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PC-Controlled Flexible Production of Brickwork

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Abstract

The pre-fabrication of ready-made building elements - in particular of brick walls - has been practised successfully in the Federal Republic of Germany for some 20 years. The rapidly increasing demand for building material requires the decision from the manufacturers either to increase their manufacturing capacities or to build new plants. This paper presents a new development of a pre-fab-plant of Messrs. Anliker, which is a solution entirely based on computer-aided manufacturing. The individual components of the hardware and software used are part of a modular conception which makes it possible to refit existing plants or to build up new ones in future.

1. INTRODUCTION

Today's building industry is characterized by a tremendous demand for building capacity - clearly in evidence in the new, eastern federal states and most likely to be expected in the neighbouring eastern countries in future. The most important part of the demand for building will be for homes and flats, for which there is no equivalent production capacity due to the insufficient construction of such buildings in former years and the lack of skilled personnel. In order to ensure fast construction of a building pre-fabrication of ready-made concrete elements, brick walls and brick ceilings has been successfully applied for many years. This type of production guarantees both a high volume of production capacity as well as a reduction of the minimum time required for assembly on site. At the same time the process of pre-fabrication always takes place under the same conditions and circumstances which makes it possible to achieve a high standard of quality. Production is possible inde-pendent of season and weather conditions and it is always possible to step up production by shift work to meet increasing demand.

Experience has shown that the demand for individual architecture must not be limited by pre-fabrication, i.e. production must be flexible enough to meet this demand. The efficient production of complete walls started in the factory of Messrs. Anliker in 1986 with the construction of a brick-laying-machine which was initially used for the own demand. Soon it turned out, however, that other companies were interested in the conception of this machine

and Messrs. Anliker have since built and sold 23 machines of this type. Decisive for this success has certainly been that the requirements of both the user and the manu-facturer of the machine could be met directly.

2. COMPUTER-AIDED DESIGN OF PRE-FABRICATED HOUSES.

Planning a pre-fabricated house or building starts with a number of sketches put on paper by the architect and presented to the client. When this stage has been completed the final plans will be available - either drawn by hand or by a CAD-system, according to the working method of the architect.
The use of a CAD-system allows 2D or 3D data as well as different system-specific or standard data formats (for instance DXF, IGES etc.).
For the programme WANDPLAN which was realised within the framework of this research project to the present day two interfaces have been developed (see fig. 1).
In the first case such data as length and width of wall, position of windows and doors etc. can be entered manually on the basis of the plan for the building (see fig. 2). In this case the dialogue masks can be prepared by the user in such a way as to minimize the number of data to be entered.
In the second case an interface was programmed for a CAD-system already used by Messrs. Anliker for planning concrete elements. The break-down of complete walls into production units is done on the CAD-system.
From the data entered the programme calculates the number of full- and half-size bricks required as well as the type of cut to be made. These details can be printed, if required, together with other important data, such as for instance weight, centre of gravity and dimensions of the wall. In order to make full use of the capacity of the brick laying machine the programme combines the individual walls to complete units. The production data can then be fed into the production computer via floppy or network connection.

3. PRODUCTION PLANT

Two important requirements which had to be met by the production plant have been: first of all to manufacture wall of different thicknesses, and secondly to account for different tolerances in brick length by cutting the bricks automatically to size. At the same time it has been attempted to conceive the various parts of the machine in such a way that they are as robust as possible and simple in design in order to be able to offer a machine which is dependable and reasonable in price. The layout of the installation is shown in fig. 3 and is briefly explained as follows.
When the bricks are taken from their pallet always two pieces are always gripped and placed on a conveyor belt once they have been turned by 90°. Using an external gripping device makes it possible to securely grip bricks which are inaccurately placed on the pallet. The separation of the bricks is ensured by using two belts operating at different speeds. The various layers of bricks for a wall are put together on the positioning belt and the real length is measured with a built-in incremental measuring device. The half- and odd-size bricks are cut to size by the sawing station. The remaining part of the brick is buffered for possible use, provided there is a demand for an equal or smaller size in the next step. Window and door openings in the wall are spared out. Once a complete layer of bricks has been put together

this is clamped by cylinders installed horizontally and turned over onto the turn-over table of the MULTISTONE plant. Whilst this layer of the wall is then turned over to be integrated into the wall the next layer of bricks is put together on the positioning belt.

