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How to Benefit from Earthquakes

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Abstract: Earthquakes are natural events and it is quite easy and beneficial to convert them to wealth (national asset) rather than catastrophe. The earthquakes exert their catastrophe on the buildings/structures founded in soil grounds. There is not even a single case study of an earthquake that caused a catastrophe where structures/buildings are founded on/in a rocky ground that is not proper for agriculture. However, almost all inland earthquakes, particularly strike-slip and normal fault zones ultimately create larger and thicker soil mantle, which is heated by (a) kinetic energy created by particle movements and (b) higher geothermal gradient peculiar to active fault zones. So, people should use fertile soil plains for agriculture and surrounding rocky lands for settlement in accordance with the recommendations of Mother Nature and State Laws and in accordance with the maxim "Love the nature, never challenge it".

Key words: earthquake, geotechnics, rock, soil fertility, agriculture

Kako imati koristi od potresa

Sažetak: Potresi su prirodni događaji i prilično ih je lako i korisno pretvoriti u bogatstvo (nacionalno dobro), umjesto u katastrofu. Potresi uzrokuju katastrofu na zgradama/objektima temeljenim na zemljanim terenima. Ne postoji niti jedna studija slučaja potresa koji je izazvao katastrofu a da su objekti/zgrade temeljeni na/u kamenitom terenu koji nije pogodan za poljoprivredu. Međutim, gotovo svi kopneni potresi, osobito zone rasjeda s pomakom po pružanju i normalnih rasjeda, u konačnici stvaraju veći i deblji pokrov tla, koji se zagrijava (a) kinetičkom energijom koju proizvodi kretanje čestica i (b) višim geotermalnim gradijentom koji je svojstven aktivnim rasjednim zonama. Stoga bi ljudi trebali koristiti ravnice s plodnom zemljom za poljoprivredu, a okolna kamenita zemljišta za naseljavanje u skladu s preporukama majke prirode i državnih zakona te u skladu s maksimom „Voli prirodu, nikad je ne izazivaj“.

Ključne riječi: earthquake, geotechnics, rock, soil fertility, agriculture

1. INTRODUCTION

In the world every year about 13 million, 1.8 billion, and 5 million people are negatively affected by earthquakes, floods, and landslides respectively. In other words, nearly a quarter of the world's population is negatively affected by natural events. [1] The number of casualties (dead and injured) exceeds 200 thousand/year. Although those natural events could be converted to wealth rather than catastrophe. The proposed approach is quite easy and profitable, especially for national assets. [2,3]

The authors' team have been struggling since 1970s to tell all people that inland earthquakes kill only and only in soil plains which favor farming and endangering structures. In many countries such soil lands are protected by law.

The main reason behind disaster in soil is (1) the hypocenter of all earthquakes is located in stronger rocks. (2) Seismic energy attenuates in strong rocks at a very high rate. (3) The seismic energy from rock to soil at an instant is 1000 to 5000 times greater than that the soil transmits. (4) The excess energy turns into amplitude amplification.

Authors try to explain this situation with two examples below.

2. TARUMI EARTHQUAKE

The Tarumi earthquake is one of the very explanatory case studies. It has proved the superiority of rocky ground over soil ground in terms of earthquake disaster. Casualty in Tarumi, which is adjacent to epicenter and settled on rocky ground, is zero. Similarly, casualty in Kita, Nishi, and Hanshin, which are situated on rocky grounds in the vicinity is zero too. However, casualty in Kobe, which is around 50 km far from the epicenter and settled in soil plain and manmade fill lands, is around 41.000. This situation is tried to demonstrate in Figures 1 and 2.

"It's not the earthquake, it is the building that kills." and similar unscientific postulates prevent the public from understanding the simple and concise facts behind the earthquake catastrophe. The authors' team has been trying to explain the thousand-times justified truth behind earthquake disaster for around half a century. The truth is confirmed in every earthquake with a magnitude (Mw)>5.5.

Figure 1. depicts epicenters of (a) Tarumi earthquake (M=6.9 and Dfocal=17.6 km, at UTC time 1995-01-16 20:46:53) and the others having a magnitude greater than 5 in the interval of 1900-2020). [4,5].

