

A Concept about Guide on Hazards for the Real Estate Business – An Example from Bulgaria

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Abstract: The paper is a part of wider investigation related to the application of basic sciences to the sustainable development of society. It deals with the presentation of knowledge to the real estate (fast growing business) about the local natural and man-made hazards in the near vicinity of any structure (inhabitant, recreation area, land, etc.) and their influence to the social safety and human comfort of life. The structure, necessary information and knowledge base for visible or hidden hazards about a guide for the real estate business is included. An example of application the knowledge about seismic hazard and related phenomena simplified to be more available to the non-specialists (such as real estate agents and companies) targeted to Sofia (the largest urban center and capital of Bulgaria) can attract and improve the learning abilities of the real estate for the society's sake.

Key words: Real estate, local environment, hazards, knowledge guide.

1. Introduction

The everyday practice of real estate business is focused on the view, comfort, location, size etc. parameters of the property to sell. Usually, the investors follow the projects and did their work according the codes and regulations for construction, anti-seismic measures, etc. The property buyers are interested of price, location, size, comfort, etc. Almost nobody takes care about the local environment (possible hazards which are typical for the site or can emerge during the exploitation of the property) of buildings, land, parks, recreation areas, etc. This study is focused to the distribution of knowledge between real estate agents and companies about the possible influence of local environment (different visible or hidden hazards – natural or anthropogenic), which can reflect the property owners about the price, quality and comfort.

A lack of knowledge about threats for buildings, land and other varieties of property could be an important factor for the cost-benefit analysis as well (for example, the local ground conditions variations frequently lead

to unexpected instabilities). During the last years there are some minor attempts to use specialized maps and other data to help buyers analyze the risks of fires, floods and other climatic disasters when searching for a new house (www.nytimes.com).

There are also some experiments to assess the man-made anthropogenic hazards at the enthusiastic level to warn about possible threats the occupants or users (www.classicrealtyna.com) of property. But all of these attempts are rather partial and do not have a systematic way of presentation and display.

The objective is to promote the specific knowledge guide for the real estate agents and companies about the following effects and phenomena [1, 2]: Earthquakes and secondary effects of earthquakes, erosion, landslides (especially deep sliding surfaces), rock falls, abrasion, suffusion, radon and electromagnetic pollution by GSM operators, TV and Internet providers, influence of nearby located antennas, electric power lines, icing and disruption especially for the energy supply lines (electricity, satellite transmissions, etc.)

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Secondary effects of strong earthquakes could be aftershocks, co-seismic faults and cracks, liquefaction, tsunamis, avalanches, activated landslides and stone falls – all of them not included up to now into any code or regulation. The effects of the above-mentioned phenomena were frequently observed in the past [3] and recently [4], tsunamis for nearshore areas, floods (river beds), winds (tornadoes, hail storms and other meteorological hazards). All of the mentioned threats have specific behavior frequently expressed by nonlinear functions [5]. This means that a little changes in the initial conditions can lead to major differences in the destructive potential of disasters. Special attention is paid during the last years about fire vulnerability by short circuits at homes, fire hazard emergency systems of pipe-lines, gas-stations, etc.

There are a lot of surprises which is difficult to assess if there is not a specific knowledge provided by experts and specialists for different hazards [6]. If this knowledge is available in advance, for sure it will reflect to the prices of the real estate both for sellers and buyers. AND IT CAN HELP A LOT THE REAL ESTATE BUSINESS! There is a significant lack of knowledge about the local hazards, which are known or can appear spontaneously in the lifetime of any property [1].

The idea is to create an understandable guide effective by simplicity, explainability and easy performance in the everyday practice of the real estate agents and companies. The Guide can be issued as book (synthesized as well as booklets on different topics), on-line platforms, instructive videos, mass-media distributed, etc.

2. Method and Materials

In Bulgaria there are more than 60 natural hazards and dangerous phenomena [7]. Only nine out of them (less than 20%) are included in the codes and regulations to the new buildings' constructions. All of the remaining hazards and dangerous phenomena have a wide distribution throughout the country, but nobody

takes care about their influence to the new or former property. Due to this many new owners are surprised by the natural and anthropogenic hazards that frequently are bringing them the results of negative effects to the property.

