Integrated Planning, Prefabrication and Logistics

Peter Maack
Schulstrasse 22 - D-21376 Salzhausen / Germany

In recent years demand for low-cost housing construction – to these the following paragraphs are to relate – has been increasingly requested by politics and management. A lot of examples have shown that quite a considerable reduction of costs of production can be achieved without loss of quality, and that this effect can be achieved without having to resort to low wage, foreign work-force. A large part of the development of the reduction of costs of production must be attributed to integrated planning, prefabricated parts and better logistics.

1. Integrated planning

By integrated planning we understand optimizing of a building-task with given, aimed at costs. It is in general carried out by only one architect who varies the building-task together with engineers and in cooperation with local building firms according to quality and aimed at costs until the lowest cost-margin has been arrived at. Referring to the dutch model this workgroup is often called "building-team". The work is usually carried out in one of two ways.

1.1 The "Building-team" under supervision by free enterprise

Building-clients commission an experienced "building-team" to plan a building task that should consist of at least 50 units *(homes)* (flats or houses) due to increased expense. The cost-aim will be able to be set to 20 % lower than achievable by conventional solutions. The building-team will produce an optimized solution according to the level of quality set by the building-client. If the cost-aim cannot be achieved an adjustment of the given layout has to be made by varying it. Where the final price falls below the aim-costs the building-client benefits and, if the contracts are formulated to that extent, in a small degree the building-team as well. This variant has the advantage that the economic advantages fall to the building-client and that he is in a position to plan the quality of the building-task up to the end due to the cooperation. The disadvantages lie in the overriddance of rules of commission in construction of social homes and of rules of crafts where general building-tasks are concerned due to cooperation with crafters. This should however be no hindrance for the carrying out of these tasks.

1.2 The building-team under supervision of construction-firms that offer turn-key homes

Experienced construction-firms have been using the tool "building-team" for some time now to optimize building-tasks. This enables them to offer reasonable prices to building-clients. All further possible advantages that can be achieved by the building-team fall to the offerer of the object.

It is advantageous that a building-client receives a construction-work for a fixed price and a description of the building-task. Disadvantageous however is that after the contract is signed control over the object is lost and that optimizing procedures are often carried out without looking into every detail. Just as described above the "building-team" operates contradictory to the rules.

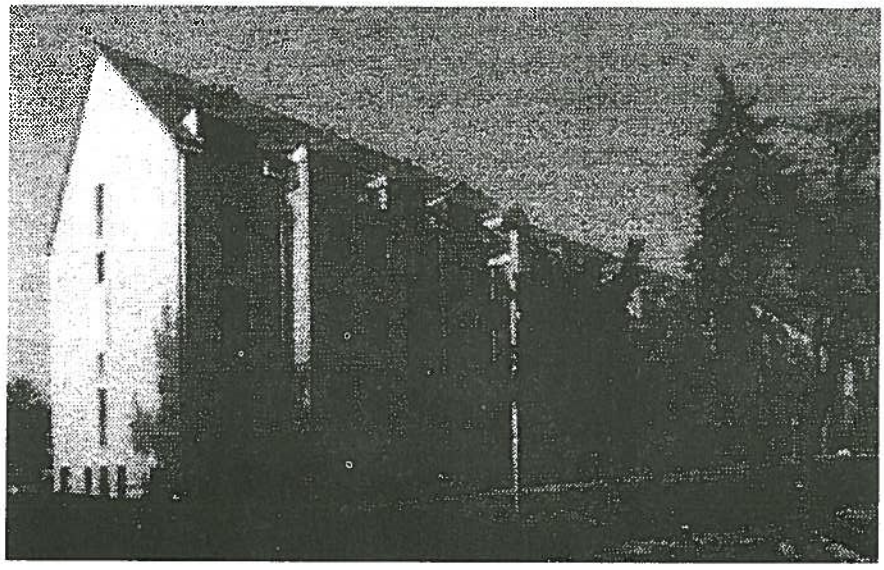


Fig. 1: Hall of residence for 200 students

The Fig. 1 shows a construction with 200 student-homes in Greifswald that has been produced for 1,500 DM per m^2 inclusive corridors and tax in 1994. For this building-task the building-team developed a special form of construction and special methods of proceeding that resulted in these very low costs without loss of quality.

