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Providing a method for seismic rehabilitation based on the results obtained from analysis of historical places

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ABSTRACT

Nowadays, various methods are used for seismic rehabilitation in the world. In this regard, a research derived from analysis of Historical places and basic physics rules was led to a method that created seismic rehabilitation in structures with the cheapest and most abundant materials (the best and most economical of it is building materials). The overall strategy is based on this that, waves instead of penetrating into the structure cross its structure with executive tricks and return to the ground. In fact, it returns the force generated by the waves to the ground itself (which is the source of the earthquake waves). This method is briefly called parasite on earthquake waves. The process is generally such that the common point for presenting a new building system is investigated by having a general strategy and reverse analysis of Historical places. At the end, after analyzing the Historical places monument and performing tests on its replica and comparing it with other replicas, it was concluded that this monument has used this strategy for its seismic rehabilitation.

1. INTRODUCTION

As you know, there are four types of earthquakes: S, P, Love and Rayleigh waves that the motion of two types of S and Rayleigh waves is a perpendicular motion and two other types is horizontal motion (Figure 1) [8]

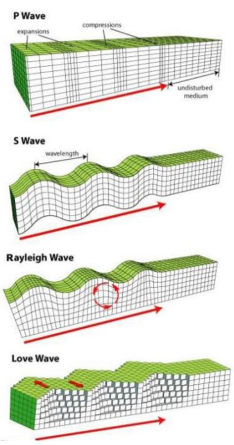

Figure 1. Types of earthquake waves

Various inventions have been taken place to separate buildings from earthquake oscillations. Since the impact of an earthquake on a building depends on the soil type and structural properties of the building, design for earthquake is a complex part of the theory of structures. Only in the last few years, adequate information on earthquake motions and dynamic properties of buildings has been obtained and the possibility of reliable design based on earthquake has been provided. Despite their capabilities, they still have limitations and shortcomings. One of these methods is the separation method; the good intention of seismic separation method is simplicity of its theory. Imagine a building built on a ball bearing. At the time of the earthquake, the building remains almost still and immobile. Because of the earthquake waves, it is only the foundation of the building that is strongly moving with the ground. Rolling ball bearing modulates the relative motions between the superstructure part of the structure and the ground. Of course, vertical separation is also required for the overall performance of the building against vertical vibrations [3].

Although, this method seems interesting and convincing perceptually as well as it has a surprising successful record and of course, limit but seismic separation method cannot be prescribed as a medicine for all seismic diseases. The following considerations limit the applicability of this method:

• Flexible buildings, which generally have more than ten floors height and natural vibration alternation time more than 0.1 second, may not sufficiently benefit from changing their alternation time between 0.2 and 0.3 seconds.

• Sites located on the bed of deep accumulations of soft soil have long vibration alternation time and a separation system with similar alternation time can lead to resonance.

• In dense urban sites, horizontal wide seams that provide the possibility of relative motions between the superstructure part of the building and the foundation are about 400 mm that lead to the loss of a part of the useful underlying surface in the building.

• In general, the initial cost of a separate seismic building is a percentage higher than the cost of a building connected to ground, but as Ron Mayes points out, if the employer decide to take a position against earthquake insurance and not to accept it, the income from non-paying additional annual premiums and saving and using them for investing can compensate the cost of the seismic separation system in return period between 3 to 7 years. When a devastating earthquake occurs, the costs caused by non-working that may be uninsured have any initial

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cost considerations, especially if the building contents have a significant financial value.

• Some current regulations still have a conservative approach to the system, which has rarely been tested in real buildings. They limit the potential benefits of the system and undermine the enthusiasm of designers to use it. These regulations have this effect by requiring investigations and testing procedures and extensive and exhausting analysis [3].

Another common way used to deal with earthquake waves is to lighten buildings with light materials that it is due to the famous Newton's formula, which is as follows:

$$\vec{F} = m\vec{a}$$

In fact, according to this formula, the more the weight of the building is greater, the more force is on it from earthquake waves. And so they build buildings light that have advantages and disadvantages. However, the purpose of this article is to present a method separate from existing methods.

2. RESEARCH METHODOLOGY

In this method, the material of substructure (if it is soil, soil to be used, and if it is rock, rock to be used) is used as the main material of the structure for wave transfer from ground to structure and again from structure to ground. The reason for this issue is one of the principles of physics in the field of waves and states that when the material of environment or the material of transferring wave changes, the velocity of the wave changes and consequently its direction changes (the law of wave refraction (that follows Snell's law))

According to the principle mentioned when material of building is from the bed materials of structure, the wave does not divert and the structure acts seamlessly, this integration results in a better response to earthquake waves (which nowadays, scientists state it in another way). [7].

According to research, the best types of arches for these types of integrated monuments are:
1- Arch to be 4-center

2- Arches to be close to the 4 center arch of steep 5-O seven (the best type of 4-center arch).