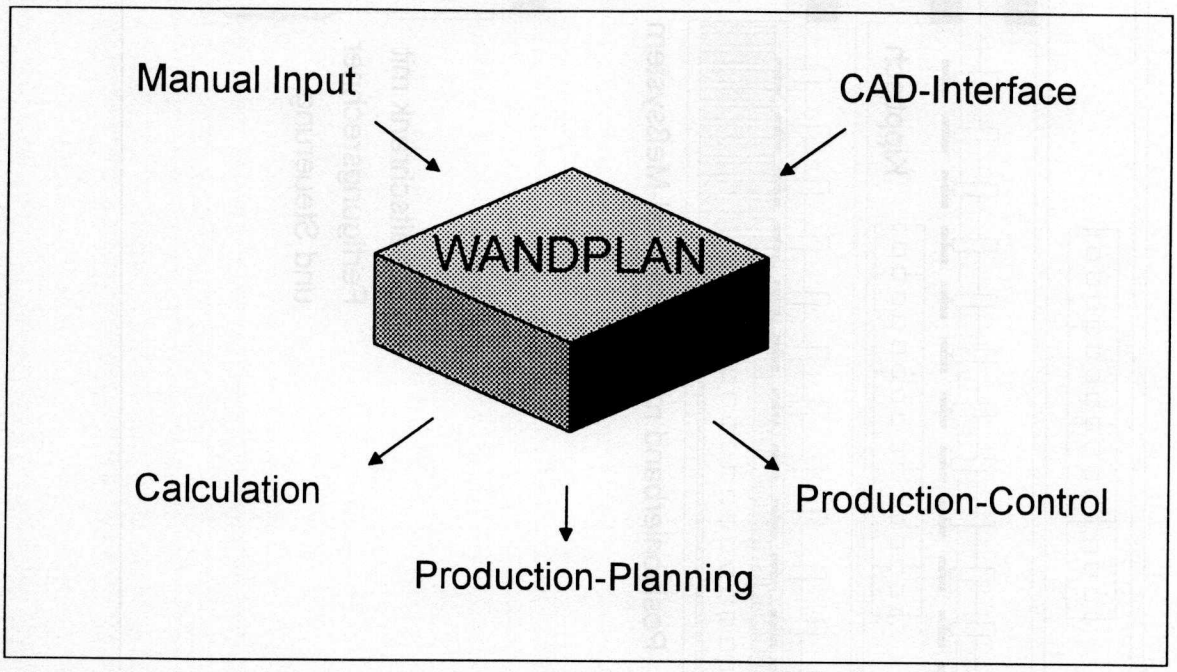


Fig. 1: Interfaces to the Programm WANDPLAN

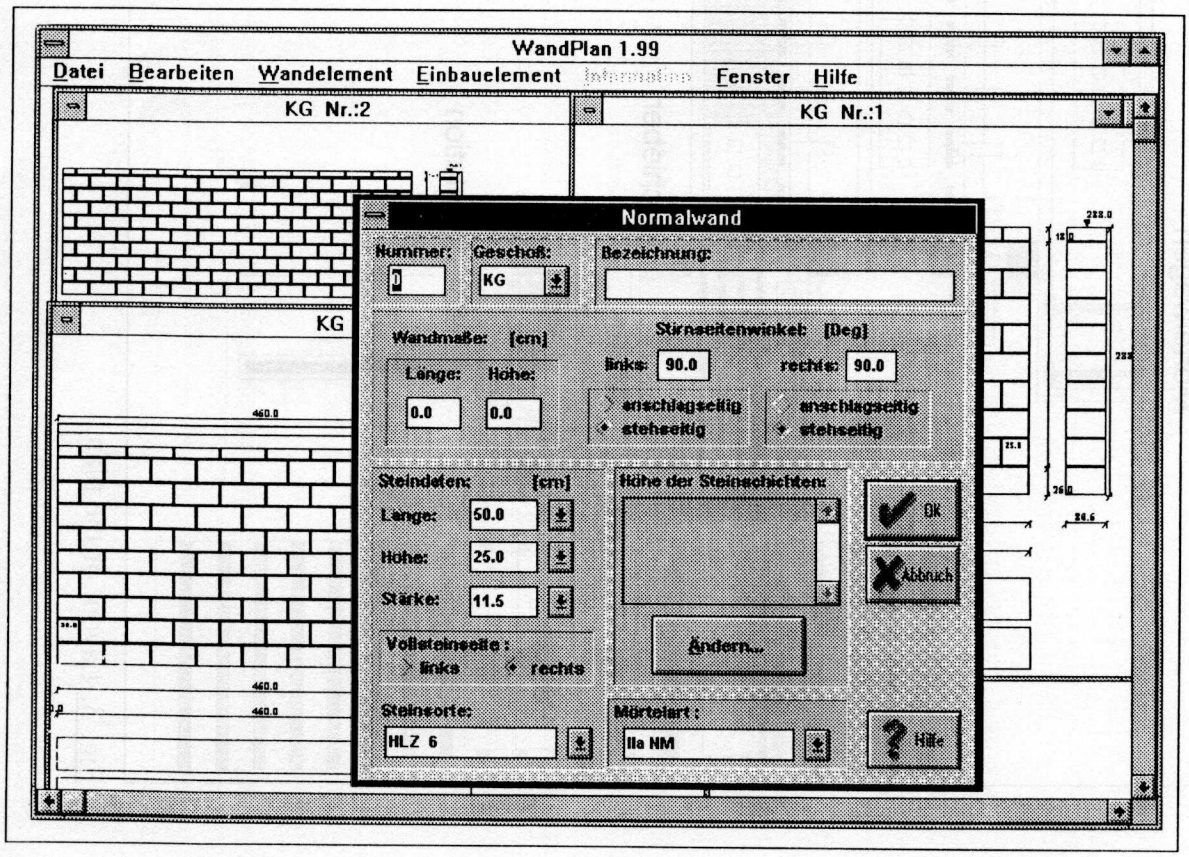


Fig. 2: Manual Input

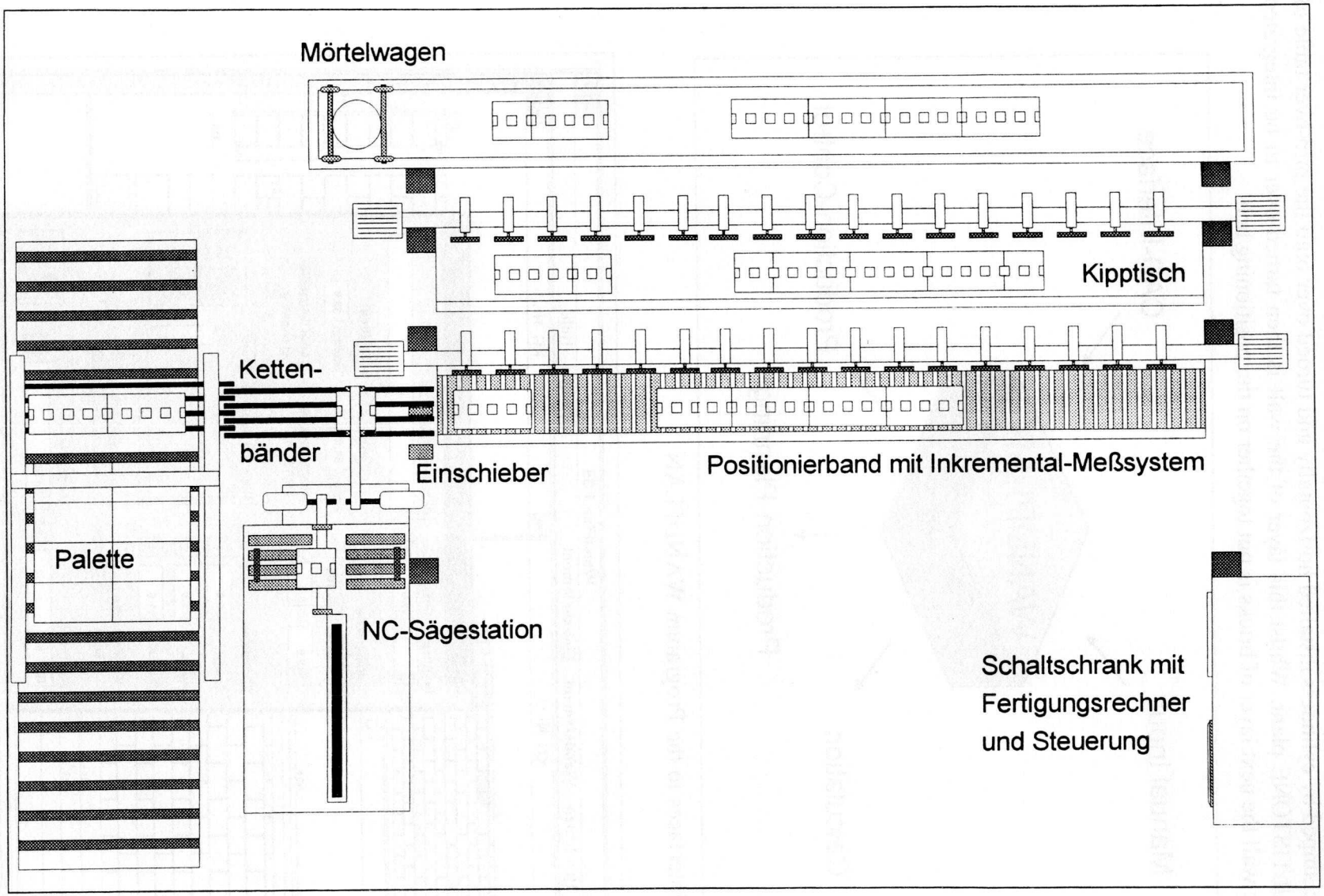
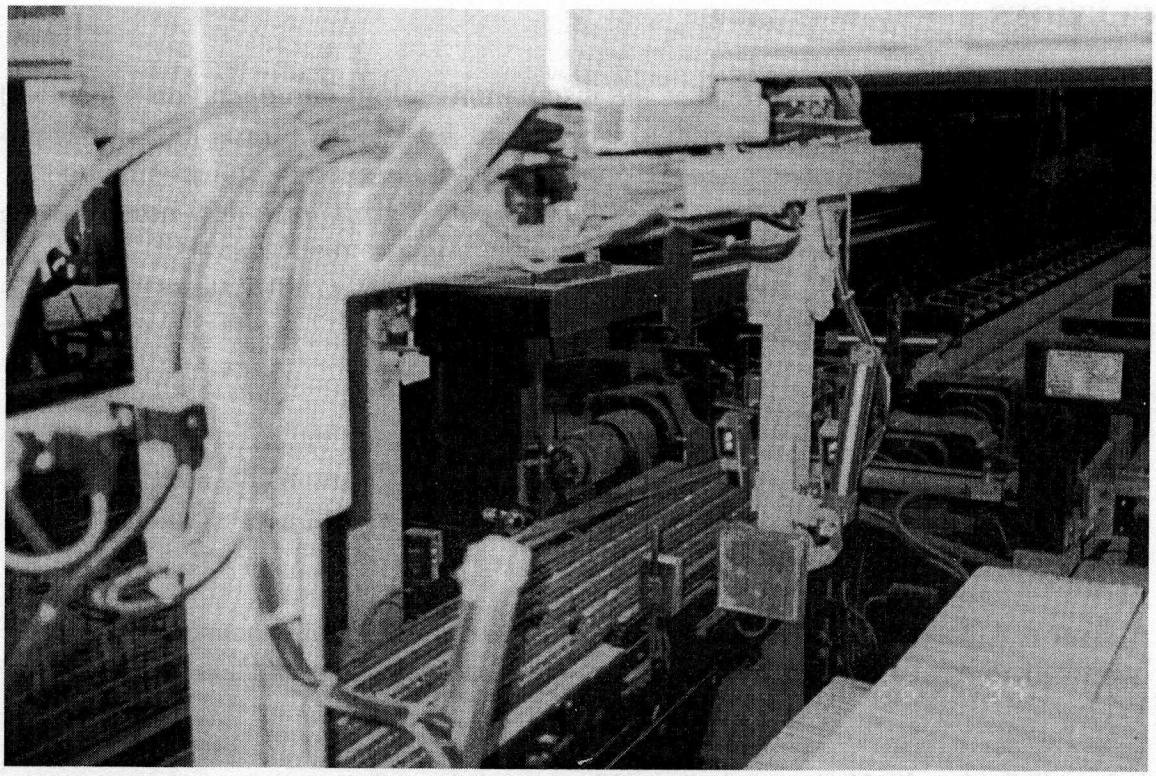
