economic effects, too.

As a result of the efforts made for the initiation and fulfilment of the abovementioned projects, the elaboration and approval of new normative acts in the building field was possible:
- "Geophysics of hazardous natural processes"
- Safety technique of the territory, buildings and structures against hazardous geological processes. General information
- Buildings in seismic areas. General guidance
This study contains as well the compartment "**Seismic risk assessment of the territory of Chisinau city**".
This kind of project was developed for the first time in Chisinau city.

The roundtable participants laid stress on the decreased competency level of the population, including that of the didactic staff as to the safety rules and organization of urgent actions for saving and protecting children in the event of an earthquake. Currently, the popularization of knowledge about the nature of the earthquakes and the provision with methodical support for didactic staff training and for skill development for the creation of an appropriate behaviour during an earthquake and in the period that follows it have a particular importance.

The subject ANTI-RISK EDUCATION IN THE EVENT OF AN EARTHQUAKE excited a vivid interest during the roundtable at which representatives of the central public administration, of the preschool, school, university and academic environment took part (41 participants).
According to the roundtable agenda, the following reports have been listened to: -

- The opportunity of realizing what is the seismic risk (rapporteur: A. Bantuş, Dr., University Lecturer, Director of the ECMNR*)*
- Lessons learned from the earthquakes from the recent period (rapporteur: Alexandru Oprea, Head of the Civil Protection Department of the Ministry of Internal Affairs)
- The common efforts of the local public and scientific authorities for the mitigation of the seismic risk in Chisinau city. (rapporteur: Alexandru Boldesco, Chief Engineer of the General Department of Architecture, Urbanism and Land Relations of Chisinau Municipal Council)
- Efficient solutions for organizing training classes in educational institutions for earthquake risk mitigation (rapporteur: Vladimir Guţu, PhD, University Lecturer at Moldova State University)

- The experience of the Republic of Moldova in protecting population against earthquakes (rapporteur: Vitali Mutaf**,** lieutenant colonel of the s/s, Deputy Head of the Civil Protection Department)
- Anti-risk training of pupils in schools – a solution for improving their resistance against potential earthquakes (rapporteur: Kolio P. Kolev, Director of the European Centre for Risk Prevention, Sofia, Bulgaria).
- The efficiency of the current system of training local public administration authorities on issues of prevention and liquidation of earthquake consequences. Issues and proposals. (Rapporteur: Victor Mirza, Major of the s/s, Deputy Head of the Republican Training Centre)
- Enhancement of the earthquake resistance capacity through training, education and knowledge - (Rapporteur: Dimitar Yonchev, Professor, Director of the Centre for Security, New Bulgarian University)
- Training system administration for local earthquakes-(rapporteur: Veaceslav Pavlov, Academy of Sciences of Moldova)
- Psychological involvement in the educational process of preventing consequences of the earthquakes-(Rapporteur: Angela Potâng, Dr., Associate Professor)
- Implementation of educational activities in schools as to seismic risk mitigation. (Rapporteur: Larisa Bantuş, Dr., Associate Professor)

debates, the exchange of opinions and analysis, the following objectives were fulfilled and proposed:

- The development of an active communication policy.
- The promotion of the seismic risk prevention culture by implementing educational activities on seismic risk management in schools.
- To disseminate knowledge about the nature of earthquakes and to provide methodical support for didactic staff training and development of skills for the creation of an appropriate behaviour in situations of seismic risk.

In result of a thorough analysis and exchange of views, the following conclusions took shape:

1. It is appropriate to improve the comprehension of the seismic risk by pupils, students and the society as a whole in order to focus the political attention on its management, too.
2. The inclusion of anti-stress skills and of an appropriate behavior in the event of an earthquake as an optional or extracurricular subject.
3. Introducing a unit at the Moldova State University- the education in emergency situations - at the Faculty of Psychology and Sciences of Education, the graduates/representatives of which could then go into schools to inform and prepare children and didactic staff.
4. The collaboration between psychologists and specialists from SPC and Emergencies Situations in order to improve the psychological methods of prevention and mitigation of earthquake consequences.
5. To contribute to the development of an active communication policy between European states regarding the preparation of students and people who use scientific knowledge about earthquakes in the shaken areas from Vrancea.
6. To contribute to changing population and especially teachers' attitude towards the need to know and create correct behavioral skills of automated type: before earthquake, during and after the earthquake and the combination with child-centered education.
7. To organize trainings in educational institutions, drawing contests, information, national and international competitions, to organize exhibitions about earthquakes and encouraging participants more frequently.
8. As well, in result of the debates, it was concluded that the introduction of new subjects in the school curriculum is not appropriate because the school program is overloaded, but new objectives and skills might be introduced in other subjects related to the Education for a Healthy Lifestyle, Civil Protection, Safety Management in Emergencies, Life Skills, and especially within educative classes. Practical lessons and periodic seminars for teachers with the organization of simulations can be organized in collaboration with the Civil Protection Department.

The roundtable participants considered that this type of work with the financial support of the Council of Europe is especially useful, important and efficient and they supported unanimously:

1. Making suggestions for conducting studies in the field of highly qualified didactic staff training for natural risk management.
2. The popularization of the safety rules in case of earthquakes.
3. The development of conceptual reference points concerning the education strategy in the field of protection against earthquakes in educational institutions.
4. The development of educational principles in the field of protection in the event of earthquakes:
   - The adjustment of anti-risk education to pupil's personality.
   - Carrying out the educational process against the background of the collaboration relations between the pupil and the teacher.
   - The timely transparency and notification of all the persons concerned (pupils, parents, teachers, students, technical staff, etc.) concerning the seismic risks.
   - The use of different strategies and technologies concerning the development of an appropriate behaviour to pupils, students, teachers, technical staff in the event of an earthquake.
   - The creation of a behavioural skill of automated type: before the earthquake, during the earthquake and immediately after the earthquake.

The roundtable participants have highly appreciated this activity organized by the European Centre for Mitigation of Natural Risks, qualifying it as a successful and efficient one, having a long-term effect in the mobilization and bringing together of the persons interested in opening up, participating and collaborating in the field of seismic risk prevention culture.

TESEC

In the western areas of Ukraine (from the XVII centuries up to our time) earthquakes are generally characterised by the depths of fires (h) 2-10 km and magnitudes (M) <5.5. Due to the small depth these earthquakes cause local vibrations of soil surfaces with intensity of 7-7.5 points. The same vibrations are felt in Zakarpattya due to the earthquakes deeper (h=35 km) and bigger in size (M=6.8) with fires located in Romania (Pishkolz) at the distance of about 60 km from the Ukrainian borders. In Prykarpattya the biggest authentically described earthquake took place in 1875 near the region Velyki Mosty (in the Lvov region). It was characterised by the magnitude M=5.3, fire's depth of h=19 km and was felt in the epicentral zone with the intensity of 6 points.
A considerable part of the Ukrainian territory is under influence of the undercrust earthquakes, which take place in the Vranch zone in Romania (area of the joint between the Eastern and Southern Carpathians). Fires of the earthquakes, which are capable to become the reason of macroseismic manifestations on the territory of Ukraine, are located in the mantle at depths ranging from 80 to 190 km. Maximum magnitudes of earthquakes in this zone reached 7.6 points. Due to the big depths and magnitudes, earthquakes of the Vranch zone become apperent on the huge territory: from the South of Greece to the North of Finland.
On the epicentres' map the earthquakes' fires in the Vranch zone are presented since XI century with magnitudes over 3.5 points. Isoseists of the strongest earthquakes in the Vranch zone are reliably established for the last two centuries. For the construction of isoseists the published materials were used, and for the earthquakes of 1977-1990 - authors' data.

Seismicity of the Crimean-Black Sea region is defined by the epicentres of the earthquakes located in the water area of the Black sea, near the Southern coast of Crimea which are characterised by the highest indicators throughout the Ukrainian territory: magnitudes up to 6.8. On the epicentres' map the Crimean earthquakes are presented with magnitudes, exceeding 2.0, during supervision period between the I century BC up to the present time. On the flat part of Crimea and the Sea of Azov fires of earthquakes with magnitudes over 1.0 are shown.

It is possible to consider the delta of Danube as separate seismic area. Here throughout the historical times earthquakes with maximum magnitude of about 7 points took place, which together with Vranch earthquakes' zone represent serious danger to the territory of Odessa region.

In the central part of Ukraine, in particular within the Ukrainian board, for the last centuries only several earthquakes with small depths (5-10 km) and low magnitudes (M = 3) were authentically fixed. These earthquakes had local character of seismic influence. The strongest earthquake in the Eastern part of Ukraine is considered to be the one in 1913 near Kupyansk (magnitude 3.5, local vibrations with the intensity up to 5-6 points). In the western part of Ukraine, near urban village Mykulynzi in the Ternopil region, earthquake with magnitude of 4 took place on January 3rd, 2002, and had intensity of 6 points in the epicentre with 7 points' effects on the weakened soils. Heretofore the specified territory had indicator of 5 points.

In Ukraine the national network of seismic supervision was created, with 18 seismic and 14 complex geophysical stations. The oldest is the seismic station "Lviv" which was founded in 1899. Digital seismic station "Kiev" was created in 1994 and it is a part of the Global seismic network.
The knowledge on specific damage and vulnerability of buildings in Ukraine after past great Vrancea earthquakes has been collected.

ECPR
After the destructive earthquake in Southern Bulgaria on 14th and 18th April 1928 the next 50 years are relatively quiet with regard to seismic activity. This creates the impression that the seismic danger has disappeared and it is no longer necessary to spend resources in this regard. Even in 1975 scientists started to research the foreign experience in a neighboring country for reduction by 30% of the steel consumption in reinforced concrete construction.

In this atmosphere of relief on March 4, 1977 comes the destructive earthquake with epicenter Vrancea, Romania. The earthquake causes a mass psychological impact on the population in Bulgaria, especially the citizens of the town of Svishtov who have witnessed how just in a few seconds an eight-storey residential flat rotates around its axis and with a terrible bang goes down, covered in clouds of dust /more than 100 people died/. Mass psychosis of fear and insecurity spreads around many towns in Southern Bulgaria and in Sofia.

A Central Scientific-Technical Committee was immediately founded with the task to document and research the earthquake. The committee publishes a preliminary report on the destructions and damages in Romania and Bulgaria. A complex target program was developed for long-term fundamental and applied surveys in the field of seismotectonics, engineering geology, hydrogeology, seismology, seismic mechanics and anti-seismic construction and the related socio-economic problems.

The Bulgarian Academy of Sciences developed a program on seismology and anti-seismic construction, which was to be implemented by 1990. The program was not realized.
The earthquakes in Vrancea and later in Velingrad were followed by urgent tasks for the construction of a network of seismic stations for signalization in case of earthquakes.

