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Protection from the Effect of Horizontal Forces of Remains of High Walls within Hilandar Monastery Block, on Holy Mount in Greece

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ABSTRACT: It is necessary to protect – support adequately the independent walls and free standing chimneys, which have been - due to different reasons, (demolition caused by earthquakes, fire, or dilapidation and fall of certain parts of a building) - left alone and free in space, in a way which will enable them to receive the effect of horizontal forces: seismic forces (earthquake) and the effect of wind. Considering the fact that the effect of these seismic forces endangers directly the stability of above mentioned parts of buildings, which, due to unfortunate concurrence of circumstances, had remained statically endangered and unstable in space; their protection is necessary in order to prevent a fall.

1 INTRODUCTION

Examples of protection of particular walls within Hilandar monastery block, on Holy Mount, on the peninsula of Athos in Greece will be shown in this work.

The name Holy Mount appeared in the world of Eastern Christianity, when Athos began to follow the idea of creating the most important monastic community of that time. Holy Mount of Athon, as some call it, for more than 1000 years has been the most important spiritual and educational centre of the whole Orthodox East and in the following centuries it had entered the joint cultural inheritance of mankind. Hilandar Monastery, the fourth in the hierarchy of the Holy Mount monasteries, and one of the most important spiritual and cultural centers of Serbian people, was founded long ago, in 1199.

Since the monastery is situated on the peninsula of Athos in the Aegean Sea the strong winds blowing from the sea direction and the humidity they bring along penetrated deep through the walls. The time has led to a fall of some parts of the buildings and some walls have been left to stand independent and free in space, so their further existence has been endangered.

2 PROTECTION OF HIGH WALLS FROM THE EFFECT OF HORIZONTAL FORCES

2.1 Protection of walls with a spatial wood truss structure

The example of protection of a stone wall is done on the remains of the old Palace St. Vasilije (from 1302).

The age and height of this wall endangered stability of its parts, as well as the fact that its perpendicular side walls had been torn down. Thus this wall remained alone and unstable and it was necessary to protect it with an auxiliary construction to prevent its further destruction and possible fall. This wall has been protected with a wood truss construction. Wood truss construction has been installed within the system of a spatial wood truss structure made of timber (converted timber). Spatial wood truss structures had been installed on both sides of the wall (Figure 1). This type of protective construction has a temporary character and it serves as a

protection until the final rebuilding of this wall. This construction does not enable covering of the remains of the wall which are subject of protection and does not prevent the effect of atmospheric conditions (rain, snow); that is its disadvantage. The wood truss is exposed to the effect of atmospheric conditions (rain, sun), therefore it may be ruined and its durability is limited.

Figure 1: Protection of wall of stone with a wood truss, St. Vasilije

2.2 Protection of walls with a tube –shaped steel scaffolding

In a disastrous fire in March 2005 the mayor part of a monastery complex burned down. An immeasurable damage and the condition of a Hilandar monastery required urgent intervention and reconstruction of most endangered parts of the monastery and the elements of construction.

A great number of walls was left to stand free in space, without points of support, (since wooden ceilings between the floors had burned down in a fire); so it was necessary to protect them and enable them to receive the effect of horizontal forces , wind and earthquake (seismic forces).

The wall in Palace from 1640 is an example of this type of protection. It has been anticipated to protect it with a tube–shaped scaffolding placed only on one side of the building – face side. This solution has been selected because it allows an access to the wall from one side and easier work on rebuilding and reconstruction of whole building.

It has been planned to protect a mud brick wall higher than 16m by placing timbers, interconnected with screws, in both directions (horizontally and vertically)on both sides of the wall. It is necessary to connect this wood construction with a construction made of a tube-shaped scaffolding. Considering the fact that joints on a tube- shaped scaffolding cannot receive the tightening force that may appear in them, it has been anticipated to install a tie-beam from the top of the construction to the anchor block (only one) (Figure 2), which would be buried into the ground at a necessary distance from the wall. It was not physically possible to lay more foundations on this location, so one anchor block and one tie-beam had been placed. Anchor block is placed on the level of a truss (a plane perpendicular to the wall that is being protected).

