

TURKEY:
• Historic Areas of
Istanbul (No 356)

scr 356-1999.pdf

UNESCO

Mission in Istanbul (S. Sophia)



TECHNICAL REPORT

6th April, 1999

Prof. Eng. Giorgio Croci

PROF. ING. GIORGIO CROCI
ORDINARIO DI TECNICA DELLE COSTRUZIONI
NELLA FACOLTA' DI INGEGNERIA DI ROMA
ST. VIA FONTE DI FAUNO 2A ROMA
TEL. .. 39-06-5746335 - FAX .. 39-06-5781268
E-MAIL: mc 3832 @ mc link.it

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REPORT ON THE MISSION AT HAGIA SOPHIA

Giorgio CROCI

With reference to the request of UNESCO, I have undertaken a mission to Hagia Sofia on the 18th and 19th March 1999.

During the mission I met the following people:

- *Ali Kikickaya (archaeologist)*
Director of Hagia Sophia Museum
- *Serdar Tugrul (engineer)*
Director of Surveying and Monuments of Istanbul
- *Ulku Izmiriligil (archaeologist/architect)*
Director of the Central Laboratory for Restoration and Conservation
- *Prof. Dr. Mufit Yorulmaz (engineer/architect)*
Technical University of Istanbul
- *Prof. Dr. Zeynep Ahunbay (architect/restorer)*
Technical University of Istanbul, Head of the Department of Restoration, Director of Icomos Turkey
- *Prof. Dr. Mustafa Erdik*
Bosphorus University, Department of Earthquake engineering
- *Dr. Emel Orgen, Anitlar Ve Muzeler, Genel Muourlugu*
- *Prof. Nevzat Ilhan, Icomos Turkey*
- *Dr. Eng. Gorun Ozsen, Yuksek Mimar*

The following points have been discussed:

- ***Structural analysis***

The results obtained up today appear satisfactory to individuate the structural behaviour under the effect of seismic actions, the weak points of the structure and the possible mechanisms of failure.

More in depth studies can certainly be interesting from an academic point of view, but only partially useful from a practical point of view, due to the uncertainties that in any case remain, as for instance the stresses distribution created by the various partial collapses and rebuildings, the alteration produced by the large permanent deformations and plasticizations, etc. .

Mathematical models are a very useful tool for the qualitative analysis of complex phenomena but they have to be interpreted and their results cannot be taken as granted.

- ***Investigations***

Many investigations have been carried out up today but only part of them has been utilized to better understand the structural behaviour.

Before deciding on new investigations it is necessary to have a general picture of what has been done (and to have translated in English at least a summary of the documents in Turkish); only then it will be possible to complete a general coherent plan of investigations and to individuate if further tests are actually relevant to improve the knowledge.

What appears from a first analysis of the data available is that the strength of the four main pillars, where most of the covering marble slabs are detached, is not clearly known (only some short insufficient endoscopic tests have been carried out).

As this is a very delicate point it has been suggested to provisionally remove some of these slabs in order to look at the masonry state and then realize some endoscopic analysis arriving till the core of the pillars (the length of the drills has to be 3-4 meters).

- ***Interventions***

Some reinforcements measures have been proposed on the basis of the results of the mathematical models.

Even if these proposals appear conceptually correct and coherent with the possible mechanisms of collapse, it isn't possible for the moment to judge if these measures are really useful and necessary.

I think that any safety evaluation should be based on an integration among the results of the calculations, the analysis of the historical events that have affected the structure in the past and

the interpretation of the present deformed situation, taking into account, even if in a qualitative way, the effect of discontinuities, cracks, inclinations, etc.,

Following this philosophy I think that great care should be placed in analysing the local situation of the dome, that in many zones has lost its curvature, and presents great cusps along the lines of discontinuity between the survived portions and the rebuilt ones, collapsed after the earthquakes of the 10th and 14th centuries.

Another delicate point is the state of the main pillars that presently is unknown. Even if the stresses aren't there very high, due to the large sections, it is well known that crushing phenomena may suddenly appear without evident signs (especially when, as in this case, there is a lining) and therefore it is indispensable to ascertain the actual state.

These are just few among the points which it is necessary to reflect on; in my opinion, we have sufficient data to start the discussion: it is necessary to strengthen the structure?; then, if the answer is positive, what kind and proportion of reinforcements do we have to adopt?

- ***Local coordination and International Multidisciplinary Committee***

It has been stressed the need of having a coordination among the various studies, researches, projects, and more in general activities, related to Hagia Sophia; the coordination includes also the creation of a center of documentation.

To achieve this objective the three Authorities involved in Hagia Sofia (Museum, Laboratory and Surveying) have agreed to establish a permanent staff with these specific tasks.

As regards the interpretation of the data and the decisions to be undertaken for the safety of Hagia Sofia, everyone has agreed on the opportunity to set up an International Committee, enlarging the present National Committee with some foreign experts; the Director of the Laboratory Mrs Ulku Izmiriligil, and Mrs Emel Orgen, representative of the Ministry of Tourisme and Culture, will present this proposal to the Ministry and will suggest to UNESCO the names of the foreign experts.

The main task of the International Committee should be to take the decisions on the interventions, taking into account at the same time the safety requirements and the need to respect the historical value of the Monument, considering all the pieces of information that can contribute to the full understanding of the present situation, including the results of the structural analysis, the data on the material characteristics, the analysis of the history of the collapses and reconstructions, the examination of the present deformed situations, etc.

The International Committee should meet periodically in order to follow the various activities.

It has been asked the UNESCO for a financial support to the International Committee.

- *Next actions*

Probably the official set up of the International Committee will require a certain lapse of time.

It has been proposed in the meantime to organize a workshop at Hagia Sophia the 8th , the 9th and 10th of June with the participation of the present National Committee members and the foreign experts that are proposed as future members of the International Committee.

The task of this workshop would be the analysis of all the documents and to start the discussion on the possible interventions.

- *Thanks*

I want to end this report thanking all the people that I have met for the friendly and positive atmosphere.

Special tanks to Mrs Ulku Izmiriligil, Director of the Central Laboratory for Restoration and conservation, and to Mrs Emel Orgen, representative of the Ministry of Culture, for the excellent and fruitful organization of the meetings.

I think that the meetings have been very useful and have posed the basis for a lasting international cooperation on one of the most outstanding (and complex) monuments of the world.