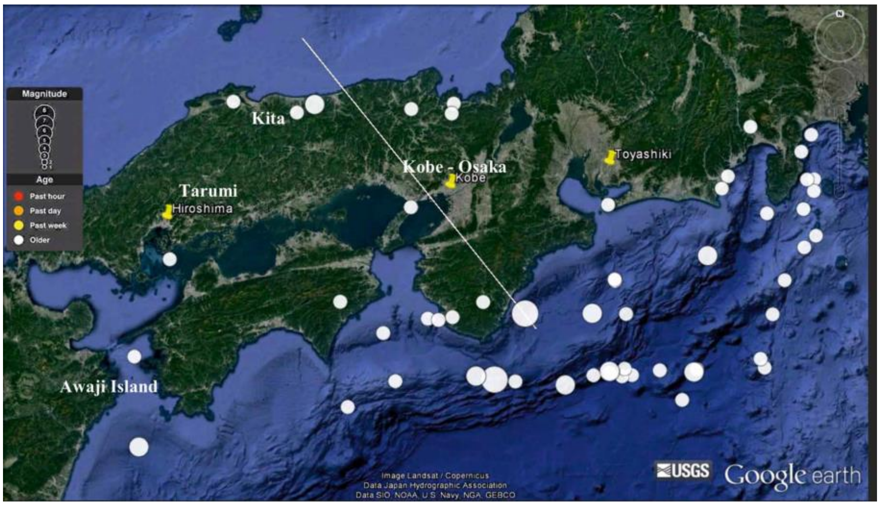

Figure 1. Epicenters of earthquakes

Tarumi earthquake did not create and any catastrophe in Tarumi and the other towns in the vicinity which are founded on rocky ground whereas it caused very high disaster in Kobe which is settled in soil plain and manmade fills (Figure 2).