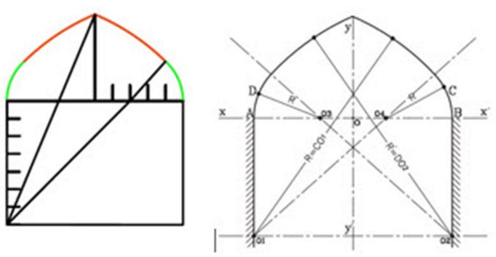

Figure 2. drawing the shape of the 4-center arch (left) and the steep 5-O seven (right)

According to the hypothesis, when one of the types of vertical waves reaches to building, vertical force is applied that reaches the primary arc through the base of the arch and then the secondary arc and when it shakes the two arcs (due to their elasticity of arcs), it reflects the waves, contrary to the vertical force applied to the arch (Figs 2-5). Reflected waves from the primary arc produce a secondary wave that has a vertical force against the vertical wave force. The points on the column are the abdominal points and the peak of the wave produced.

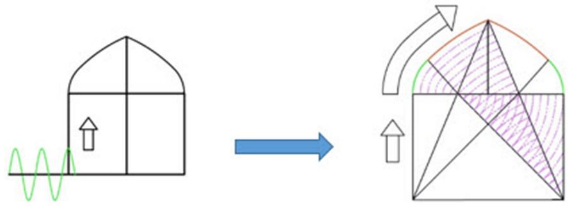

Figure 3. Reflection of waves

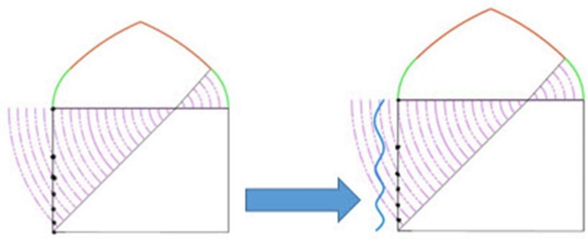

Figure 4. Reflected waves from the primary arc

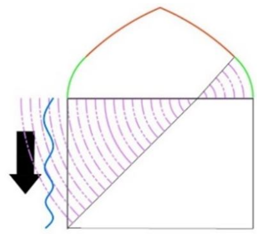

Figure 5. Wave direction

It should be noted that if the wave emitted at the first arc is placed on a spiral on both sides of arch, the earthquake recursive wave is rotated in three dimensions, which results in a confrontation with vertical and horizontal forces. In fact, by this method, it is counteracted with all four types of earthquake waves (Figure 6).

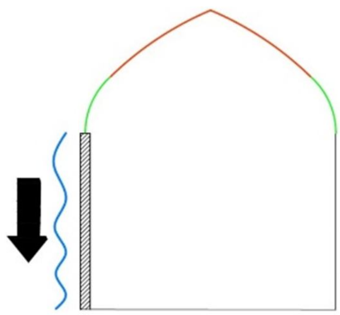

Figure 6. Twisted column

According to the documentation, this method has been used in some of the traditional architecture, such as the Vakil Mosque. It is noteworthy that this mosque is located in 8 km from the earthquake fault (Figure 7).

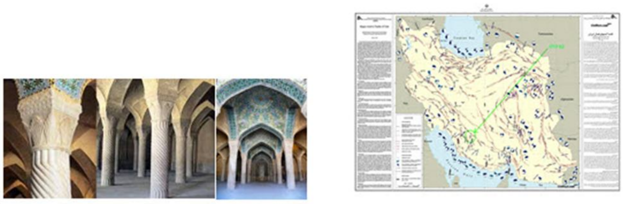

Figure 7. Columns of Vakil Mosque of Shiraz and its distance from earthquake fault

Today, scholars have found the reason of this issue and consider the reason of the spiral columns the increase of their elasticity (AGENCY, 2013). Now we reach to the wave emitted by the second arc: The wave emitted by the second arc is easily removed from the building (Fig. 8):

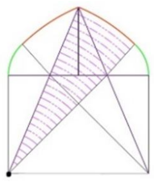

Figure 8. Wave emitted from the second arc

The reflected waves from the second arc are concentrated beneath the base of the arc, so-called its power in the building is subtracted and transferred its power to the earth.

If we want to resemble this arch method in nature and in our daily lives, we have to resemble it with a loudspeaker that takes the waves emitted from the earth by its two bases and reflects the same waves again to the surface; It reflects the same signal when it is given a signal.

It may be hard to believe that an integrated clay monument (mortar material is from its own type, such as mud) can withstand against earthquake, because structures in many parts of the world have been damaged by earthquake a lot. It is important to note that this method has several changes to these types of buildings:

1. The demolished masonry structures are built of mortar material other than the main material of structure, which results in the wave breaking in building and the building doesn't function seamlessly.
2. The type of arch used in building has not been ideal in this regard.

