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Report on Stabilisation Measures in the Eastern Buddha Niche, 2009

The signatory was on site together with Bert Praxenthaler and Mujtabah Mirzai from 5–15 June, 2009, to make the above mentioned examinations.

The Sixth Expert Working Group in Tokyo, 19–20 January 2008 recommended *the conservation of the original surface fragments at the back wall of the East Buddha niche by a restorer. The appropriate conservation strategy for the endangered parts of the backside (e.g. shoulders, head) has to be defined jointly using all the necessary technical expertise (compare p. ##).*

On April 16, 2009 an expert meeting with representatives of UNESCO took place in Munich, where the further procedure in the stabilisation of the back wall was agreed.

Stabilisation works in the back wall

When the scaffold reached the shoulders the detritus was removed from them and temporary foundations for the further construction of the scaffold were made hereon (see fig. 1). The wire net fixed above the head was removed, then the loose rock fragments in the area of the cervix (see fig. 2). Afterwards the scaffold could be completed.

Before the stabilisation works at the back wall could start all rock fragments on the verge of falling were provisionally fixed with tension belts. The left and the right shoulders have been provisionally protected (see figs. 3 and 4), as well as the head and the wedge under the eastern gallery above the head (see fig. 5).

Afterwards all smaller rock parts which had been separated from the back wall by the explosion were secured. This concerns blocks of about 20 x 20 x 15 cm up to about 1.0 x 0.5 x 0.5 m. To secure these blocks high quality steel nails with a length of 50 cm resp. 100 cm were bought. To fill in the joint spaces Ledan was used, an injection mortar which is chemically-physically similar to hydraulic lime, and with which positive experience was made in restrengthening of paint layers on stonework underground.

To secure the blocks of the above-named dimensions it is necessary to fill the joint that separates the block from the back wall with injection mortar and to harden it. Then the rock can be drilled through, in the borehole filled with mortar a rock nail of the necessary length can be inserted (see figs. 6 and 7). If the joint were not filled in with mortar before, the rock could continue to loosen from the back wall by the vibrations of the drilling and eventually fall down.

The situation is different at the big blocks at both should-

ers, at the head and under the eastern gallery, concerning blocks of several tons of weight, which cannot be secured with the above described measures. According to the agreements on April 16, 2009 in Munich these blocks have to be secured with rock anchors of several meters of length whose number and spatial arrangement will be decided by the experts together in situ in October 2009.

Documentation of the fractures in the back wall

Due to the explosion in March 2001 rock sections which have been partially loosened and are now on the verge of falling can be observed at the back wall of the niche of the Eastern Buddha.

From the back wall of the niche a topographic record was made by a 3D scan in October 2006. From this scan I. Mayer from the Technical University Vienna and G. Toubekis from RWTH Aachen University created a front view rectified image of the back wall in a scale of 1:50 in order to record the discontinuities and partially loosened blocks. Based on these records the RWTH Aachen Center of Documentation and Conservation has made a comprehensive description of the back wall of the niche and its specific features (see p. ##, figs. 11–15).

The procedure at this description becomes apparent in the summary (see p. ##, fig. 11), where the back wall is divided into stripes resulting from the floors of the scaffold. Each stripe is two meters high, as the distance of the floors. The documentation begins with the stripe between floors 3 and 4 in the lowest part of the back wall and ends with the stripe between floors 12 and 13 where the scaffold ended in the year 2008.

The completion of the scaffold in the year 2009 made it possible to document the higher areas of the back wall, starting at stripe 11/12 and ending at stripe 14/15. Stripe 11/12 between floors 11 and 12 is characterized by well-preserved parts of the Buddha at the western side, by a small number of joints in the middle part (field d and e), and by a rock gusset in field f which is no longer connected to the back wall. The right shoulder is affected in many parts due to several newly formed joints parallel to the wall and loosened from the back wall (see stripe 12/13, field c and d). Some joints are open for several centimetres. At the explosion a large number of rock pieces have been settled on the shoulder (field b), which all have been removed now that the in-situ rock is visible again.



△ Fig. 1a. Right shoulder after removal of the loose rock fragments



△ Fig. 1b. Left shoulder after removal of the loose rock fragments



△ Fig. 2a. Head of the Eastern Buddha before removing the loose rock fragments



△ Fig. 2b. Head of the Eastern Buddha after removing the loose rock fragments



△ Fig. 3a. Provisional stabilisation of left shoulder (upper part) with tension belts



△ Fig. 3b. Provisional stabilisation of left shoulder (lower part) with tension belts

▽ Fig. 4a. Provisional stabilisation of right shoulder



▽ Fig. 4b. Provisional stabilisation of right shoulder





△ Fig. 5a. Loose wedge under the Eastern gallery



△ Fig. 5b. Provisional stabilisation of the loose wedge



△ Fig. 6a. Drilling of anchor borehole



△ Fig. 6b. Removal of dust from the borehole



△ Fig. 7a. Preparations for refilling the borehole



△ Fig. 7b. Filling Ledan into the borehole

▽ Fig. 8a. Pushing anchor as far as possible into the borehole



▽ Fig. 8b. Driving anchor into the borehole with a hammer





Fig. 9. Trace of an open joint parallel to the back wall (red line)

The ICOMOS team in the Western Buddha niche, October 17, 2009



The left shoulder is also affected in many parts due to several new formed joints parallel to the slope and loosened from the back wall (see stripe 11/12, field f and g as well as stripe 12/13, field f, g and h). Some joints are open up to about 10 cm. In these open joints decimetre large rock pieces can be seen which fell into the open joint from the upper side of the shoulder. The left shoulder was also covered with a large number of rock pieces which settled there at the explosion. This detritus was removed so that the in-situ rock is now visible.

The back wall of the Eastern Buddha still shows in its highest part remains of the Buddha head (see stripe 13/14 fields d, e and stripe 14/15 fields b, c, d). The remains of the head are a large rock plate which is affected in joints parallel to the slope by newly formed ones. The joints are slightly open. The joint behind the remains of the head continues along the both shoulders. It is clearly visible as continuation in the corner of the back wall and both side walls of the niche (see fig. 9). It could not be found out how far this large joint continues upwards. But behind the shoulders is an opening of several centimetres which allows the conclusion that this joint must continue at least several meters vertically downwards.

This joint separates, at least in the area of shoulders and head, the remains of the Buddha body from the original back wall continuing above the shoulders and next to the head. In

the shoulder area a 2 to 2.5 m thick rock part is separated from the in-situ rock by a dorsal open vertical joint.

Conclusions

The stabilisation of the smaller loose rock blocks in the back wall of the Eastern Buddha is largely finished. For this purpose the open joints have been filled with injection mortar and the particular blocks have been fixed with rock nails of 0.5 resp. 1.0 m length at the back wall.

Up to now the larger rock blocks at both shoulders, at the head and under the eastern gallery on the verge of falling are only provisionally secured. The final stabilisation with rock anchors still has to be accomplished. The steps in this process are:

1. Filling up the open joints with injection mortar;
2. Determination of the orientation and length of the rock anchors;
3. Drilling of the anchor boreholes (40 mm in diameter);
4. Setting of the rock anchors.

The documentation of the fractures in the back wall is finished and has been integrated in the topographic records of the back wall.