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# Behavior Analysis of Minarets at the Destructive Factors Actions

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***Abstract* – Etymological minaret comes from the Arabian "manarat", meaning "illumination place", "lighthouse", the term was taken in Turkish (minaret) and French. The minaret is a particularly important component of a mosque, which is the object of study of this article, analyzing environmental factors, especially water, which acts on minaret materials located in the Black Sea area. The minaret is a high tower built into the actual construction, from which muezin calls his believers to work. Due to its visibility from distant horizons, it provides important information to visitors in the region, namely the presence of Muslim believers in that area.**

***Keywords – minaret, mosque***

## 1. INTRODUCTION

From the architectural point of view, the minaret can have different shapes depending on the location, and the period in which it is constructed by taking cylindrical, conical, rectangular shapes. On the inside or outdoors there is a helical staircase that provides access to the top where a balcony is provided around the minaret, from which the muezin makes the call to the job. The number of minarets in a mosque may vary depending on the size of the mosque (Istanbul's Sultanahmet Mosque has 6 minarets) (Fig. 1).

**Fig. 1** Sultanahmet Mosque (www.travel.usnews.com)

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As a rule in our country, a single minaret is built at the mosques, based on the cross-shaped section of the square, then from a higher height to the circle section. The helical staircase is located inside, providing access to the balcony.

The roof usually has a wooden shingle and the sheet metal. The dimensions of minarets and construction materials and technologies vary according to the importance of the mosque, and the period in which it was built. For example, at the Esmahan Sultan Mosque in Mangalia built in 1573, the resistance structure is made of stone masonry, and the minaret was about 30m high, but at the end of the 19th century because of a thunderbolt the minaret suffered great damage, so it was completely restored reaching 15.5 m high.

Among the mosques with stone masonry minaret can be also mentioned the ones from Babadag Gazi Ali Pasa Mosque (fig.3), Mosque from Amzacea, Main Mosque from Medgidia (fig.4), Mosque from Tulcea (fig.7) , Mosque from Isaccea (fig.5), Mosque from Macin, Cernavoda, Albesti, Cotu Vaii, Hunchiar Mosque from Constanta.

