

Christian Prilhofer Consulting

# Economic evaluation of a new design of circulating plant for producing double walls and/or solid walls

When prices are stagnating, it becomes ever more important to produce current and future products on economic circulating plant. We have therefore sought

to develop a new design of small circulating plant that can also still generate profits during the current period.



Production plant for slabs demoulding area and the mould-handling robots.

by Peter Kawan

When developing this new design for producing double walls and/or solid walls, we first of all examined the advantages and disadvantages of the existing designs to find an economical solution for a new concept.

Essentially, there are three different types of circulating plant.

## a.) Unadaptable circulating plant based on the single-line principle

This type of plant is the most economical and the easiest type to build. Almost all the machinery for producing slabs or floor elements are built

in this way. This type of system can also be used for producing double walls when production performance and the level of automation are not too high.

## b.) Flexible circulating plant with several lines or levels

This type of plant is very good for producing slabs or floor elements and double walls in mixed operation and with high production performance and high levels of automation (from 150m<sup>2</sup> of placed concrete per hour).

When solid walls or similar complex elements must also be produced at even higher levels of automation, a system with several levels in the moulding

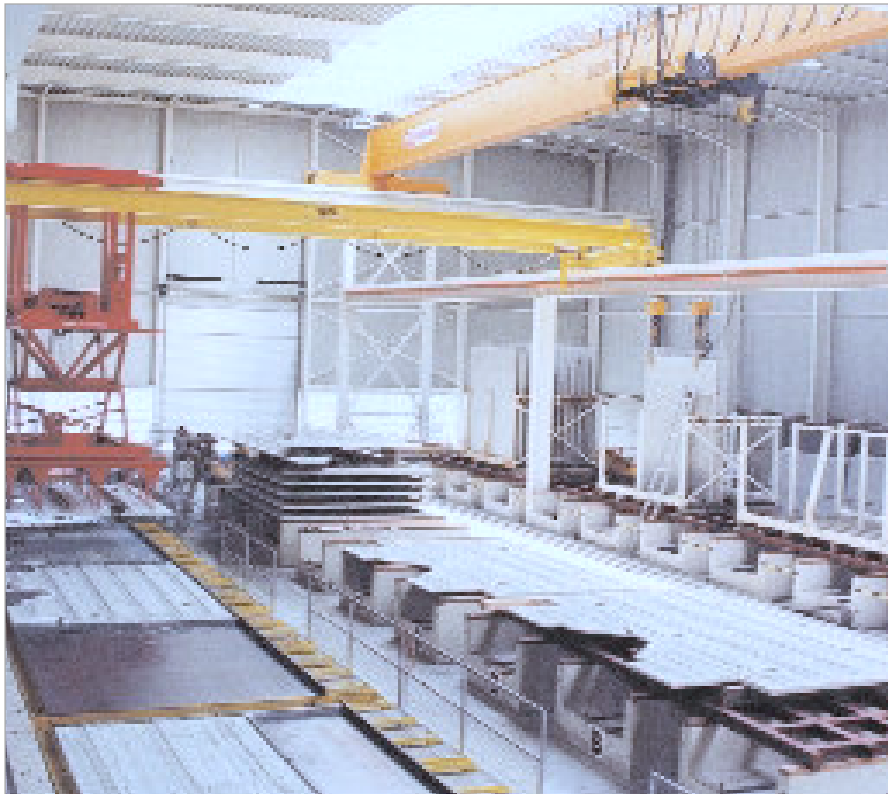
and reinforcement areas offers the best solution.

The following points apply to both systems:

- Flexible cycle times in the moulding and reinforcement areas
- Different demoulding lines and demoulding cranes
- Optimum use of automatic machinery and systems (no waiting time during pallet changeover)

## c.) Plant with a central travelling platform or a section of cross lift trucs

This type of system is especially suited to producing sandwich elements and



**Demoulding area: production plant for roofing elements and double walls**

parts for industrial construction (individual items more than 30 tonnes in weight and 1m high can be produced). We have also constructed such a system for producing solid walls and double walls.

The difference between this system and those described above is that the pallets in the moulding and reinforcement area are not conveyed by means of rollers and friction wheels but instead by means of a central travelling platform (the most economical solution) or pairs of cross lift trucks on each workstation.

In this type of system, 3 of which we have already produced, the pallets can be conveyed from one workstation to the next at any time, without having to take cycle times into account.

But what would a new design for a circulating plant for producing products for double walls and solid walls look like?

**The basic details of the new design are as follows:**

- Compact pallets, 3.0 x 8.5 m
- Loading level, 60%
- Area covered per pallet, 15 m<sup>2</sup>
- System performance of 6 pallets per hour (single skin) during double wall production and 3 pallets per hour

- during solid wall production
- Resulting in an output of 45m<sup>2</sup> of finished wall per hour, i.e. 63,000m<sup>2</sup> of finished wall per year on single shift operation or 126,000m<sup>2</sup> of finished wall per year when operating two shifts.

