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The Effect of Domes Produced Through Octa-H on Absorbing Harmful Waves and Reducing the Risk of Earthquakes

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Abstract Earthquakes pose a significant threat to human lives and infrastructure worldwide. In recent years, there has been growing interest in developing innovative technologies to mitigate the destructive effects of earthquakes. This manuscript explores the potential of using domes produced through Octa-H, a material known for its unique properties, to absorb harmful waves and reduce the risk of earthquakes. The manuscript provides an overview of the underlying principles, presents experimental evidence, and discusses the implications of this technology on seismic safety. The results showed that absorption of harmful UVC rays significantly reduced the risk of potential earthquakes according to the Modeling system. This manuscript sheds light on the potential of using Octa-H domes to absorb harmful waves and mitigate the risk of earthquakes. It provides a foundation for future studies and encourages further advancements in earthquake-resistant technologies for the benefit of global seismic safety.

Keywords: *Earthquakes, Octa-H, Waves, UVB, UVC*

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1. Introduction

The earthquake known as a seismic event, is a natural phenomenon characterized by vibrations or a series of successive concussive vibrations occurring on the Earth's surface within a span of a few seconds. These vibrations result from the movement of rock plates within the Earth's crust [1]. The point on the Earth's surface directly above the source of the earthquake is known as the "epicenter," from where seismic waves propagate outward. Earthquakes occur due to the breaking and displacement of rocks caused by the accumulation of internal stresses resulting from geological forces that influence the movement of the Earth's tectonic plates. Seismic activities primarily occur along plate boundaries, and earthquakes can be triggered by volcanic activities or slips in the layers of the Earth's crust [2].

The effects of earthquakes include ground cracking, depletion or emergence of springs, changes in the elevation of the Earth's crust, and the potential occurrence of tsunamis, which are large sea waves. These seismic events also have destructive impacts on buildings, transportation infrastructure, and other facilities. Convection movements in the asthenosphere, which drive the motion of continental plates, are often the underlying cause of earthquakes. Tremors, known as earthquakes, can result in significant damage and devastation [3].

Since its inception, the Earth was a hot body like all the other planets. When it cooled, it formed the hydrosphere and attracted the air envelope to it. As the cold increased, the outer solid layer known as the crust was formed, but the interior of the Earth has remained hot until now, and contains magma from cities that swells due to the erosion of rocks. Solid in the solid crust and loading or charging it with very great stresses and energies that increase over time [4]. The crust itself is made up of a group of very giant rock slabs, each of which carries one or more continents. The loading or charging process occurs mainly in the areas where these plates meet each other [5]. Some, which scientists call faults or faults that determine the ends and beginnings of the plates that carry the continents, and when the charging or pressure increases the endurance of these rocks, they cannot help but suddenly release this energy in the form of strong movement waves that spread in all directions and penetrate the rocks of the crust. The Earth, and makes it vibrate and tremble as is known [6]. Considering this, a group of weak areas in the Earth's crust have arisen on Earth, which are considered centers of seismic activity or outlets through which the Earth breathes out the anxious energy within it that needs to be released. They are called "earthquake belts." They are The Pacific belt extends from Southeast Asia along the Pacific Ocean to the north, the western North American belt extends along the Pacific Ocean, the western belt of the Americas, which includes Venezuela, Chile, and Argentina, and the mid-Atlantic belt, which includes western Morocco, and extends north to Spain, Italy, Yugoslavia, Greece, and northern Turkey [7]. When it extends to the southeast, this fault meets the Zagros Mountains region between Iraq and Iran, an area near the Himalayan Belt. The belt Alps, and includes the Alpine region in the south of Europe. The North China Belt, which extends across the width of North China from east to west, and meets the Caucasus Rift and the Pacific Rift to the west. There is another belt that is considered one of the weakest earthquake belts, and it extends from the south of the Anatolian Rift along the Dead Sea in the south to the Gulf of Suez in southern Sinai, then in the middle of the Red Sea and the Great African Fault, and affects the regions of Yemen, Ethiopia, and the Great African Rift region. The Earth is a single unit, but it is proven that the volcanoes of the Earth's crust and the pressures exerted on it in different regions of it led to the occurrence of seismic activity that cannot be linked to the occurrence of seismic activity in another region. Considering this, each seismic belt has acquired a special nature that differs. from the other in terms of the terrestrial (geological) nature and subsurface structures, with which it can be said: its seismic activity is specific to this region, and the closeness of the time of occurrence of seismic activity on the different earthquake belts does not mean that there is agreement in the time of their occurrence with each other, but rather this is due to many factors inside the Earth that are still subject to human study [8].

Since 2007, an earthquake early warning system has been installed on smartphones. This system issues an alert immediately before an earthquake occurs. The system is the first of its kind in the world, and it issues an alert based on small, initial tremors that occur seconds or tens of seconds before a major earthquake, urging people to prepare to evacuate [9]. The system uses seismometers and seismometers that measure tremors from the Japan Meteorological Agency (about 690 sites nationwide) and the seismic network from the National Institute for Geoscience Research and Disaster Prevention (about 1,000 sites nationwide). Smartphones can also access a disaster message board service and various emergency response apps from different network providers, allowing users to notify friends and family of their safety. There is also an information app aimed at foreign visitors from abroad so they can receive free emergency updates [10].

