Undermined Foundations Exploring the Adverse Effects of Endogenous Factors on Building Soil Stability

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Abstract

Numerous variables affect the qualities of foundation soil. Among these are endogenous processes. Building structures and foundation soil are subject to several elements that might have varying degrees of effect. Endogenous processes are unavoidable elements. Construction projects must deal with the consequences of these processes and their interactions. We are unable to deal with these occurrences if we cannot foresee their appearance, the intensity of their impact, and any potential aftereffects. Endogenous processes include the tectonic motions that result in subsidence, landslides, erosion, earthquakes, waterlogging, flooded regions, and many other phenomena. Additionally, an earthquake is an endogenous process. Earthquakes, building collapses, landslides, liquefaction of soil, subsidence, and elevation changes are all caused by earthquakes. Volcanic activity is the final phenomena discussed in this paper. Volcanic activity results in terrain changes, building collapses, landslides, earthquakes, and fires.

It is impossible to distinguish between endogenous and external processes. Groundwater, rock characteristics, terrain shape, and many other aspects are influenced by the combined influence of exogenous and endogenous causes. Endogenous speech processes are often considerably larger, more damaging, yet occur across a much smaller region.

Keywords: Endogenous factor, tectonic motion, earthquakes, volcanic activity, structures.

1. Introduction

Rock material's composition and stress-strain variations are brought about by these processes. It is vital to adjust to males since they have the ability to impact these processes. This is an excellent location for constructing buildings, keeping an eye on developments and potential hazards associated with these occurrences, and installing the right safety measures in high-risk locations. Figure 1 shows the fundamental framework of endogenous events and their consequences.

This is how seismic activity, volcanic activity, and plate tectonics all play a role. There are hazards everywhere that are connected to the emergence of endogenous processes. As a result of tectonic movements, related seismic activity, and volcanic eruptions, we may conclude that the borders of the

tectonic plates carry the most danger. Therefore, continually adapting to local circumstances and any phenomena happening at a site is a fundamental component of building.

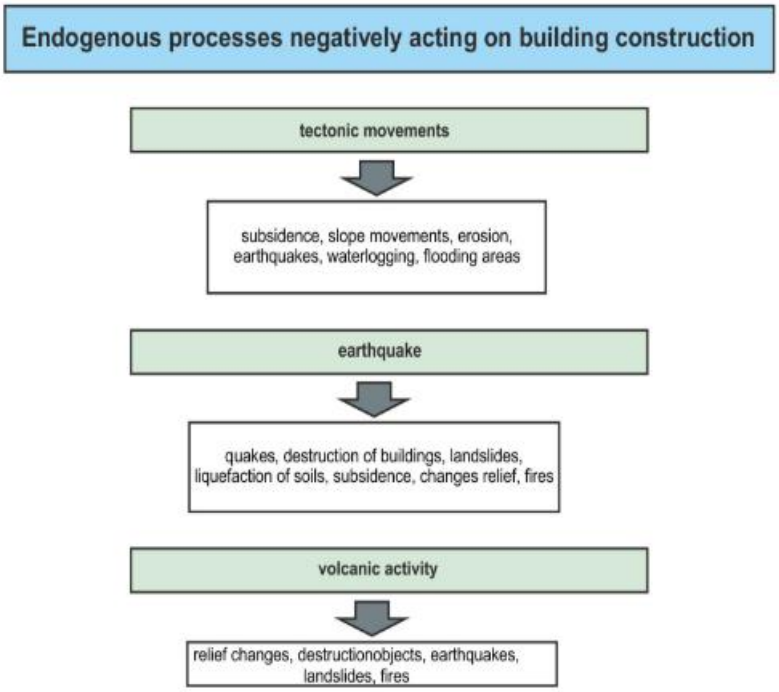

Figure 1: Endogenous processes that have a detrimental impact on the development of buildings.

1. The relationship between urbanization and tectonic movements

Among the endogenous factors that have a detrimental impact on building are tectonic movements. The harmful impact of tectonic changes extends beyond the foundations of buildings. The strongest geodynamic phenomena, it is linked to many other unfavorable circumstances.

The idea of the so-called conventional flows provides an explanation for tectonic motions, which are the outcome of internal forces operating in the earth's mantle. The mantle of Earth is constantly moving and warming. Each of the tectonic plates moves at a different pace. The direction in which they travel defines the kind of damaging action. Collisions may result from differences in the direction and speed of movement.

We can differentiate between translation, convergence, and divergence movement based on the movement of tectonic plates. New crust forms as a result of plates moving in different directions. Together with the magma production, there is regular earthquake activity and volcanic activity.

Oceanic and continental plates collide when they move in a convergent manner. Their effects on the surface of the planet vary depending on the kind of collision. Because oceanic crust is lighter than continental crust, it subducts under it and is accompanied by intense volcanic activity. It is possible that massive mountain ranges like South America's Andes will arise when two continental plates collide.