1. Tectonics, engineering geology and hydrogeology

After the earthquake from March 4, 1977 the sector of geo-tectonics at the Geological Institute of the Bulgarian Academy of Sciences and the Geological-Geographical Faculty of the Sofia University, together with the specialists from the sector of engineering geology and hydrogeology at the Geological Institute of the Bulgarian Academy of Sciences, examined the connection of the seismic effects with the geological composition of Northern Bulgaria.
Brief data about the effect of centre Vrancea in Bulgaria until March 4, 1977. The most significant manifestations of the Vrancea centre regularly affect the territory of our country. Almost in every case there are strips of maximum seismic impact with orientation SW – NE. One of them, the steeper direction, is within the range 30-45º (direction

Tvarditsa), and the other one is with orientation approximately 70º (direction Yablanitsa). The strips in these directions are well differentiated in Northern Bulgaria. The depth of the earthquake-shaken layers of the upper mantle does not affect the selection of one of the abovementioned directions. During the earthquake from March 4, 1977 in North-Eastern Bulgaria there were also several not wide zones of more substantial damages on the buildings in orientation SE (120º).

By intensity of the earthquake impact of the Vrancea center, documented values close to the values from March 4, 1977 were achieved on November 10, 1940 with the strongest (VIII degree) impact by Forel-Mercalli in Nikopol and VII-VIII degree in Svishtov and Tetovo. Significant VII degree effects were noted along the entire Danube coast from Silistra to Vidin, to the south of Nikopol, Svishtov, Ruse, in the districts of Razgrad and Tarnovo. Weaker, but still significant is the VI degree impact in G. Oryahovitsa, Pleven, Mihaylovgrad, Shipka, the district of Kazanlak, Dalboki (district of Stara Zagora), Starosel (district of Plovdiv) and Letnitsa (district of Godech). Effects of V degree (as per Forel-Mercalli) were noted in Sevlievo, Tvarditsa, between Kazanlak and Karlovo, Koprivshtitsa, Hisar, St. Zagora, Septemvri, Brezovo (district of Plovdiv), Velingrad, Hvoyna, Devin, Ihtiman, Vakarel, Novoseltsi, Sofia, Cherni Vrah, Musala, Dragalevtsi, Pancherevo, Breznik, St. Dimitrov, Razlog, Yakoruda. The abovementioned increased values are probably the result of remobilization of seismic lines in relation to fault disruptions in a north eastern and south western direction, as well as in lines with sub-meridian orientation.

1.1. Seismotectonics conclusions

The deformations of the terrain and of the constructions caused by the earthquakes on March 4, 1977 are allocated too unevenly on the area of Northern Bulgaria. Besides in the Danube region, there are also damages far to the south of it. They form strips with various widths, mainly with elongation to SW and SE. Thus, for example, significant effects are characteristics even for the village of Polski Senovets, which is located to the north of Gorna Oryahovitsa, for Razgrad and the district of Razgrad, for the villages Chernolik, Bradvari, Dulovo, etc., each of them located at least dozens of kilometres to the south of the Danube coast. In several cases under analogous engineering-geological and hydrogeological conditions in the same or in different settlements the seismic effects are not the same. With almost the same type of buildings and relatively identical quality of performance it should be assumed that in the allocation of the seismic energy there was a tectonic factor – mainly the fault structures. Together with the south western and the south eastern direction in the allocation of the density of the flow of seismic energy, there are also strips with maximum intensities with sub-equatorial orientation. These directions and especially the first two are directions with the largest saturation of faults in the regmatic network of Northern Bulgaria. The southeastern (Berkovsko) direction is particularly characteristic of North-Eastern Bulgaria, where it is represented by several first-rate faults established by a geophysical method. The southwestern direction is covered mainly by the so called Tvardishka fault system (35-45º). But as a whole in our country, as well as in the plan of the entire Southeastern Europe, the isoseistic map of the quake from March 4, 1977 marks a clear elongation with orientation WSW, i.e. along the so called Yablanitsa direction.

The preliminary work map, prepared by us, of the more significant disruptions in Northern Bulgaria there is a series of strips with SE direction. One of them is too wide and long and is followed along the line Tutrakan – Tolbuhin – Balchik (110º). Here we should note the disruptions on the terrain and the buildings, which however are not the same along the entire length of the strip. The seismic impacts sharply decrease from NW to SE. According to information from the population here the initial impact was felt, as if coming from NE. The strip Tutrakan – Balchik is largely covered by the hidden fault Tolbuhin – Dulovo, which in the foundation of the Moesia platform runs into the demarcating zone between the North Bulgarian protuberance and the Tutrakan depression. In the eastern part of the strip, more exactly to the east of the place, where it crosses the Tolbuhin sub-meridian fault, the earthquake impact weakens relatively quickly. A certain shielding role of this fault can be assumed. In the limits of this strip there were seismic lines noted on March 31, 1901, on November 8, 1911 and on August 9, 1912.

To the southeast of the Tutrakan – Balchik strip and almost parallel to it is the Vetovo – Razgrad strip (130-140º). It is relatively shorter, with quite similar degree of destruction, and it's relatively straightforward. The deformations in it are significant. According to information from the population, a strong rocking was felt there in direction NNE – SSW. This strip coincides too well with a depth fault along the foundation, as well as with a photo lineament 140º. This strip has been activated numerous times during other quakes – on September 13, 1903 and during the Razgrad earthquakes from 1913 and 1942.

Further to the southwest there is the next strip between the village of G. Ablanovo and the village of Opaka (120-130º). It is also marked well on the grounds of solid damages of the buildings. They are particularly severe in the crossing of the strip with another northeaster strip – the G. Ablanovo strip. This is in the region of Dve Mogili and the villages Ekzarh Yosif, G. Ablanovo and Trastenik. Within the limits of Dve Mogili there are strips of substantially damages construction sites, which are with the direction of the strip between G. Ablanovo and Opaka. This strip also covers well a fault established in depth with the same orientation. Only its south eastern outskirts coincide with the analogously oriented seismic line in relation to the Razgrad quakes from 1942.

Next is the Yantra strip (150-160º). It is formed along the lower stream of the Yantra River from its mouth up to Gara Byala. The deformations caused by the earthquake to areas of the terrain with various sizes and to the settlements lead to the conclusion that there is a possible hidden fault with direction towards 150º, which contributed to the transmission of more significant seismic energy. Here there are many manifestations of sand volcanism in the mixed terrace of the Danube River and the Yantra River.

Further to the west there are the Osam (150-160º) and the Gulyantsi – Brashlqnsko (approximately 160º) strips. The first one is along the lower stream of the Osam River. In a series of settlements the damages from the quake are somewhat allocated in girdles with various width, which are identical to the orientation of the strip. In these areas it is assumed that there is a fault with similar orientation. The second strip is mapped according to scarce information,

within a very limited length. It is the shortest of all NW – SE strips.

A series of strips with increased disruptions are with SW direction. They are characteristic mainly of the western and partly the middle part of Northern Bulgaria. It refers to the directions, which in a general aspect coincide with the overall elongation of the flow of diffusion of the seismic energy, which is characteristic of the impact of the Vrancea centre. There are several such strips: G. Ablanovsko strip (30-40º) in the district of Ruse, coinciding at least partially with the Danube fault and the quite representative wide and long photo lineament bundle G. Ablanovo; the Vitsko strip (approximately 40º), which is covered by the famous Etropole line in these areas; the Koshavo-Vidin strip (45º), well folded in with the Oltensko crypto-fault line. All three strips mark increased seismic impacts. It is characteristic that they are monitored even further in the limits of the country, and in specific cases (for example the Vitsko strip) they even reach Middle Bulgaria.

There are also strips in WSW direction. They lie mainly in the middle part of Bulgaria. The Marten – Tutrakan strip (approximately 80º) is near the Danube coast. Its presence can be related to a fault, for which there is information from the decryption of cosmic photographs.

Besides the abovementioned main strips with directions SW and SE, there are also some secondary strips with sub-equatorial and sub-meridian orientation. Amongst them noteworthy is the sub-equatorial Danube strip. It is monitored from Oryahovo and Nikopol, through Svishtov to the east, up to Dve Mogili. Here there are severe damages of the buildings in the settlements (for example in Svishtov, the village of Krivina), often in areas with analogous direction to the strip, but also an entire series of newly formed cracks and faults with predominant sub-equatorial direction. Many of them are related to landslides activated along the coast. With regard to its orientation and location the Danube strip is well covered by a hidden fault line.

Another sub-equatorial strip with more limited linear dimensions is the Ruse – Tetovo strip. It is highly likely that it is conditioned by a fault with the same orientation, for which there is information in the section Chervena Voda – Tetovo. It is possible that it is also related to the line, which coincides with the strip and which manifested during the quake in North eastern Bulgaria in 1940.

The Popintsi - Dulovo strip has sub-meridian orientation. It is quite wide and the damages in it are substantial. On Bulgarian territory we do not have information about such a fault, but in Romania there is an analogous one, which could spread south to the Danube River.

The presence of significant seismic impacts in Bulgaria, quite close to the most significant ones in Romania, shows that in the Moesia platform there are substantial fault lines, which contribute to the absorption of the flow of seismic energy. This, of course, is contributed mainly by the fault structures in NE direction. However, it is worth noting that in the western half of Northern Bulgaria, where the density of such oriented fault lines is greater, the impact of the Vrancea quake is relatively weaker than in its eastern half, where, on the contrary, the fault lines with NW direction are predominant. The reasons for these differences in the seismic impact should probably be searched for elsewhere. It is possible that the tectonic behaviour of the North Bulgarian protuberance, which - still raising nowadays - is in the course of a process of tectonic disintegration, has a decisive role. Furthermore, the relatively weakened seismic impact to the west of the Iskar River could be viewed as a result of the tectonic behaviour of the Lom depression, which is an area of sustainable sinking and respectively loading with a thick platform superstructure (up to 10-12 km).

In the end we will pay attention to several sections with limited area from Northern Bulgaria, where the damages are relatively greater. In most cases they coincide with the position of fault junctions, i.e. they are located in such areas, where established fault lines cross. Such are the Gulyantsi junction, the Somovit – Nikopol junction, the Novgrad junction, the Dve Mogili junction and the Sredna Kula junction, located at the crossings of faults with sub-equatorial and diagonal direction. Other junctions, such as the Razgrad and the Opaka junctions lie on crossings of diagonal faults, and the Chernolika junction is located on crossings of diagonal and sub-meridian faults.

1.2. Engineering-geological conditions and their impact of the effects of the earthquake.

The Vrancea earthquake from March 4, 1977, which caused severe damages on the territory of Romania, also affected the central parts of Northern Bulgaria. Here we summarize the performed observations and researches of the impact of the engineering-geological conditions on the effects of this earthquake. Together with the confirmation of known regularities and the establishment of new ones, there are results and facts, which are difficult to explain at this stage and need additional examinations.

The earthquake from March 4 was one of the deepest earthquakes on the globe in 1977. It was registered by all seismic stations in the world. According to data from the International Seismology Centre it was registered by 560 seismic stations within the range of epicentral distances 0 – 157º. The earthquake caused great material damages in Romania and on the territories of Bulgaria and Moldova. The seismic movement of the ground caused by the earthquake is characterized by an unusual allocation of the intensities. There is a certain tendency of focusing around the macro epicentre and islands of high intensity at large distances from the central area.

