

DIGITIZING AND CNC-PREMANUFACTURING OF STONE-SCULPTURES¹

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Today's manufacturing of sculptures, plastic arts, capitals, reliefs, ornaments etc. from natural stone is traditionally and almost exclusively done by sculptors manual work. Especially pre-machining of the raw stoneblock demands heavy physical work. From pre- up to finish-machining the single level-points are transferred with help of a mechanical pantograph mechanism from the original to the duplicate to be manufactured.

The ITW in co-operation with the Sächsische Sandsteinwerke Pirna has developed a CNC-machine and the technological procedure to automate the pre-machining of sculptures.

The original sculpture is digitized applying an optical 3D-sensor. Digitizing is possible either using an 3D-coordinate measuring machine as handling system or using the sensor as „flying“ sensor. The digitized point-cloud is scaled up by an offset depending on the required allowance. From horizontal cross-section derived contour-curves are the information needed for the NC-code-generation. The functions of the CNC stone cutting machine are moving the cut-off-wheel in the right vertical positions and cutting the contour-curves in the raw-stoneblock. After cutting all curves the remaining laminas can be easily sledged. Result is an rough-machined sculpture, which may be finish-machined by the sculptor or stone-mason.

To perform the infeed and cutting motions the CNC-stone-cutting-machine is equipped with 3 NC-axis. The contour-curves are cut by a horizontal aligned diamond cut-off wheel. The traversing-distances ranges up to 500 mm in horizontal and 1000 mm in vertical direction. Maximum blank dimensions of the stoneblock may be 1000 x 1000 x 1200 mm.

The developed CNC stone cutting machine together with the technology described was tested by the ITW under filed conditions in the Sächsische Sandsteinwerke Pirna. The expectations in seven manual work and time were proven but the sculptors challenge to make an "original copy" was preserved.

Due to the large diameter of the diamond cut-off-wheel contours including sharp bends can not be cut up to the allowance. Further developments will respect this and use milling and/or drilling heads to improve the state of preprocessing.