In both described cases a building-team tries to use the possibilities offered by the market for the construction of buildings. In these processes prefabricated parts are being increasingly used as the planning of the building team often leads to far more effective use of prefabricated parts. As the aim to produce buildings with low costs and high quality should to a far extent make use of prefabricated parts the following paragraphs try to give an overview of the possibilities of the common market for prefabricated parts. Offers for stairs, balconies and similar parts are known. This text therefore is to present possibilities of acquiring parts for walls, ceilings and roofs.

2. Prefabricated parts

2.1 Prefabricated walls

Walls made from prefabricated parts for low-cost construction should be slim and heavy to produce the optimum in achievement using the lowest possible area. In general walls of concrete and brick-blocks can be made use of to this effect.

2.1.1 Concrete walls

Concrete walls can be ideally adjusted to the necessary conditions of the erection of a building. Due to concentrations of installation for heating, water and sewage the integration of electrical wire is in general sufficient. Surfaces are at least wallpaper-ready.

2.1.2 Brick-block masonry walls

Prefabricated walls made of brick-block masonry for the common market are often only to be had as relatively thick walls for building-carcasses. Plastered walls directly from the fabrication can be delivered only in rare cases, as these walls are usually used for small objects where the necessary information for the production cannot be given in necessary advance. Additionally slim and heavy walls, for example 11.5 cm thick, can rarely be produced in transportable form. These walls are normally built on site.

Prefabrication-constructions for the common market are therefore relatively rare.

For firms that produce these walls for their own use in buildings (the product "house") they offer on the market the situation is different. For this two ways of production have been established.

Standing construction of brick-block masonry walls

For smaller firms machines are offered on the market that produce walls in fabrication-halls standing as frame-construction (Fig. 2). These walls are then transported to the building-site. In general these walls are produced with a thickness of 17.5 to 36.5 cm. In some cases they are available on the common market.

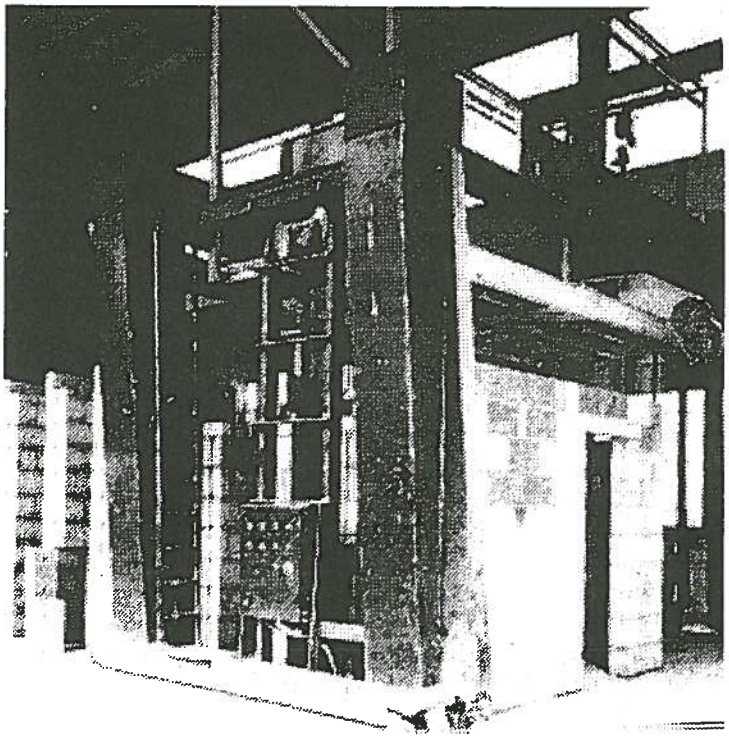


Fig 2: Plant for wall production with standing frame-construction

The most advanced machine for standing construction of walls is for some years now in use at the firm Süba. It produces brick-block masonry outside-walls in general 24 cm thick and of these 300 m² per day and shift (Fig. 3).

