CHAPTER 8: CONCLUSION

The discussion of the conclusions of the thesis was done according to results of the analyses made following the methodological approaches taking into account the historical inputs. Firstly, according to science of art result of the analysis of masonry walls of the baths structures are listed on the below paragraph.

Assumptions for the results of the IQM

The case studies are masonry stone bath structures which are located in different locations with different seismic magnitudes and different wall construction types. For investigating the ancient precautions for seismic construction techniques of these structures; they were analyzed by the methodology that pointed out their specifications according to quality and quantity analysis.

The assumption of this part of the methodology is clarified correspondingly the locations, seismic magnitudes of the locations and IQM-numerical values of the masonry wall structures of the case studies.

The case studies evaluations are listed below according to the methodology for the quality index in three different loading actions; vertical, out of plane and in the plane respectively:

- Süleymanpaşa Bath, located in Bilecik city in secondary seismic area get ‘C-C-C’.
- Emirler Bath, located in Bilecik city in secondary seismic area get ‘C-C-C’.
- İsmail Bey Bath, located in İznik city in first seismic area get ‘C-C-C’.
- Gazi Mihal Bath, located in Edirne city in third seismic area get ‘B-C-B’.
- Beylerbeyi Bath, located in Edirne city in third seismic area get ‘A-B-B’.
- Yeniçeri Bath, located in Edirne city in third seismic area get ‘B-C-B’.
- Keşan Bath, located in Edirne city border in secondary seismic area get ‘B-C-C’.
- Havsa Sokullu Bath, located in Edirne city border in third seismic area get ‘A-B-B’.

From all these results it could be said that in some case it may have been awareness of construction precautions because of the building details and IQM quality index. However, it could be said that there was no awareness of the differences of the seismic magnitudes between the different cities and locations. Therefore construction details could not have been shaped according to the seismic locations. Edirne is the lowest seismic area but the related Bath structures IQM quality index is the higher compared to the other cities. İznik is the highest seismic area related the Bath structure IQM quality index is the lowest one. Bilecik and Keşan are in the middle seismic areas related in these locations bath’s IQM quality index is lower than Edirne’s baths.

Secondly, inputs of science of art for analyzing the damage and collapse of case study bath structures were examined in the second part. In this part four case studies in three different seismic risk group locations were analyzed according to the methodology of damage and collapse analysis. In these analyses the base actions were reunited in groups that were discussed in the previous chapters. Vertical action, in plane action and out of plane action are the main collapse mechanism of the structures. By using these actions the analysis of the buildings were done with three main groups. In the first group of analysis the macro parts of the structures collapsed and crack definitions were done. These definitions

were done with elevation of each case by considering compression strength, tension strength and cross section of the masonry considering movement of diatones, horizontal and vertical actions.

In the second group of analysis, the structural analysis of the entire building was done with reference to outer walls and their connections, determination of the load system and which connections between the walls and tie beams were functioning. The identification of the external structural elements which were located out of the whole form of the building and their possible failure mechanisms was also made.

In the third group of analysis, the closure structures which were domes, half domes and vaults were studied. Their dimensional geometric sections of the current structural system were analyzed. The identification of the used materials and construction techniques are essential. The crack patterns and their possible deformations were identified.

By the guidance of these analyses of the case studies with three main actions and their damage and static collapse analysis; the precautions in designing the structural form and construction details of these case study buildings in the historical times were investigated. These precautions were mainly: the plan of the building, form of the elevations and external parts, timber tie beams, corner and elevation supports, vertical studs.

The information obtained from four case studies, examined according to the seismic precaution ideas are listed below.

In İsmail Bey bath, ten mechanisms of collapse analysis were studied. In these analyses the bath structure was highly sensitive to vertical and out of plane actions however the bath was more resistant to the in plane actions compared to the other actions.

The seismic precautions of the İsmail Bey bath were as follows; the walls were clamped in two sides with other walls by timber tie beams; however there were no diatones and the masonry wall shows low quality in orthogonal distribution type. Secondly the plan shape of the building was rectangular with a regular grid of the masonry walls which made the structure more resistant to the horizontal actions. Thirdly the domes were in a higher level than the vault structure. This could introduce a weakness of strength between these two structures. There were no vertical studs and no corner and wall supports.

