

# **THE RE-FORMATION OF ARENA FLOOR DECK IN THE COLOSSEUM IN ROMA**

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## **SUMMARY**

The reconstruction of part of the wooden arena flooring and its entrance corridor, following wide interdisciplinary studies, puts into practice a project based on an accurate philological analysis of the original structural traces and on indications deduced by comparing other amphitheatres. Taking into account the size limitations due to the historical walls, reinforced wood beams with carbon and aramidica fibres were used just where necessary.

## **1. ARCHAEOLOGICAL RESEARCHES AND PRELIMINARY STUDIES**

The reconstruction of part of the arena floor and its entrance corridor on the eastern side followed four years of studies and researches.

The Soprintendenza Archeologica di Roma, responsible for the safety of the monument, has entrusted the German Archaeological Institute to carry out the graphic survey of the hypogeal that has been achieved with utmost care of details. In a second time the Dipartimento di Ingegneria Strutturale e Geotecnica of the University “La Sapienza” of Rome has been entrusted to carry out the preliminary studies and then the executive design. Particularly important for the design has been the perception, clearly evident from the graphic survey, of the higher position of the walls supporting the floor between the end of the 5<sup>th</sup> and the beginning of the 6<sup>th</sup> century, if compared to the original Flavian level.

Although not very considerable, that level increase conditioned the preliminary design choices: an arena floor according to the high-mediaeval level would have caused the partial concealment of the structures along the arena border and would have presented the monument

in a way corresponding to a limited time phase and verified in accidental situations (although such a way is correct from the philological point of view as regards an ancient structure). As a matter of fact at the beginning of the 6<sup>th</sup> century the hypogeal spaces were filled by earth and the last performances were made on an earth basement in substitution of the wooden floor [1].

The Soprintendenza Archeologica has chosen a first partial reconstruction of the wooden floor at the Flavian level to reproduce the original function of the Amphitheatre, that lasted for about 4 centuries, and has defined the intervention area in the eastern sector, where the ancient structures (dug since 1874-75) are the most damaged due to their outside exposure and past destruction. Such a choice does not hinder further developments already under preliminary elaboration for a more complete rebuilding.

The supporting points for the new floor structure along the eastern corridor and in the hypogeal area have been found in correspondence of the original walls. Those walls are made with travertine blocks dated at the time of the Severian repairs in the 3<sup>rd</sup> century (after the 217 fire) and tufa blocks of the Flavian age. Just the first row (or a little more) is maintained (fig. 1, 4).

The choice to propose again, with the interposition of modern elements, the scanning of the original bearing structure, has been determined not only by philological reasons and by the necessity to find enough resistant foundations, but also by the necessity not to occupy the original hypogeal spaces. Those spaces are expected to be used (in a near future) for new passages available for expositions open to the public.

In the area chosen to lean the new structure, archaeological excavations have been carried out in order to achieve a typological analysis of the structure and soil strata underneath the pavement and the foundation walls. In a second time some vertical drilling were carried out to evaluate not only the depth of the foundations but also to evaluate the typology and the consistency of the foundational ground.

The research has also given a lot of information relative to the evolution of the construction techniques of the arena hypogeal [2]. Having reached a suitable level of the building site at an average of 15.7m over the sea level, the Flavian workers proceeded in smoothing the existent walls of the late Republican age. Later they filled the free spaces and finally they dug for the construction of the hypogeal walls foundations, until they reached a suitable geological stratum. The ground strata without older human traces has not been found at uniform level. For such a reason diggings were carried out at various depths. At least in the analysed cases the depth registered is between -3.25 to -5.10m from the hypogeal base floor. On the bottom of the digging a concrete structure was laid with a variable height in order to obtain a well levelled top structure. On this concrete structure a concrete platform was also built of a variable thickness (0.10 – 1.60m) having a not homogeneous consistence and composition. The base rows of the hypogeal walls (in tufa blocks) were finally laid down on the platform just in correspondence of the underneath concrete walls. In order to put down blocks of not uniform sizes it has been necessary to cut the platform in several points.