2.1. Confronting with earthquake horizontal waves

The waves p and love are waves that move horizontally. Various methods can be used to counteract these waves, such as:

1- Filature of the arches [5]
2- Using the buttress [5]
3. Using sand aeolian as suggested by researchers and engineers 10 cm below the foundation [4].

The important point is that, in the first two methods, they must be applied in a way that to have the least interference in the integrated structure so that the wave in the structure (due to another material in the structure) not to be redirected.

About the third factor mentioned, it should be noted that this factor causes lateral movement of the structure and produces a response similar to seismic separators.

2.2. Historical places

Perhaps the most important example in this regard and may help the hypothesis of this study is the monument of Historical places, the initial construction of this interesting and unique monument is related to the last 700 years. It has two vibrant circular minarets with 7.5 meters high; they are placed in distance of 9.2 meters from each other and 10 meters high above a monument. When one of the minarets is vibrated by a person, the next minaret begins to vibrate immediately, though a significant vibration is transferred to other parts of the structure. This unique function has become a mystery for architectural and structural engineers over the years. Visitors from all over the world will automatically vibrate the next minaret by climbing on top of one of the minarets and shaking it [6]. According to the research and analysis, this method has been used in the construction of Historical places. (Figure 9)

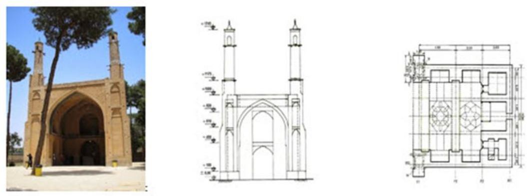

Figure 9. Characteristics of Historical places

According to the investigations, the type of arch used in this building consists of the following arcs (Fig. 10):

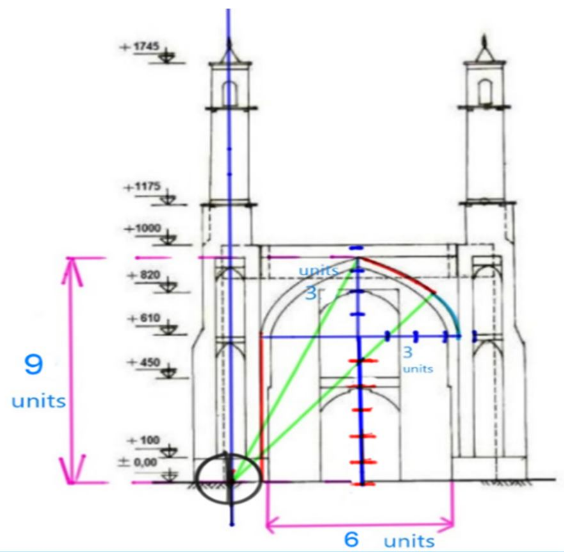

Figure 10. Analysis of the porch arch of Historical places

According to the figure, the center of the red arc is located in the middle of the minaret (below it) (the blue line is passed from the middle of the minaret). This issue results in more vibration in the two lateral pillars of arches and eventually the minarets and the building of Historical places has more vibration. The analyzed arch of Historical places is composed of 9 units in 6 units and its second arc (turquoise arc) is away from the outer part of the arch in amount of 3 units. The height and width of both pairs of arcs is 3 by 3 units, which actually creates a square in the upper part of Historical places that provides a relatively good stability (due to the square formation). It should be noted that in Fig. 11, as you can see, when an arc (by default from building materials) is shaken, it concentrates the maximum waves produced from the minarets (based on the elasticity of the building materials) at the center of the hypothetical circle. But only a small amount of the waves are reflected due to contact with arc, and as you can see in the figure, the designer of Historical places (Sheikh Baha'i) directs the reflected waves on the minarets in a targeted manner to create the most vibration in the building (Figure 11).

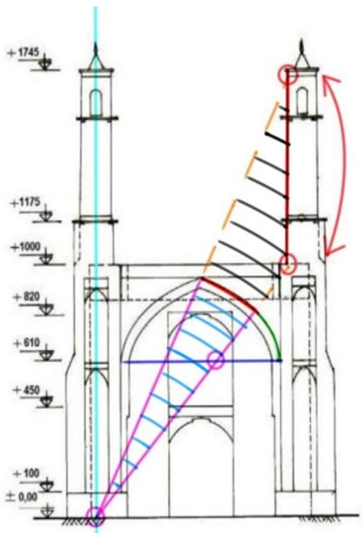

Figure 11. Waves removed from the arcs

The plan of Historical places separated from the porch is as the square, which is more resistant to the artificial seismic created in the structure (Figure 12).