The third possibility, which is often followed by an earthquake, is to shift the plates in the opposite horizontal direction. The San Andreas Fault in California is the most well-known transform fault on the continent. Areas on the margins of tectonic plates and, to some degree, even outside of them are particularly susceptible. Numerous secondary consequences, including erosion, landslides, subsidence, earthquakes, volcanic activity, tsunamis, waterlogging, flooded regions, and many more, are brought on by tectonic movements. Conditions related to hydrology, hydrogeology, geomorphology, and geology may all be significantly impacted. There may be brittle failure, fissures, fractures in faults, river alterations, depression floods, aquifer connections, and more.

From the standpoint of constructing foundations, it is an element beyond of our control. A deeper understanding of Earth and its natural relationships and principles, together with enhanced exploration techniques and information from other fields, enables human adaptability to these impacts.

Every building design should take into account the local environment and the dangers that are present there. In regions where earthquakes occur often, improper building design may put lives in risk in addition to destroying structures and resulting in significant financial losses. Author Doğangün has researched this topic.

Earthquakes are frequent in Turkey. In Turkey, interior earthquakes tend to be more devastating than coastal ones. Because of the movement of the Arab and African continental plates, the majority of earthquakes are located along the North Anatolian fault, East Anatolian fault, Northeast Anatolian fault, and Western Anatolian fault. Numerous buildings sustain significant damage because they are not designed for these circumstances. For materials to withstand motions without experiencing significant structural flaws, they must possess flexibility.

2. Earthquakes and the urbanization process

Another endogenous phenomena that has a detrimental impact on building is an earthquake. Despite its size and intimate relationship to tectonic changes, it merits particular study. There is a build-up of energy underneath the surface that will be unleashed, along with the ability to go beyond one's

physical limitations. There may be variations in the epicenter of the earthquake. We differentiate between shallow and deep earthquakes based on that.

Tectonic activity is the primary source of the most devastating and extensive earthquakes. They do not have the same strength and scope as tectonic earthquakes, but they may also be triggered by volcanic activity. An earthquake brought on by the collapse of subterranean caverns, such those found in karst regions, is the least common scenario. There are earthquakes caused by humans in addition to those that occur naturally.

Understanding natural earthquakes and other endogenous processes as a part of our planet that we have no control over is essential. In every place that is vulnerable to earthquakes, it is important to consider the development of earthquake monitoring techniques, expand one's understanding of seismic dynamics, and create new design components that won't seriously harm people or property. The underlying strata also influence how strong secondary impacts are on structures. Certain rocks are better at absorbing shock energy.

The chapter on earthquakes caused by humans is a distinct one and is not included in the category of endogenous processes since this topic has been covered in previous publications. For the purpose of determining whether the study region is suitable for constructing foundations, information about the possible danger of earthquakes is required. Because the effects of earthquakes vary depending on the kind of rock, it is important to understand the local engineering geology and geomorphology in terms of landslide susceptibility and other factors. The building's height and location within the landscape both have a significant impact on the material's ability to absorb seismic energy.

Bird et al.'s paper presents the phenomenon of soil liquefaction caused by earthquakes. Place-to-place variations exist in risks. It is important to delineate the domains of risk and susceptibility of the several building components. Accurate assessments of the catastrophic effects in liquefaction-prone locations may lead to appropriate actions and perhaps benefit insurance companies and other organizations. It is not possible to accept earthquake loss models at face value worldwide. Since every place is unique, it is crucial to base this discussion mostly on case studies of particular individuals. A dispassionate assessment of geotechnics is crucial. Enough representative input data serves as the foundation. Major damage is often caused in a very limited region by soil liquefaction.

One way to define soil liquefaction is the abrupt change of soil properties from solid to liquid. Liquification is a possibility for fine-grained soils. Mostly, they are sands. When the degree of saturation equals 1, the soil is saturated with water.

As a result of liquefaction and water, the pressure within the pores rises, making the grains lighter. The so-called sensitive clays are also liquefiable. They often have a high compressibility and a limited bearing capacity.

The disastrous impacts of earthquakes on structures in Turkey are discussed in Kirac et al. (2011)'s paper, which also tackles the topic of acceptable construction materials. Many locations employ design components completely inappropriately. This is particularly true when weak storeys are being constructed. These simple stories are often used as garages, retail spaces, and offices. These structures often have more stiff levels above ground than their foundations. The authors Celep et al. also report another case study from Turkey.

An earthquake in Turkey's Elazik region resulted in significant damage to buildings' concrete walls, the total collapse of many structures, and fatalities. One of Turkey's seismically active areas is Elazik. It is situated almost where the north Anatolian fault and the Anatolian fault meet at the northeastern end of the Anatolian fault. Unsuitable construction materials are not earthquake-resistant. In addition to contributing to destructive acts, landslides and rock falls in hilly locations were other harmful results. The majority of the rocks in the region are sedimentary, magmatic, and metamorphosed.