In Gazi Mihal Bey bath, five mechanisms of collapse analysis were detected. In these analyses the bath structure was highly sensitive to out of plane actions. However in plane action could have caused a risk of collapse chain. The structure could be seen to show more resistance to the vertical actions.

Seismic precautions of the Gazi Mihal bath were; the walls clamped in two sides with other walls by timber tie beams, presence of diatones with better quality masonry related to the other cases. Secondly the plan shape was square with orthogonal masonry walls. Thirdly, there were stone supports of corners of the structure. However the location of the wide and high domes near the outer walls could be risk for the horizontal actions. As well there were no vertical timber studs and external outer wall supports.

In Keşan bath, six mechanisms of collapse analysis were detected. In these analysis bath structure was highly sensitive to out of plane actions. However, resistance to vertical and in plane actions could be seen more effective related to the out plane action.

Seismic precautions of the Keşan bath were; the diatone stones were used inside of the masonry wall, average quality of masonry, rectangular plan shape with axial walls. However there were no timber tie beams inside of the masonry, no timber studs, and no supports for the external masonry wall on their corner or in the middle. In addition some areas were impaired the unity of the grid plan shape.

In Süleymanpaşa bath, four details of collapsed analysis were detected. In this analysis bath structure was highly sensitive to out of plane actions. However vertical and in plane actions could be seen more resistant relevant to the out plane action.

There were no seismic precautions of the Süleymanpaşa bath. Conversely the masonry quality was the worse in comparison to the other cases. There were no intention for the axial plan layout, any timber ties and timber studs, no corner supports.

As a result of the data's and examination of the precautions of bath case studies:

In İsmail Bey bath; timber tie beams and grid plan layout could be the only the precautions of seismicity. However lack of additional supports on the corners and the walls, lower quality of masonry and level differences between the closure structures could be the signs of not awareness of seismicity.

In Gazi Mihal Bey bath; timber tie beams, grid plan layout, average quality of masonry walls and corner supports could be the precautions of the seismicity. However the structure was located in the lowest magnitude of seismic region relevant to other cases. This caused a doubt that the quality of the structure related to seismicity or financial ease of this construction in that era.

In Keşan bath; diatones stones inside the masonry, average quality of the masonry and the grid plan layout could be the precautions of the seismicity. However the structure was located in the middle magnitude of seismic region relevant to other cases. There were very few clues for the horizontal strength of the structure therefore it could be the signs of not awareness of seismicity.

In Süleymanpaşa bath; there was no awareness for seismicity.

According to the two methodological analyses it could said that, in some cities after the earthquakes the builders were conscious the danger destruction of the seismic activity. Therefore some of the seismic precautions were done in randomly for providing extra strength for the buildings under the horizontal actions. However these precautions were not used in every building in high seismic areas.

Away from the awareness of the seismicity, the second synthesis of this research was the application of those structural elements in a clever way by the ancient masons and architects for strengthening the buildings. As it was mentioned before, the variation of the construction details of the masonry walls, transitional elements, domes was the signs of tendency for providing an extra strength of the buildings. However strengthening the buildings were not limited only the construction scale by the ancient builders. Also they thought about plan scale as well as sectional scale. But more in plan scale. The continuity of the masonry wall from one side to another was an important decision and understanding level of the structural behavior of buildings into plan scale by the builders. The tambour and the perpendicular supports of the walls were the clues about their level of knowledge and experience of the deformation of the special structural elements such as domes and masonry walls in sectional scale. Therefore, it could be said that the ancient masons and architects had wide experience for the structures in the level of construction and planning design with reinforcing techniques for make them stronger for horizontal loads.

The comparison of the bath structures with their specifications, differences and similarities is presented on (Table 8.1). In this table structural analysis, constructional material specifications, functional layouts of the baths were compared giving the reference to the chapters and the pages in this thesis. After previous analysis, this comparison was provided in order to have a general look of the case studies.

CHAPTER 8: CONCLUSION

In this study, the reason for the survival of structures from the past to future were examined. For the future research, preservation of these structures should be the goal of the research because of their cultural value and their witnesses for the past.