The method of seismic data collection and interpretation follows the standard procedure well described in [5]. As a result, map of epicenters and faults is constructed for the time interval 1990-2009 [8] – Fig. 1.

The seismic hazard is considered by the seismic code of Bulgaria [9], which provide protection for constructions to withstand vibrations with intensity of up to IX EMS degree. The integrated new concept for earthquake's safety for Sofia city, has been developed in [10].

There are several threats related to the seismic hazard, unfortunately not assessed or regulated by any code. It turns out that without any attention (consideration) have been left dangerous phenomena, like liquefaction, activation of landslides or avalanches, appearance of seismic surface cracks and co-seismic dislocations, etc. (Table 1). In Table 1 except the hazardous phenomena/effects and their physical characteristics, important recommendations about real estate agents are suggested.

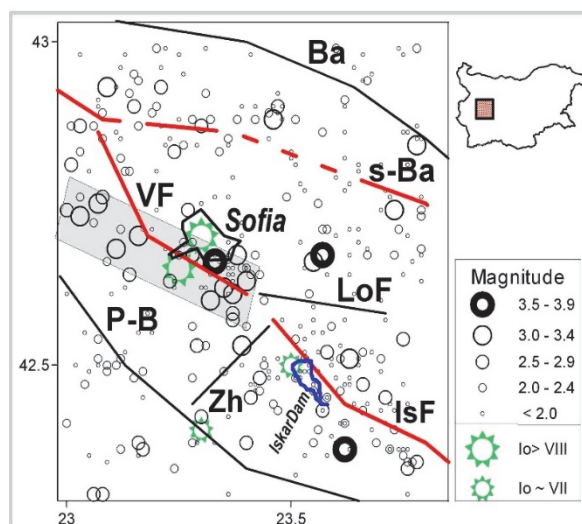
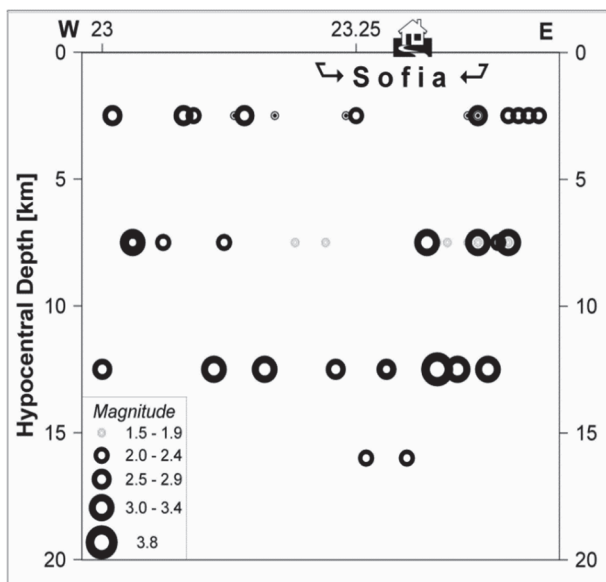


Fig. 1 Seismicity of Sofia and surroundings with active faults [8].

Table 1 Seismic danger and related hazards. Parameters for practical use by the real estate companies.

Hazard	Parameter	Vulnerable objects:	Source of information	Rules	Measuring unit	Recommendation
Earthquake	Vibration	Man-made structures and people	Seismic code Int (Ii) scale	+	Intensity (Ii), acceleration (m/s ²)	Lowest value of Vs_30
Earthquake	Surface dislocations	Man-made structures and people	Maps	-	meters	Avoid
Earthquake	Avalanches (winter time)	Man-made structures and people	Monitoring	-	volume	Avoid
Ground conditions	Liquefaction	Man-made structures (less people), Land	Maps Vs_30	-	m/s	High Vs_30
Type of rocks	Hardness	Man-made structures (less people)	Geology maps	+	Rigid modulus	Hard rocks
Underground water	Water level	Man-made structures (less people)	Maps	-	m	Deeper is better
Landslides	Volume, velocity	Man-made structures, People, Land	Maps	-	Size (m ³ , m/s)	Avoid slides
Faults	Activity	Man-made structures (less people)	Maps	-	Size	Low activity

**Fig. 2** Depth distribution of the earthquake hypocenters along the Vitosha fault [11].

In Fig. 1, the epicenters of known seismic events with magnitude larger than 1.8 in Sofia region are presented with the registered largest seismic event with magnitude 3.8. The spatial distribution is diffuse with activity concentration along some well-known faults (for example – Vitosha fault). The Vitosha fault generated the strongest earthquakes during the considered time interval [8]. The depth distribution of seismic sources along the Vitosha fault (Fig. 2) shows that the active depth of earthquake generation extends down to 15-18 km. In the same time, such a distribution

is useful to assess the depth of past and impending earthquakes.