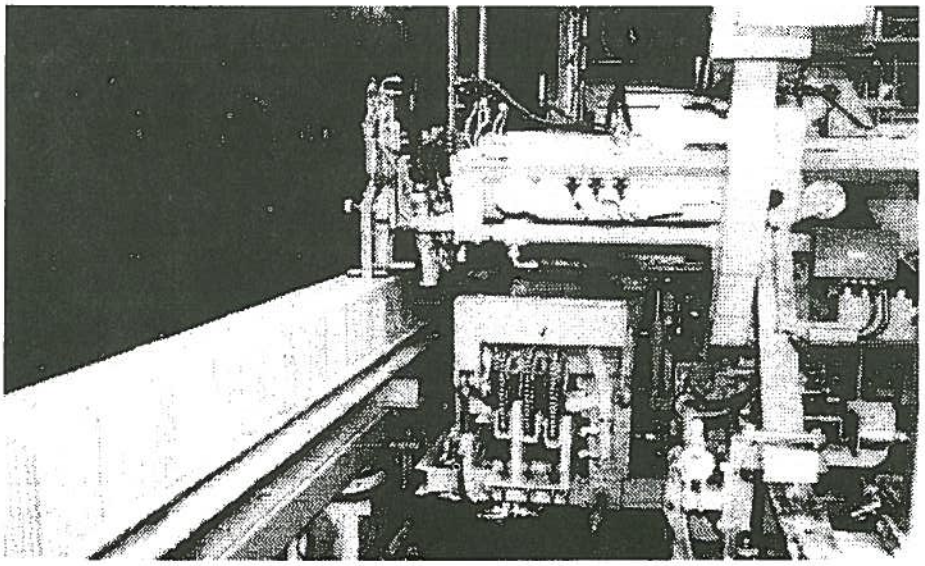


Fig. 3: Production of brick-block masonry outside-walls

Lying construction of brick-block masonry walls

The lying construction of brick-block masonry walls has considerable advantages due to simplicity of production. The Figure 4 shows a production of the firm 'Ziegelmontagebau' (brick-block masonry construction) in Rötz for whom we were responsible for all of the CAD/CAM-system next to product advisement. It stands as the top of this form of production in Germany. Next to walls ceilings made of brick-blocks are produced as well. The plastering of the walls is partially done lying down and partially hanging. The walls come including all installations and all the constructional work is included in the CAD-system.

