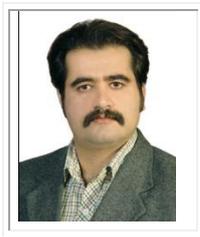


Application, Polymeric composites in strengthening of structures in bushehr monuments



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Abstract

In an environment like Bushehr in which building material are attacked by high levels of moisture and from another point of view high levels of ground water combined with destructive effects of sulfates and other destructive material are destroying these tremendously precious buildings built from stone and plaster. Using metals as supporters and strengthening agents might cause secondary damages, so within this article we are trying to propose composites - which present great resistance against climactic and environmental factors- as good strengthening agents which can be used to strengthen these buildings.

Keywords: stone monuments, Polymeric composites, Environmental damage, strengthening

Introduction:

Because the live culture of a nation is hidden in their application of building materials and its tools. The subject of restoration of historical monuments issues three matters:

First: After the recognition phase of the building material and the tools which our predecessors invented and used in their buildings, in facing their spatial-physical product which is damaged by several phenomenas. Should we use the same building materials and tools as our predecessors did? Is this the only way that we could embrace the technophilosophical past and the highly regarded traditions of that time? And is rehabilitating the monument to its initial form the best and most well-advised way of rehabilitation? At last, do we always face monuments with traditional building materials in restoration, then what should we do in relation with invaluable monuments which are built in the last hundred years[1]?

Second: If we accept that our predecessors built the building which is the subject of restoration, shaped it with culture of their time and gave it practical substantiation and cultural entity, In course of continuing the performance and existence of the building we can use our own culture to influence its shape, application and existence. On the basis of our tendencies and cultural entities in the time of the interference in the building, and using our technical facilities we should represent some of the aspects of our culture [1].

Third: Can we establish a theory once and for all which could be used as the unique theory in field of rehabilitation of architectural spaces and use it as an international manual for specialists in the field of architectural restoration [1]?

We would like to cite Karl Marx's sentence another time which is: "the only constant principle of the universe is Change". Because the manmade building is built out of material, either mixed or pure, the after the building is made these material used in the structure of the building start changing and the output could be seen from the shape of it "because it is its fate and it's unchangeable". Ideas and values are changing, too. As it is simply reviewable in our own society within the past three and four decades. I think there's no need for further explanation in this writing.

If we look again at the definition available for restoration with the attitude that ourselves and our environment are changing we can give a satisfying answer to those questions. with the same notion we can investigate concepts like reversibility.

If we accept that the change is in the nature of the material, reversibility would be unacceptable for us. Imagine a stone-made building with some rock which was intact up until yesterday and is destroyed by some damages today. And the specialist decided based on the plan he designed to remove that rock. - we can also suppose that the rock was removed by itself -then he puts a new rock in place of the old one. In the future it's possible that because of the malfunction of the plan or coming of new plans we would see it necessary to replace the new rock with another one. Now we turn the focus to the other rock which is not replaced up to now and it's one of the main rocks. This basic question raises is this old rock the same as the one put in the main building or did the passing of time changed it? Our answer to this question can help us solve the problem of either accepting or rejecting reversibility. We believe despite of their appearance change in

building material like any other kind of material happens and reversing this process is impossible.

With this interpretation it is better if we look for a more dynamic concept so that we transfer things in their best shape to our posterities with our interferences on the buildings and other cultural treasures of this country. Maybe we could use methods which would make future measures possible. This is why we suggest the word “afresh treatment”.

Iranians and the notion of Modernity:

In fact it is probably necessary to distinguish between the two concepts of tradition and heritage. Indeed, heritage like tradition is a set which is transferred from one generation to another. But it doesn't have the same ideological load that is we can't make an ideology out of heritage. We have a local heritage and a national heritage and a human one. Khayyam khani¹ is a local heritage, Dehdashti Mansion and manouchehr atashi are a part of national heritage but Persepolis and Hafez are human heritage of ours which is beyond national identity.

Cultural heritage which is delivered to us by material and immaterial ways, is a set which has a especial position in the collective memory of a nation and is the vital element of cultural identity and it is the source of any kind of intellectual and artistic creativity in the course of time. This heritage is a set of the experiences of previous generations. It is our duty to retain it and pass it to next generation. We should value some traditions because it will make cultural human heritage and these traditions will make creative cultural diversity.