Felt in the epicentral area – northwest from Foksani, and in the area of the Romanian capital at VIII degree, the earthquake created effects close to the ones caused by the maximum intensity in the district of Iasi (Northern Romania), in a wide area around the macro-seismic epicentre and in Southern Romania (district of Craiova) and a not small area along the Danube coast, covering regions from Romania, as well as from Northern Bulgaria. The field of high intensities (VIII and VII – VIII degree) is non-symmetric and torn. The cover of the discrete fields of intensity VII – VIII degree is obviously drawn in direction northeast – southwest, outlined convincingly by the isoline at VII degree. We should note the considerably weaker fading of the intensity from the macro epicentre to the southwest.

This effect is coordinated with the main direction of the tearing in the center. The steep sinking of the plain of tearing to the northwest most probably conditions the non-symmetric allocation in direction northwest-southeast towards the epicenter of the field of intensity VII degree. In the areas with intensity not lower than VII degree, as expected, the effect from the central process is too dim. In the overall macro-seismic field there is unevenness – faster, followed by slower fading of the intensity between subsequent isolines. It is difficult to reach a quality conclusion about the course of fading of the intensity under V degree – a significant gradient to the southwest, south, southeast, relatively smaller to the northwest and north, and minimal to the northeast from the epicentre.

2. Seismology

The centre in the region of Vrancea has the following significant peculiarities: relatively large depth (80 – 120 km) of the strong earthquakes with magnitude M => 7; large area of the macro-seismic impact; approximate constancy of the interval between two strong earthquakes; specificity in the azimuth allocation of the density of the flow of seismic energy; relative long-period transmission of seismic waves, etc.

2.1. Seismic impact in Bulgaria

The seismic impact of the earthquake from March 4, 1977 on our territory is assessed on the grounds of an analysis of the effects in the towns and villages, information on which is gathered through inquiries and personal observations.

From March 5 to March 11, 1977 there was a macro-seismic survey in 106 settlements in the middle and eastern part of Northern Bulgaria by a group of seismologists – collaborators of the Geophysical Institute at the Bulgarian Academy of Sciences. They visited places, where the earthquake had caused an impact of at least V – VI degree in the form of residual effect on the buildings, which allows for increasing the objectivity of the assessment. The inclusion of several other settlements with manifestations, characteristic of lower intensities, constitutes an exception.

Upon the impact of VI degree most of the residents have gone out of their homes, there are cracks in the plaster, single demolished and 10-20% cracked chimneys, and seldom there are cracks in the walls between windows. In Shabla some very old and worn out houses have become uninhabitable, in Balchik there are very few damaged architectural decorations, and in Kochmar – isolated chimneys shifted to the east or with chipped-off parts.

Upon intensity of VI – VIII degree the observations show 40-50% damaged and a lot of fallen chimneys (masoned with mud and seldom with cement), isolated cracks in the carrying walls of brick houses, cracks and shifts of bricks around beams above windows and doors. In Gorsko Slivovo there were also demolished parts of walls in old houses, in Milkovitsa mainly the north western walls were damaged, and in Byala Voda there were cracks in the carrying southern and south western walls. The north western region of Gigen looked more affected than the south eastern and the damages were mainly in the south eastern walls. In Slivo Pole there were horizontal cracks under roofs, which had occurred due to the weight of the top slabs. In the walls of buildings in Dekov there were opened old cracks – an indicator of unfavourable padding; the new cracks were mainly in the south eastern walls. The damages in the north western and the south eastern walls of the buildings were caused by the highly-energetic transverse wave, while in Byala Voda and Dekov they were caused by more high-speed transverse waves.

The consequences from quakes VII degree were over 50% damages chimneys, multiple cracks around the openings in walls, broken eaves, in many old houses there were severe disruptions and damages in the carrying parts and some demolished filler walls, and in residential flats – only internal disruptions. In Dolni Vit there were vertical cracks almost along the entire height of the buildings and around the corners. In Levski approximately 30 houses with wooden beams had damages in the carrying construction, and in the 4-5-floor massive flats the most damaged were the second floors. In Gorna Oryahovitsa there were third-degree damages in 8 residential flats, all with stores on the ground floor; heavy damages were observed in 14 public buildings. In Lyubenovo there were cracks mainly in southern and south eastern walls (again the impact of the transverse wave). In Barin there was a different impact on the buildings located along the eastern-south eastern and along the western-north western slope of the gully. In Brest in the semi-massive one- and two-floor buildings as a result of old sagging of the foundation there were slanting and vertical cracks from the windows to the roofs.

The information received from the municipality of Oryahovo contained the following figures (added to the conclusions from the survey, they gave the impact in the town an assessment of VII – VII degree): total cracked buildings or only with fallen chimneys – approximately 700; completely uninhabitable due to damages in the carrying construction – 138. In old and newer semi-massive houses there were severely cracked and even demolished walls, with predominant cracks in the eastern corners.

The reference made on March 9 in the district gave information about the affected buildings in the district of Razgrad – 76 agricultural buildings, 26 schools (3 unusable and 23 for light repairs), 34 kindergartens (3 unusable, 23 for major repairs and 8 for light repairs), 208 residential buildings (48 completely demolished, 160 uninhabitable), 1600 buildings damaged in various degrees. In Razgrad approximately 166 buildings with various designations are uninhabitable, and 750 are affected in various degrees. Seriously damaged were some industrial and public buildings: MOK D. Blagoev – damaged roof (factory No 1), demolished building and partially demolished washing line, damaged hearing grid (factory No 2), damaged boiler (factory No 5), and severely damaged rope line. The cooling installation in the poultry slaughterhouse was damaged. The second floor of the spare parts factory was sagging. The antibiotics factory there was a damaged steam pipe and a damaged boiler. In the veterinary clinic – a monolithic two-floor building, completed 4 years ago and located to the north of the town, the southern corner was chipped-off (the cross-beam was 5 m away from the corner) and the building was cracked under the first floor slab. The county hospital had three buildings subject to demolition, as well as a four-floor building with two additional floors (from

which 190 hospital beds were removed). Under the weight of the additional floors in the lower two floors all integrated pipes were damaged, and the wide vertical cracks in the walls were continuing to spread open. The kindergarten located 300 m away from the county hospital was first dimensioned for small rooms, but later the intermediate walls were taken down. The ceiling of the ground floor had an old crack across the entire slab, and due to the earthquake the external walls had separated. Completed only three months ago, the children's institution in quarter Buzludzha had a cracked corner and a cracked wall. The bus station had a cracked under-roof blind wall and a cracked staircase. In quarter Buzludzha, built-up with brick two-floor houses, there were external cracks mainly between the openings in southern and southwest-

3. Impact of the earthquake on the buildings and installations

In order to analyse the deformed and stressed state of a construction during an earthquake, it is necessary to:
1) know the nature, power and duration of the seismic impact for the site in question;
2) know the geometric, strength and deformation characteristics of the construction in question;
3) use sufficiently accurate methods for examination of the response of the constructive systems in a non-elastic stage upon a specific seismic impact.

At this stage of development of the scientific examinations these three conditions have not yet found a simple and complete solution due to their extreme complexity. Each of these conditions is related to a series of prerequisites, assumptions and simplifications with the purpose of obtaining a final solution with the available scarce information about the earthquake, its impact on the construction and the methods for examination. The adoption of one or another method of examination amongst the popular ones up to now depends on the available information about the earthquake and the construction.

The proposed analysis of the damages and destruction in the buildings from the earthquake in Vrancea (March 4, 1977) uses methods with the necessary experimental data, recordings and the observed deformations in the constructions. On account of the use of methods, which do not offer a simple solution, often times several methods are applied, in order to assess their reliability. Where possible, the calculated characteristics are compared to the experimental data and recordings, which are accepted as criteria for assessment of the obtained results.

The main factors, which the impact of the earthquake on the buildings and installations depends on, are: the mechanism of the earthquake and the nature of the generated seismic waves; the dynamic and spectral characteristics of the seismic waves (accelerations, velocities, shifts, predominant frequencies (periods), response spectrums, spectral density, etc.); the geological conditions from the epicentre to the site in question, the local engineering-geological and hydrogeological conditions, the relation of the dynamic characteristics of the buildings and installations and the characteristics of the received seismic waves; the resistance capacity of the buildings and installations and their capacity to re-allocate the forces between the carrying elements with development of non-elastic deformations, smaller than the limit ones, etc.

The specific mechanism of the earthquake in Vrancea generates seismic waves with comparatively not high seismic accelerations, but large shifts with predominant period 1 to 2,5 s. The analysis of the behaviour of buildings and installations upon seismic impacts must take into consideration that for the low and hard buildings with periods of inherent oscillations up to 0,4 s, determinative are the dimensions of the seismic accelerations and the high frequencies (low periods) of the seismic waves. For averagely flexible buildings with periods up to 1,0 s determinative are the velocities of the seismic waves, and for the flexible and tall buildings and installations – the shifts in the foundation and the periods of the seismic waves over 1 s.

3.1. Impact of the earthquake of the buildings and installations of the territory of Bulgaria.
3.1.1. Residential and public buildings

Masonry constructions. The masonry constructions, particularly the ones built more than 50 years ago without security against earthquakes, are characterized by a low resistance capacity to earthquake impacts. This type of buildings is usually built with wooden floor and roof constructions with a weak connection of the wooden beams with the brick masonry. The non-homogeneity of the floor constructions, their low hardness and the poor connection with the walls does not allow for re-allocation of the seismic forces between the walls. The brittleness of the brick masonry and its breaking down upon alternating loading prevent the masonry constructions from developing substantial non-elastic deformations and re-allocating the forces between the carrying elements.

Despite these disadvantages of the masonry constructions, they did not suffer serious damages during the earthquake in Vrancea mainly because of its specific spectral composition. As mentioned above, the earthquake manifested on our territory with long-period waves – T over 1 s. The masonry buildings are with period from 0,1 to 0,25 s and the earthquake had a weak impact on them Thus for example the two-floor brick building in Svishtov, located 100 m away from the completely demolished hostel of the factory "Sviloza", did not suffer serious damages despite the poor state of the building prior to the earthquake. Other similar buildings also have minimal damages. Even the single-floor building in the village of Batin, built of stone masonry and sun-dried bricks masoned with a mud solution, suffered less damages than a series of reinforced concrete buildings with a higher period of inherent oscillations. While the churches with stone and brick masonry were destroyed in mass numbers during the Plovdiv earthquakes, the church of one of the villages near Danube has more significant damages mainly in the bell tower, which has a higher period of inherent oscillations.

Some masonry buildings, for example in the village of Ekzarh Yosifovo and elsewhere, have significant destruction despite the low period of the buildings. In these cases we should note that the local geological conditions amplify the short-period seismic waves, on account of which the earthquake Vrancea from March 4, 1977 also demolished masonry buildings. Over 160 masonry single-floor buildings in Nikopol were severely damaged not only because of

amplification of the short-period seismic waves, but also because of the extremely poor construction – sub-dried bricks, masoned with mud solution without connection between the brick walls at the corners, poor connection of the roof wooden constructions and the sun-dried brick walls, etc.

The masonry constructions usually serve as benchmark for determining the intensity of the earthquakes. The Vrancea earthquake, due to its specific mechanism, is an exception to this rule – it spared a large number of old masonry buildings, but inflicted more serious damages to the flexible buildings with higher periods.
The power of the seismic impact in Svishtov can be assessed by the more detailed analysis of the destruction in some of the larger masonry buildings.

