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Optimal pallet loading increases productivity

The eleventh article in the series "Increasing Productivity and Quality Management" focuses on the subject of pallet loading in a precast facility. There is certainly a direct correlation between the loading of production pallets and the productivity of the facility. This report explains the mechanics of pallet loading and discusses the factors that influence the degree of such loading. It also shows that optimal loading is not necessarily only about maximizing the surface to be concreted, and that issues such as ergonomics and the homogenization of cycle times are important factors.

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General mechanics of pallet loading

The term pallet loading generally refers to the arrangement of the elements to be manufactured on production pallets. In order to achieve optimal loading of pallets, the master computer takes a number of orders into consideration. Depending on the planning horizon of the factories concerned, either one shift or several daily productions are taken into account. Work preparation may also encompass individual batches.

Stack presorting

The first step in pallet loading is stack presorting. Stacking is usually carried out on the CAD system. The building to be constructed is split up into floor and wall elements. Based on the installation plan and the anticipated site conditions, the design engineer determines the order of assembly. Taking this order into account, along with the maximum height and weight limits, the stacks are now formed. Floor slabs are stacked horizontally on top of each other and transported lying down. Walls are loaded onto A-frames or inloader racks and brought to the site in an upright position. In precast facilities, these stacks are formed on stacking stations. They are controlled from the lift-off station. Precast facilities usually have between two and eight stacking stations.

The aim of presorting the stacks is to determine the optimal order in which the stacks are to be produced. Adjacent stacks in this production sequence should complement each other optimally as far as possible. For stack presorting, the following criteria, among others, are taken into account: size, product type, wall thickness, type of concrete.

As far as possible, the sequence in which the stacks are produced should ensure that stacks which complement each other geometrically and require the same production processes are positioned adjacent to each other. Thus, for example, long slabs used for a car parking garage complement short flooring slabs used for a family home. In this way, stack presorting creates the ideal conditions to achieve good results for the pallet loading process.

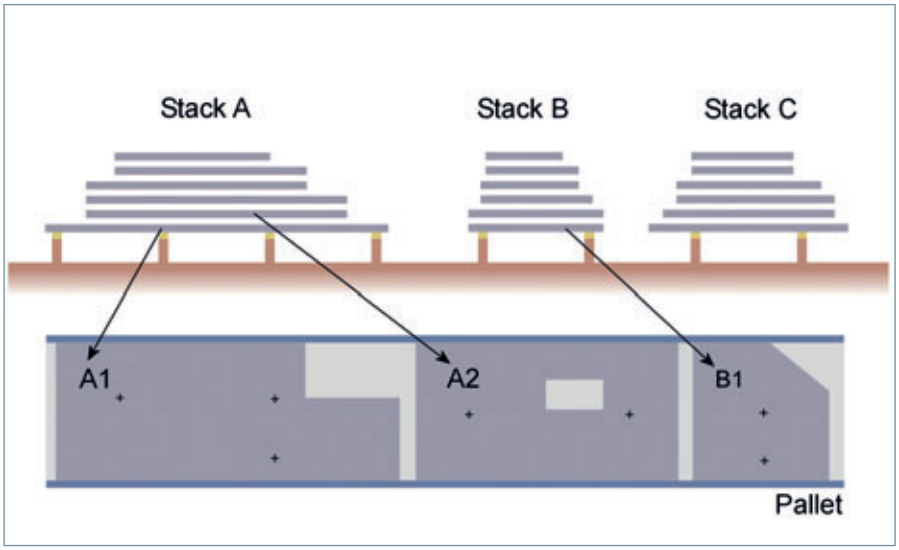

Fig. 1: Schematic diagram showing pallet loading with three stacks

Automatic pallet loading

For an explanation of automatic pallet loading, let us construct an example. Let us assume, Prefab Construction Ltd produces prefabricated slabs and has three stacking stations. The stacking stations are called A, B and C. Due to transport height limitations, a maximum of six elements can form one stack. The bottom element in stack A is designated A1 and the top one A6. CAD transfers 23 stacks to the UniCAM master computer. The stack presorting program calculates the best possible sequence for production.

When automatic pallet loading is initiated in the master computer, the default stacking order is worked out virtually. The three stacking stations are loaded with the first three stacks. Only the bottom elements in the stacks come into consideration for loading the first pallet, for example, A1 + B1 + C1 or A1 + A2 + B1 (see Fig. 1). Going through all the possibilities for this first pallet, there are 10 variants. Then, considering the degree of loading for each of these variants, the optimum pallet loading can be determined. When calculating pallet loading, UniCAM uses an algorithm reminiscent of a chess computer. UniCAM always tries to think several moves in advance before settling on its next move. The programme works its way through one pallet at a time. When a stack is full, the next stack is put in its place. Thus, all 23 stacks are processed virtually.