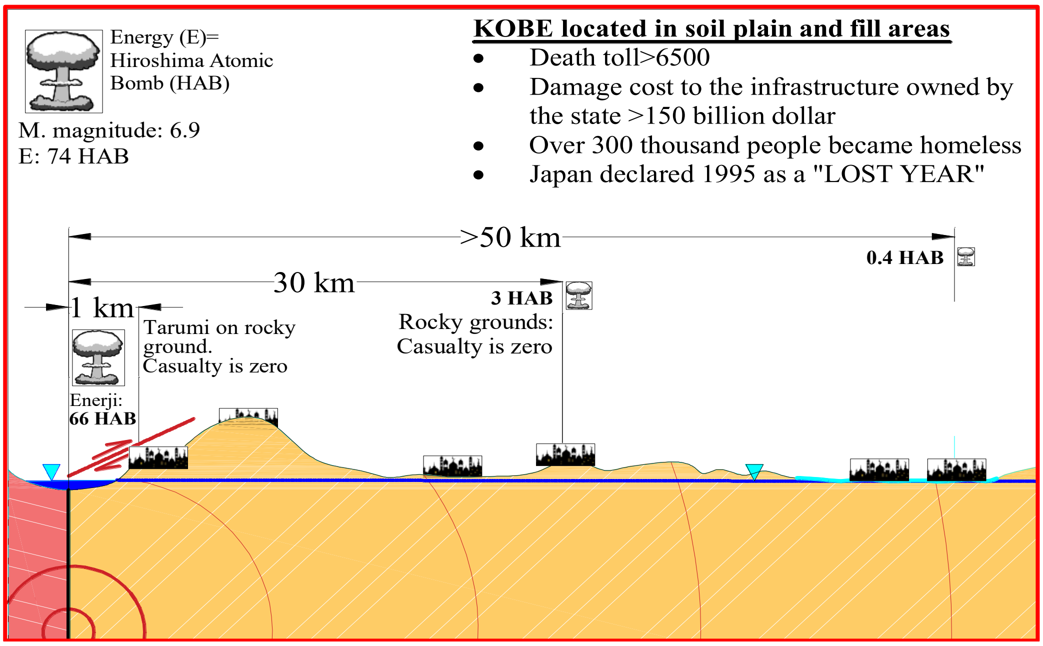

Figure 2. Consequences of the earthquake in Tarumi

3. MARAS/TURKEY EARTHQUAKE AND CHARACTERISTICS OF PULL-APART BASINS FORMED ALONG STRIKE-SLIP FAULTS

The recent earthquake (Mw: 7.7, Dfocal: 8.6 km, 6.02.2023, 04.17 am) hit Pazarcik/Maras/Turkey. The epicenter is within the soil plain of the township Cigdemtepe (Crocushill) which has been founded on a weak rock of clayey limestone of Pazarcik [6]. The exerted energy at Cigdemtepe is over 1000 Hiroshima Atomic Bombs (HAB) based on formulations [7,8,9]. The casualty is zero. However, less than one thousandth of 1 HAB (<1HAB/1000) reached the Battalgazi and Harran soil plains, orderly 160 and 200 km away from the epicenter, and caused the bitter catastrophe. In spite of that a very severe catastrophe came out in those two and other soil plains. There has not been any casualty on rocky grounds even adjacent to the fault cracks and very close to the epicenter (Figures 3 and 4).

While the casualty is zero in Çiğdemtepe (Crocushill) adjacent to the epicenter of the earthquake, it is over 2500 in the Harran plain, 200 km away. According to [6] It underlines that the structures are exposed to earthquake disaster if they are built in soil ground.