District court. The building has two floors, with carrying brick walls 50 cm think on the first floor and 38 cm on the second. The foundations are made of stone masonry. The floor constructions are made of wooden beams, which do not establish a good connection between the walls. The roof construction is classic, wooden with cover of roof-tiles on mud over a plank liner.

The destruction on the façade walls is mainly in the beams above the windows, performed as arches. In this case the destruction is also in the area of the openings as a result of development of vertical shearing stresses. The destruction in the interior of the building is significantly greater as a result of the poor connection between the wooden floor constructions and the brick masonry. The lack of steel anchoring parts is the reason for more severe destruction.

Due to the impossibility for reconstruction, the building was demolished.

Reinforced concrete monolithic frame buildings. A large part of this type of buildings demonstrated good behaviour during the earthquake on March 4, 1977. In regions with increased seismic activity, adverse engineering-geological conditions, a combination of inexpedient architectural and constructive decisions and mainly due to the poor quality of performance of the construction works, some buildings suffered substantial damages and destruction.

The reasons for the adverse response of some of the monolithic frame buildings during the earthquake can be systemized, as follows:

1. The seismic activity of some regions manifested in a higher degree as foreseen in the operative maps for seismic division into districts. This refers particularly to regions, which were envisaged in the maps with intensity VI degree, but actually manifested with activity up to VII and VIII degree. In these regions the buildings have not been calculated for impact of seismic forces, however experience shows that buildings, which were properly designed and performed in good quality, can withstand earthquakes of VII and partially VIII degree.
2. The lack of micro-seismic survey in responsible buildings and installations, as well as the failure to consider the local geological and hydrological conditions.
3. Low quality of performance of the construction works, contaminated additive materials, unsorted concrete and strengths, which have not reached the design strengths, frozen concrete during work in winter conditions. Poorly performed reinforcement works, insufficient anchoring of the reinforcement, incorrect bending, congesting of the reinforcement, lack of concrete cover, lack of stirrups, often congested or separated without reason.
4. Incorrect architectural-planning decisions with complicated forms, non-symmetric planning, removal of brick walls in ground floors, poor solutions for anti-earthquake joints, etc. led to unfavourable consequences for this type of buildings.
5. Constructively the buildings are not secured against earthquakes (they have not been calculated for this), and in some cases no constructive undertakings have been conducted for horizontal loading. In some of the cases an inexpedient constructive solution has been adopted, which decreases the horizontal carrying capacity of the buildings. In many cases the recommendations for constructive measures for buildings in regions with VII or higher degree of seismicity have not been observed.
6. Unfavorable construction of flexible buildings over weak soils, often with high ground water.

The earthquake from March 4, 1977 in Vrancea also caused significant damages in monolithic frame buildings. The damages can be systematized depending on the constructive elements, in which they have manifested.

a) Damages in the brick walls. In many cases they are non-constructive – cracking of the plaster with oriented and non-oriented directions, and its coming off the walls. Another group of damages in the walls is the manifestation of cracks along the entire thickness of the brick masonry. There are horizontal cracks in the brick walls under the beams and on the floor, which means a disruption of the connection with the brick wall, and vertical cracks between the wall and the column. In most cases there are simultaneous horizontal and vertical cracks. These damages in the walls are characteristic of buildings without a monolithic connection between the brick walls and the reinforced concrete frame, which is characteristic of the system with lift-slabs. When the brick walls have monolithic connection with the frame construction, there are cases of single or crossed diagonal destructive cracks.

b) Damages in the columns. Usually they are in the junction column – beam and beam – column, or in the upper and lower end of the columns. They constitute crushing of the concrete in the pressure zone, especially in the case of poor quality unsorted concrete with insufficient strength, falling or dragging of the longitudinal reinforcement, lack of or insufficient stirrups – separated or performed in poor quality.

c) Damages in the beams. Usually they are in the junction beam – column. They constitute crushing of the pressure zone of the concrete due to poor execution, unsorted state or insufficient strength, congested, drawn-out or dragging reinforcement, insufficient or poorly executed stirrups, in most cases separated.

d) General damages and destruction in buildings. When the deformation joints between the blocks are not well constructed or their place is not properly envisaged, damages occur around them. There are damages in the foundations – cracking of the soil around them. In several cases, where all of the abovementioned adverse conditions are combined under poor engineering-geological conditions and increased seismic intensity, entire buildings are destroyed.

Damages in residential and public buildings. A residential flat in quarter 188 in Svishtov, designed in 1966 by the

District Design Organization – V. Tarnovo, invested by ONS – Svishtov, has a monolithic frame reinforced concrete construction, based on single foundations over loess. The flat consists of a basement, stores with clear height of 6 m and 9 residential floors with 36 apartments. In plan the building consists of 2 separate rectangular bodies connected with a common staircase cell. The staircase flights are anchored in the two bodies, and the short sides of the staircase cell are fully glazed. The building has a flexible first floor due to the presence of stores, as a result of which the hardness of the floor is very low compared to the others.

A characteristic feature of the frame construction is the shifting by half a floor of the floor constructions of both bodies of the building, and the connection between them is realized only through the platforms of the staircase cell. The carrying frame of the individual bodies consists of 18 columns placed at not big distances, connected with beams in two directions. Most of the columns are rectangular with dimensions from 25x25 to 40x50 cm. Only three columns are circular. The beams are 25x12 cm wide and comparatively low heights. All columns are on separate foundations, some of which overlap. The round walls in the basement of the building are performed as concrete continuous walls, 35 cm thick.

The non-symmetric connection of the two bodies of the building through the staircase cell causes non-coinciding of the tracks of the resultants of the horizontal wind and earthquake forces, acting on the two bodies. On account of this there are torsion moments in a horizontal direction with particularly adverse consequences upon non-synchronous oscillation of both bodies. The connection of the columns at the staircase cell with the slabs in the middle of the floor height is also not favourable.

Large-panel buildings. The large-panel construction takes up a substantial place in the overall volume of residential construction in seismic regions. On the grounds of the features of this constructive system, some experimental data and the experience from the earthquake on March 4, 1977 we have reached the conclusion that the use of this type of construction in seismic regions is completely justified. This constructive system survived the seismic impact from March 4, 1977 in comparatively the best state. The surveyed constructions are residential flats, which had cracks and insignificant damages along the connecting joints. We will track the state of the large-panel construction only in Northern Bulgaria and Sofia, since the data about Southern Bulgaria is scarce or completely lacking.

In the residential complexes Tsarevets and Mladost in Svishtov there are large-panel buildings. The panels are made in the home-construction factory in V. Tarnovo according to the nomenclature for construction in regions with seismicity of VIII degree. The inspection and the conversations with the inhabitants show that the buildings have survived the earthquake in a good condition.

The eight-floor flats in Ruse in general have no serious damages. An exception is flat Vezhen with the following defects: cracks in the deformation joint up to 0,5 mm along the façade, vertical cracks on the northern blind wall between the two panels from the second to the fourth floor. In the panels of the zero cycle and the treenail connections there are no cracks. On all floors of the fourth entrance there are slight cracks along the ceilings between the wall and floor panels in the entrance halls, slight cracks between the staircase flights and the staircase platforms.

In the county of Silistra there is no information about damages except for the 8-floor flat Druzhba in Silistra, where there are superficial cracks in the connections between the panels and above the doors.

In the county of Tolbuhin only in some of the large-panel buildings there are insignificant hairline cracks above openings (windows and doors).

In the county of Vratsa the large-panel buildings have not been calculated against earthquake impacts, and the connections between the individual wall panels are performed by welding two iron rods with Ø16. In one of the sites additional horizontal rods are used for connections between the two panels from the zero cycle and the first floor. Performed in this way the connection is not able to withstand the shearing and torsion forces. Such poor quality performance of the connections is found in many sites in the country.

The experimental hysteresis loops of tested connections between floor and wall panels show that this type of connection has great resistance capacity and capacity to absorb energy, as well as to admit non-elastic deformation to a certain extent. Its incorrect performance however eliminates this good possibility for increased carrying capacity.

A large-panel residential flat in Kozloduy (No. 33), as well as others in Oryahovo (residential flat Dunav), have received horizontal cracks between the individual wall panels and in some of the treenails. There are also cracks in the panels above doors and windows.

The performed inspection of 9 sites in the county of Vidin shows that 6 are in operation and 3 are under construction. The sites in operation are according to the nomenclature of Glavproekt. In isolated places on the first floors there are cracks along the monolith concrete at the treenails and along the ground coat at horizontal and vertical joints. There are chimneys detached from the panels and faience tiles detached from the chimneys in the service rooms. The sites under construction are 8-floor according to nomenclature Bn-IV-VIII, H = 2.80 m. They have cracks along the ground coat at vertical and horizontal joints. The chimneys, which are of siphon type, were masoned prior to the earthquake, but have not been plastered and fastened to the ceilings, and as a result they have been demolished, whereas the plastered ones have detached with a gap of 0,5 cm from the panels. There are also cracks on the connections at the staircase flights and the floor panels at the treenails on the first floors. Cracks on walls and floor panels as a result of the earthquake have not been ascertained.

In the first experimental large-panel building in Sofia (192 N. Tsankov Str.), built in 1958, there are no cracks or damages. The performed inspection of the first residential complex with large-panel buildings "Tolstoy" shows that the panels prepared on site have no cracks or damages, except for slight cracks in the staircases. In some buildings

there are slight cracks in the places of the connections.

The good behaviour of the large-panel construction during the earthquake from March 4, 1977 led to the idea of serial panel construction with increased number of floors. This however should not happen without the necessary experimental examinations of reinforced connections and treenails, as well as natural examinations following an approved program in 2 – 3 test buildings.

Buildings with lift-slabs (LS). Immediately after the earthquake specialists from the Bulgarian Academy of Sciences visited the affected regions. They surveyed buildings executed with the LS method, and here we note the sites, which have received the most severe defects. The buildings are divided in to two groups. The first group includes the buildings in towns and settlements, which according to the Rules of construction in earthquake regions of 1964 are in non-seismic regions and have not been calculated against earthquakes (Svishtov, Dulovo, Dve Mogili, Pleven, Ruse, Sevlievo, Knezha, Kozloduy, etc.).

The seismic intensity in Svishtov is up to VII and partially up to VIII degree. To the east of the completely demolished 11-floor monolithic building there is a complex of four 8-floor and five 5-floor buildings with LS. The distance of these flats to the demolished buildings is from 100 to 500 m.

The 8-floor buildings have a reinforced concrete staircase cell executed with a creeping casing. The floors are shifted in height at 1/2 floor in both ends of the staircase flights. The reinforced concrete slabs do not cover the staircase, but are pushed against it. The buildings have not been calculated for earthquake impacts.