The seismic source depth has a direct effect to the buildings stock; it has been explicitly demonstrated that the shallower seismic events have larger destructive potential than the deeper ones.

It is important to mention that the seismic code does not consider separately the local and regional seismic sources. The local sources are much more dangerous for the building stock than the regional. If the distance is more than 50 km from the known seismic sources in Bulgaria it is rather low probable to expect serious destructions from earthquakes generated by these sources. While buildings are generally equipped to handle vertical forces from their weight and gravity, they cannot handle side-to-side forces emitted by quakes. This horizontal load vibrates walls, floors, columns, beams and the connectors that hold them together. The difference in movement between the bottom and top of buildings exerts extreme stress, causing the supporting frame to rupture and the entire structure to collapse.

As seen the Table 1 reflects most types of hazards related to the seismic activity, as well as the measurable parameters influencing the property – buildings, land, and people. The vulnerable objects as well as the rules (obligatory codes, mapping, etc.) regulated by laws and these ones not included in the regulations.

Here, the importance of local and regional seismic sources to the seismic danger of Sofia is systemized in Table 2. The most important parameters are the expected maximum magnitude M_{max} , the depth of the hypocenter (averaged and considered for all sources) and the distance between the seismic source and the interested site. The frequency content of the seismic waves emitted by each source is an important parameter about the expected resonance effects. It is presented in

qualitative levels, just to be more understandable by the non-specialists. The important exception is the Vrancea source (Roumania) as indicated in Table 2. The risk is also presented in a qualitative scale. The table 2 shows as well as the expected maximum magnitude which the faults can generate used in all models (deterministic and probabilistic) for the risk assessment used up to now. The last version is based on research and the results of the World Bank [12].

Table 2 Local and far field dangerous seismic sources for Sofia region, expected maximum magnitude and level of seismic risk.

Source	Type of source	Distance to Sofia (km)	Depth of source (km)	M_{max} (modeled)	Frequency content	Risk
Sofia						
Vitosha fault zone	Local	0-20	0-20	6.5-7.0	High	High
Central fault zone	Local	0-10	0-20	6.5	High	High
Northern fault zone	Local	0-20	0-20	6.5	High	High
Blagoevgrad	Regional	60-100	0-40	7.5-8.0	Middle	High
Plovdiv	Regional	120-150	0-40	7.0-7.5	Middle	Middle
Vrancea	Regional	390-430	90-150	7.0-7.5	Low	Middle