Figure 3. Consequences of the earthquake in the plain of Harran

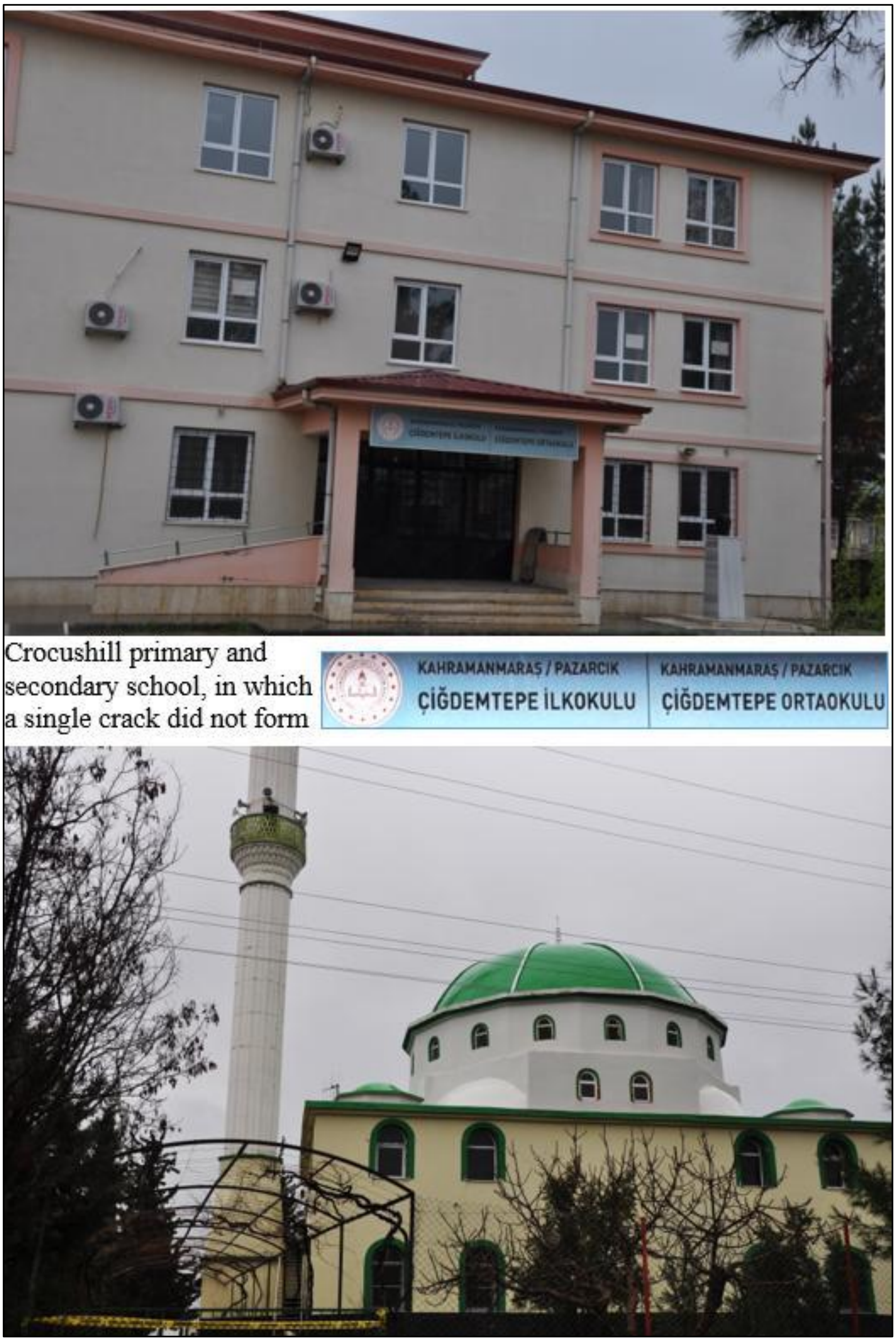

Figure 4. Damage cost is nearly zero in Cigdemtepe (Crocushill) which is adjacent to the epicenter

Pull-apart basin is peculiar to the strike-slip faults. Over 90% of such basins are filled in alluvium (Qa) which is a mixture of numerous organic matters and minerals originated in the respective catchment. It is the best soil for agriculture. The rest is represented by lakes (Figure 5) which are invaluable components of the nature.

The mother nature created soil for agriculture and rocky ground for settlement. Beyond the arctic zone, the low lands of soil plains are rich in CO2, good for plants and higher lands of rocky grounds are rich in O2, favourable for human being.

Due to the higher molecular weight (44 g) of CO2 than that of the ambient air (29 g), the soil plains are covered with a CO2 blanket. Light waves with a short-wave length (high frequency) pass through this blanket. The reflected wave with greater wavelength could not pass throughout. So, the ambient air gets hot and more humid. It is a desirable environment for plants but negatively affects human health.

Figure 5 depicts the formation of Hazar lake of fresh water (6x20 km in areal extent and 213 m in depth) under the pull-apart mechanism valid along the Dead Sea fault from Aqaba/Jordon at far south to Karliova/Turkey at far north. [5]