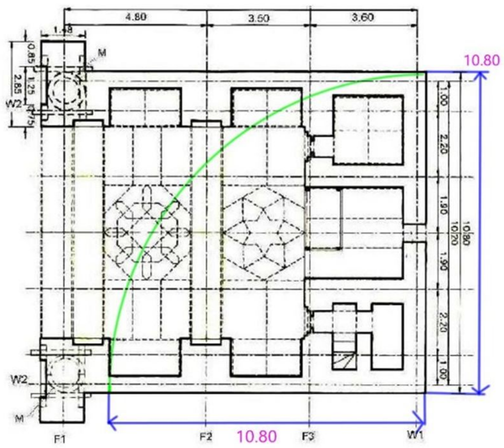

Figure 12. Square form of the Historical places plan

According to experiments conducted by researchers, the cause of vibration the minarets are considered as a diapason or a pendulum [6]. But according to research conducted, it is likely that the type of porch arch and its sections transmit this artificial vibration to the entire structure and especially to the minarets. In fact, it can be said that the role of a thread that connects the two spheres in the pendulum plays the porch arc. According to the research, the architect may have intended to show a kind of artificial earthquake to prove that these structures are resistant to this type of arch. It is noteworthy that even today these types of integrated buildings (which are also similar to the underground material) cannot be evaluated in earthquake simulator systems because the material of under surface is not the same as the material of building that is from mud dried. The best method to prove it, according to research is the method of creating an artificial earthquake from the material of the structure itself that is observed in Historical places well.

Surveys show that the proportions in the Historical places (eg the ratio of the height of the minarets to the width of the building) follow the golden proportions (Figure 13):

$$\frac{1745}{1080} = 1.615 \sim 1.618$$

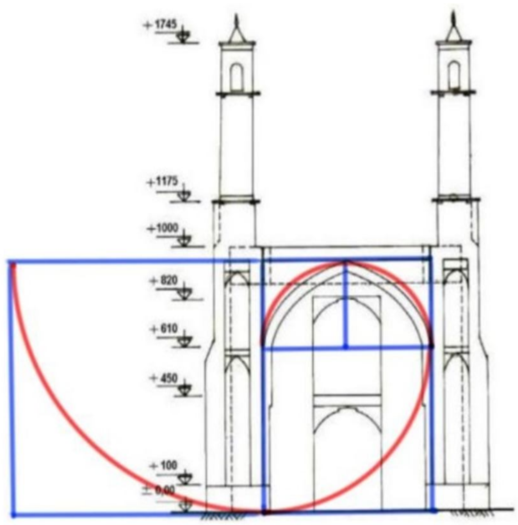

Figure 13. Golden proportion in the porch arch of Historical places

Another point according to the analysis is that the arch proportions follow the Fibonacci spiral. These golden proportions, and consequently the Fibonacci spiral obtain a series of information that the subsequent analysis is formed (derived from the laws of physics) and the amount of load on the roof and earthquake tolerated is obtained as follows:

We used a general strategy to obtain the load tolerated on the roof of these types of structures: "All roof load should be transferred to the columns on both sides of the arch." This strategy depends solely on the type of arch that is created between the two spans. To obtain the type of arc and its properties, we start the basic laws of physics and extend it, for example:

When a ball is released from a certain altitude, it falls with a constant acceleration of gravity. If we put the same ball on a sloping surface, the earth's gravitational acceleration moves downward again, but at a slower acceleration. Now if we do the same thing on an arc that is part of a circle arc, it comes down with variable acceleration. In order to be able to better place the arc load on the columns of two sides of the arc so that the intensity of changes of the velocity has the most amount compared to the acceleration of ball released, we should use an arch that each half of it uses two arcs i.e 4-center arch. Now the question is how much the radius of the arc of circle and its angle are. Assuming this problem, the velocity equation of an accelerated motion by assuming the initial velocity to be zero is as follows:

$$V = tx^2$$

And its derivative is acceleration:

$$a = 2tx$$

The diagrams are as follows (Figure 14).

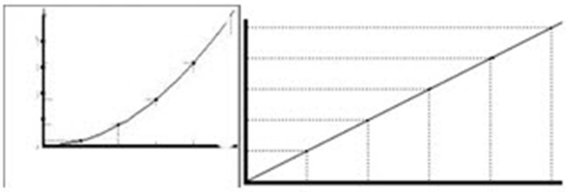

Figure 14. Velocity and acceleration

Now we solve the angle and radius of the arc drawn in the arch:

So far, we have concluded that the best arch for this issue is the 4-center arch but if we extend the second hypothetical arc (in both sides of the arch) as long as the tangent line on the arcs is parallel to ground, we reach two symmetrical points to symmetry line in the center of arch. If we connect them to the ground (vertically), a frame will be formed that the arch around that will have the best performance for bearing load, that cause is the equation discussed earlier. (a= 2tx) because it is precisely at the points that the arcs of other arc are not able to load on the opposite column due to the lack of slope at those points. Perhaps the reason that our ancestors defined for the arch of frame is this issue to specify the arch bearing range (Fig. 15).