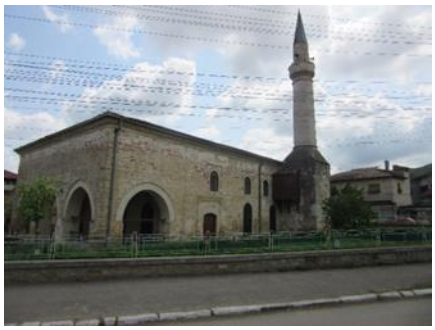

**Fig. 2** Mosque from Babadag

**Fig. 3** Mosque from Medgidia

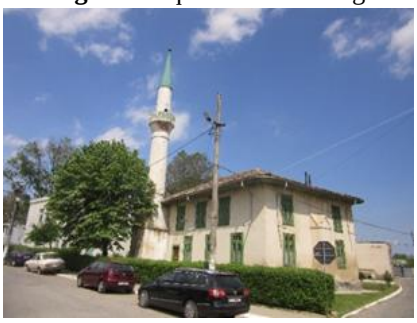

**Fig. 4** Mosque from Isaccea

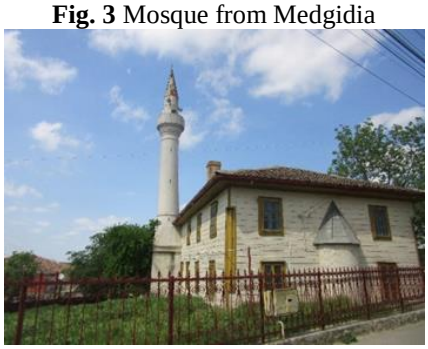

**Fig. 5** Mosque from Măcin

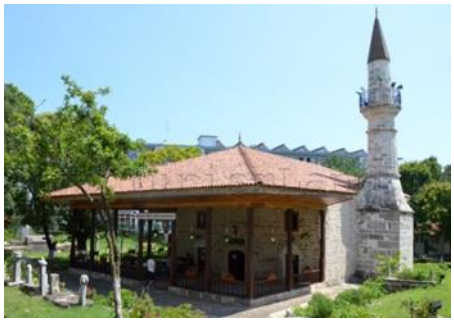

**Fig. 6** Esmahan Sultan Mosque from Mangalia

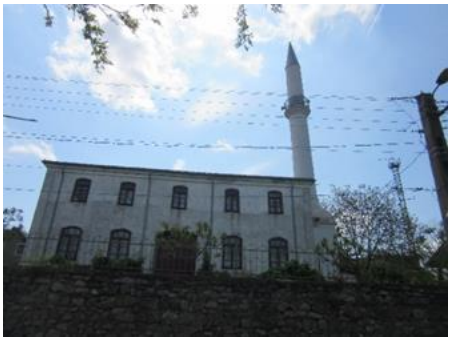

**Fig. 7** Mosque from Tulcea

The stone masonry minarets are made of mortar and stone, and the outside is plastered and finished. Inside plastering works are not done, the only interior finishing operations are the grinding of the interior masonry. The central spindle and the steps are all made of stone with variable dimensions. A special case is at the Mangalia Mosque (fig.6) where no binder was used at the beginning to build the masonry but steel casts were cast in place in stone holes.

Another material used for the construction of the resistance structure of the minarets is the reinforced concrete, a material that has been used since the beginning of the 20th century and can be found at the minarets of the mosques in Negru Voda (fig. 9), Tuzla, 23 August, Lazu, the Carol I Mosque in Constanta (fig. 8), Topraisar, Pecineaga. The exterior finishing is achieved thanks to the special formwork that gives the final shape of the minarets. Characteristic of reinforced concrete minarets, the inner diameter varies from bottom to top from 120 cm to 100 cm and the wall thickness is 20 cm and the height is approximately 30 m. The steps are also reinforced concrete being embedded in the walls of the minaret and on the other side in the central spindle which is also reinforced concrete. The roof has a wooden shingle, and the sheet metal, except for the Carol mosque, the roof of which is made of concrete.

The characteristic dimensions of the steps of the minarets vary so that the height is between 15-20 cm and the width between 20-30 cm.

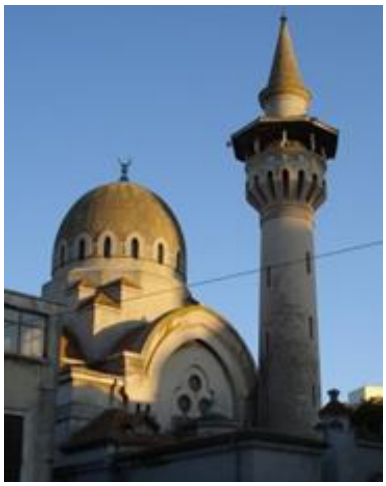

**Fig. 8** Carol I Mosque

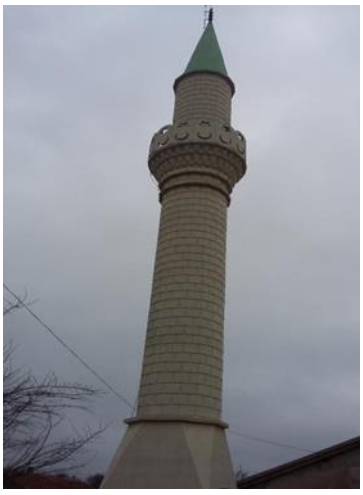

**Fig. 9** Minaret from Negru Voda Mosque

## 2. EXPERIMENT DESCRIPTION

The destructive factors of the water enriching environment come from: groundwater, meteoric waters, seawater, condensation.

Underground waters are a destructive factor requiring a thorough study to combat as accurately as possible the destruction due to their action. Due to fluctuations in the groundwater level, there is pressure on minarets' foundations, pressures that can lead to tilting them or even worse when they collapse. Thus, for the detection of the groundwater level in the minarets area, geotechnical studies will be carried out.

The meteoric waters are those waters that come from atmospheric precipitation: water, snow. It is especially important to create a proper drainage system so that these waters do not penetrate into the soil around the minarets foundation.

Marine waters are waters that act on the outer surface of minarets, with a very high salt content affecting the constituent materials of the minaret.

## 3. RESULTS AND SIGNIFICANCES

A problem arising from the action of water is the exfoliation of the paint on the outside of the minaret and the dampness appearance of the minaret.

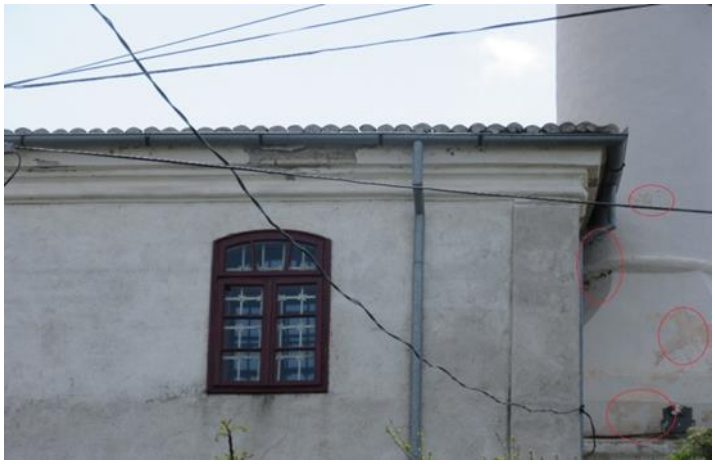

**Fig. 10** Mosque from Tulcea

The solution to counteract these destructive factors is to clean the exfoliated and dampness areas in order to reapply the exterior paint and create a drainage system so as to prevent maximum infiltration.