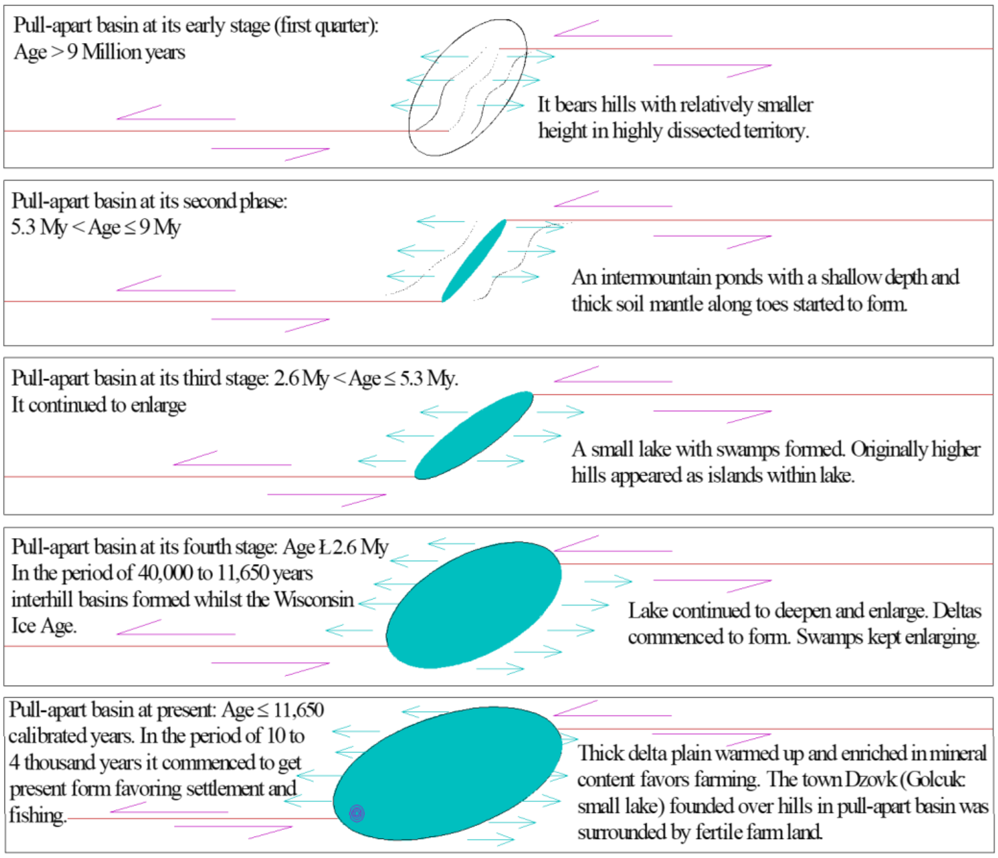

Figure 5. Formation of freshwater Lake Hazar

4. THE REASON BEHIND THE HIGHER ENERGY CONSUMPTION IN ROCK

A well-known simple test configuration was presented in [6]. It shows that the viscosity increases, wavelength decreases (frequency increases) and wave energy attenuates rapidly. Rock has higher strength properties than soil does. Hence, seismic wave energy attenuates quickly in rocky medium which in turn does not harm structures. As viscosity (resistance to flow) increases, amplitude and wavelength decreases, frequency increases, and wave energy attenuates rapidly. Seismic wave energy attenuates at a high rate in rock whereas in soil it attenuates at a lower rate.

The same phenomenon is valid for light energy attenuation. As the sun rises and sets, the sun is at the farthest point to the observer. Redness dominates the horizon. Therefore, red light with a relatively longer wavelength and lower frequency reaches the observer, while others are attenuated or ceased out (Figure 6). As all seismic records and relevant literature present, the velocity and energy consumption ratios are directly proportional with the frequency of a wave whereas wave length is inversely proportional with the frequency.

A sound wave with a wave length (λ, m) 2.5 propagates in sea water with a velocity (v, m/s) 1600 and frequency of (f, Hz) 4000. The same sound propagates in ambient air with a velocity of 343 m/s and frequency of 857.5 Hz. One may easily find the ratio (R, -) of kinetic energy (Ek, kJ) loss in water (Ekw) and air (Eka) by substituting mw=1000g/lt, ma=29g/22.4lt, and squares of respective velocities into the equation given as:

$$R = \left[\frac{\frac{1}{2}m_w v_w^2}{\frac{1}{2}m_a v_a^2}\right] = \frac{1000}{1.31} * \left[\left(\frac{1600^2}{343^2}\right)\right] = 763.36 * 2176 = 16{,}610 \quad (1)$$

More explicitly, energy lost per instant time is 16,610 times greater in sea when compared with that in air.

Rock unit mass (γ_r, t/m^3) below the soil mantle starts with 2.65 and increases with depth and may attain 4.6 in ultramafic rocks. Practically it could be taken as 3.2 provided that the focal depth (depth to hypocenter) is greater than 5 km. Seismic velocity in rock (v_r, m/s) also increases with depth, and so does the frequency. The average v_r could be 4000. However, in soil the unit mass (γ_s) varies from 1.4 to 1.8 with depth, while for liquefaction, it approaches 1.2. For the sake of practice, it could be regarded as 1.6. The mean v_s for the uppermost soil mantle (which is the main concern in the study of catastrophe) could be taken as 100.

$$R = \left[\frac{\frac{1}{2}m_r v_r^2}{\frac{1}{2}m_s v_s^2}\right] = \frac{3.2}{1.6} * \left[\left(\frac{4000^2}{100^2}\right)\right] = 2 * 1600 = 3200 \quad (2)$$

So, the energy lost per instant time 3200 times is greater in rock when compared with that in soil. This is the main reason why an earthquake could not exert its catastrophe on settlements/structures founded on rock. From several aspects, the rocky ground with hummocky topography is the right place to be used as residential area while soil plain is good for agriculture.