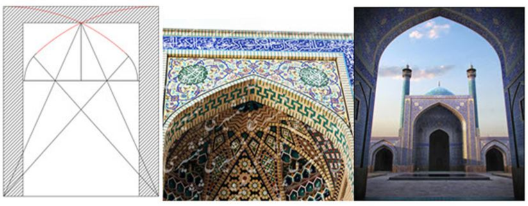

Figure 15. How to form an arch frame

To calculate the angle and radius of the arcs we need to know:

The best proportion between the arch span and the height of the span is 1to 1, i.e, the square form because it will have the best performance against the waves, plus that the proportions of both halves of the arch must also be inscribed in the square, which is due to the same reason of the property of square form, in addition, it will have the ability to hold the load against earthquake waves. It is interesting that if we perform these proportions together, we will achieve exactly the same spiral formed in the proportions of Historical places (Figure 16).

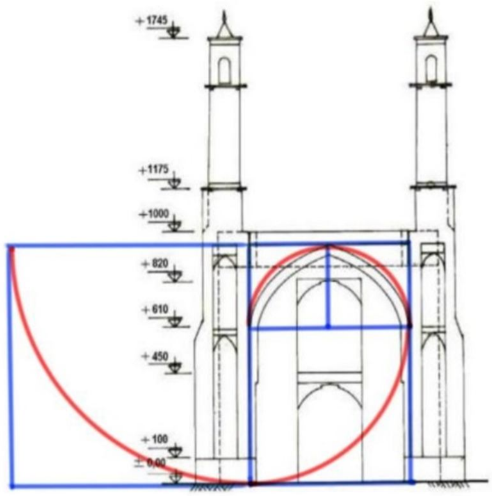

Figure 16. How to form gold proportions in Historical places

Perhaps the architect of Historical places (Sheikh Baha'i) has achieved this golden proportion from these simple equations at that time. After investigating this subject according to the analysis of the Historical places, its span (if we divide it into two halves) is divided into 3 parts and the height of the span divided to 6 parts. We should know that the best segmentation of span and height is the segmentation that follows the first numbers because they do not divide into smaller components, and its execution process will be easier due to the modularity in the design, as our predecessors did in their best arches, such as steep 5-O seven which used divisions of 5 (one side of the span) and 7 parts in height (Fig. 17).

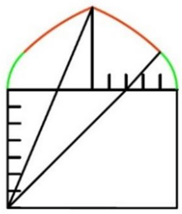

Figure 17. Steep 5-O seven arch

This process has been done in a different way in the arch of Historical places so that the architect has used forms to have the ability of maintaining load against the waves because he has intended to create an artificial earthquake in the building. But in steep 5-O seven arches, the target is more bearing than confronting with the waves and therefore it covers a longer span (5-unit to 3-unit ratio of Historical places arch) and it seems the best structures implemented with traditional materials must follow the structural rules of Historical places to confront earthquake.

Now we use Historical places analysis to obtain the angle of the arcs. According to the analysis, angles 50, 16, 24 have been used and the center of the larger arcs of one unit is placed on the ground line outside the arc, just below the center of the diameter of the minarets and this is because the minarets have greater vibration. As if the architect has no fear of further vibration (Figure 18).

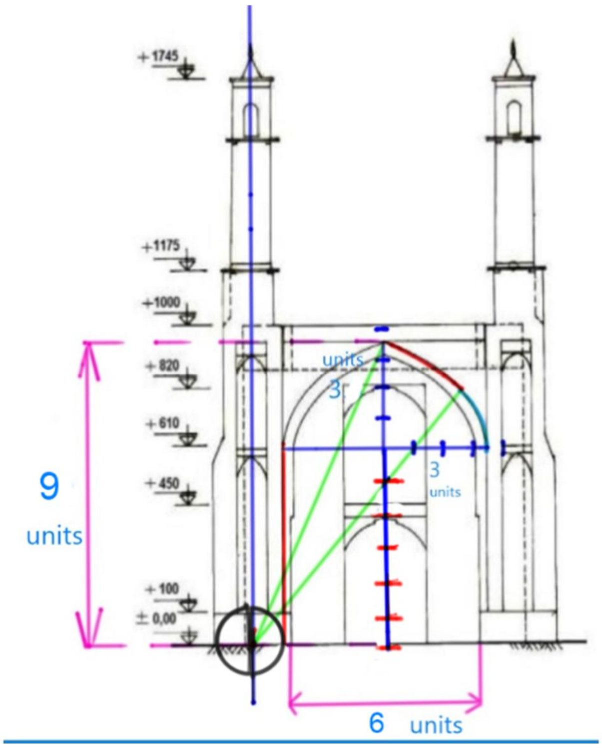

Figure 18. Placing the center of larger arc outside the arch

So, according to these principles, one of the two centers of arcs is placed there, and the second arc is placed with no more than one position, and the center of the arc should be placed in the first partition of the center just like what happened in Historical places. Now, if we connect these lines together, the analyzed angles will be obtained (Figure 19).