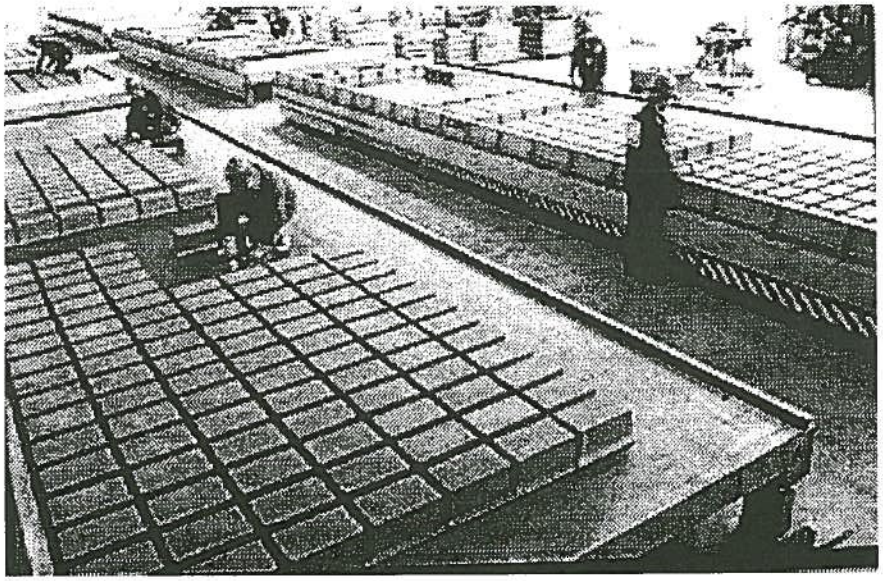


Fig. 4: Lying construction of brick-block masonry

2.2 Prefabricated parts for ceilings

Besides walls the low-cost prefabrication of ceilings plays an important part for the optimal planning of home-construction. Commonly half-precast ceiling-parts and prefabricated ceilings are being used in the market. The underside usually is smooth due to the steel-formwork which makes plastering unnecessary. Except for houses (single-unit), where sometimes the topping-finish can be omitted all ceilings must be fitted with it which is very disadvantageous in assembly-construction.

The Fig. 5 shows in principle a for patenting registered ceiling that gives an assemble-ready ceiling made of reinforced concrete that leaves the statical functions on the underside and the topping-finish-functions on the upper side, using two known elementary ceilings. Using the hollow, free space all necessary installations can be carried out. The ceiling provides for all demands concerning fire- and sound-protection. Erected in the right manner it is ready for coating with carpet or hard floor-surfacing directly after its mounting.

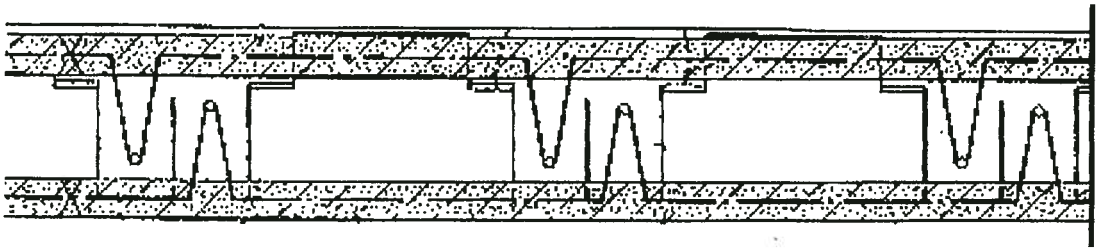


Fig. 5: Assemble-ready ceiling

2.3 Prefabricated parts for roofs

The fitting-techniques usually are apt to suffer from deficiency of lack of offers on the market for fitting-roofs. Right now two possibilities for construction exist on the market.

2.3.1. Roofs made out of conventional building materials with load-bearing parts made of wood

On the basis of the in Holland developed method for slab-building for roofs, simple roof-slabs are to be had on the market that allow for a rapid fitting. It is unfavourable that the building-technique does not allow construction of complicated roof-structures as demanded by the planners. Favourable on the other hand is the ease and quickness with which simple roofs can be mounted.

2.3.2. Solid roofs

Next to solid roofs made out of brick-blocks, light-weight concrete or heavy concrete, which play only a minor role in the market due to expense, solid roofs are now to be had that in principal consist of an elementary floor with a concrete-slab of 5 cm thickness and backing for rafters (Fig. 6). Insulation can be put in between the backing in any desired thickness. The roofing on a trade-common foil- or different roof deck is carried out as usual. Normally all solid floors have extensive advantages concerning constructional physics. They have a considerably better warmth protection than light-weight roofs, the thickness of the insulation is as variable as in conventional roofs and the sound protection is usually better. The costs for the last discussed solid floor, that is

right now offered in the market as Süba-solid floor and that will be open for use in other projects, are not higher than those for conventional roofs and therefor allow for an increase in quality without rise in costs.