The principles of wavelength, frequency, and energy consumption rate in a respective wave are presented at Figure 6. At the moment of sunrise and sunset, sun is at the farthest point to the observer. Hence, red light with longer wavelength (lower frequency) can reach an observer while the others attenuate. One may observe this at the moment of sunrise and sunset. [10]

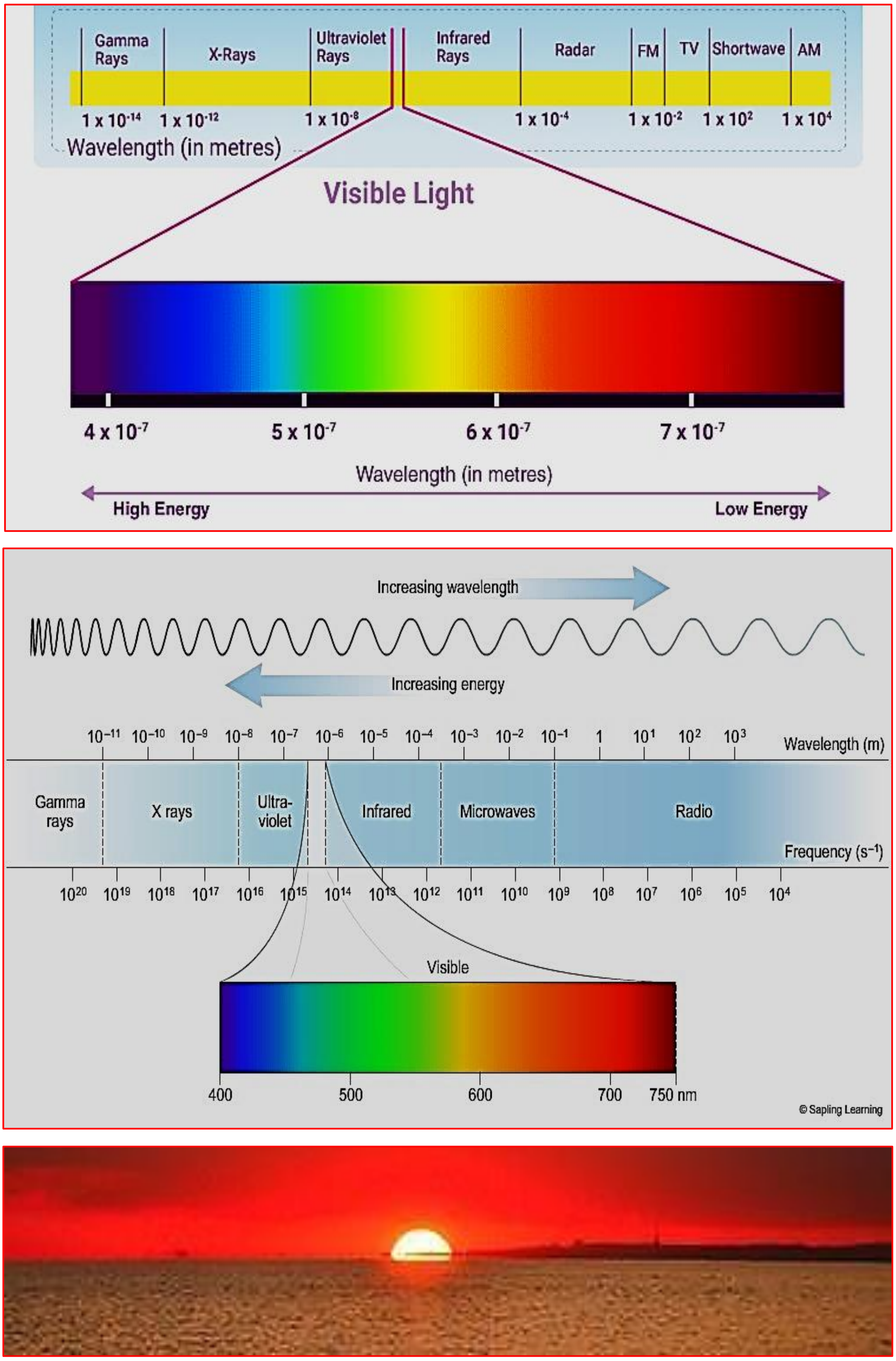

Figure 6. The principles of wavelength, frequency, and energy consumption rate in a respective wave