National identity is the product of collective continuation of a nation and will appear in history, language and the sense of solidarity among people. Iranian culture is a rich and ancient culture, and it is familiar with influencing other cultures and being influenced by other cultures. Some years ago a writer believed that arrival of tractors to Iran is a threat to our identity; this saying is due to lack of trust to Iranian culture [2]. In this case we should remember Gandhi's saying “I don't want to enclose my house with walls and I don't want to close its windows to wind and I want cultures of every nation to pass through my house but I will never let the blowing of the wind damage the foundations of this house which are completely firm”

The old Bushehr texture

From geographical point of view the old bushehr texture is located north to the Bushehr peninsula and it is limited from three directions (north, east and west) by sea and from south it confronts the city's texture.

Factors that influence the formation of the old texture:

- a) Temperature and its difference in a year and in a day especially during warm months of the year
- b) Winds and their blow direction. Especially local winds which blow from sea.
- c) High relative humidity, especially in summer

¹ Khayyam khani: Local method to read poetry of Rubaiyat of Omar Khayyam

d) Angle sun exposure in different seasons



Fig 1: The old Bushehr texture

The old Bushehr texture is built in full harmony with its climate. High humidity and severe heat caused the old design to make extremely narrow passages with high buildings on the sides for reducing the heat and humidity. These passages in addition to their shading which would prevent direct sunlight exposure would make air breeze possible and this lowers humidity. This air breeze in addition to lowering the humidity of passages will attract moisture from walls of sides of passage. Because of the use of proper building materials like marine porous rocks and mortar and with walls drying inside moisture is absorbed. In fact, creating this air breeze in passages would guide some of internal space moisture to outside via walls. Walls become closer in higher parts to create more air breeze in them and sometimes they become as close as 30 centimeters. In fact, despite numerous difficulties in implementation, second floor become console like. Sometimes these walls become so close together that maybe from structural point of view it is better for them to be connected in the upper floor. This will make a shelter like shape; but firstly the moisture of the passages exit more difficultly, secondly walls of the upper floor would not be associated with outside air and they will retain moisture.



Fig 2: porous material

In houses of this texture many doors and windows towards the yard(alley) are installed in order to facilitate air flow and adjust it to hot season of the year. They used bright colors and white color was used as often as possible in order to minimize sunlight heat absorption. The natural state of the land in the location which the old texture is built is in such a way that the eastern part is higher than the western part. This matter is considered

in this texture's construction and in eastern part within places which are higher most of the buildings' heights are lower so that when the city is viewed from above most roofs are in the same level. This type of dealing with the location's topography is because of three reasons; first reason is that if the buildings were made step like in accordance to topography, the whole texture would be directed towards west. Then much more heat would be absorbed and the shading of buildings on each other would be much less. Second reason is because people use the roof as a resting place and if they were not at the same level some would be able to see others. The third reason is because the eastern part is higher than the western part; the ground water level is lower relative to western part there for we have less rising moisture reaching the building. Thus there's no need for a high ground floor.



Fig 3: Narrow streets and high walls

Intervention to treat

Architectural and urban restoration plans always have dependencies and continuities with the recognition of the issue –both in terms of mixing the branches of architecture and in terms of construction pathology-and without considering them it is impossible to achieve an acceptable plan. In the following plan it is the same. In other words, the following plan is rooted in the data we gave before. Some of the places which writer is able, the highest degree of care is taken so that a plan takes shape based on what we have but due to some deficiencies which are beyond the writer's ability, some parts are given or assumed to be known. Maybe we can show our intent by bringing some examples. When we want to use new building materials both traditional and modern, we cannot ignore their components' connection. The same is mentioned in the plan where we want to use FRP jackets we



Fig 4: Effect of rising moisture

would assume that tensile, flexural and shear resistance in junctions of FRPs and rocks and especially gachineh ² are acceptable for us. For this purpose, in other cases we suggest that characteristic tests are done properly so if there's a need for a proper surface for this technique, it gets prepared. We think of old buildings built in Bushehr port as monuments built from a composite of stone and plaster. The plaster is considered the matrix and the stone is considered the booster. In fact, from another point of view we can consider this monument a composite or mixture which shows its architectural mélange. Thus with mixing of a few elements, a single building took shape and it has got all the initial shaping elements in itself. But at last it is a place for people to live and spend some time.