3. The impact of volcanic activity on urbanization

Tectonic activity and volcanic activity are mostly correlated. One issue with this factor is that it is so large that each component requires special attention. Volcanic activity may be anticipated, particularly on the margins of tectonic plates, as accompanying phenomena are particularly tectonic activity. Volcanic activity may cause landslides, fires, earthquakes, or a shift in terrain. It can also result in the destruction of structures. A characteristic of volcanic activity is the magma that rises to the surface. A silicate melt of a potentially different kind is called magma. It might be either alkaline magma with a much greater viscosity and therefore a larger flow rate, or acidic magma with a low viscosity. Without rising to the surface, magma may enter weak spots in the crust of the planet. As a result, different-sized and shaped magma masses are formed. Following our departure from the surface of the planet, we discuss volcanic activity. Lava may flow or appear as pyroclastic material, which is a mixture of disgorged lava and nearby rock fragments. Additionally, the production of gaseous materials, geysers, and thermal springs are correlated with volcanic activity.

Volcanic activity is not a global phenomenon; it only occurs in a relatively small region. However, the effects of volcanic activity are disastrous in the impacted regions. It is often connected to human death.

Volcano activity is beyond our control. Nonetheless, careful assessment and close observation of potentially dangerous locations are essential. Geophysical techniques, seismic stations that record surface variations via remote sensing, thermometry, geodetic techniques, and several more ways may all be used for monitoring.

Given how complicated the process of predicting volcanic activity is, it is critical to continuously improve it. Building foundations in these regions should be kept to a minimum due to the limits of security measures and warnings against this phenomenon. A few of the volcanic soils contain naturally occurring thermal springs or are very fruitful. Therefore, not all effects of volcanic activity

are bad, and humans might even benefit from them.

Building barriers against lava flows may be one way to lessen the harmful impacts of volcanic activity. In order to use volcanic rocks as foundation soil, we must first describe their mechanical and physical characteristics. Del Potro and Hürlimann discuss characteristic features of volcanic rocks that are easily accessible in landslide sites.

There are four geotechnical classifications for volcanic material. These include pyroclastic rocks, volcanic soils, autoclastic breccias, and lavas. The many types of volcanic soils are: cohesive soils, low cohesive soils, autoclastic breccia, fresh highly welded pyroclastic rocks, severely altered and welded pyroclastic rocks, weakly welded and/or interlocking pyroclastic rocks. It was found that the weakest and most prone to landslides soils were volcanic soils. They belong to the cohesive and non-cohesive rock types and have a low tensile strength. It is difficult to ascertain these materials' characteristics. Often, outcrops are located in remote areas or on very steep, difficult-to-access slopes. For a deeper knowledge of volcanic materials as foundation soils, it is essential to standardize the geotechnical categorization of these materials.

The characteristics of foundation soils in volcanic regions are greatly impacted by the topography and climate. Kawamura and Miura released a paper on the characteristics of volcanic soils in cold climates. Soil deformation and leaking may be caused by precipitation, freezing, and thawing. If this happens on a slope, it results in collapse and landslides.

The only way to comprehend volcanic activity is to think about active volcanoes. There are several locations across the globe with remnants of volcanic activity devoid of any volcanic threat. We may concentrate on the volcanic bodies in these regions only in terms of the underlying soil. For instance, these regions are found in the Czech Republic. Among them is the region of the Central Mountains of Czechia. The region was covered with quaternary sediments, mostly loess, and the effect of erosion activities modeled the topography with the loss of less solid rocks. It's easy to see landslides on the steep slopes of extinct volcanoes.

4. Conclusions

Man cannot influence a number of things that occur on Earth. Endogenous processes are one kind of them. Numerous additional phenomena are entangled with endogenous processes, and these phenomena adversely affect the condition of the underlying soil and building structures. The most powerful geodynamic phenomena is represented by tectonic movements. The borders of lithospheric plates are primarily the most susceptible places. In particular, subsidence, landslides, erosion, earthquakes, volcanoes, tsunamis, waterlogging, and flooded regions are the indirect effects of tectonic processes.

Earthquakes and tectonic processes are related to each other. Seismic waves propagate as a result of the release of stored energy. In addition to their tectonic origin, naturally occurring earthquakes may result from the collapse of subterranean caverns or volcanic activity. Human activity may potentially

take the place of the formation's natural genesis. We refer to this as technical seismicity. earthquakes' destructive power, but also the characteristics of the underlying strata and the kinds and locations of structural components in the landscape. Volcanic activity was one of the endogenous processes. It is intimately related to seismic activity and plate tectonics. When magma seeps through the earth's crust, it reaches the surface and endangers the surrounding area. Its makeup determines its qualities.

Although this occurrence is limited to a certain location, it has very harmful effects. Villages are often found in high-risk regions close to active volcanoes, which may result in fatalities in the event of an eruption. In these situations, more careful observation and foresight are required. Building damage and variations in terrain are secondary signs of volcanic activity. Earthquakes, landslides, and fires may also occur in conjunction with volcanic activity. Alongside the existence of volcanic activity, other natural phenomena such as thermal springs and geysers also develop and may have beneficial impacts on people. Volcanic soils have high levels of fertility. Understanding the many kinds of foundation soils, their hazards, and the creation of new technologies all depend on our ability to comprehend the other components and how they interact with one another. These variables include just a portion of endogenous processes.

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