Ultimately one may forward that the energy transfer from rock to soil at one time is “E”, and one in 3200 of “E” is transmitted by the soil at the same time span. The excess energy (3199 “E”) is converted into amplitude amplification in the soil [10]. Consequently, it causes disasters even hundred kilometers away from the epicenter (Figure 7).

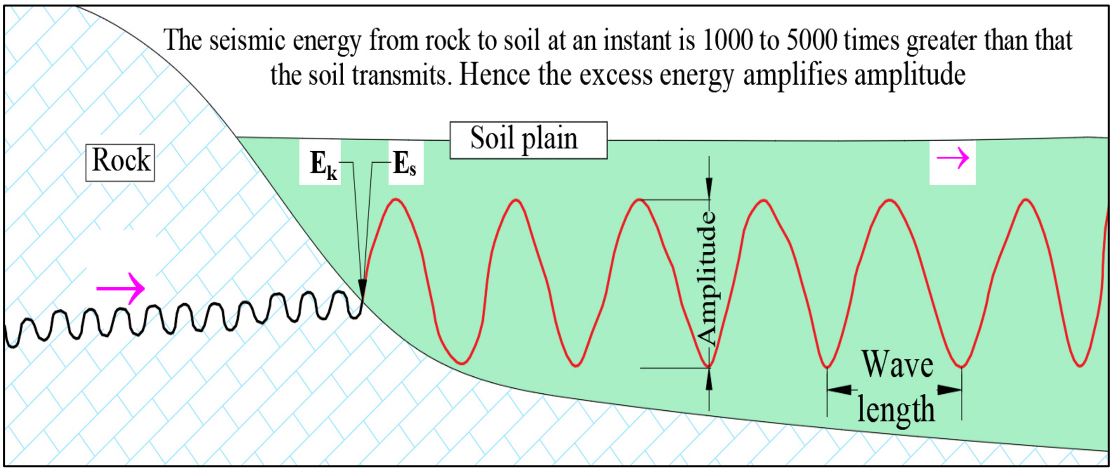

Figure 7. The seismic energy attenuates at a higher rate in stronger rocks, the energy transferred from the rock to the soil at an instant is “Ekr”, roughly 0.1% of Ekr is transmitted by the soil, the remaining (excess) energy magnifies amplitude and, therefore, causes disaster

5. DISCUSSION

Since 1970s, catastrophic earthquakes, particularly in Anatolia, have been observed and searched by the authors’ team. Ultimately, the authors reached a concise and comprehensive conclusion that buildings and the other civil structures founded on/in rocky ground even in the vicinity of the active fault have not been affected noticeably. This is valid for every country [5]. The main reason behind this is that a saturated rocky ground, compared with saturated soil has; (a) zero liquefaction potential, (b) million times higher modulus of elasticity, (c) appreciably higher strength, (d) extremely low potential to create resonance in case of two-story building (h~6 m) or taller, and (e) extremely low risk of bedding fault. [2]

The strategic ingredients that keep a country uprise are healthy food and drink. Fault belts create the most fertile soil plains. For example, Menderes and Gediz plains (Turkey), which are the homeland of orderly (endemic) dried figs (Sarilop-Sarizeybek) and (endemic) dried grapes (Sultani) are created by Aegean graben fault system and the unit alluvium which is being derived from numerous geological units in the catchment. The plains still subside and alluvium fills in. The unit alluvium is being enriched in trace elements and heated by the respective faults. Also, earthquakes create disasters in these fertile plains. In addition, such agricultural lands are protected by the constitution and related laws, statutes, and regulations.

