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Stoneworking Techniques at Persepolis from Quarry to the Terrace

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Abstract

Masonry materials for the colossal monumental structures of Persepolis, the awe-inspiring architectural complex from the Achaemenid period, would be sourced from the surrounding mountains that occasionally lie up to 40 km away. Several techniques were involved in splitting stone from quarry masses. Once split, stonecutters would choose where in the structure and for what purpose each block befitted. At times, impurities were detected in blocks either before splitting or during rough cutting at the quarry site, or after final dressing on the construction site, viz. the Terrace. Apart from those for quarrying, Achaemenian masons applied several other techniques as part of setting, attaching and dressing processes on the construction site. Some blocks bear marks that were made by stonecutters and have thus been categorized as stonecutter's marks. Yet, there are other related symbols that are instead connected with specific techniques used by masons for setting in place and holding together separate stone blocks. The present work addresses problems the stonecutters had to tackle while selecting blocks for using in the structures on the Terrace, and placing them atop each other during the construction process.

Keywords: Persepolis, Stone Mason, Impurity Veins, Setting Techniques.

Article Type: Review Article

Introduction

Stonemasons working at Persepolis had to acquire required building material from the nearby mountains girdling the Marvdasht plain. While invariably being of limestone type, the employed stone blocks vary in quality, and sometimes, in color (Shahbazi 2005: 2).

The use of blocks at this architectural complex was contingent on their quality. Blocks designed to bear inscriptions were selected from among those of the highest quality.

The questions now arise are: How and when the stonemasons decided on quality of the blocks and structural parts they suited the best? And, how the blocks were aligned during their setting in place?

Detection of Veins at Quarry

Stone blocks used as building and ornamental elements at Persepolis come in two general types, both of which belong to the limestone family (Amanollahi 2005: 79), a typical characteristic of which are frequently occurring veins.

The quarrymen made frequent use of the hoary technique of swelling wood (Nylander 1965: 49), which involved driving a hard wood peg into the artificially made fissures. At times, veins would be detected after the block was split away, while at others it was presumably at the time of making the mentioned fissures that they were noticed and, thereby, disqualified the relevant mass for further work. Our hypothesis indeed rests on the observation that at some quarries there were wedge slots on the rock face from which no blocks were removed (Figure 1).

Detection of Veins in Rough Cutting

Once blocks were separated, the stonecutter would decide on where to use them in the structure based on their quality and dimensions. To facilitate their imminent transport, blocks were trimmed off as much as possible at the quarry (Schmidt 1953:

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Figure. 1: *Wedge slots on a rock face*

57). Yet, the fine cutting and dressing would be postponed until the rough blocks were set in their planned position on the Terrace to prevent the possible damage during transport.

The initial rough cutting to lighten the blocks provided another opportunity for detecting potential veins. Those with excess veins would be discarded at the quarry site (Figure. 2). Yet, a trivial vein did not preclude the block's use and it was bonded with metal clamps (Figure. 3).



Figure. 2: *Rough cut, double-headed capital discarded at quarry site*



Figure. 3: *A clamped column shaft*

Stone Setting Techniques

Once transported to the Terrace, the rough cut blocks were set in their place (Schmidt 1953: 113) before the final dressing and polishing would be effected. The latter began from the top and continued down to the bottom (Figure. 4).



Figure. 4: *Rough cut blocks at the unfinished gate*

Yet a problem arose thence as there was no way to ascertain whether the invisible surfaces of the two superimposed blocks fitted satisfactorily. The stonecutters' solution was to apply a red pigment (yet to be characterized as resin or paint by chemical analysis) to the surface of the lower block. The upper block was then hoisted up and was lifted again shortly. The process would be repeated, at the case may be, until the entire base of the upper block was consistently stained to evince an adequate pairing (Figure. 5).

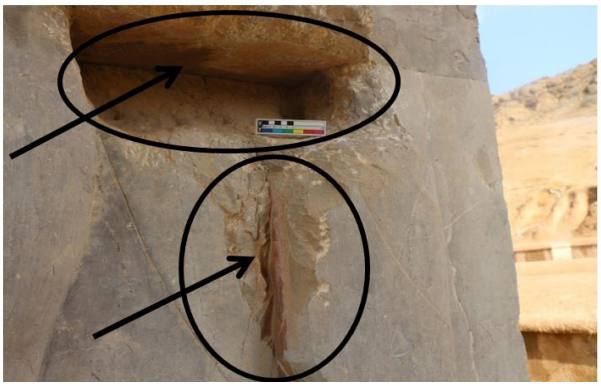


Figure. 5: *Pigment used for pairing the blocks*

A second notable problem in this context was that once the upper block was lifted, it was quite possible that it might not have been re-set exactly at the same angle as it was initially, at the time of the final placement. The solution was to make into the surface of the lower block some slits at four directions (in some cases only there examples were recorded), which were to be replicated at the corresponding points for the upper block (the

observed depth for these slits varied between 2–3 mm)(Figure. 6). Nylander has also mentioned these colors in his book Ionians in Pasargadae.(Nylander 1970: 39)