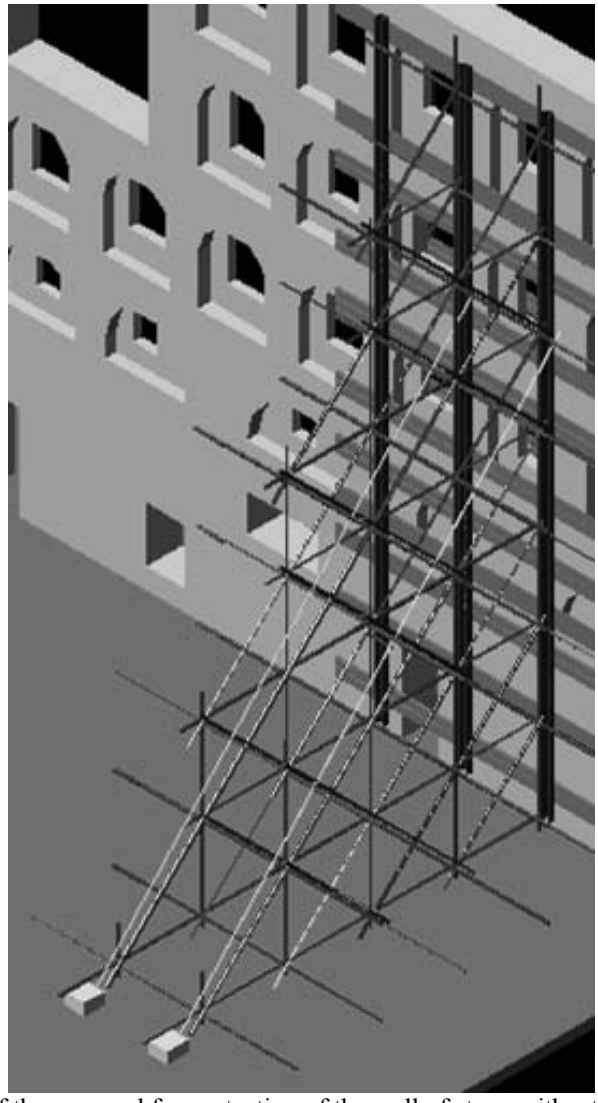

Figure 2 : Animation of the proposal for protection of the wall of stone with a tube-shaped scaffolding, Palace, 1640

It is also feasible to protect the walls with a tube-shaped steel scaffolding, and the project documentation for particular walls has been made. Proposal for the protection of walls of Priory has been made with a tube-shaped steel profiles as a spatial truss placed on one – face side of the building (Figure 3). This built wall has also been protected from one side only in order to enable easier access and work on rebuilding and reconstruction. As in the previous example, first timbers interconnected by screws had been placed in both directions (horizontally and vertically) on both sides of the wall. This construction was then connected to a tube-shaped scaffolding construction. It has been planned to place large number of anchor blocks, which is allowed by the environment (location) and terrain against which the tube- shaped scaffolding construction is leant.

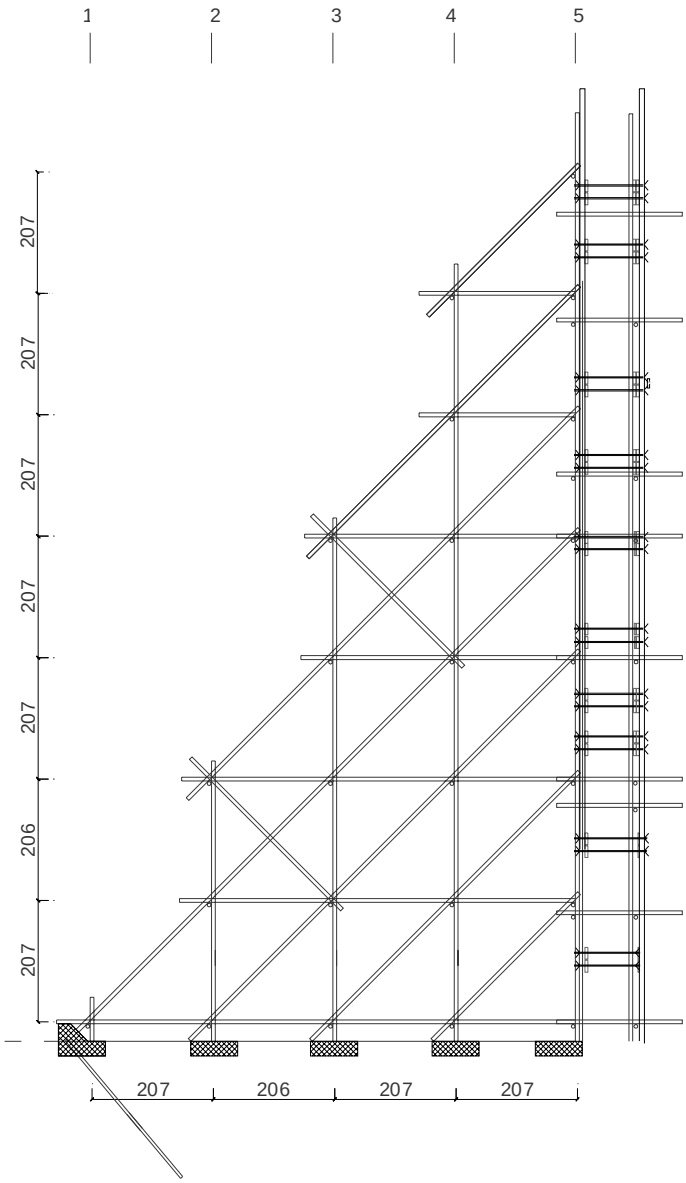

Figure 3 : Proposal for protection of the wall with a tube-shaped scaffolding with more anchor blocks – only protective construction of the wall is shown