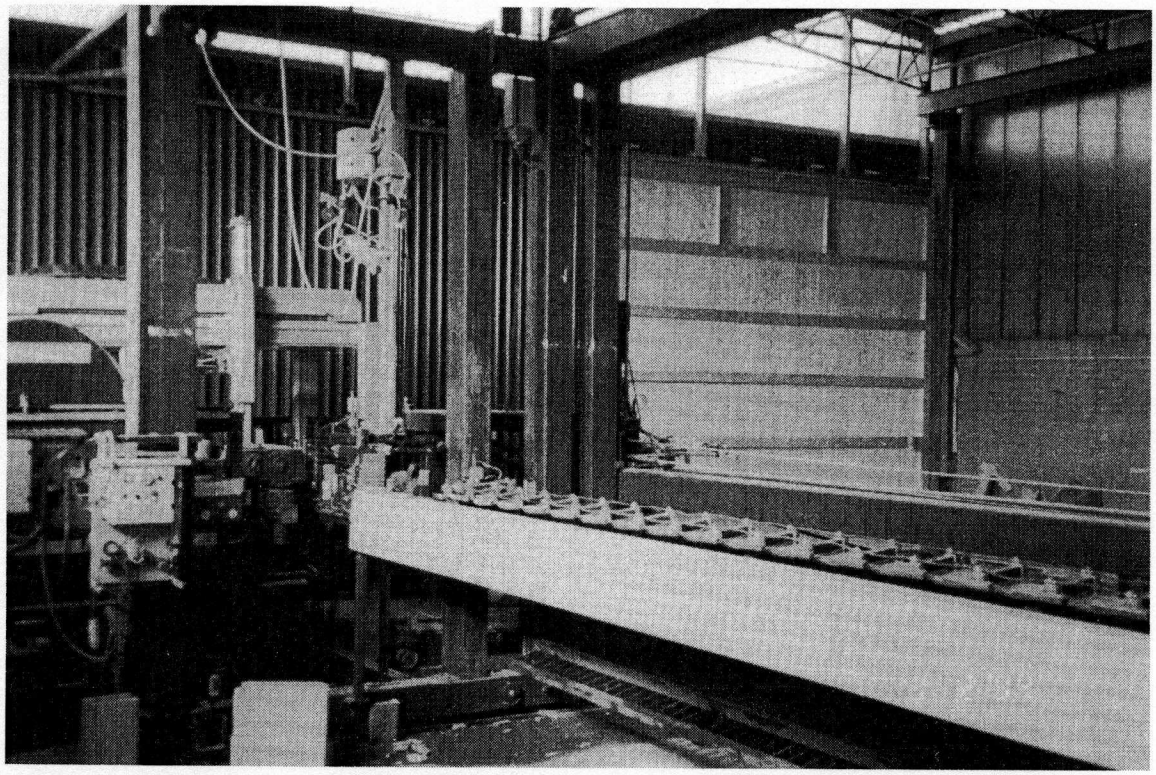


Fig. 3: Layout of the plant



Pic. 1: Brick Pallet and Gripper



Pic. 2: Sawing Station and Positioning-Belt

CONCLUSIONS

At the moment the individual functions of the installation are put into operation which will be followed by a fully automatic test run. This could lead to new insights for the improvement of individual components and the optimization of the overall production time.
A future development will look into the possibility of conceiving a low-noise sawing machine with a larger buffer for making better use of cut bricks to reduce waste.
Additional software tools will consist of connections to other CAD-systems, i.e. DXF-interface, and various calculation modules.

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