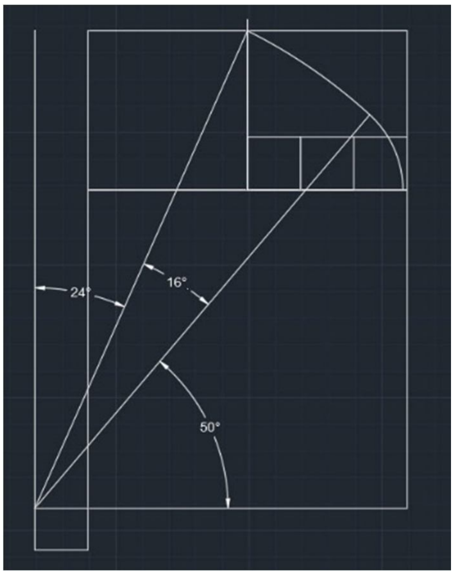

Figure 19. How to form the angles of the arch arc of Historical places

2.3. Calculating the amount of tolerable load by arch

To calculate the amount of load tolerated by the arch, according to the figure, the amount of load specified in the arch frame should be calculated with thickness. According to the figure, the desirable load of the range specified is specified by hachure (Figure 20).

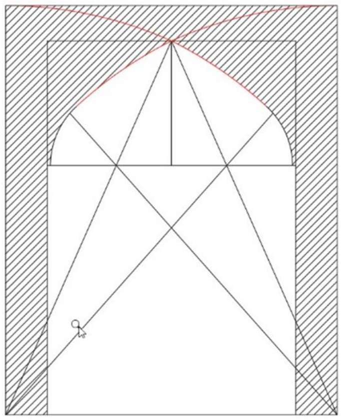

Figure 20. Range of load tolerated by the arch

We use the density equation to calculate it:

$$1{:}\ \iota = \frac{m}{V} \rightarrow m = \iota . V$$

$$2;\ \iota \sim 1500\ (kg/m^3)$$

According to the equation, the mass tolerated by the lower arch is obtained by the product of the density in the volume of the selected range. And calculating the desirable volume in the arch with the thickness is obtained from the following equation (Fig. 21).

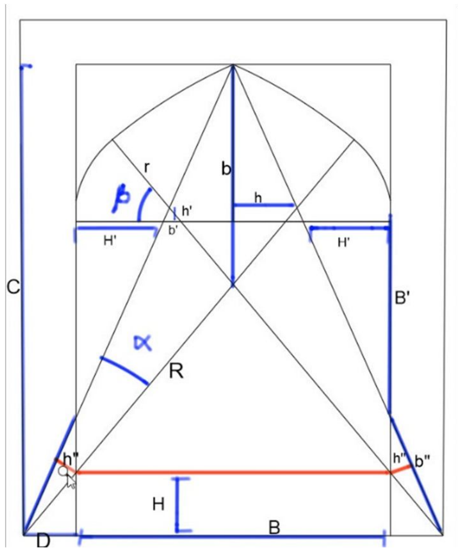

Figure 21. Naming of different parts of the arch

$$3{:}\quad V = v - v' - v"$$

$$4{:}\ v = A.B.a$$

$$5{:}\qquad v' = (H.B) + \left(\frac{H".B}{2}\right) + \left(\frac{2H'.B'}{2}\right) + \left(\frac{2\pi R^2.\alpha}{360}\right) + \left(\frac{2\pi r^2.\beta}{360}\right) - \left(\frac{2b.h}{2}\right) - \left(\frac{2h'.b"}{2}\right) - \left(\frac{2h'.b'}{2}\right)$$

$$6{:}\ v" = D.C$$

$$\rightarrow V = A.B.a - \left((H.B) + \left(\frac{H".B}{2}\right) + \left(\frac{2H'.B'}{2}\right) + \left(\frac{2\pi R^2.\alpha}{360}\right) + \left(\frac{2\pi r^2.\beta}{360}\right) - \left(\frac{2b.h}{2}\right) - \left(\frac{2h'.b"}{2}\right)\right)$$

Finally, the amount of force tolerated:

$$7: \begin{cases} m = \iota.v \\ F = m.g \end{cases} \rightarrow F = \iota.v.g$$

In fact, in this way we form the clay to the clay to be static, ie static. This method has been implemented by Nader Khalili in Goltaftan structures; one of the basic capabilities of it is the unique confronting with earthquake waves.

2.4. Tolerance of seismic waves according to analyzes from Historical places

To confront with the earthquake waves in this style, according to the studies, high weight should be used instead of using low weights in different directions. By default, earthquake forces are applied to all x, y, and z axes. In this regard, the arch itself is used to confront vertical forces as predicted, and to confront horizontal forces, buttress, filature and Aeolian sand is used that buttress and filature is used about Historical places. So that a monument with a square shape on the back of the arch, two buttress on the two sides of the arch, and filature around the minaret. Finally, according to the obtained analysis, the balance among the structural weight force (with the forms obtained from the analysis) should be used to counter the earthquake force in different directions. As:

$$8: F_{\text{Vertical}} = F_{s,Reyleigh} \rightarrow \iota.v.g = F_{s,Reyleigh}$$

$$9: F_{Horizental} = F_{p,love} \rightarrow \iota.v.g = F_{p,love}$$

This equation indicates that the tolerability of the earthquake waves depends on the volume, form, and mass of the structure.