Fig 5: Oxidizing effect

In the following part of the writing we would investigate the places and kinds of polymeric composites which can be used in restoration of the desired buildings. Before doing so, it is important to say that the suggestions proposed might look smeary. But the writer's opinion is that we can use these methods in restoration of different stone monuments and of course all the methods should not be used on a particular building. We will propose a way to interested people, but application of these methods need a more thorough understanding of materials and also the studied monuments.

The same as the previous chapter, we believe that we can use composites in architectural restoration to urban restoration. Also in restoration plan of Bushehr monuments we tried to investigate the use of these materials in various procedures and methods.

- tools and equipment such as scaffolding, the stairs, hand tools of building.



Fig 6: The planks are manufactured from a composite of polyester resin and glass fiber

2 : Mortar between the stones that are used as filler

reinforcement, making them non-conductive, non-corrosive, non-slip and non-lap.

- Shielding of the primary and preventive plans To protect the earth under the foundation and repel moisture due to high groundwater levels in the region using Geosynthetics.



Fig 7: Types of Geosynthetics³

- Strengthen the structural foundation system using composite rebar reinforced with glass fibers in the design of the new foundation. Also recommend something for places that the structural foundation system need to be strengthened but not the concept that we would embed new foundation.



Fig 8: composite rebar reinforced with glass fibers

- Strengthening of the structural part, which covers the walls and columns, and methods using these materials are given. For example, in the corners and joints with poor connectivity which we saw their effects on pathology, it is suggested that the bars (G - F - R-P) to be used. To prevent drift and the opening in the stone buildings that we see in this

3 : <http://en.wikipedia.org/wiki/File:Geosynthetics2.jpg>

region we explain How to use textures or jackets of (F – R– P). It is noteworthy that the jackets should be placed in positions which are focuses of stresses towards it. For example, according to the pathology seen in the stone buildings in the opening, cracks in the corners are observed to 45 degrees that the way of consolidation in the scheme is seen.

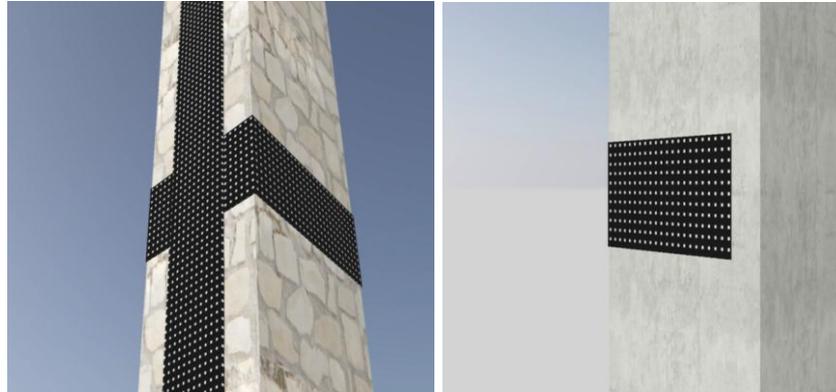


Fig 9: Left: Retrofitting of a column before the plaster coating, Right: one of the columns for showing the FRP structural repair has been used without the growth plate plaster, we have established for the display is referred

- to inhibit micro cracks and leave some small cracks that are likely to activate we can use a picket(stitching dog) of (FRP).



Fig 10: picket of made with FRP

- We use these materials to achieve a revitalization scheme. The floor made of composite materials on the floor of the main runs we have considered. The floor plan can be a plaster form like a past run(performance) but to use composite material. The floor in such building could be several positive features.