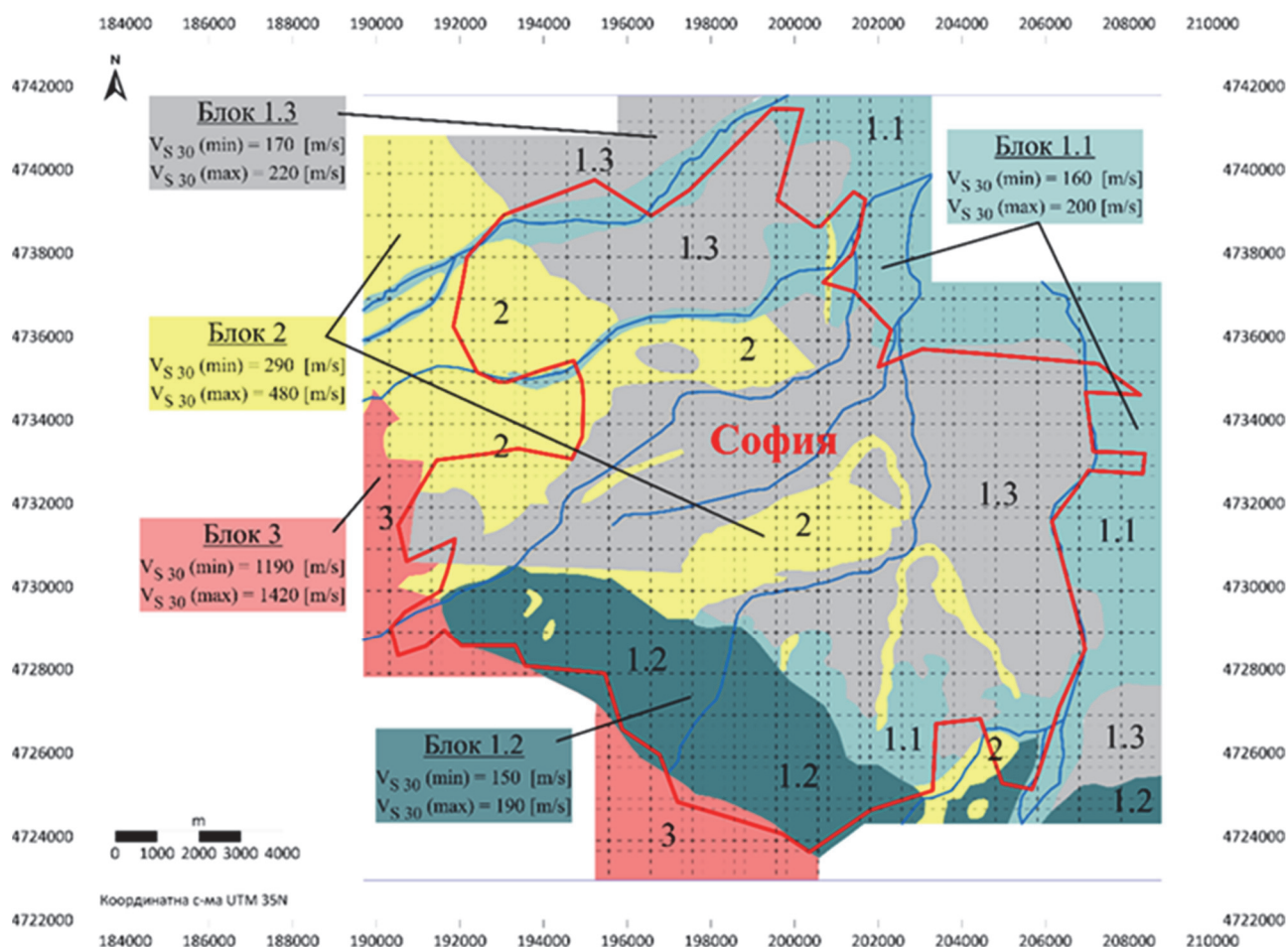


Fig. 3 Map of the V_{S30} for Sofia region [13].

The ground condition is another parameter increasing or decreasing the seismic influence – sometimes up to 2-3 intensity degree variation around intensity of shaken on the average ground conditions determined by geologists.

From the practice and observations, it is proved that hard rocks are much more stable than the sediments. The sediment rocks also differ in their properties – marbles and lame stones are much more stable than the alluvium and diluvium (not consolidated sand, gravel and silt). To assess the influence of the ground conditions to the seismic hazard the V_s_{30} maps are constructed. Such map for Sofia and surroundings is presented in Fig. 3. The V_s_{30} is an average parameter presenting the velocity of secondary waves (S- seismic waves, the most destructive ones) down to 30 meters depth, including hardness of the rocks, underground water level, ability to liquefaction, etc.

The highest velocity means the highest stability of the ground and vice-versa – the lowest velocity means the lowest stability [13].

3. Results and Discussions

Each chapter of the proposed guide is intended to include according the international specialized educational Project CABARET [14], the following topics:

- Short and understandable physical description of the phenomenon – expected magnitude, intensity, size, quantity, destructive potential, limits established by regulations, etc.;
- Peculiarities of each specific locality and its vulnerability to the existing and expected hazardous phenomena;
- Possible negative effects to the property and/or the humans (damages, collapses, health problems, psychological consequences, etc.);
- Ways to reveal or investigate the dangerous phenomena;
- Ways to avoid and/or to eliminate these negative effects;

- Reflection to the safety, comfort and price of the property.

There are also some new tendencies of the real estate assessment related to the hazards.