The amount of tolerance of artificial seismic waves in Historical places is obtained with analysis conducted by the International Earthquake Research Institute [1] (Figure 22).

2.5. Tests conducted by the Earthquake Research Institute on the building

The way of arranging the vibration recording sensors and for performing the experiments is shown in Fig. 8 and the results of the experiments are showed in Tables 1, 2 and 3 respectively. {3}

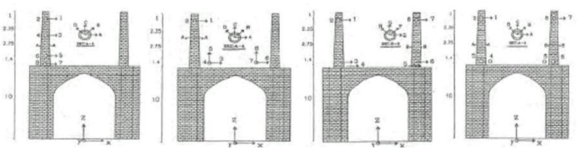

Figure 22. The arrangement of the sensors in the dynamic testing of the first to fourth stages

Table 1. Average vibrational frequency in different directions of stimulation in Hz (first mode)

Vibration direction / Vibration type	A	B	C	D	E	F	C	H
Forced vibration	2.1	2.1	1.8	1.9	2.25	2	1.95	1.85
Free vibration	2.33	2.27	2	2	2.5	2.2	2.25	2.42

Table 2. The ratio of the stimulant amplitude of the next tip to the stimulated tip

Test stage	Test name	ratio of amplitude of the tip		Considerations
Third	TST3 A TST3 B TST3 C TST3 D	1.1 1.2 0.93 1	2.3 8.3 3.2 3.1	Amplitudes are in the direction of Y-axis
	TST3 E TST3 F TST3 G TST3 H	3.1 2.3 2.4 2.1 1.4 1.1 2.7 2		
Fourth	TST4 E TST4 F TST4 G TST4 H	1.9 1.5 1.5 2.4	1.2 1 1 1	Amplitudes are in the direction of x-axis

Table 3. The ratio of the vibration amplitude of the base to the ceiling in the first mode

Test stage	Test name	ratio of amplitude of the tip		Considerations
Third	TST3 A TST3 B TST3 C TST3 D	0.11 0.13 0.7 0.9	0.24 0.24 0.04 0.01	
	TST3 E TST3 F TST3 G TST3 H	0.1 0.23 0.17 0.14	0.26 0.11 0.3 0.38	
Fourth	TST4 E TST4 F TST4 G TST4 H	0.35 0.22 0.25 0.11	0.29 0.09 0.09 0.23	

Analyzes formed in the Abacus software were conducted by other researchers [2] that its vibration rate was consistent with what was previously measured physically. And one of the reasons for this is that the material of Historical places in this software is considered by the designer as micro and similar which the result of test and analysis is obtained more accurately (Figures 23 and 24).

2.6. Modal analysis of whole structures and edging

The values of natural frequency and natural alternate time of the structure in the first 4 modes of vibration after modal analysis in Abaqus software are as Table 8 and Figures 12 to 15. (According to test results)

Table 8. Frequency values and natural alternate time of the first four modes of the structure

Mode number	Frequency (Hz)	Alternate time (sec)
1	**2.212**	**.45**
2	**2.6**	**.38**

3	**2.66**	**.37**
4	**2.686**	**.37**

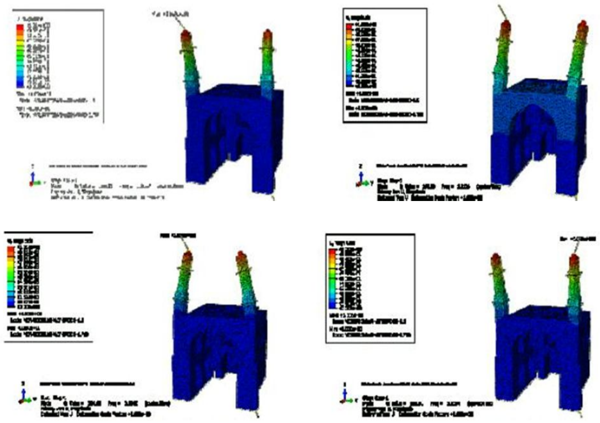

Figure 23. Historical places analysis by Abacus software

2.7. Modal analysis of edging structure

The natural frequency values of the first four modes of the edging Structure after modal analysis in Abaqus software are in accordance with Table 9 and Figures 16 to 19. {10}. (According to test results) (Connection of the Structure to the ceiling is assumed to be clamped.)

Table 9. Natural frequency values and natural alternate time of the first four modes of the edging Structure

Mode number	(Hz) frequency	Alternate time (sec)
1	2.97	33.
2	3.05	32.
3	10.44	1.
4	11.39	08.