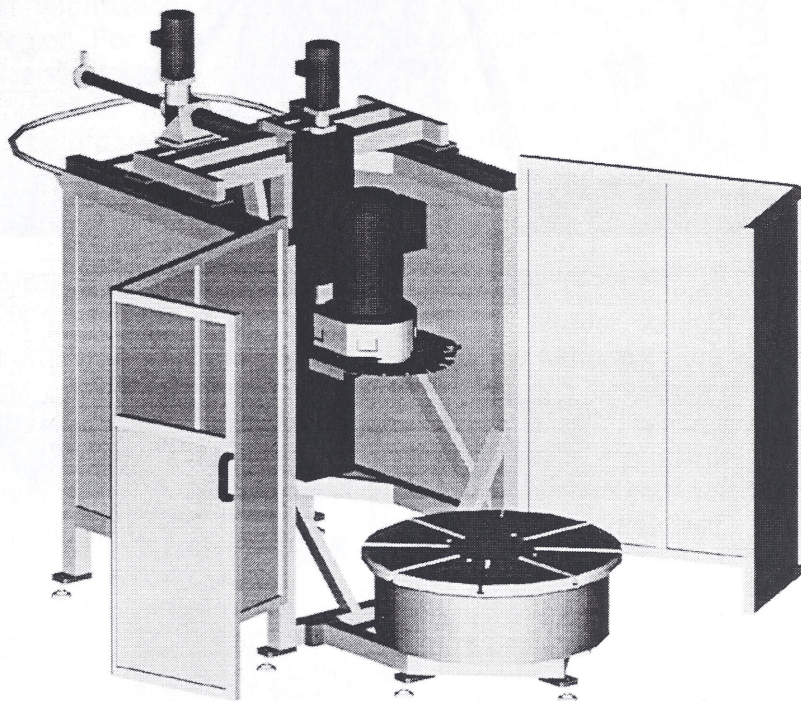


Fig 1 CNC stone cutting machine

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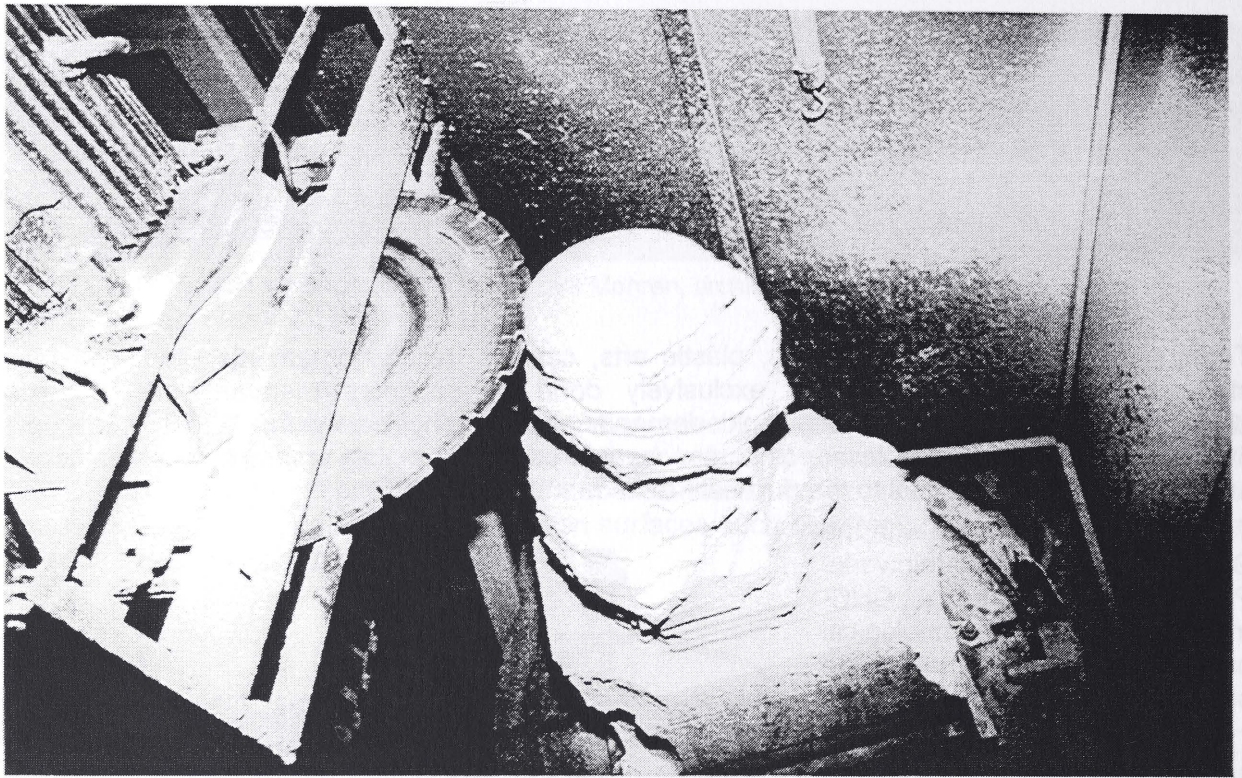


Fig 2 Pre-machining of a sculpture at a CNC stone cutting machine

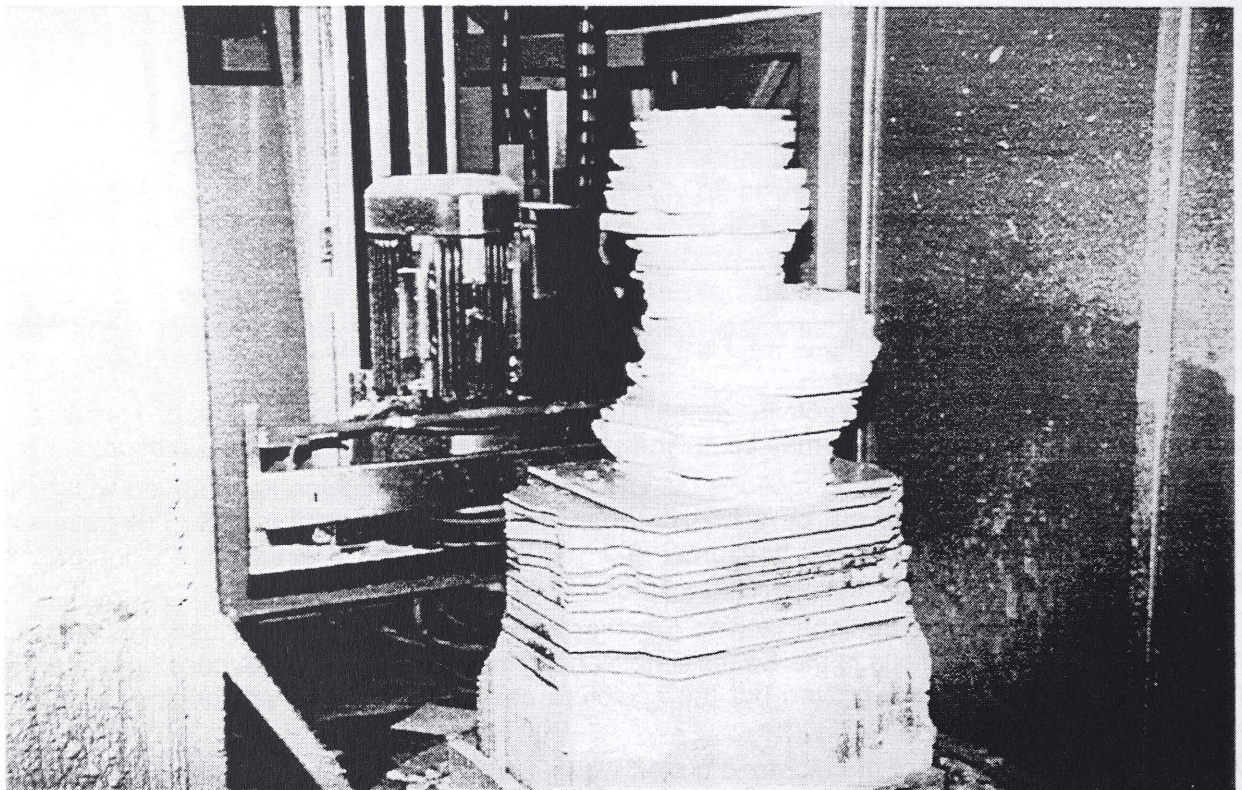


Fig 3 Pre-machined sculpture with partly cut off lamellas