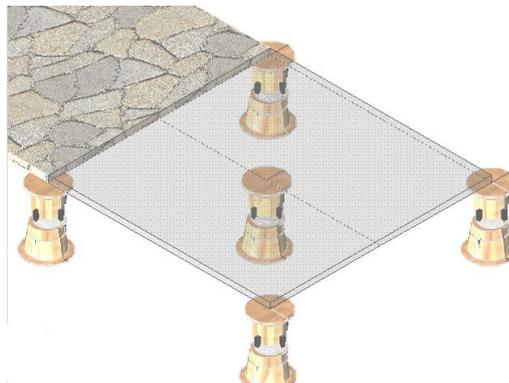


Fig 11: false floor in different heights that can be run from the ground

- such as we saw in the images to one meter from the floor, plaster Coating of internal parts of the walls and columns are dug, we proposed in this plan that we have Here the use of composite panels hole shaped, but having run, we lined up we can chalk that possible moisture have not been able to help drainage cache control, we let disposal. Quick Links to repel moisture from the exterior of the Knapen siphons [7] using the (FRP) are made. Which are not oxidized against moisture and has an acceptable resistance are not easily break.

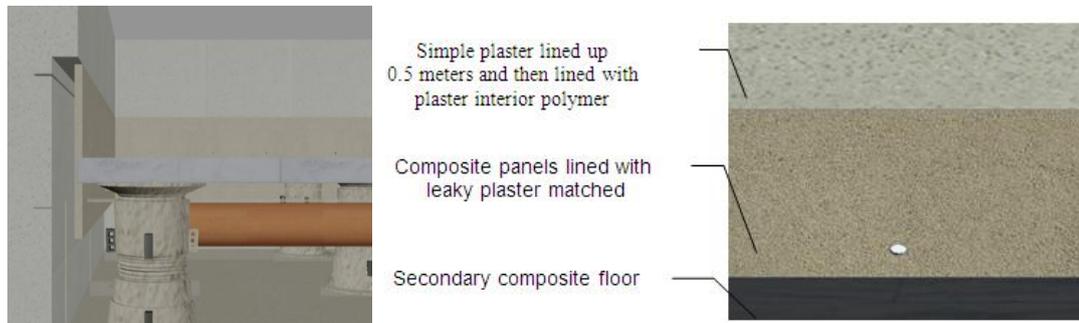


Fig 12: Details coating walls and cover the floor and connecting it to the wall

- walls should be cleaned or removed where ever needed then rebuild. in this way it is recommended to use plaster coating that reinforced with internal polymer in the bigger height than 50cm from floor because in addition to its good function in tension it decreases levels of humidity absorption. There are two ways for reconstruction which suffer damage in lower parts. First is using separate FRP parts which linked with bolts or glue. Other way is casting with composite putty which is a mixture of macroscopic glass parts plus resin and resin can be epoxy or polyester. After making the collapsed parts it is ready to put them in considered places.

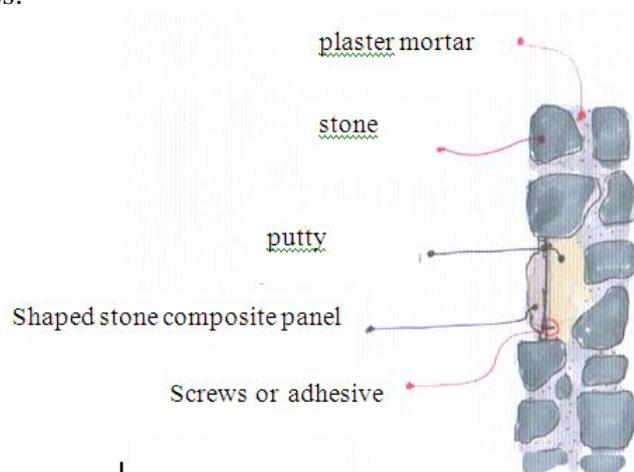


Fig 13: Use the putty or filler composite for reconstruction

- Roof Organizing can be constructed with composite materials considering removing reinforcing obstacle like dust and plaster coatings before renovation. Implementation renovation as it mentioned in details and plaster coating over it with composite that used in Geosynthetics for directing descending humidity-specially in higher parts of dome which are weaker against humidity-to drains.

- In some surfaces with the intention of exposing used composite materials for instance in some part of floor, parts which reinforced by curtain or composite, we can represent visitors material that used in shell and skeleton.

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