

CONSTRUCTION AND DEVELOPMENT STAGES OF THE WOODEN ARENA FLOORING OF THE COLOSSEUM IN ROME

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Following a generous offer made by Rome's Archeological Superintendence, the German Archeological Institute in Rome commenced an investigation of the construction details of the arena and the basement of the Colosseum in 1996. The Colosseum forms part of a series of well preserved major structures of antiquity whose state of preservation is inversely proportional to our knowledge of the history of the building. Because – notwithstanding a great deal of work already done on the amphitheatre, of which the major works of J. C. Golvin and C. Landes, both based on much material, are cases in point – there remain many important and unsolved problems, especially as regards the technical handling of the games. Apart from the evaluation of written sources, such problems can be clarified only by interpreting the excavation findings themselves. And this can only be done by recording all the relevant details in the most accurate possible manner. One may well be surprised to learn that the greatest and also most complex installation of the Colosseum, namely the arena with its two-story structure – also known as *hypogeum* - has not yet been appropriately investigated. But it is also very readily explained by the multitude of its component structures, at first sight a seemingly terrifying confusion, and the consequent difficulties one must expect in recording the findings. I would like to go into this report on the works only as regards the current state of the most important construction and development stages of the arena flooring, and not before I have briefly explained their relevant aspects. As for now, I can address only a relative description. Archaeological studies on the absolute dating of sections of construction are under way and older findings are discussed.

The present situation of the podium and the arena border dates back to the excavation of 1938/39, when the whole basement was freed from the earth mass. The excavation was closely linked to consolidation and restoration measures for the border of the arena, and this was also the case during the excavation of 1874/75. If on the one hand we know little about the 1874/75 restoration and we can reconstruct it thanks to some pictures, on the other hand the restoration of 1938/39 is greatly documented. Director of the restoration and excavation works was Mr. G. Cozzo, an engineer that had already explained his large knowledge of the Colosseum in his book 'Ingegneria Romana'. Nevertheless, it is not always clear why his good observations

were not considered for restoration. In particular, his reconstruction of cavea in the E. sector of the amphitheatre can be misleading, because he reproduced the constructional situation of cavea, podium and arena (combat area) wrongly. The angle of inclination of 30° is too steep for this part of cavea, which has such an inclination only after the 4th ambulatory that runs on the backside of the podium. The reconstruction above all ignored the existence of a podium wall, so that the sidewall of the 5th ambulatory, which was not visible in ancient Rome, now constitutes the border of the reconstructed tiers of seats in the cavea. It is unclear why it was decided to renounce restoring the wall podium, especially because Mr. Cozzo indicates a wall height of 2.50 m, that was recognised by Mr. P. Bianchi, an architect, as early as in 1812 and was roughly reconstructed with drawings. Even more surprising is the fact that the 5th ambulatory back wall, with its 24 niches, is still interpreted as a podium wall by a wide range of experts. The niches are interpreted as the place where the archers stayed, whose task was to keep off wild animals from the protective fencing that, in turn, was apparently built during venationes to defend the spectators.



Fig. 1 General view of the podium north wall

Before we show our studies as they are at present, we must show some data that can help understand the building structure of the basement and podium. The basement is divided in 15 corridors by 14 walls. Six of them follow the elliptical ground plan, while the remaining eight run horizontally from E. to W.

The new studies of the podium area show that remains of the podium wall are preserved in

four places. There are two travertine blocks in sector 1, three in sector 2, four in sector 3 and two more blocks at a distance of 120 m from them. All the blocks are surrounded up to their upper layer by the stones, consisting of rough tufa pieces and cement, that were used here during the restoration works of 1938/39. Analysing the single blocks of the podium wall, the result is that three blocks in sector 2 are no longer in situ, as we can see from the cramp holes on the upper layer that no longer match. Both blocks of sector 1, which have been a point of reference so far for the reconstruction of the podium wall. Therefore, only the blocks in sector 3 and the greatly restored wall section of the so-called "Path of Commodus" can give us information on the position and height of the podium wall as well as on its linking to the arena flooring and to the basement. The precise knowledge of how podium and basement connected together is of topical interest because the Soprintendenza plans to reconstruct a part of the arena flooring at the same height as the ancient walking level. The controversy over this project has shown that in ancient times the arena flooring was completely renovated several times, its walking level raised and its wooden structure greatly changed.