One of the 8-floor flats has severely cracked 25-centimeter exterior joints, opened by several centimetres, along the diagonal of the barrier walls. Some of the bricks, mainly of effective ceramics (fours), are completely demolished. The reinforced concrete cell has horizontal cracks under the platforms (where the technological joints of the creeping casing were probably located), as well as cracked beams above the doors of the cell. There is no disruption of the connection column – slab. A substantial part of the energy of the earthquake impact was absorbed by the 25-centimeter brick walls between the columns, which have served as vertical discs. The joints between the slabs and the staircase cell have hairline cracks. One of the facades has cracks going through the console formation of the slabs. The frame of the building is not damaged. The staircase cell is fit for operation. Such cracks, but with smaller sizes and less in number, can be found in another 8-floor building. The other three buildings have survived the earthquake without significant damages.

At approximately 100 m from the demolished monolithic building there is an 8-floor building under construction. Its architectural-planning solution is similar to the other 8-floor buildings. The entrances of the apartments are from the two platforms of the staircase. The construction has a reinforced concrete cell executed with a creeping casing and reinforced concrete discs between the columns.

3.1.2. Technological equipment

The security of the technological equipment during earthquakes constitutes a serious problem in view of the normal operation of the large-scale industrial enterprises (TPP, NPP, chemical plants, etc.). The damage and destruction of steam, gas and electricity plants can lead to fires, explosions and poisonings.

As a result of incorrect connection of the steam boilers with the carrying construction in some TPP the freight elevator shafts at the boilers are demolished. The adjacent reinforced concrete columns of the carrying construction are also damaged.

The earthquake inflicted severe damages to the equipment of the electricity substations. In substation Moesia, G. Oryahovitsa, Ruse-Center, Alfatar, Tutrakan, Ruse-1 and Svishtov there are broken isolators for voltage 110 and 220 kV, and cathode drain lines. One transformer in substation Moesia has turned around due to insufficient anchoring, and another one in substation Polski Trambesh has tilted and damaged the adjacent installations.

The earthquake has not inflicted any damages to distribution lines of all voltage ratings, as well as in the cable power lines. This is explained by the great elasticity of the distribution lines and the good dimensioning of the top of the columns. Damages are inflicted only to the high voltage grids. In most cases there are torn conductors due to mechanical tension and sometimes due to short circuit caused by their asynchronous swinging.

4. Social and mental consequences from the earthquake.
4.1. Behaviour of the population

The earthquake from March 4, 1977 with epicentre in Vrancea had an effect on a very large ground area. The strong seismic effect inflicted quite a lot of material and moral damages. They attract the interest of specialists and become the reason for a search for means of preservation of the modern material and spiritual culture of mankind against future earthquakes. While the damages in the field of material culture are subject to restoration, reconstruction and renovation, the damages in the field of human mentality are hard to heal and still not too well examined. The atmosphere of insecurity established after the earthquake showed that anti-seismic preparation in our country was not conducted, regardless of the fact that Bulgaria is located in one of the active seismic girdles of the Earth.

Since during the earthquake the seismic devices in Bulgaria have gone out of order, the earthquake is practically left without a "seismic biography" in the annals of the scientific specialists. Its power and destructive effect in the material and spiritual field can be judged by practical observations, conclusions and summarizations on the grounds of the collected oral and written information from the population, as well as the opinions of specialists who have visited the affected places in the country.

The interviews with workers and specialists from NPP Kozloduy and the town on March 8, 1977 show the conscientious, even heroic behaviour of the on-duty teams during the earthquake.

An opinion of one of the engineers: "There was no panic in the plant. But it's good that we forget about these natural disasters! Otherwise we would live with the terrible memories, when the ground was shaking." One of the workers shared: "We felt a very strong quake. We pulled ourselves together after the shaking, we ran outside, we left the women and children on the street and ran towards NPP. Our coast is on a rock. We were shaking together with the ground, but it's good that the plant and the nuclear reactor did not suffer damages. I think that if the three buildings in Svishtov had not gone down, the damages from the earthquake everywhere in the country would have been similar, without human lives lost."

The people have calmed down after the disaster they experienced. They talk with concern about NPP, where they work. The main equipment of the plant is in a stable condition. The reactor and the pipelines are in a good working condition. The rescue works are also running well, the state of the citizens of Kozloduy and the workers at the plant is getting better. The damages inflicted on the residential buildings and the industrial plants in the town and the county are being repaired. The chimney of the plant has a deviation of approximately 2,60 m along the ellipse. Only a few minutes after the beginning of the quake all people were back at their workstations. The on-duty teams, which did not leave their workstations at all, ensured the stable operation of the devices and did not deprive the country of lighting and energy in this critical moment.

An opinion of the chief engineer of NPP: "The behaviour of the on-duty teams during the quake was really heroic. These are people who overcame the initial fear of the unexpected disaster, did not run outside, but stayed at the electronic panels and continued their work in the interest of the order, which was needed in this situation."

Liliya G. Furlinska from the Production-Technical department shared: "After the quake we arrived at the plant. Those who were on duty had turned off one of the reactors and the other one was intentionally left on, in order to provide electricity and lighting in the country. During the next half hour absolutely all Bulgarian and Russian specialists arrived at their workstations."

Vladimir Berov, senior engineer, operator of the reactor: "I was on duty on Friday night. I've been working here since 1972. I was sitting and suddenly I felt as if I was kicked in the back. Then I felt a very strong earthquake. During the next few seconds the four workers on duty in the room waited to see if the ground will continue to shake. My thought was – I hope we can save some of the equipment! I am responsible for the reactor and its operation!"

Ivan Petrashev: "I was the on-duty engineer that night. When the quake began, I decided that the instructions say – if we cannot control the reactor, we must stop it."

A collective opinion of residents of Kozloduy (March 7, 1977): "During the quake due to the fear we were united. But after some time these feelings will fade away. It is very important what place in this process will be taken by the leader – as an authority, a personality and a public figure. During disasters people need a leader to give them courage, to unite them and to show them how to overcome the disaster."

On March 7 eng. Yanka Yankova from department "Construction and Architecture" of ONS – Svishtov shared: "The restoration of the material damages caused by the earthquake requires a lot of funds. All residents living in flats built according to the lift-slab method have moved out. The chairman of ONS issued an order against the dissemination of harmful rumours. The horror personally for me was greater when I realized that there are demolished flats around us and that we could have been among the deceased."

In the centre of Svishtov there are posters – a call to fight against the harmful rumour that on March 7 as a result of a failure in the pipeline network of the chemical plant "Sviloza" a poisonous gas has been released and is nearing the town. The residents are in panic – this leads to a mass withdrawal of over 3000 people beyond the limits of the town. There are injured and distressed people.

According to the opinion of witnesses passing through a hostel of the chemical plant on March 4, 1977 at about 21:23 hrs it began to turn around its axis, it sunk and then was demolished. The evening of March 7, when we visited the place, the clearing was still on-going. It was expected that the next day there would be many victims found, because only the ruins of the lowest floors were left, where most of the running people had reached.

4.2. Mentality in the moments of the quake.

The effect of the earthquake on the mentality of the people is not comparable to any material damages. It is too difficult to determine the amplitude of the mental manifestations in the conditions of the earthquake and especially after it. The question arises – why during an earthquake, which sometimes may not occur even once in the lifetime of a person, the horror of death is greater than its everyday presence in road accidents, which only for a few months take the lives of much more people than in an earthquake, and it's interesting why in the moment of the quake a person reacts decisively and quickly regardless of the surprise of the disaster, in order to save the life of his relatives and his own life, and after the fading of the natural disaster some of the people are obsessed with feelings of doom, anxiety and insecurity. How long do these psychological phenomena leave a mark in the soul of a person, is he protected from the surprise of a new psychological intervention, from the consequences of the mental distress suffered during the quake? What is the interaction of the personality and of the social groups in their behaviour during and after the extreme situation?

The general thing in the behaviour of an individual person and of a group of people during an earthquake is that the

personality falls under the impact of strong and unexpected irritants, with regard to which there is no gathered experience. The unclear, unusual, tense psychological situation, filled with horror, uncertainty and fear of death, causes a total influence on the person. Not everyone could orientate properly, take a decision and find the successful outcome of the disaster. In such a dramatic situation, in which nature unexpectedly attacks the personality, there is a verification of the specific social roles, a revaluation of the values. The situation, which arises upon an earthquake, is most significant in an existential sense for the person – for a brief period of time, surprisingly and dramatically the personality can be attacked by various disasters, death being the greatest among them. The earthquake as a mental notion in the soul of a person is sometimes even scarier than in reality. In this case nature plays the role of a powerful, unknown and monstrous extreme, in the clutches of which the human life loses its meaning. The only means of fighting against this feeling is the overall experience of the person, the scientific knowledge and the social experience.

The common mental stress in our country after the quake on March 4, 1977 is also due to the fact that after 1928 there is a relatively quiet period with regard to the seismicity of the region. The shock was incredibly powerful in the affected areas around the Danube River, where the earthquake has occurred at VII and VIII degree as per the MSK scale, and particularly in regions with demolished buildings and victims. The reason for this shock objectively are the considerable movements of the earth, the big deformations and movements of the buildings, the occurrence of rumbling, creaking, alarming sounds and roll, the observed shining in the atmosphere, the interruption of the electricity, the lightings from short circuits in the grid, the falling of heavy objects, the difficulty to retain balance, the outburst of fires, the cracking of walls, the falling of chimneys, etc. The people, who at this moment were on the higher floors, have experienced the quake in a more severe psychological degree. These people (particularly in the new complexes) get the illusion that the buildings are shaking with amplitude of about 1 m. The instinct for self-preservation and protection of the kids forces the people to go out in their underwear, barefoot, others take their cars and go outside of town, others start walking towards their villas or stop near the field. In public places (cinema, theatre, holiday halls) the sense of responsibility towards yourself has contributed to the establishment of a calmer atmosphere for quick evacuation without panic.

The earthquake brings up questions related to the pathopsychology of a man. The quake inflicts transitory changes in the human brain and consciousness, on account of which we can talk about the onset of stress. Such moments are marked by the question of the power of the human will, the freedom to act, the overcoming of external and internal obstacles, which have occurred suddenly. This is a significant problem for the personal, as well as for the collective will and for the interaction between them. The tragedy brings out the respect in people, but this is passing respect. In Svishtov most of the victims were found on the stairs, while they were running. The mass multi-floor construction, the alienation of the man from the earth causes a progression of the fear. During an earthquake the fear is all-consuming and thus practically uncontrollable. It is in the basis of all mental phenomena related to the moment of the earthquake and after it – the fear before the unknown. All other phenomena in the soul of every individual person and of the social groups related to the earthquake depend on the mutual relation of the fear and the will of the person. Since the earthquake is over in just a few seconds, people are not able to make sense of the event, to gather experience in the struggle with it and to take a decision. Therefore the idea of the disaster comes after, when the actual danger has passed. The idea of the disaster is usually an illusion, greatly exaggerated, close to the dimensions of science fiction. The tragedy has passed through the mentality of all people and therefore it is common, but everyone wants to be understood, heard and calmed by the others. That's why the personal problem of the stress becomes public. Through the pathological idea of the disaster people are relieved of the horror they have experienced, they allocate their fear, their anxieties and their insecurity to the others. The duration of this process depends of the personal characteristics of the individual people. The more sensitive ones need more time, and the people with a more rational mind undertake the line of stable behaviour in a shorter period of time.