A no longer existing gallery used to be all along the perimeter of the arena, connected through openings with the playground and with the entrance corridors on the main axis. The reconstruction at the beginning of the 20<sup>th</sup> century has nearly completely cancelled ancient structures as well as structural traces along the border. The latest archaeological searches have progressively rediscovered these structures through the partial removal of the modern works. In such a way very useful indications on the original location of the arena ground floor and the podium wall were obtained. A deep pipe, that collected the arena and the "cavea" rain waters, was located at the base of the podium wall and was connected vertically (on the main axes) with the hypogeal annular drainage pipe.

The original wooden structure was not close to the podium wall, but was separated by the pipe at a distance of about 0.50m. Such indication has been very valuable for the design of the floor rebuilding, not only because it has stated the actual size of the arena, but also because it suggests and allows to consider the volumetric and planimetric dimension of the pipe still to be used in the drainage of the arena rain waters.

## 2. DESIGN AND RECONSTRUCTION WORKS OF THE ARENA FLOOR

The reconstruction of the arena flooring is required by the need to give back to the monument the performance floor as well as the covering of the hypogeal rooms, in order to contribute to the proper understanding of its form and function.

At the same time the covering of the hypogeal structures and walls protects them from the weathering and makes possible and lasting their restoration.

The archaeological researches so far made, define in a very precise way the reconstruction conditions with all the due respect for the monument, particularly the use of wood for the flooring structures, the respect of the Flavian level and the recovery of the hypogeal spaces clarifying their original function as back of the stage.

Some hypothesis of the preliminary design referring to the whole reconstruction of the arena flooring have been set aside in this phase because it is technically impossible to pass over everywhere the hypogeal walls with wooden structures, still taking into account the design conditions identified by the archaeological researches (the recovering of the Flavian level



Figure 1 : The arena flooring rebuilt by laminated wood at the Flavian level



Figure 2 : The rebuilt arena in line with the hypogeal masonry structures



Figure 3 : The rebuilt arena and the eastern entrance corridor

without any occupation of the hypogeal rooms with new structures or at most a very reduced one). It was therefore decided to design, in a first phase, a partial reconstruction of the arena floor limited to the eastern area (fig. 1 and 2) and its entrance corridor from the eastern door (fig. 3). In this area the residual masonry structures (the tufa foundation blocks in the arena hypogeal (fig. 4) and the travertine blocks along the corridor (fig. 5 and 6)), have supported, thanks to their resistance, the new floor structure with some few necessary additions to reach



Figure 4 : Arena timber structures and the new pillars leaned on the interposed blocks



Figure 5 : Timber structures of the entrance corridor leaned on interposed blocks.

the right floor level. At the arena border the support on the structures restored in the 20<sup>th</sup> century allows to partially dismantle them and recover the ancient perimetrical pipe for the water flowing according to the position pointed out by the archaeological surveys.

The new structures of the framework (girders and flooring) and the pillars are made with laminated wood or in laminated wood reinforced with carbon fibres (pulltruded bars) and aramidica fibres (multi-axial tissue) in all those cases when it is necessary to contain the resistant sections within the limitations due to the historical masonry (fig. 7 and 8).

The assembling of the wooden elements with stainless steel plates and bolts, makes possible the dismantling for a wider reversibility; for this reason the reinforced concrete basements (pozzolanic concrete with stainless steel reinforcements) placed between the wooden pillars and the historical masonry can be easily removed since they are merely leaned against the historical stone and separated from it by a suitable isolation.

At the arena border a bent wooden beam, simply leaned, ends the timber structure and fixes it horizontally to the monument foundations by means of a few radial stainless steel ties.

The new structures have been carried out in a complete reversible manner, with constant aim to maintain a throughout continuity and compatibility with the archaeological pre-existences. The right interpretation of the ancient structures and the recovery of the hypogeal functionality were in this way safeguarded. While ancient suggestions are re-proposed, such as that of the timber structure and that of the floor like a ship's deck with golden sand over it, modern



Figure 6 : Timber structures of the entrance corridor directly leaned on the travertine blocks



Figure 7 : Laminated wooden beams with composite reinforcements over-passing the historical masonry



Figure 8 : The new structure in laminated wood and in composite reinforced laminated wood

technologies are used, like the laminated wood and the reinforcements made with composite materials employing carbon and aramidica fibres.

### 3. ACKNOWLEDGEMENTS

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