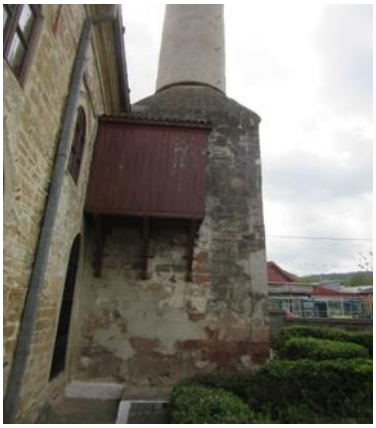

**Fig. 11** Minaret from Babadag Mosque

Another problem is the collapse of the plaster as a result of infiltrations, the appearance of vegetation on the minaret (Fig. 11). Solution: Removing the plaster, removing vegetation and creating a proper drainage system.

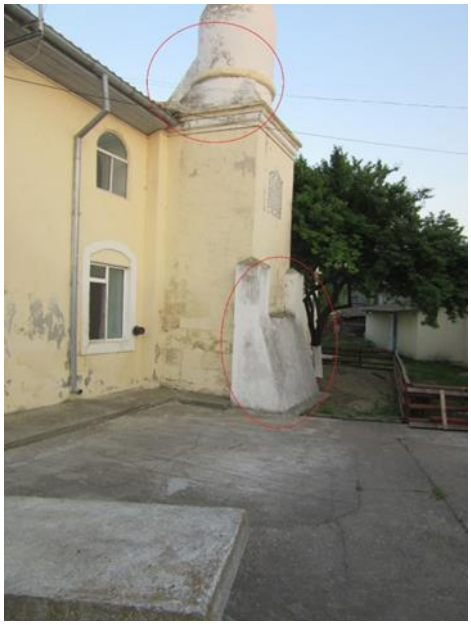

**Fig. 12** Mosque from Cernavodă

As a result of the drainage caused by the underground water at a very high level, deformations of the minaret appeared (Fig. 12). Adopted solution: At the base of the minaret, an reinforced concrete reinforcement system was built starting from the bottom of the foundation. A reinforced concrete beam was built at the top and supported on a reinforced concrete frame system inside the glazing (Fig 13).

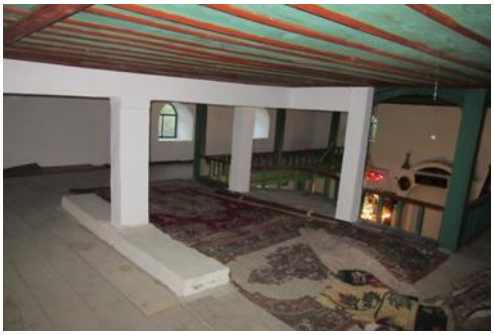

**Fig. 13** The structure inside the Mosque from Cernavoda

Another problem is the result of the action of meteoric waters, a phenomenon that is visible. It can be seen how the water from the roof is infiltrated in the fissure (fig. 14) and precipitation water infiltrates through the cracks between the window and glaf, thus degrading the entire wall (Fig. 15). The solution to combat these rising is proper sealing of

windows to no water gets inside and creating a drainage system on the roof of the minaret so that water does not keep above it.

**Fig. 14** Minaret Eaves by Carol I Mosque

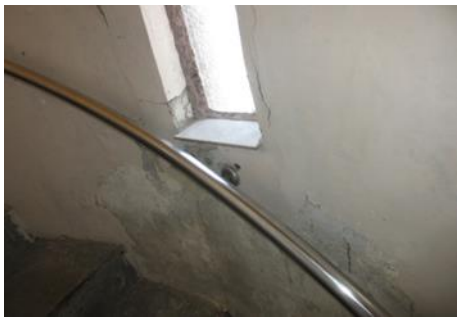

**Fig. 15** Minaret inside by Carol I Mosque

## 4. CONCLUSION

The minaret is a very important part of a mosque. It is very important to combat as much as possible the action of the destructive factors on these constructions, for their preservation so that their exploitation can be accomplished without any problems.

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