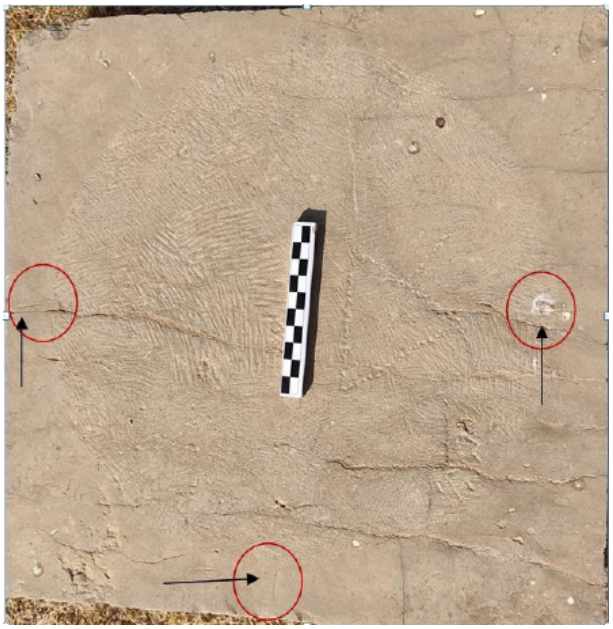


Figure. 6: *Guiding slits made into the blocks to facilitate alignment*

Then, four engraved marks each in a different form were worked out in the visible surface of the block exactly along the same axes as the inner slits to act as alignment guides.

These signs resemble the marks that stonecutter's had made on the stone reliefs and have been described by M. Roaf (1983: 93). The same signs would be repeated symmetrically on the upper block when it was hoisted in place and before it was lifted to begin the pigment test (Figure. 7).

A different aligning technique was however applied for none-circular blocks used in walls and foundations. In these contexts, the adjacent stones have finely hewn edges but are roughly cut in inner



Figure. 7: *Holding together the blocks and their alignment marks*

parts. On the exterior surface of the stone was carved a horizontal line, serving as a mason's line, along which the flanking stone was set, and then both stones were attached together. The same line was repeated until the whole course was complete. For the upper courses, which likely started from one end of the wall and continued to the other, an almost similar method described above for the alignments of column components was used, which involved the same pigment test and similar alignment marks. Roaf believes: there are three kinds of mark: lollipop marks showing the location of column axes, T-shaped marks indicating the edges of walls, and rectangular marks in the middle of walls. Some of the lollipop marks indicate the edges of walls of the side chambers as well as of column axes (Roaf 1978:67) (Figure. 8).



Figure. 8: *Marks created for pairing and attaching stones in walls*

Detection of Veins in Fine Dressing

As stated above, high damage potential during transport meant that the fine cutting of the blocks would be carried out after their setting. This presented another problem for stonecutters as in some cases veins would come out on the blocks during the process. In such occasions, veins and defects were handled as follows: If the vein was large, the involved part was emptied and a patch of the same stone type was set in. Numerous examples of this type of repair are discernible on stones used in walls and on other architectural elements, stone carvings and reliefs. Iron clamps set in lead were used to stop large cracks from spreading. In smaller cracks, the surrounding area was trimmed with a wide chisel or stonecutter's hammer to prevent their propagation (Tilia 1972: 3).

Because of their irregular shapes, the large veins were removed and the resultant cavity was shaped into a regular square, circle, etc. (Figure. 9). Then, a piece of stone of the same dimensions as the cavity was cut and inserted into the latter (Figure. 10). To ensure the patch perfectly matched the cavity, again the pigment test was applied (Figure. 11). The last step was to affix the patch with a dovetail clamp or metal pegs (Figure. 12).



Figure. 9: *Holes cut to insert stone patches on the reliefs*



Figure. 10: *An example of stone patches used for restoration*



Figure. 11: *Traces of pigment in the cavity created for patching*



Figure. 12: *Restoration with clamp*

Unrepairable blocks that proved impracticable for the originally intended purposes would be utilized in other parts. This postulation is based on the fact that there are several finely cut and dressed stones that had been used at such irrelevant parts as foundations and drainage canals after their veins were detected during in situ fine cutting (Figurs. 13, 14).



Figure. 13: *Discarded column element used in the foundations of Hadish Palace*



Figure. 14: *Discarded column shaft used in the drainage canal*

Conclusions

The reasons that some remains of stone structures at Persepolis have remained standing through the ages is the peculiar techniques the Achaemenian masons applied while setting the stones in place. They were particularly concerned with the quality of stones right from the start. It was decided at quarrying site in which structural part the separated blocks would be utilized. They made the blocks as light as possible to facilitate their transport to the Terrace. The distinct technique they used in holding blocks together is unattested even in the later periods. Blocks with impurities were either repaired or replaced with better ones, while those with major defects would be utilized in less important or invisible structural parts.

Acknowledgment

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