Please note that the realty “Earthquakes create disaster in settlements founded in soil plain rather than rocky ground” is valid all over the world. Moreover, soil plains particularly the ones created by faulting and filled in with alluvium, are vitally important for agriculture and all gaseous heavy pollutants are suspended in moisture covering soil plains (lowlands) like a dome-shaped cloud and poisoning all O2 breathing organisms including people.

The researchers could easily understand the proposed earthquake reality comprising (a) the problem is so simple and easy to visualize, (b) it is quite practical to figure out and implement effective management practices, and (c) the recommended solution is a very high-earning project to save lives and properties and to gain extensive first-class agriculture fields which provide strategic products to eat and drink. The most common question posed to authors is: "Why couldn't you tell the world these facts for half a century, even though the suggestion was so obvious? The answer is threefold.

1. Sometimes a person sees the truth. She/he tries to explain until her/his energy is exhausted. In fact, it is easy to understand when the facts are told. But those who are in a position to see it before resist. They do everything they can to prevent it. They even resort to brute force. A long time later, this reality is accepted by the relevant medium. However, life may not be enough for the period that should be expected.
2. Almost all of the relevant engineering disciplines revolve around; (a) constructing buildings resistive to earthquake forces and (b) predicting when and where will an earthquake hit. They resist to see the truth that they experience. Almost all countries have representatives who infiltrate some organizations and institutions, especially to hide the fact of earthquakes. These are financed by those who hope for help from the hunger of innocent peoples. These organizations and intelligence agents, who also hold the means of communication in their hands, are extremely powerful in deceiving innocent people. Therefore, it is quite difficult to prevent them. However, the practical question should be “Where does an earthquake create catastrophe?”. The answer is simply “thick (t>20 m) soil mantle with shallow (d<20 m) water table”.
3. In spite of the above obstacles, the authors’ team has succeeded to save many ten million of innocent people and their properties in and abroad, particularly during the last three decades. People understand the facts better when they live and see the earthquake reality. Hence, the best and practical solution is to establish a new settlement on rocky ground prior to the next earthquake will hit in the vicinity.

Conclusively, about one quarter of the world is suffered from disasters caused by earthquake, flood, and landslide which are natural events. It is quite easy, quick, and profitable to convert such natural events into wealth not to catastrophe. Almost all of the relevant engineering disciplines focus on; (a) constructing buildings resistive to earthquake forces and (b) predicting when and where will an earthquake hit. Naturally, such researches have to be conducted in academic medium. However, it should not prevent to select proper rocky sites for construction, particularly in seismically active regions and preserve fertile soil grounds for agriculture. It is urgent to save people and their properties from catastrophe caused by earthquake, flood, and landslide.

It is strongly recommendable that engineers should study the damage to structures and casualties after every destructive earthquake by accounting whether the structures are founded in/on soil or rock at first. Definitely, they will reach the same conclusion that rocky ground is much superior to soil ground in order to minimize/avoid earthquake catastrophe.

6. CONCLUSIONS AND RECOMMENDATIONS

Every earthquake with a magnitude greater than 5.5 proved that the earthquake (EQ) disasters occur only in soil ground. Soil thickness (t>20 m), soil plain width (B>200 m) and shallow (d<20 m) water table conditions escalate the risk noticeably. The authors think that the main barrier in front of selecting right places to prevent earthquake catastrophe is to ignore the superiority of rocky ground over soil ground in terms of liquefaction, amplitude magnification, modulus of elasticity, shear strength, and other engineering characteristics in the selection of a proper settlement land (rocky ground). The simple but radical solution is (i) to select rocky ground for settlement, (ii) construction shall be performed in accordance with international codes, and (iii) fertile soil lands have to be preserved for agriculture.

ACKNOWLEDGEMENT

The authors and their team appreciate decision-makers who follow the principles of science and art. It is possible to put an end to the natural disasters caused by earthquakes within two years. It is urgent, easy, and profitable. Every country has the power to implement this kind of project. They can earn more than they spend in a short time and forever.

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