After such a natural shock the mentality does not change in an obvious manner for a long period of time, because the upbringing, the intelligence and the culture play a decisive role. The tragedy fades away, but the idea of the instincts manifested during the earthquake remains alive for a long time. As the disaster is mass and individual, so the reassessment of the values is mass and individual. The reassessment of the values is the closest phenomenon, which occurs after the stress fades away. The experience from the twenty or thirty seconds of the earthquake is equal in power to hundreds of read pages and hundreds of days lived. There arises a pseudo-new idea of the meaning of life, of its purposes. Under the effect of the natural shock and the feat of the unknown (the fear of this event happening again) the personality tries to cope with negative emotions, which underline the senselessness of human life and the helplessness before nature.

4.3. Personal behaviour in the common misfortune.

Reflection in the consciousness. Upon the perception of the earthquake for every person there are common mental regularities acting through the common property of each living matter – sensuousness. Through the sensuousness the external energy of the earthquake has become a fact for the consciousness. Regardless of whether the earthquake has been perceived by different people in a different manner – some perceive it first with their hearing organs, others have first felt the shaking of the ground or the floor under their feet, others have observed the falling of objects or the vibrations of the walls, etc. Sometimes the first impressions of the disaster are "underground rumbling", "a sense of sinking", "passing of waves through the streets", "blue light", etc. The reflection of the earthquake is a prejudiced, subjective reflection of a specific person. For example a villager from Gorna Studena, county of Veliko Tarnovo, tells this story: "As if a big tractor was ploughing outside. At first I thought that it is passing through the street. Then the ground under my feet started to shake. I called my wife and we ran to the courtyard. I was telling her – get away from there, it's an earthquake! I lost balance and fell to the ground. At this moment the chimney of the house also fell." A four-year-old girl in the embrace of her grandmother cried: "Granny, are we dying?" Therefore it is necessary to consider the specific satiation of perception of the earthquake. The main question, which people were asking after the earthquake on March 4, was: "Where were you during the earthquake?" The question is not a random one, because on the grounds of the known activity from the human experience the

personality is trying to orientate in the arising extreme situation. A group of viewers in a dark cinema hall are telling this story: "Somebody shouted "What is this?", and we all listened. Suddenly the people in the hall started to look around. There were exclamations "Something is happening!" and we all jumped out of our chairs." In the moment of the earthquake the personality is looking for a symptom of definiteness, which could give information on what is happening. Two young people in the street are asking the questions: "Who is playing with the trees? Who is playing with the house?"

The next mental stage of perception of the reception of a signal, some information about the natural disaster, which depends on the specific occupation of the personality in that moment. A 24-year-old man is relating: "Suddenly the house started shaking, the windows started banging. I thought that someone is banging outside, but then the house started rocking. In the next moment I noticed that the chandelier was swinging, the walls were moving and the pictures started falling down one by one. I heard a whizzing from the outside, as if airplanes were passing by." After the reception of information about the disaster the personality comes out of the state of indefiniteness and starts to make unusual ascertainment about the disaster. For the specific situation everything is particular – the rumble, the noise, the loss of balance, the squeaking of the panels, the walls, the falling of objects. In the situation of the earthquake the bearers of the same information have different characteristics – from the slight shaking of the bed to the demolition of an entire residential flat. The final answer of the question "What is this?" in the moment of the earthquake is a complex intellectual activity of the personality. After the person experiences and assesses the situation, he asks the question "What should I do?" in the onset disaster. The extreme of the earthquake determines a very high intellectual and emotional tension in the course of the time needed to take a decision. The moment of assessment, which the fateful decision depends on, determines the behavior after that. Many people "do not know", "ask themselves" or "do not remember" how they found themselves amongst a group of running people. These cases can be explained by the great power of the energetic impact of the quake and the minimum term for taking a deliberate decision.

The behaviour. As one of the most unexpected and unusual in its complexity and power irritants the earthquakes brings the nervous system of the personality to the ultimate level of excitation. Increased sensitivity accompanies the person for a long time after the disaster has faded. Any noise similar to the banging of windows, the cracking of walls or the noise of an airplane, the slightest loss of balance is enough to bring the nervous system in a state of anxiousness and excitation. Another peculiarity of the need to transfer information, sometimes even false information, which creates panic. For example the situation of mass panic, which spread in Svishtov on March 7 in relation to the false rumour about the release of a poisonous gas from the chemical plant. The information about the false danger spreads with a lightning speed. Random residents warn by phone kindergartens, hospitals, schools. Random drivers alarm the neighbouring villages and the region around Svishtov. This is not an ordinary need for communication; this is a need of very complex social dimensions – the sense of duty, of responsibility to the family, to the public. The amplitudes of response during this extreme situation are too complicated – from the fear and horror to the heroism, from the complete desperation to the mobilization of the will of the personality.

The human actions during the earthquake are multiform, but nevertheless they have common characteristics, which are the most widespread and therefore the most impressive for the human behaviour. The quake in the labyrinths of mentality assumes very interesting and varied reflections. The personality in a non-standard situation – the choice of behaviour, the taking of a decision and the actions during the natural extreme – create a basis for psychological variety, for stimulation of the moral values, for reassessment of life. Not for nothing some of the people inquired told that this was a "man-quake", not an earthquake. Therefore during the quake there were individual and group forms of behavior with great variety. Adequate is that, which corresponds to the requirements, established by the extreme situation before the personality or before the group of people. The inadequate behaviour is related to passive, panic characteristics, in some cases unexplainable even by the person who performs them.

It is not a coincidence that panic together with fear is the most characteristic moment in the behaviour of the personality or the group of people during natural disasters. It is not always the most widespread phenomenon, but it is the most impressively related to the experienced horror. The mass panic during the quake was too weak compared to the panic created just after the disaster (the rumor of a poisonous gas in Svishtov). During the disaster there are almost no registered cases of breaking-up of interpersonal relations.

The mental states of anxious tension are very favourable for the lightning spreading of rumours and panic. In this situation the mass media plays a very important role, the value of its authenticity and the range of its influence increase. During the quake and six months after that the most current and valued information was related to the earthquake. The panic stress states cover people in an instant, they spread with a lightning speed and sometimes there are even cases of self-suggestion of false danger. An employee of the Ministry of Interior – Svishtov stated: "Most of the people were holding a handkerchief in front of their noses, because they thought they smelled gas. But on this date the wind was blowing in the other direction of the plant and none of the residents noticed that. Many people requested first aid because they thought they were gassed…" The case of the mass panic in Svishtov on March 7 is related mostly with the illusory perception of the situation. The mass panic during an earthquake poses a series of problems related to the regulation of the behaviour of groups of people under the conditions of a critical situation and the period of its fading.

During the earthquake on March 4 the adaptive, adequate behaviour was the most observed. Its description includes the following elements: "I saw a movement, I heard noises, I felt shaking, I understood what was happening, I quickly went outside." In these cases there is hardly any horror or fear, because most of the people have had previous experience (mainly older people who have memories from previous earthquakes).

One of the most stable and mass reactions during the quake is the initiative behaviour. The initiative person first identifies the disaster amongst the overall silence, which not always expresses misunderstanding, but rather fear and horror; he calls for action, coordinated, instructs, commands, and when necessary, intervenes physically. The

greatest manifestations of initiative behaviour are related to immediate rendering of help during the quake and after it, sometimes with the risk of your own health and security. These cases are widespread and present the personality not only as emotionally stable, but most of all as a socialistic personality with a high sense of responsibility.

Dominating mental states of the spirit. They are directly dependant on the degree of tension and the domination of one or another component of the critical situation. One of the characteristic manifestations during and after the earthquake is the disorganization of the personality. Here's the story of a man who lives in the immediate vicinity of one of the completely demolished residential flats in Svishtov: "I live on the sixth floor, I was standing at the window and saw the sinking of the adjacent flat into the ground. I immediately understood what was happening, I took the kids and decided to go out of the apartment. At this moment my neighbours from the opposite apartment tried to grab my kids by force. After I defended myself, they still managed to grab something – my coat, and immediately ran outside." The mass fear is a predominant mental reaction amongst people during the quake. The strong phase of fear dominates: "I could not move"; "I was running without direction"; "I was afraid of a second earthquake", etc. The elimination of this state from the spirit of the person takes a short or a longer period of time. Hours after the quake people were still sharing that they felt as if the ground beneath them was shaking. Sometimes the fear effect transforms into anger and aggressiveness – pushing away the people who are trying to calm you down, not believing that the danger has passed. The apprehension is a dominating mental state for the individual person, as well as for a group of people after the fading of the quake. Despite the scientific forecasts that the quake will not be repeated, the dissemination of the rumour that on March 11 there will be another earthquake was accepted as true. On March 11 in the evening the streets of some towns were again filled with people who feared a second earthquake.

The various negative mental states are also characteristic of the post-critical situation. Anxiety, which transitions into increased contact between the people as a peculiar form of relief of internal stress. The mass behaviour in the various cases shows that the interpersonal relations in the period after the earthquake were extremely dynamic. The earthquake was a reason and topic of discussion – you could talk to anybody, knock on every door, in a private home or in a public institution. As a clearly expressed socially-psychological phenomenon the anxiety was the most widespread dominant in the state of the individual person and of the masses. The anxiety was defence against the last attacks of the experienced fear. The common disaster had monopoly over the feelings of the people who were facing the danger. Philosophic concepts were dominating the conversations about the perception of the event. Some of these summarizing opinions are: "I still cannot believe that a person can be so helpless. I am 20 years old and just now I understood the value of life. I feel an unusual goodness inside me. I started to look inside myself. Now I understand that I should not pay attention to the small problems and conflicts", etc.

The mental state of mass grief was too clearly distinguished. The death and misfortune, which overtook us during the earthquake, are too different from the death by illness, old age or car accident. The natural disaster is perceived as a chance, uncontrollable by humans and therefore the death caused by it is perceived as unfair, especially for the children. The equal possibility for everyone to be among the dead also causes strongly negative mental states.

As a form of danger, which comes very unexpectedly, the quake "unmasked" the spirit of the individual personality or of the mass mentality. In the ordinary, everyday life a person can mask some of his negative qualities. This however is very difficult in extreme situations, as was the earthquake. In such situations the instinct for self-preservation acts first and the personality sometimes does things it should not be doing (chaotic and disorderly action), and in other cases it acts in the most reasonable and expedient manner. In this sense the earthquake can be viewed as one of the most certain, truthful and deep indicators for examination of the unmasked human spirit. After such a violent natural experiment the strong personalities rethink the experience, and quickly go back to their normal life. From a psychological point of view the effect of the earthquake on the spirit also has a positive effect – a reason for regulation, mastering your personal behaviour, tempering the character and the strength of the will.

4.4. Intimate behaviour in the common misfortune.

The intimacy of every person includes the relation to the deeply personal, valuable and known things. In this sense the earthquake from March 4, 1977 can be defined as a monstrous intervention in the deepest, most intimate layers of the mentality of a person. The strongest impact was on the marital-family relations.

More than 85% of the people examined in Svishtov indicated the saving of the children as the first reaction during the disaster. A tragic confirmation of this is the pose of the bodies of the fathers who were found in the ruins of the two demolished residential flats in Svishtov. The bodies of the parents were disfigured, while the bodies of the children – comparatively preserved. Particularly tragic is the case with M.P. who died while covering his child with his body, while it was sleeping in bed. A series of signs (still wet and matted hair and body covered by dust) show that the father has run from the bathroom, in order to save his child.