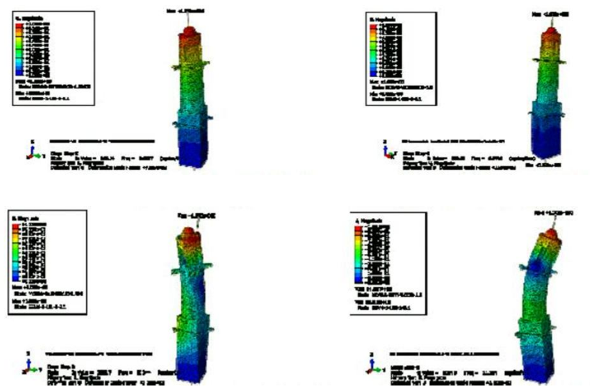

Figure 24. Modal analysis of the edging Structure

According to the results of the modal analysis, it can be seen that the free natural vibrational frequency of Structure in the main mode (modulus) is 2.97 Hz (as shown in Fig. 16). The results show the free vibration frequency test for the edging Structure about 2 to 2.5. The reason for the discrepancy is clamping of edging Structure on the ceiling, according to Table 3, the rotation and deformation at the junction of Structure to the ceiling is not zero.

2.8. Designing test

In order to better understand the Historical places building, the replica of this structure was designed (on a scale of 1.1000) with various arches in 4 different forms by 3D printer from a flexible material fully and in the left side of each of the arches, a spring is connected in length of 15 cm and on the other side, (precisely symmetrical) 20 impacts are applied by a hammer that its section is a circle in diameter of 1.25 (with equal forces so that the distance of impacts is 70 hundredth of a second) and this issue is repeated for 10 times and the average time that springs have after vibrating impacts is calculated (Fig. 25).

Figure 25. Design of arches and hammers

Table 1. Results from the replica test

Test number / Arch number	1	2	3	4	5	6	7	8	9	10	Mean
1	25.18	30.01	21.18	28.40	29.56	22.68	31.15	27.72	22.61	25.06	26.35
2	16	17	17	16.58	17.14	19.49	16.04	14.26	20.78	13.57	16.78
3	16	19.86	20.29	18.35	23.35	18.82	22.90	23.36	24.55	27.94	21.54
4	17.30	19.7	23	13	27	20	19	24	20	17	20

According to the results of the experiment, 4-center arch, which is an example of the arch of Historical places, has the highest vibration in its spring compared to other springs of other arches. Therefore, these types of arches can perform better than other arches due to a specific type of arcs, proportions, integrated material and the amount of distance from the roof thickness. In fact, these types of arcs give more elastic properties to the building against seismic waves, which the important point is the type of arc form.

2.9. The required soil for structural bed:

Regarding the material and characteristics of the bed, it should be noted that the main purpose of the structure and bed is to create an integrated environment so that the waves are not scattered and according to the needs and requirements of the employer, the type of bed soil can be designed. In fact, this method has a great flexibility in bed materials and building, if the bed soil is a soil with a lot of impurities, digging has to be done to reach an integrated layer and then the same soil is taken and converted during the process and mixes with water and fills the digging area very slowly so that the mud is prepared (which after drying is like the integrated layer of bed), it will be dried (although with electricity and electrodes, the process may be faster (depending on the applied voltage)) and then it can execute the structure with molds seamlessly with the lower surface, or as rapid Lego construction together, which are prefabricated and built fast. There is generally no limit in this area and there are many ways to do it.

3. CONCLUSION

The general trend in proving this plan is in a way that initially considering a general strategy and continuing to design its details on the one hand and reverse engineering of Historical places (according to the analysis) from other side lead to reach a common point by the two methods. The results show that it is not possible to test this hypothetical model on the devices creating artificial earthquake and does not obtain the desirable result because the material used under the replica is a material opposite to the material of the galin structure and the waves produced are scattered in different directions, causing the replica to collapse. But in order to know the extent of earthquake tolerance in these types of structures, we must create a kind of artificial earthquake from the material of structure, an issue that the architect of Historical places (Sheikh Baha'i) has performed and created an artificial earthquake by shaking the minarets in the building. In this regard, the designer of Historical places has made his design in a way that each part of it shakes at the desirable time and not interferes with the shaking of the other part. This is what researchers have found by its investigating. The mathematical process in this article is written to be close to the thinking of constructor of Historical places (simple mathematics that has been existed in that time). In fact because of the author's belief according to the age of Historical places and the lack of sufficient facilities at that time, using complex mathematics is not required, as well as one of the goals is to achieve the engineering attitude of this structure according to the thinking of that time. According to surveys, the extent of confronting against earthquake waves in these types of structures has a great capability of confronting, and as the relationships show, to get more accurate information we need to know where and to deal with how much Richter of earthquakes and other building needs, we need this kind of structure. In fact, the design and the exact mathematics of it need to know some of the unknowns that exist. It should be mentioned that we need a structure with what height, location, earthquake force etc. Finally the structure is designed but these types of structures have a lot of flexibility in design which is out of this discussion.

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