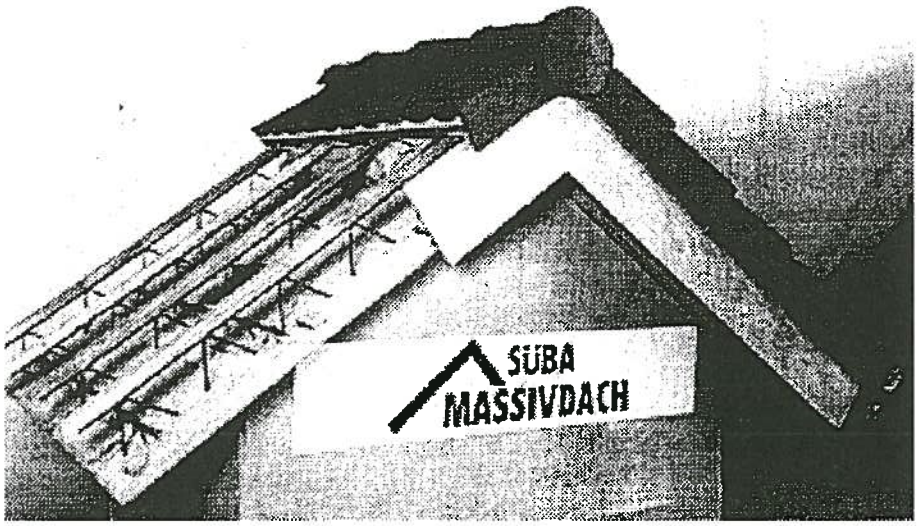


Fig. 6: Model of a solid roof

3. Logistics

A production of houses using the most advanced logistics is the firm Ziegelmontagebau in Rötz. Here all work from dealing with applications to construction are planned and directed. All parts necessary for Roof, floor and wall are to be considered in the computer-program for all the constructional work. The control of the production is carried out by computer, so that even the automatic brick-laying machines are integrated into the program. Coupled with the system are the accountancy, stocking etc..

Right now we are at work to transfer the advantages of the central production as described in the example of the brick-block fitting-construction to the decentralized production. With such a system the advantages of varied suppliers of prefabricated parts and other work for the building-task that can be found on the market could be registered in time and be integrated into the planning. It would also be conceivable to thereby transfer the advantages of lowering of costs by the work of a building team to smaller building-tasks.

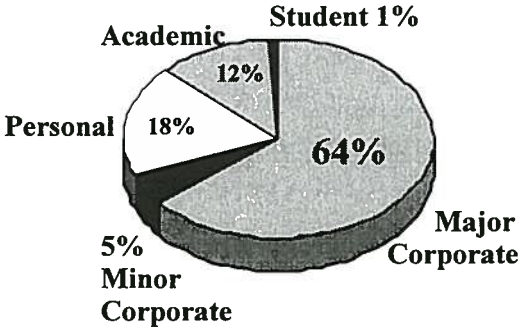
To summarize we can say that by the pressure due to recession and by the pressure of politics and economy decided advance was made possible in the low-cost construction of homes. By further development, to a large extent of the logistic systems and the cooperation of firms, further considerable cost-advantages will be possible to be achieved.

about IAARC

The growing interest shown internationally towards the end of the 1980's in ARC matters led to the formation of IAARC in 1990. By then a number of international symposia (ISARC) had already been convened and the creation of IAARC satisfied the demand for an umbrella organisation.

IAARC is a global community with specific concern for all fields of construction, operation and maintenance, including nuclear structures, road and transport systems and construction in space. IAARC's membership is not just restricted to end-users, manufacturers and researchers, but welcomes participation from other industrial sectors and from government organisations.

The first 14 ISARCs, hosted in several countries world-wide, have yielded over 1,000 refereed papers bound into proceedings. Together these form a compelling illustration of how ARC developments continue to march towards the market place. Contributions from all continents at ISARCs provide the major platform for delegates to exchange views and information and discuss how they might work together on new projects.



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