The love towards our children and our readiness to sacrifice ourselves in the event of a natural disaster are marked very strongly. Moreover – the known fetishizaiton of children's things found in the ruins (toys, clothes, shoes) has a shocking effect on most of the people present at the clearing of the demolished flats in Svishtov. Usually the mothers identify the body of the child the quickest with external expressions of mental emotions, the fathers try not to show their feeling of tragedy, but their state is usually accompanied by the tense and dramatic silence, which sometimes ends with feeling unwell or fainting.

The intimate relation of the children towards the parents during the disaster is also a mental feature of the experienced tragedy. A series of cases of intimate relation between parents and children uncover an extremely complex spectrum of moral and mental manifestations of the personality of our contemporary. The symbolic place occupied by the children in the life of their parents is so deep and strong that the loss of your own life loses ground to the idea of losing the life of the children.

The self-sacrifice of the parents, the particular feeling of guilt when they have been away from their children during the disaster, and the self-approval of the parental personality are interrelated mental phenomena in the intimate spectrum of the experiences of the parents. A series of examples during the earthquake prove that the actual value of the loving relation towards the children, towards the friends, towards the people who have been affected by the accident is the striving for hope, wellbeing, and happiness for those who we love. In essence love is always a positive and active motive of the human mentality. It manifests not only as a desire, but also as readiness, and often as self-sacrifice for the people closest to us. Therefore in the night after the earthquake there were mass manifestations of risk for your own life directed mainly at the good of the people. Exceptional examples of this behaviour, a combination between the human and the official duty, with bright humane feelings were observed everywhere in the country, particularly in Svishtov. The behaviour of the employees of the Ministry of Interior, Civil Defence, the municipality and especially the behaviour of the medical personnel of the district hospital in Svishtov was led by high moral and ethical motives. In the first minutes after the earthquake an Operative Staff is established, which constantly, day and night struggles and coordinates the operations on rescuing the victims. One of the bulletins of the Operative Staff says: "Without being called, all medical personnel arrived at the hospital. Only five were missing – they were buried under the ruins."

Besides between parents and children, strong mental feelings of affection, love, self-sacrifice were manifested between the spouses during the disaster. In one of those cases a father, the only survivor of a family of four, develops a severe mental reaction with a marked tendency towards suicide. Particularly tragic are those cases of unbearable grief when the marital relations in a family have been normal. And in cases of marital depressions and conflicts the quake affects the stability or the final break-up between man and woman. The loss of the wide, with who the man has been in unbearable relations, many times subjected to experiments for living together and with several divorce cases, causes the man to feel an incredible feeling of guilt and manifestation of a guilty conscience for the unhappy marital life before the disaster. The man is mentally broken by the loss of his wife.

The psychology of intimate relations during a disaster also includes the relations between grown-up sons and daughters and elderly parents. In the first hours after the quake the telephone network in the country was flooded by an information wave – children were interested how their parents were feeling; they wanted to hear their voices. The telephone network was overloaded and was unable to overcome the communication boom related to the thesis "I want to hear their voice; this means they are alive and well!" But there are also cases of negative relation towards elderly people – while running to the outside some of them were forgotten in the homes.

During the earthquake and after it the people represented a very large family with identical thoughts and feelings, and readiness for mutual support. But in the conditions after the earthquake the social measure between the moral duty, conscience and honour in several cases was overtaken by a certain form of fanaticism.

But the predominant positive manifestations and behaviour during the disaster of individual persons or of groups of people show the social maturity and the moral responsibility of the personality of a socialistic type.

The earthquake was also a strong indicator of manifestations of negative nature, of primitive, amoral conduct. The most significant mark of these manifestations related to unceremonious selfishness was the marauding. Therefore the analysis of the conditions and the opportunity for marauding during a mass disaster are an important indicator of the moral of a society. The level of their manifestation is a very important social criterion for moral purity of the people. Therefore the reaction of the residents in Svishtov to the individual cases of marauding in the night after the earthquake is too symptomatic and characteristic. On the background of the mass suffering the public was ready to lynch, to get physical with the marauders. Only thanks to the call for discipline on behalf of the employees of the Ministry of Interior the marauders were saved from public judgment and physical retribution.

4.5. Mental phenomena after the disaster.

The connection between the physical characteristics of the earthquake and the scales of its mental consequences is obvious. The mental stress in the post-critical situation is caused and maintained by the objective consequences of the natural shock that affected a wide range of values in the personal and public life. Usually the number of the victims or the amount of destruction could not characterize the actual destructive power of the earthquake. In the situation of the earthquake the tragedy of the victims is perceived much more strongly because it is the result of an inevitable, sudden, uncontrollable natural disaster. The experience in the moment of the earthquake leaves reflections and accumulation of mental shock in the mentality after the disaster. The fading of the mental stress takes a much longer period, sometimes months, even years. Some people shared their feeling that "mankind is dying". The mental stress during the quake is characterized by high emotional amplitude, but in a mental aspect its power is greatly reduced.

Under the effect of the realized fear the mental ideas of the disaster and the memory of the earthquake in the post-critical situation a process of inadequate and unstable behaviour develops, which often changes its characteristics – from strong emotional expression to depression, indifference, grief. In such a state a person is demoralized, expecting a new unknown danger of an earthquake. The memory of the disaster clears up, takes up a predominant part of the conscientious action, the relations with other people are subjected to the total topic "do you remember how it was; I don't feel like doing anything, what's the point now!" The tension after the earthquake is a permanent mental state up to the moment when the personality gradually starts to lose interest in its own memories, insinuations and ideas of the disaster. A woman at the age of 25 shared: "I live in constant terror and this is preventing me from thinking normally during the whole day."

The extremely powerful stress agents of the quake determinate in the post-critical situation mainly through the ideas in the mind of the person. He begins to search, to orientate towards the physical and social parameters of the living environment. A woman at the age of 36 says: "Now I think that in the town, with its tall buildings, the chances for survival upon a new earthquake are very small." A person may think that the flat, where he lives, is too tall, the stairs are too narrow, when the tram passes by the walls start to shake, etc. The people felt a mass desire to live

"closer to the ground". Under the effect of the fearful tension a series of conditions of the environment, where a person lives, become symbols of a new danger. "I feel terror every time I have to go home on the sixth floor" – says a middle-aged woman.

In the post-critical situation there is a particularly strong feeling of anxious expectation. It is a result of the shifted and incorrect assessment of the objective reality in the mind of a person. The roles of fantasy and insinuation prevail. A person does not fear reality anymore, he fears the expected dangers of the future in hyperbolized fantastical images. A woman at the age of 32 shared: "I frequently imagined how the town would look like after a strong earthquake. Sometimes I even dream of this picture and after that I feel depressed the whole day." The fear is shifted by the immediate danger in the moment of the disaster towards the threat of the unknown nature of the future. The fear transitions into anxiety with regard to the perspectives, which arise on the grounds of the fantasy and the insinuation from the experienced event. Particularly characteristic in these cases is the decreased critical attitude of thinking, as a result of which there is a serious vacuum in the actual assessments and choices of behaviour of the person. In the situation of anxiety the papers published a certain amount of information about small earthquakes in various countries near Bulgaria – Greece, Turkey, Iran, etc. In other cases this information would have been perceived as something normal, but then the comments were that "something is going to happen!".

After the disaster the personality enriches and rationalizes itself and its life much more deeply and forms a new behaviour for protection of its values. The anxiety in many cases becomes the reason for searching of an exit from the critical situation. Furthermore, the state of the post-critical situation broadens the range of personal experiences. The changes in relations between people, the created mental vacuum in the minds of the person, the lack of personal experience in emergency situations are reasons for dissemination of various rumours.

The rumour is a phenomenon, which includes in itself complex mental components. It may become the reason for panic behaviour and negative human manifestations. They also constitute an interest for the social psychology, because in the conditions of an extreme situation and especially after it they could overtake the function of the official sources of information, to decrease the "conjuncture" of the communications and the sense of trust towards the media. The rumour is most of all a piece of news which must fill the mental vacuum in the mind of the person after the quake, and as a fabrication it disorganizes the social life, maintains the fearful tension.

Rumours can be various, but during the quake they were predominantly two types – some ascertained what had happened, others forecasted what could happen in the future. For example: "The entire town of Svishtov is destroyed! On March 11 there will be another earthquake – exactly at 9:20 hrs!" The first type of rumours "supplement" the content of the emotional experience, the second type of rumours amplify the anxiety, the sense of doom. The rumour is started by somebody, supplemented by various carriers and is designated for mass consumption. The rumour does not have a specific author, but it is always presented as coming from a specific source.

In the conditions of information "hunger" in the post-critical situation many people directed their interests exactly towards the topic of earthquakes. Our newspapers and magazines published a series of materials in this field. The Bulgarian television also presented some information. But the overall impression was that the mass media covered the matters, which interested the people in the country, in a restrained manner and sometimes with great delay. Therefore in post-critical situations the problem for regulation of the social behaviour is particularly serious. The personal and social responsibility of the individual person and of the community in such a situation enhances its role. A good example of high virtue in such cases is the assumption of personal responsibility and risk without looking for social recognition. Such an example is the struggle for saving the lives of D.L. buried beneath the ruins in Svishtov – more than ten hours eng. Velchev, corporal Kazanov and private Todorov were working under a concrete slab, which could crumble over them at any moment.

4.6. Conclusions and deduction.

The mass media played a very important role for the mental state of the population during and after the earthquake. The disadvantage of this information was that it gave hastened conclusions and incorrect statements. The tragedy of entire countries was concisely suppressed and the mass heroism manifested on that day was announced just as a campaign, without personification of the participants. If the press and the television had competent and timely reports, information from the place of the event, photographs from the restorative works, interviews and opinions of more specialists, the "anti-seismic" feeling among the people would have been more stable despite the stress after the quake.

It is not impossible to be surprised again by analogous or similar natural disasters in the future. Therefore it is necessary to think about preparation, information and training of the population. At every spontaneous natural disaster the citizens need to remain calm, not to panic and to act with organization. Upon feeling the first signs of the earthquake the citizens must not leave the building in panic, but rather stay in the safest place, which is presumed to be near one of the interior walls of the construction or in an interior corridor, away from windows and exterior walls. After the passing of the first quake, all heaters, lighting fixtures, television sets and gas installations must be switched off; just take the most important things and personal documents and immediately leave the buildings. The home must be locked, the exit should be through the stairs (not the elevator) and the people must go to a safe distance away from the buildings. You must avoid standing under power lines, tram and trolley lines, and the movement should be along the middle of the streets. People in public places (cinemas, theatres, saloons) must remain calm and leave the buildings without panic. Priority must be given to the women and children. Specialists – physicians, engineers, workers, materially liable persons and others, who are on duty, must leave their workstations only upon instruction. During the earthquake the personal vehicles must not be left on the road lane, in order not to congest the road arteries. After the fading of the earthquake the return to the workstations and the homes may resume only after an announcement by the competent bodies. In order to prevent epidemics water from water

sources can be consumed after permission from the competent bodies. The entry in buildings must be done with extreme care due to the danger of collapsing. Do not go in with torches, lanterns or lit cigarettes in gasified buildings. After the fading of the disaster the citizens should inform their relatives of their state.