For example:

- Ability of the owners to react adequately to the warnings issued by the early warning systems [15];
- Nearest location to the evacuation roads and evacuation facilities to perform successful evacuation, especially in case of time deficit warnings (for example - earthquakes, nearshore tsunamis, tornadoes, etc.)
- Possibilities to eliminate the negative effects by simple and effective measures given by authorities to individuals and population through instructions by specialists [16].

There are many general recommendations about the safety and protection (social and individual) against natural and man-made hazards [17], but there is no even single specifically targeted guide to the real estate business.

The intended knowledge book needs a lot of specialized experts who have knowledge of different scientific and practical disciplines – engineers, scientists in the fields of geology, geophysics, meteorology, radiology and so on, persons familiar with codes, rules and regulations, medical specialists etc. (for example [7]).

The guide must present simplified knowledge easy to understand and suitable for non-specialists (real-estate agents and similar professionals).

The Book must contain general instructions how to assess and avoid (when possible) the threats to the property and people. The simplified approach needs to present (for example in table form - Table 3) the sensitivity of the building types to the influence of the local and regional seismic sources (SS) emitting seismic waves on the construction of the building, considering their resonance properties as well. The resonance effect is a heaviest factor responsible for the building stability. Own resonance frequency is strongly magnifying the vibrations of the construction, leading to its destruction.

Table 3 Seismic influence on different types of structures in Sofia region (example).

Type of structure: Seismic effects	Masonry structures	Large-panel buildings	Buildings with bundled slabs	Buildings with creeping framework	Wooden buildings	Concrete frame with bricks	Buildings with large-area framework
Local SS effect	High	Low	Low	Low	High	Low	Low
Regional SS effect	Low	High	Middle	Middle	Low	Middle	Low
Ability to resonance	High from local SS	High from regional SS	Middle	Low	High from local SS	Middle	Middle
Vulnerability	High from local SS	High from regional SS	Middle	Middle	High from local SS	Low to Middle	Low

It is important to mention that even if M_{max} is realized, distances larger than 60-80 km from the seismic source guarantee the low level of damages for all kind of structures.

Especially for Sofia as the largest and most populated city in Bulgaria a few investigations have been carried out. Special attention is focused to the large panel buildings as a main element of the city infrastructure. Several large inhabitant complexes (like “Ljulin”, “Mladost”, etc.) are containing the vast majority of people leaving in such property.

The World Bank research indicated the high seismic risk of these building stock and the modeled consequences indicate the large number of victims and destructions [12].

Some measures have been proposed for few districts in Sofia, but they only reveal the hardness of the situation and will be very difficult to perform effectively.

As an important issue for the preparedness of people the distribution of knowledge how to behave before, during and after the earthquake for safe live measures is essential [2].

4. In-depth Analysis – The Future Intentions

Developing the idea to provide and distribute the knowledge about natural and/or man-made hazards targeted to the real estate agents and companies we reach to deeper recommendations regarding our suggestions:

- To create the systematic guides for the real estate agents and companies to make them familiar with all possible local threats and hazards. This will improve

the knowledge and can help the owners, sellers, rentals and buyers to the comfort of live in the respective property or expected troubles. This also can reflect to the process of the properties assessment in wide range;

- To open educational courses on a platform for distant education considering the national and international cooperation to distribution of knowledge [16];

- To open attendance courses for basic knowledge on the most important problems to know and be familiar;

- To provide both – owners and customers to be familiar with such a knowledge and its existence;

- To disseminate books, booklets and short instructions with knowledge and specific parameters depending on the real situations for any object and any local condition.

5. Conclusions

An important task about production and promotion of a knowledge book (Guide) for instructions and better understanding of natural and anthropogenic hazards is formulated as a complete concept.

The improved knowledge of the real estate agents and companies to the natural and manmade hazards can drastically increase the competence and bring additional profit informing the buyers about details of expected and/or random appearance of any danger not considered by the rules and regulations. The case-study for Sofia and surroundings for the seismic hazard and secondary effects by earthquakes is presented.

The will of investors to produce building environment improving the comfort of the property

owners, it seems very important to provide knowledge to the real estate business by specialists in different fields of risk knowledge.

The higher quality of the real estate service can reflect directly to the prices for both parties – the sellers and buyers. First companies applying this knowledge in practice will benefit surely than others.

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