Stage A of the Arena Flooring

During Stage A, which I consider the period of the construction of the basement at the time of the Flavian emperors, the wooden construction of the arena flooring must have lain directly on

the walls of tufa blocks. These walls, which were made up of tufa, were partially substituted by brickwalls through the following stages II-IV and the modifications they entailed. Therefore, only the preserved areas of copings of walls 1, 5, 6, 9, 10 and 14 can give us information on the construction of the arena flooring for Stage A. Their level is approximately 22.60 m, which corresponds to an actual height of 6.15 m.

No remains of the arena flooring itself are left, as it was completely made up of wood. Only where the walls lie in their entire height of 22.60 m and were not modified in later stages can we recognise dovetailed voids 10 cm. high on the upper layer of the tufa blocks, which constitute the wall copings of Stage 1. Those voids run crosswise on the blocks 90 cm. high, are about 10 or 14 cm. wide – because of their form – and lie at a distance of about 1.0-1.5 cm. from one another. So far their function and importance have not been analysed in detail yet, especially because the following construction stages in the basement have covered or even rebuilt most of the voids. All this has caused that the dovetailed voids haven't been considered in connection with the arena flooring. Nevertheless, if we leave out later construction stages and assume that during Stage 1 such dovetailed voids were situated on all the wall copings in the basement, the following observations can be made on the construction of the arena flooring:

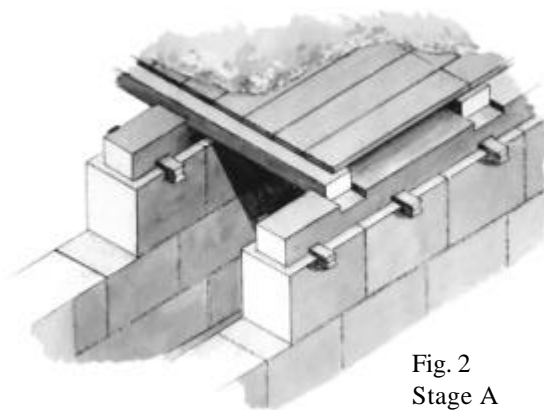


Fig. 2
Stage A

If we consider the load bearing capacity of wood, it would be better for the construction of the arena flooring if on every brickwall lay a wide beam – so-called purlin – that could transmit the burdens and forces created during the spectacles in the arena to the brickwall evenly. In theory, the purlins could be followed by boards that made up the real game area of the arena. However, since corridors D and F north, D and F south, and H are 3.0, 3.50 and 4.0 m wide respectively, the construction we mentioned before is not feasible because the span of the above-mentioned corridors is too wide even

for the strongest boards. This is the reason why we must assume that on the bearing construction a second beam structure, also known as sub-structure, lay crosswise on the first one. It reduces the span of corridors to a dimension suitable for the boards, so that the closed wooden arena flooring could be carried out only by using the sub-structure. Question remains open of how the bearing construction was fixed with walls and what the function of the dovetailed voids on the blocks' upper layer was. Since on the blocks' upper layers, apart from voids, there aren't any traces of metal plugs, cramps or metal ashes, which the purlins could be fixed to the walls with, in my opinion the connection between purlin and wall took place by means of the dovetailed voids.

If we accept their form of a dovetail and the premise that they can be interpreted as part of the consolidating system, a piece of wood having the form of a double dovetail could have been inserted in the voids thus establishing the connection between the stonewalls and the purlins. As far as construction is concerned, such connection has the advantage that it fixes the purlins against any side-slipping and lifting up. A further advantage of such simple wood connection is

that no metal is used, thus being more cost-effective, and it can be easily produced, especially because no metrical matching is needed between the positions of the voids on the upper layer of the blocks as well as on the purlins. This simple but effective connection, furthermore, allowed working in a way independent from the production of all the walls in the basement, because the adjustment and fixing of purlins for every wall were carried out individually.