The above performance is based on the following personnel requirements:

Double and solid walls			Solid walls		
<b>Demoulding</b>	<b>2</b>	<b>Employees</b>	<b>Demoulding</b>	<b>2 – 3</b>	<b>Employees</b>
<b>Moulding</b>	<b>3</b>	<b>Employees</b>	<b>Moulding</b>	<b>3 – 4</b>	<b>Employees</b>
<b>Reinforcing</b>	<b>3</b>	<b>Employees*</b>	<b>Reinforcing</b>	<b>3 – 4</b>	<b>Employees*</b>
<b>Concreting</b>	<b>1</b>	<b>Employee</b>	<b>Concreting</b>	<b>1 – 1,5</b>	<b>Employees</b>
<b>Turning (Smoothing)</b>	<b>1</b>	<b>Employee</b>	<b>Smoothing, Finishing</b>	<b>1 – 1,5</b>	<b>Employees</b>
<b>Total:</b>	<b>10</b>	<b>Employees</b>	<b>Total:</b>	<b>10 – 14</b>	<b>Employees</b>

\* 1 of whom is the shift foreman

The performance and personnel requirements for the different system designs produce the following man-hour figures per m<sup>2</sup> (estimated by Prilhofer):

Products	Personnel requirements	Output*	Wall	Man-hours per m <sup>2</sup> Prod. 50/50
<b>DW+SW</b>	<b>10 Employees</b>	<b>45 m<sup>2</sup>/h</b>	<b>0.222</b>	<b>0.244</b>
<b>SW</b>	<b>10-14 Employees</b>	<b>45 m<sup>2</sup>/h</b>	<b>0.267</b>	<b>-</b>

The various components for the new design of circulating plant are as follows:

**Hardening chamber:**

The hardening chamber is designed with 4 shelves with optional access. Segmented gates can be fitted in front of the individual shelf areas and the shelf service unit, which can be designed to run above or below, is fitted with an opening mechanism for these segmented gates.

**Amount of shelf area: 4 x 14**

**Demoulding area and exit vehicle:**

Solid walls can be pre-demoulded in the demoulding area. The wall elements can be removed at the tilting station, which is designed as a passing station, and the wall frame stored.

The mouldings from double wall production are removed at the next pallet position. Up to 6 stacking areas could be provided for in the production hall, between which an exit vehicle with three cross-lift trucks is arranged to take the conveying frame with the walls outside.

**Cleaning:**

A static cleaning and lubrication unit is arranged between the pallets to clean and lubricate them. Cleaning arrangements are subsequently planned for the parking system and the magnets.

**Moulding stations:**

A laser is used on each of the moulding stations to project the element's geo-

metry. The mould sections for producing double and solid walls are set by hand.

## Reinforcement stations:

Meshes are provided on a stage to provide reinforcement. In the case of combined double and solid wall construction, the meshes are supplemented by a lattice girders.

## Concreting station:

A combined vibration and shaking station is provided. An additional shaking station can be added for double wall production.

A bucket conveyor is used to transport the concrete from the mixing plant.

## Double wall production:

The hardened first shell is removed from the hardening chamber and transported for double wall production. The turning crane picks up the pallet with the first moulding (or a suction pallet with the first moulding) and moves this into the freshly concreted second shell. After the compaction process, the pallet with the double wall is returned to the hardening chamber.

The empty of the first shell pallet is re-stacked on the shelf or transported directly to one of the demoulding stations.

## Solid wall production:

The ready moulded and reinforced walls can also be stored in the hardening chamber before concreting. In order to be able to concrete several solid walls in succession, these pallets are removed from the hardening chamber and then returned to the hardening chamber after concreting and compaction.

The investment costs would be around 3 million Euros for the above design including the following equipment:

- Circulating plant with 50 pallets
- Compaction system, turning traverse
- Laser system
- Cleansing and lubrication system for pallets and mould systems/magnets
- Moulding system
- Concrete spreader
- Control unit
- Mesh and lattice girder treatment
- Bucket conveyor
- Crane



**Moulding and reinforcement area**

- Installation/commissioning/freight
- Hall with stages (approx. 21,000m<sup>2</sup>)
- Services on site
- Planning and co-ordination.

## **What returns can be achieved now using this new design?**

Based on a sales price ex works of 34.5 Euro/m<sup>2</sup> for double wall and 45 Euro/m<sup>2</sup> for solid wall, the following returns can be achieved:

### **Double wall production/ solid wall production:**

**Return based on single shift operation** (31,500m<sup>2</sup> of finished double wall and 31,500m<sup>2</sup> of solid wall):

approx. 8%

**Return based on double shift operation** (63,000m<sup>2</sup> of finished double wall and 63,000m<sup>2</sup> of solid wall):

approx. 40%

### **Solid wall production:**

**Return based on single shift operation** (63,000m<sup>2</sup> of solid wall):

approx. 19%

*This new design for a circulating plant, however, is not without both advantages and disadvantages:*

**Advantages:**

- Outstanding price-performance ratio
- High operating efficiency (man-hours per m<sup>2</sup>), comparable to large plant
- Low investment cost

## **Disadvantages:**

- Element lengths restricted (to approx. 8.0m)
- Production volume limited
- Capital/production volume ratio is better in large plant

This new design for a circulating plant was introduced to insiders in the industry at two presentations in Freilassing and received a totally positive reaction. ■

## **Further information:**



### **Germany**

**Christian Prilhofer Consulting**  
Pommernstraße 17  
D-83395 Freilassing, Germany  
Tel.: +49-(0)8654-69080  
Fax: +49-(0)8654-690840  
E-Mail: [mail@prilhofer.com](mailto:mail@prilhofer.com)  
Internet: [www.prilhofer.com](http://www.prilhofer.com), [www.priily.com](http://www.priily.com)

### **Austria**

**Christian Prilhofer Consulting**  
Amselweg 4  
A-4600 Thalheim/Wels, Austria  
Tel.: +43-(0)7242-51286  
Fax: +43-(0)7242-51297  
E-Mail: [prilhofer@utanet.at](mailto:prilhofer@utanet.at)  
Internet: [www.prilhofer.com](http://www.prilhofer.com), [www.priily.com](http://www.priily.com)