The degree of pallet loading is not everything

The "automatic pallet loading" module in the UniCAM master computer represents 25 years of practical experience. This means that pallet loading takes into account many individual conditions, such as minimum distances, preferred orientations, product combinations, types of concrete, dependencies of machinery and formwork system, ergonomics, processing

time, etc. Through appropriate parameterization, the software can be adapted to the specific conditions in the factory. Thus, from space optimization ensues productivity optimization.

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Organisational measures to improve pallet loading

In addition to the algorithm and the software parameters, pallet loading can be improved by organizational and structural changes in the factory. The number of stacking stations, depending on the products, can have a direct impact on pallet loading. Just two additional stacking stations increase the number of possible combinations for the loading algorithm hugely. Frequently, any gain in concreted surface area is eaten up again by waiting times. Here, a flexible system layout is of great benefit. Additional processing stations and passing lanes mean that strictly sequential processing can be replaced.

Fig. 2: Stacking stations for floor slabs

Fig. 3: Automatic pallet loading on the UniCAM master computer

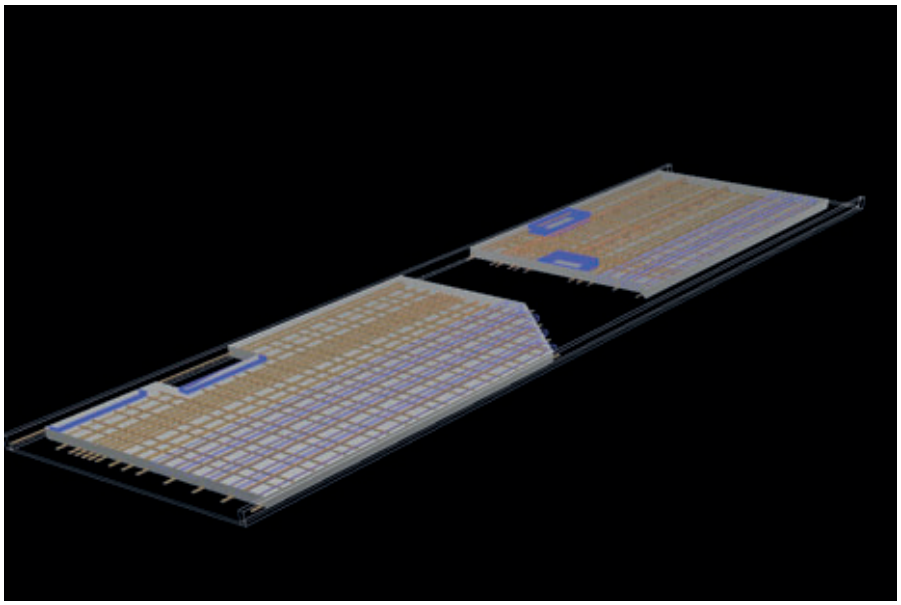

Fig. 4: Visualization of a loaded pallet

As banal as it may sound, one very important factor is accepting the right jobs for the production system. If the dimensions of the products are well suited to the pallet size, then a good use of space is easy to achieve. Homogeneous products and good complementary dimensions do the rest.

Manual optimization

Why would one need an option for manual loading in addition to automatic pallet loading? Fortunately, with his holistic appreciation of events, a human cannot be completely replaced by a programme. The worker knows his system, his colleagues and his products very well. Intuitively, he knows that a floor slab is better rotated by 180°. A part that urgently needs to be reproduced still fits on a pallet. Whatever automation is in place, it is still advantageous if a human remains in control of events.

Manual pallet loading in UniCAM supports the worker in this creative activity. Operation is intuitive using the mouse to drag and drop. Elements can be shifted either on the pallet or between pallets. If the operator moves or turns the shell of a double wall, the other shell is automatically moved as well. Millimetre-precise positioning is facilitated by selecting preferred positions.

Conclusion

Better utilization of the surface area of a production pallet only increases the productivity of a precast facility as long as the benefit is not offset by longer cycle times or increased use of resources. It is important to keep sight of the entire range of workflows when optimizing pallet loading. A good manufacturing control system offers the possibility of adapting pallet loading to the individual facility using a variety of parameters.

FURTHER INFORMATION

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