The most important thing is to remain calm and to manifest the necessary moral and life qualities of the citizens and the control bodies, in order to prevent the direct, as well as the consequential damages from the spontaneous natural disasters.

Special thought could be given to the organization of joint courses or groups in qualification for anti-seismic preparation of the citizens. The public organizations in our country together with Civil Protection and other bodies are bound to undertake the necessary measures for that. The earthquake from march 4, 1977 must be used for overall information activity amongst the community, for establishment of "anti-seismic confidence" and education of the people, in order to manifest greater stability of the mind and enhanced readiness in case of future earthquakes.

5.0. Earthquake training of the students and the population in Bulgaria

Since the main goal of the project of the European Centre (ECRB), Bucharest, Romania is the dissemination of earthquake training amongst the students and the population, it is expedient to present data about the state in this field in Bulgaria and the connection with the earthquake from March 3, 1997 with epicentre Vrancea.

The first part of this report indicates the impact of the earthquake with epicentre Vrancea from March 3, 1997 on the territory of Bulgaria and the effect, which it had on the crisis management system, and particularly on the training in risk prevention.

Until 1977 the Bulgarian schools did not offer training in prevention of natural and technological risks. There was only training for military times – protection against nuclear weapons. The subject was called "Primary military training" and had regular classes in 2nd, 3rd, 4th, 8th, 9th and 10th grade. The teachers were officers from the army reserve. After the earthquake in Vrancea in 1977 the programs of this subject were changed and included classes in prevention of natural risks in 4th, 8th and 9th grade. The preparation of the population was implemented by workplace and residence following a special program of Civil Defence, which in practice was not implemented at all and was just accounted for.

Later the European Centre in Sofia conducted an international survey and it turned out that there was hardly any experience in the field of training at a school level in the other countries around the world, with the exception of West Germany. On account of that Bulgaria was following the path of the regular classes, traditional for the Bulgarian education. Textbooks and materials in Bulgaria and from abroad were scarce. People had to develop everything independently and, of course, it was based on military practice.

Immediately after the earthquake in Vrancea in 1977 the Council of Ministers of Bulgaria established a Permanent Committee on protection of the population in case of disasters and failures with the task to eliminate the consequences. This was a new original form of management in case of extraordinary situations, which had the purpose of uniting all efforts – state, civil of science and culture. Such committees were later established in all "socialistic countries" and USSR. This practice was also transferred to the USA, state of California. Now similar structures with different names exist in almost all European countries.

The map of seismic division into districts in Bulgaria was immediately improved, which led to a change in the design, construction and control for almost the entire territory of the country.

Immediately after the earthquake in Vrancea in 1977 the Permanent Committee activated promptly and then maintained constantly all activities in Bulgaria related to the protection of the population and the prevention, on account of which several political decisions were taken with regard to the implementation of training of the population in protection in case of disasters and failures. Together with the introduction of the respective classes in the schools and with the purpose of covering the entire population with the training in the municipalities in 1978, people started to establish "Training centres on risk prevention", which were constantly operational. Some of these centers still exist. This is an expedient form of preparation of the population, especially in districts, which could be affected by an earthquake with epicentre Vrancea or other epicentres.

Of course, it is normal that after the initial stress due to the earthquake many activities are activated, but then the enthusiasm gradually starts to fade because of the fact that prevention activities are very expensive. 10 years after the earthquake in Vrancea, in Bulgaria there was another destructive earthquake in 1986 in Strazhitsa, which not only accelerated, but also restarted many of the activities, which were started in 1977. At that time almost every major municipality had a Training Centre for risk prevention, specialized depending on the existing danger in the district.

The two earthquakes in Vrancea in 1977 and in Strazhitsa in 1986 caused a lot of serious changes in the rules of anti-seismic construction in Bulgaria. The quality control of construction works was improved. This construction was actually testes and successfully passed the inspection in several districts after the earthquake in Pernik in June, 2012. After this last earthquake people came to the conclusion that the combination between good anti-seismic construction and good earthquake training leads to a significant decrease in losses, especially the loss of human lives. Therefore our work and the results of this project are extremely important, because it can summarize all good practices and disseminate them in the region.

Immediately after the major political changes in Bulgaria (1989), based on the experience from the earthquake in 1977 in Vrancea the Bulgarian schools (in 1992) introduced a new subject "Protection in case of disasters" from 1st to 10th grade (total of 47 classes). For this purpose however it was necessary to have a decision of the National Assembly. The new subject also included classes in earthquake training. In time this subject was thematically

enriched and modified. It should be noted that Russia, for example, started its training in this field mainly on the grounds of the experience in this subject in the Bulgarian schools; of course, now Russia is so far ahead of us and now it's our turn to acquire all good practices.

Based on the experience, which Bulgaria had gathered after the earthquake in Vrancea (1977), the European Centre for Risk Prevention Training at School Level (CSLT) was established within the Open Partial Agreement (EUR-OPA) in 1997 in Sofia, the successor of which is today's European Centre for Risk Prevention (ECRP). It should be noted that the establishment of the European Centre for Risk Prevention Training at School Level in 1997 was based on a political decision of EUR-OPA, since Italy, France and Spain were against the establishment of such a centre with such tasks. At that time these countries considered that such training was not necessary and that it was a consequence of the totalitarian way of thinking.

The European Centre for Risk Prevention Training at School Level (CSLT) actually initiated this activity within the framework of the Open Partial Agreement EUR-OPA. The most significant international activities of this centre, from the results of which we can also obtain a lot of positive practices, are:

- 1997 Sofia – "International Conference on Training in the field of Risk Sciences at School Level" with the participation of 14 countries and 3 international organizations;
- 1998 Plovdiv – Second European Conference – "Risk Prevention Education at School and Pre-school Level" with the participation of 14 countries and 2 international organizations;
- 2000 Sofia – "The school communities and risk management" with the participation of 12 countries;
- 2000 International Workshop "Safety of Education Process and at the Workplace in the school building";
- 2002 Sofia – Work meeting "Risk Prevention Education at School Level" (Bulgaria, Italy, Cyprus) – BEGINNING OF PROJECT "BESAFENET" with first name: eur-opabesafeschool.net;
- 2003 Sofia – Seminar "Disaster Awareness with the use internet" and especially BeSafeNet and registration European centre with this name in Cyprus.

The European Centre in Sofia from 1997 to 2004 conducted many activities within the then existing program FORM-OSE, with which it summarized the entire experience of the member-countries of EUR-OPA in the field of training at school level; the best practices were also summarized, which initiated the training in risk prevention at school and pre-school level in Europe, which up to that moment was not accepted.

The abovementioned information aims at indicating that within the agreement a lot of work has been done in the field of "culture of prevention against risks", but that work is scattered across the different centres, for example: a set of 10 textbooks published in Russia; a series of games issued by the Ministry of Interior of Spain; a pedagogical briefcase of the Ministry of Environment of France; the practice of annual national campaigns in Finland; rendering first aid, including by children, in San Marino, Armenia, Bulgaria; the results of the project of EUR-OPA, MODEM-Risks based on the implementation of the concept "Campus Virtuel"; the development of the French Institute IFFO-RME, together with the European Centre CERP, of preventive measures in case of an earthquake, the establishment and introduction of two pedagogical means of primary and secondary education and of a training module based on the adapted model of the French National Plan for aid in a school building in case of a major disaster, etc.

Based on this experience I propose that the end result of this project finds its way into the development of a national campaign, specific for every country affected by an earthquake with epicentre Vrancea – Romania, Bulgaria, Moldova, Ukraine, as well as Greece and Cyprus.

A national campaign in the field of prevention of an earthquake with epicentre Vrancea can include the following package:

- General brief leaflet about the consequences of the earthquakes with epicentre Vrancea and their impact in the affected countries, rules of conduct and action in case of an earthquake (the initial text of this leaflet can be developed by the centre in Bucharest based on the summaries from 2012 and in 2013 the text can be sent for opinions of students, journalists and specialists, after which it will be disseminated through the European Centres in each country – just like the work that the centre in Kiev is doing now with regard to radiation);
- Directions for the use of BeSafenet in its part about earthquakes;
- Directions and pedagogical advices for the use of children's training simulators for earthquakes (Romania);
- Development of a scenario for radio transmission about the earthquakes in Vrancea and the impact in other countries with educational elements and inclusion of the opinions of people from affected regions in the respective country – with the option to use this scenario in each of the affected countries;
- Optional use of parts of the textbook "Earthquake Safety Programs for Schools" of the state of California (USA), issued by FEMA, with compulsory mentioning of the manners of fastening of furniture and other objects at home in the regions endangered by earthquakes, etc.;
- Summary and translation of various lessons and lectures on prevention of the risk of an earthquake for various age groups – from kindergarten to 10th grade;
- Explanatory material for the Training Centres for risk prevention in the Bulgarian municipalities.
- The abovementioned example of a package is of course open for discussion and may be clarified in the course of our work.

Based on our work now within the framework of this project, the European Centre in Bucharest can make a list of the most important multimedia materials existing in the field of prevention of an earthquake (epicentre Vrancea). Further thought can be given to holding a festival of films on the subject of prevention of an earthquake, initially only for epicentre Vrancea.

Used literature:

- Vrancea earthquake in 1977. It's after effects in the people's republic of Bulgaria , Publishing House of the

Bulgarian Academy of Sciences, Sofia 1983
- Conclusions of European Activities of EUR-OPA
- Training-methodical teacher's guide on protection and self-defence in case of disasters, failures and catastrophes

ACTIVITIES PLANNED IN 2013 (split by partner)

Working package 1 (prepared by ECBR):

Description:
Study of contents and dissemination means required for earthquake preparedness and education materials, to take into account the local conditions of Romania and comparison with experience of Greece and Cyprus.

Associated deliverables:
D 1 - Materials for earthquake education od students and citizens, to be posted on website of ECBR and dissemination of other materials.
D 2- Seminar with partners at ECBR Bucharest, validation and improvement according to experience of Greece and Cyprus.

Work package 2 (prepared by ECMNR*):*

Description:
D 1 -Study of contents and dissemination means required for earthquake preparedness and education materials, to take into account the local conditions of Moldova and comparison with experience of Greece and Cyprus.

Associated deliverables:
Materials for earthquake education od students and citizens, to be posted on website of ECMNR and dissemination of other materials

Work package 3 (prepared by ECRP):

Description:
D 1 -Study of contents and dissemination means required for earthquake preparedness and education materials, to take into account the local conditions of Bulgaria and comparison with experience of Greece and Cyprus.

Associated deliverables:
Materials for earthquake education od students and citizens, to be posted on website of ECRP and dissemination of other materials

Work package 4 (prepared by TESEC):

Description:
D 1 -Study of contents and dissemination means required for earthquake preparedness and education materials, to take into account the local conditions of Ukraine and comparison with experience of Greece and Cyprus.

Associated deliverables:
Materials for earthquake education od students and citizens, to be posted on website of TESEC and dissemination of other materials