Stage B of the Arena Flooring

If in Stage A the construction of the arena flooring and its consolidating system is directly connected with the idea of the walls erected in the basement, Stage B is more a restoration measure that was necessary in the light of the total collapse of wall portions of Stage A. Because of the bad state of preservation of the wall copings Stage B can be proved only partially on the walls 5, 6, 9 and 10 in the form of a low brickwall. This wall, generally referred to as a wall reconstruction, has remained on the wall parts that were not destroyed or forms the border of the above-mentioned restoration measure. The wall 'reconstruction' has got the same width as the tufa stone walls and has survived up to the 6th layer, reaching a level of 22.90 m. Due to its limited height and bad state of preservation it has been generally assumed so far that it was a modern restoration measure, which was taken to protect the tufa blocks from bad weather conditions. However, the drawings (construction documentation) together with the related scientific studies have shown by means of comparisons between brick formats and mortar samples of the basement that the 'reconstructed' wall is ancient. In modern times only its covering (made up of very chalky mortar) was laid on it. Nevertheless, mortar hardly fulfils its former function of protection from bad weather, as shown by the deep cracks and the rich vegetation on it.

The studies carried out on all the remains of the 'reconstructed' wall have resulted in the fact that they are of the same construction and thus document an independent stage. Most of it consists of bipedales in the 1st layer that is followed by triangular bricks. Furthermore, the 'reconstructed' wall shows rectangular voids as large as 16 x 18 cm and about 1.10-1.20 cm far from one another. Most of them are covered by halved bipedales. The lower edges of the 16 x 18 cm large voids begin at a height of about 22.60 cm, which corresponds to the upper layer of the tufa block of Stage A, and stretch over the whole wall depth of 90 cm. On the walls 5 and 6 (corridor F North) as well as 9 and 10 (corridor F South) we can see that the voids match as far as their position is concerned, they are opposite each other. The order and size of the voids, as well as the type of their covering, allow us to assume that they are beam holes in which once were inserted the beam structure for the arena flooring.

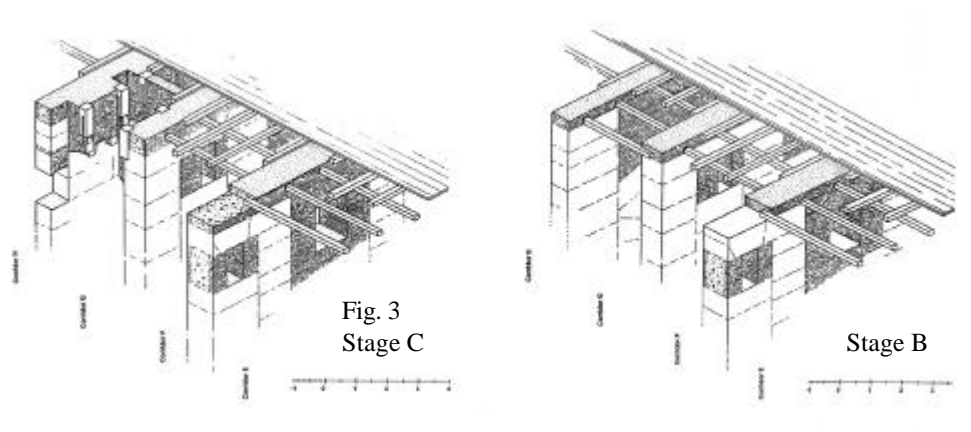
In the light of these observations we can draw the following conclusions for the construction of the arena flooring:

Since the 'constructed' wall does not take into account the dovetailed voids of Stage A, it rather covers them up, it is guaranteed that the construction of the arena flooring of Stage A was completely abandoned. Besides, – and this is an important difference as against Stage A – during Stage A both the direction and the consolidation system of the bearing beam structure change. This beam structure lies now crosswise to the respective walls and was fixed in its position through the 'reconstructed' wall, as we can see from the remaining beam holes. That the new construction cannot do likewise without a further beam structure (the so-called substructure) is clear from the total height of the 'constructed' wall. It goes beyond the beam

holes of three further brick layers, so that the boards in these positions cannot lie directly on the beam structure and thus need a substructure. This can be the basis on which a theoretical

reconstruction proposal can be made for Stage B: The beams of the bearing construction lie on the upper layer of the tufa blocks of Stage A and were fixed with the newly constructed low brickwalls – the ‘reconstructed’ wall. Where Stage A did not survive and the brickwall coping was carried out, there lies the bearing construction again on the Stage A level of about 22.60 m, as the beam holes show. The bearing construction consists of strong 16 x 18 cm beams and runs crosswise to the corridors. On top of it follows – perpendicularly to the bearing beam structure – the substructure on which the boards of the arena flooring were fixed.