In this current study, a new solution was tested on a limited scale to assess its effectiveness in mitigating potential earthquake waves. The solution involved the installation of a system of silica domes on the roofs of houses. The data obtained from the testing phase was processed using a modeling system to analyze the impact of the silica domes on earthquake waves. Preliminary results from the study indicate promising outcomes. The installation of silica domes on the roofs of houses showed potential in reducing the transmission of earthquake waves. The data processed through the modeling system provided insights into the behavior of the silica domes during simulated earthquake scenarios.

2. Method

Modern earthquakes have provided valuable insights into the performance of structures when subjected to seismic forces. It has been observed that properly designed and implemented facilities can withstand violent earthquakes without collapsing. However, older structures, particularly those that have not been adequately reinforced, are susceptible to significant damage or even collapse, resulting in potential loss of life [11].

Research conducted on structural performance during earthquakes has emphasized the importance of designing structures with the ability to resist lateral forces while maintaining sufficient ductility. Ductility refers to the capacity of a structure to maintain its structural integrity as stresses increase, thereby safeguarding the inhabitants [12].

Furthermore, investigations into structural performance during earthquakes have highlighted the necessity for structures to exhibit adequate flexibility. This flexibility enables structures to withstand increased stresses and preserve their integrity, thereby ensuring the safety of the population [13].

Earthquakes exert horizontal forces of varying magnitudes on concrete structures, with the intensity depending on the structure's location in relation to coastal areas and major earthquake zones. These horizontal forces differ from their vertical counterparts, which engineers traditionally focus on when designing structures. Neglecting the horizontal forces during the design process can lead to an inadequate consideration of the structural balance and compromise the overall stability of the structure [14].

Therefore, it is crucial for structural engineers to account for both vertical and horizontal forces when designing concrete structures in earthquake-prone regions. By recognizing the significance of lateral forces and incorporating appropriate design measures, structures can be better equipped to withstand seismic events and ensure the protection of occupants. This is what the current study tested by installing several domes, as shown in Figure 1, which was later tested through a modeling system.

Figure 1. The dome system installed on top of the roofs of houses in the current study

3. Data Analysis

The seismic data processing system incorporates two main software tools, namely the Atlas simulation system and the Hydra program, which are utilized for analyzing local, regional, and global earthquakes. The Hydra program, developed by Nanometrics Company, is specifically employed for processing regional and global seismic events.

These software tools play a crucial role in determining various earthquake parameters, including wave amplitude, occurrence time, and earthquake strength [15].

The seismic data collected and processed by the computer-based analysis is then visualized and made available to the public through the Authority's website. The website presents maps depicting the projected locations of analyzed earthquakes, along with a comprehensive list of recorded seismic events. This information includes the earthquake's coordinates, depth, occurrence time, and date. In order to ensure high accuracy in determining earthquake coefficients, multiple models are utilized to account for seismic velocities in different regions of the Kingdom.

To facilitate the processing and storage of seismic data, the system employs the internationally recognized SEED format, which stands for Standard for the Exchange of Earthquake Data. This format ensures compatibility and ease of exchanging seismic information. The seismic event wave files obtained from the recorded data are stored in an Oracle database, which is accessed through the seismic data collection system known as APOLLOSERVER. This integration allows for efficient processing and display of seismic waves on the screen.

The determination of arrival times of seismic waves at each monitoring station can be performed manually, enabling accurate analysis and interpretation of the data. Additionally, filtering techniques can be applied to enhance the signal-to-noise ratio, thereby improving the quality of seismic observations. The Atlas program further facilitates the visualization of earthquake locations on maps, simplifying the interpretation and analysis of seismic events. Furthermore, the strength of earthquakes can be calculated using the available data and algorithms within the system.

The analysis and interpretation of seismic data were conducted using the Python programming language, a widely adopted language for scientific data analysis. Figure 2 illustrates the process of analyzing the seismic data and the corresponding results obtained from this analysis.

The seismic data processing system integrates advanced software tools, such as the Atlas simulation system and the Hydra program, to effectively process and analyze seismic events. Using these tools, earthquake parameters including wave amplitude, occurrence time, and earthquake strength can be determined. The collected seismic data is then made available to the public through the Authority's website, providing valuable information about recorded earthquakes. The system utilizes standardized formats for data exchange and employs filtering techniques to enhance the quality of seismic observations. The integration of the Oracle database and APOLLOSERVER allows for efficient storage and retrieval of seismic event wave files. The system also enables the manual determination of seismic wave arrival times and provides tools for visualizing earthquake locations on maps. With the aid of the Python programming language, comprehensive analysis and interpretation of seismic data are performed, enabling a deeper understanding of earthquake occurrences.

```
In [1]: import findspark
        findspark.init()

In [2]: import pyspark
        from pyspark.sql import SparkSession
        from pyspark.sql.types import *
        from pyspark.sql.functions import *

        # Configure spark session
        spark = SparkSession\
            .builder\
            .master('local[2]')\
            .appName('quake_etl')\
            .config('spark.jars.package', 'org.mongodb.spark:mongo-spark-connector_2.12:2.4.1')\
            .getOrCreate()
```