2.3 Protection of walls with a construction of hot-rolled steel profiles

It is also possible to protect the walls with hot-rolled steel profiles; the proof of that is an auxiliary construction installed in order to protect the face walls of Palace (1816 – 1821). This spatial steel construction made of hot-rolled bearers (interconnected by welded joints) links face walls to interior walls. Timbers have been placed on the contact between the wall and a steel construction. Spatial construction within the building has been placed through two stories of the building and it occupies completely the interior of the building. The disadvantage of this construction is that is necessary to use machinery –crane– for its installation and that its spatial position within the building makes work on rebuilding and reconstruction difficult, so it will be necessary to remove it during the operations on the renovation of the building.

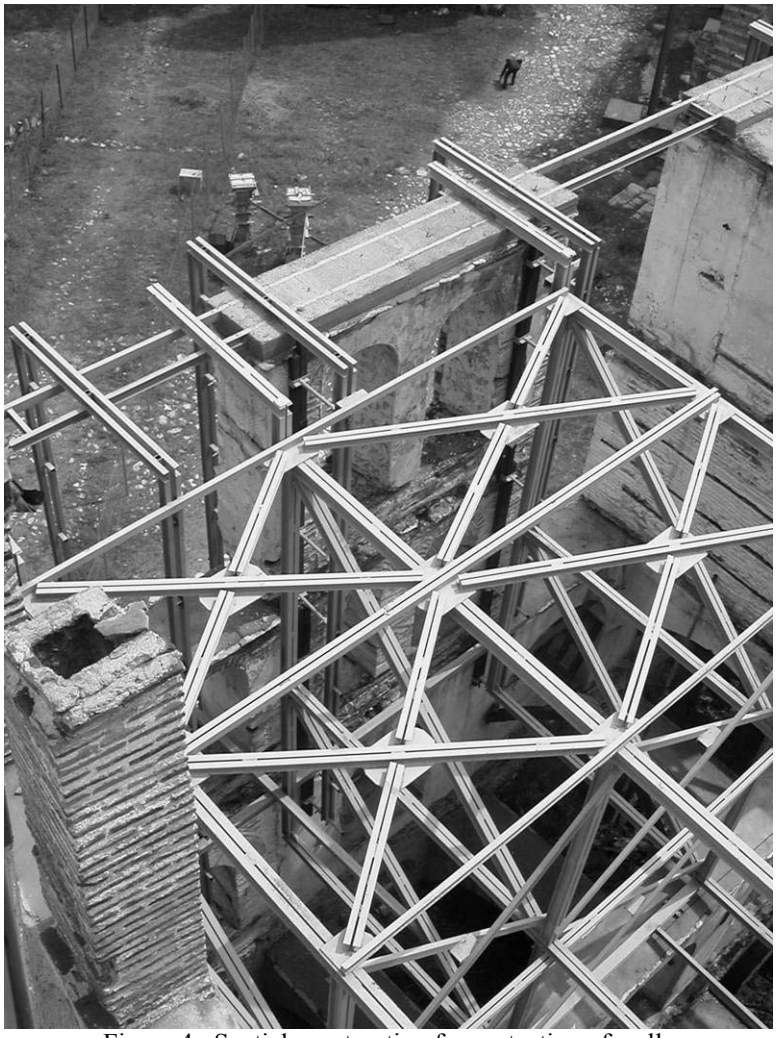

Figure 4 : Spatial construction for protection of walls

Figure 5 : Way of supporting the walls

3 PROTECTION OF FREE-STANDING CHIMNEYS FROM THE EFFECT OF HORIZONTAL FORCES

It is feasible to protect high free- standing chimneys which were left alone in space after the fall of surrounding walls with a tube-shaped scaffolding (Figure 6), by building a spatial truss construction around them and connecting the whole structure to a stable part of the building.

Figure 6 : Protection of walls with a tube-shaped scaffolding

4 RECOMMENDATION FOR PROTECTION OF HIGH FREE-STANDING WALLS AND CHIMNEYS FROM THE EFFECT OF HORIZONTAL FORCES

All quoted examples present ways and possibilities of a temporary protection–supporting- of free-standing walls and chimneys within Hilandar monastery by application of various constructive solutions. By combining different spatial structures (wood, tube-shaped profiles, welded steel profiles) it is possible to form various statically stable shapes which receive horizontal forces of wind and seismic effect (earthquake) and to protect temporarily unstable free-standing walls and chimneys from fall. Protection with wood truss bearers can be recommended as a type of temporary auxiliary construction in spite of the fact that durability of material can be seen as their disadvantage, since they are light (physically) and easy to manipulate and install without machinery; which represents their advantage. Apart from wood truss bearers, it is recommended the use of tube-shaped steel profiles, which are also easy to install – without machinery- and simple to connect.

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