Although the level of the arena flooring did not change greatly in Stages A and B, nevertheless there is a general constructional and technical difference between the two stages, which is especially clear if we look at the two different consolidating systems for the bearing beam structure. If in Stage A the system was of such a convincing static simplicity that it could be described as a stroke of genius (a perfect connection between materials tufa and wood was created by means of a double dovetail), the consolidating system of Stage B must be rather classified as an average one, especially because the connection between wooden beams and brickwalls is always problematic. In the way I have just described – through the ‘reconstructed’ wall – the mass of the three brick layers on the bearing beam structure cannot be enough under any circumstances to fix it adequately stable and sure in its position.



Stage C of the Arena Flooring

While the structural change of the arena flooring during Stage B may be observed on several basement walls, the existence of a Stage C is not completely sure. Nevertheless, we shall endeavour to examine and analyse the few structural traces that seem to indicate that there has been a further stage. This assumption is above all based on the findings in the area of the transverse axis of the basement (North-South-wise) and the lifting device that was installed in corridors E and G North as well as E and G South at a later stage. In order to make it easier to understand the constructional situation, which is very complicated in these areas, it will now be briefly described.

On each of the walls numbered 6, 9, 10, 12 and 13 there is an opening, which is approximately 1.0-1.20 m wide and 1.90-2.0 m high, in the area of the transverse axis at a level of about 19.64 m. Over most of the openings there are brick arches. The following may be noted on these brick arches and the wall portions situated above them: All arches were reduced to the level of the combat area and replaced with new, smaller arches like the cracks and different brick sizes

show. The latter actually prove that the wall portions above the arches were expanded in connection with this measure. These modified wall portions and arches reach a level of about 22.95-23.00 m and are, consequently, the highest elements of the basement walls, though higher elements can be identified in the stone supports of the lifting device pulleys in corridors E and G North as well as E and G South, whose upper borders reach approximately 23.12 m.

Considering the constructional situation in the area of the transverse axis and the E and G North as well as the E and G South corridors, we can make the following hypotheses: While the bearing structure of the arena flooring was fitted on the surface of the tufa stone block, i.e. at approx. 22.60 m, during Stage A and B, it must have been situated at a different level during Stage C due to the location of the lifting device, which was installed later, and the high wall portions in the area of the transverse axis.

This hypothesis is confirmed by the measurement of the beam holes belonging to Stage B, which indicate the position of the beam structure. If we assume that the beam holes were about 16 x 18 cm large and the evidenced substructure was made up of beams with an approx. 18 cm high cross-section, the two beam structures total approx. 22.94 m (22.60 m + 18 cm + 16 cm). Still, this measure is undoubtedly lower than the lifting device, whose height is within the range 23.12 m. Consequently, it cannot be excluded that there has been a Stage C. If that is true, the bearing structure of the arena flooring must have been located on the 'reconstructed' wall built during Stage B and fixed by means of another 'reconstructed' wall.

Temporary Dating

If we attempt to establish three chronological stages for the arena flooring, we can only make hypotheses. We are not even sure when the tufa stonewalls belonging to Stage A (Stage I) were constructed. The 'reconstructed' wall from Stage B contains bricks with stamps without writing, the so-called boli anepigrafe, that presumably date back to the Severian period, although it has not been determined when it began and when it ended. Similarly, it is impossible to establish a precise date for the very hypothetical Stage C, but we shall make some comments on the lifting device that may give us indications about its implementation and, hence, help us date Stage B. As stated above, the lifting device was subsequently installed in corridors F and G North as well as F and G South, and more precisely by means of two brick arches sustained by travertine brackets that were inserted in the walls. The documentation proves that all travertine brackets and pulley stone supports are spoil obtained from larger travertine blocks. This conjecture combined with the circumstance that the consolidation of the Eastern gallery was also carried out using spoil that was positively taken from the upper part of the Colosseum allow us to put forth the following assumption: Due to the quantity and origin of the spoil used for the consolidation of the Eastern gallery, the work and the material may be associated with the earthquake and fire in the Colosseum in the year 217 AD, the so-called Macrinus fire. If we assume that the travertine brackets and stone supports for the lifting device were constructed with material damaged during the fire in 217 AD, the lifting device and, thus, also the arena flooring belonging to Stage C were built after the fire. That this is true is proven by the lifting device, which was subsequently revamped, but without modifying its functioning radically. This work would probably not have been carried out if the lifting device had been in very poor conditions after the fire.