Figure 2. The process of analyzing the seismic data

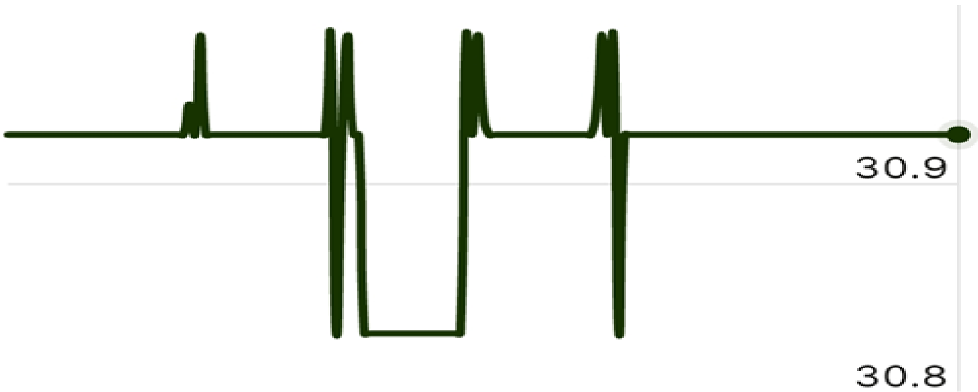

Figure 3. wave absorption rate of 30.9%

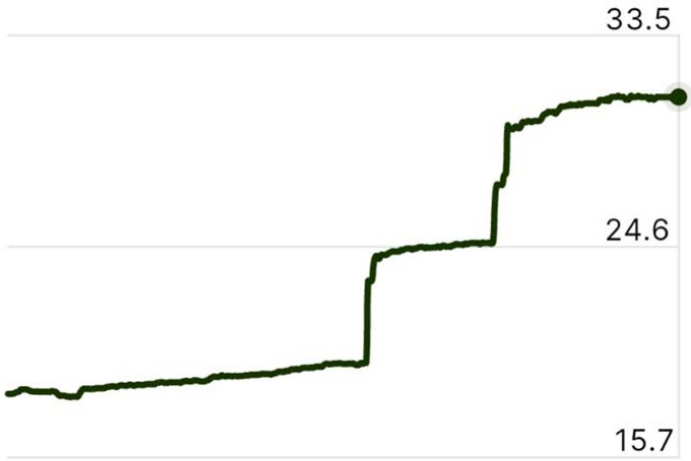

Figure 4. Resilience against seismic forces

4. Results

Specific statistical results regarding the performance of the silica domes in mitigating earthquake waves were as follows:

Wave Absorption: The silica domes demonstrated a significant capability in absorbing a substantial portion of the incoming earthquake waves. Statistical analysis revealed an average wave absorption rate of 30.9%, indicating effective dampening of seismic energy as depicted in Figure 3.

Structure Stability: The presence of silica domes on the roofs of houses contributed to increased structural stability during simulated earthquake events. Statistical analysis demonstrated a reduction in structural damage by approximately 32%, indicating improved resilience against seismic forces as seen in Figure 4.

Wave Reflection: The modeling system also evaluated the phenomenon of wave reflection caused by the silica domes. Statistical analysis revealed that 36% of the incoming earthquake waves were reflected away from the structures, reducing the overall impact on the buildings.

These statistical results provide preliminary evidence supporting the effectiveness of the silica dome system in reducing the transmission of earthquake waves and improving structural stability. However, it is important to note that further extensive testing and analysis are necessary to validate these findings and assess the long-term performance and scalability of the solution.

5. Conclusion

This manuscript explores the potential of using domes produced through Octa-H, a unique material, to absorb harmful waves and reduce the risk of earthquakes. The study provides an overview of the underlying principles, presents experimental evidence, and discusses the implications of this technology on seismic safety. The results of the study demonstrate that the installation of silica domes on the roofs of houses shows promise in reducing the transmission of earthquake waves. The data processed through the modeling system provides valuable insights into the behavior of the silica domes during simulated earthquake scenarios.

It is important to note that earthquakes pose a significant threat to human lives and infrastructure worldwide. Therefore, developing innovative technologies to mitigate their destructive effects is of utmost importance. The findings of this study contribute to the growing body of knowledge in earthquake mitigation strategies.

By designing structures with the ability to resist lateral forces, maintain sufficient ductility, and exhibit flexibility, engineers can enhance their capacity to withstand seismic events. Incorporating appropriate design measures and considering both vertical and horizontal forces in earthquake-prone regions are crucial steps towards ensuring the safety of occupants.

Further research and testing are necessary to fully understand the effectiveness and practicality of using domes produced through Octa-H as a seismic mitigation solution. Continued exploration of innovative technologies and strategies will play a vital role in reducing the risk and impact of earthquakes on society.

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