Langfang Hess Building Materials Machinery Co., Ltd., Hebei Province, 065001, China

# Innovative Railway Sleeper Production supports Expansion of Chinas High Speed Railway Network

**The German Hess Group GmbH is a global market leader for high-performance concrete block manufacturing machines & systems, cubing systems and the necessary transfer technology. Mixing technology, handling systems & surface treatment products are also in the product portfolio of the company. The Chinese subsidiary Hess Langfang with its newly expanded and modernized production facility close to Beijing, is part of the global sales and service network of the German Topwerk Group with its members Hess Group, SR Schindler, Prinzing Pfeiffer and Hess AAC Systems, and furthermore responsible for the Chinese market and the clients of all group members in China.**

Hess Langfang is a strong driving force especially for innovation and technology for producing efficient and accurate high-speed railway sleeper production lines not only in China but worldwide.

Since about 15 years Hess Langfang is developing and producing tailor made railway sleeper production lines for Chinese customers (High-Speed Train Developers and Operators) according to the very high Chinese national standards. Flexibility and continuous development are a synonym for the reliable and efficient railway sleeper plants produced by Hess Langfang.
Railway sleeper production lines vary from manual long line systems using large size molds for up to 10 sleepers per mold (4 or 5 sleepers in line) as a basic heavy-duty solution with low investment but intense use of manpower to partly or fully automated and safety-focused carousel lines with a variety of different molds and products to be produced.

Although also traditional long line plants have been realized, the focus of Hess Langfang railway sleeper plants is directed to develop modern and flexible carousel type systems which provide the following advantages:

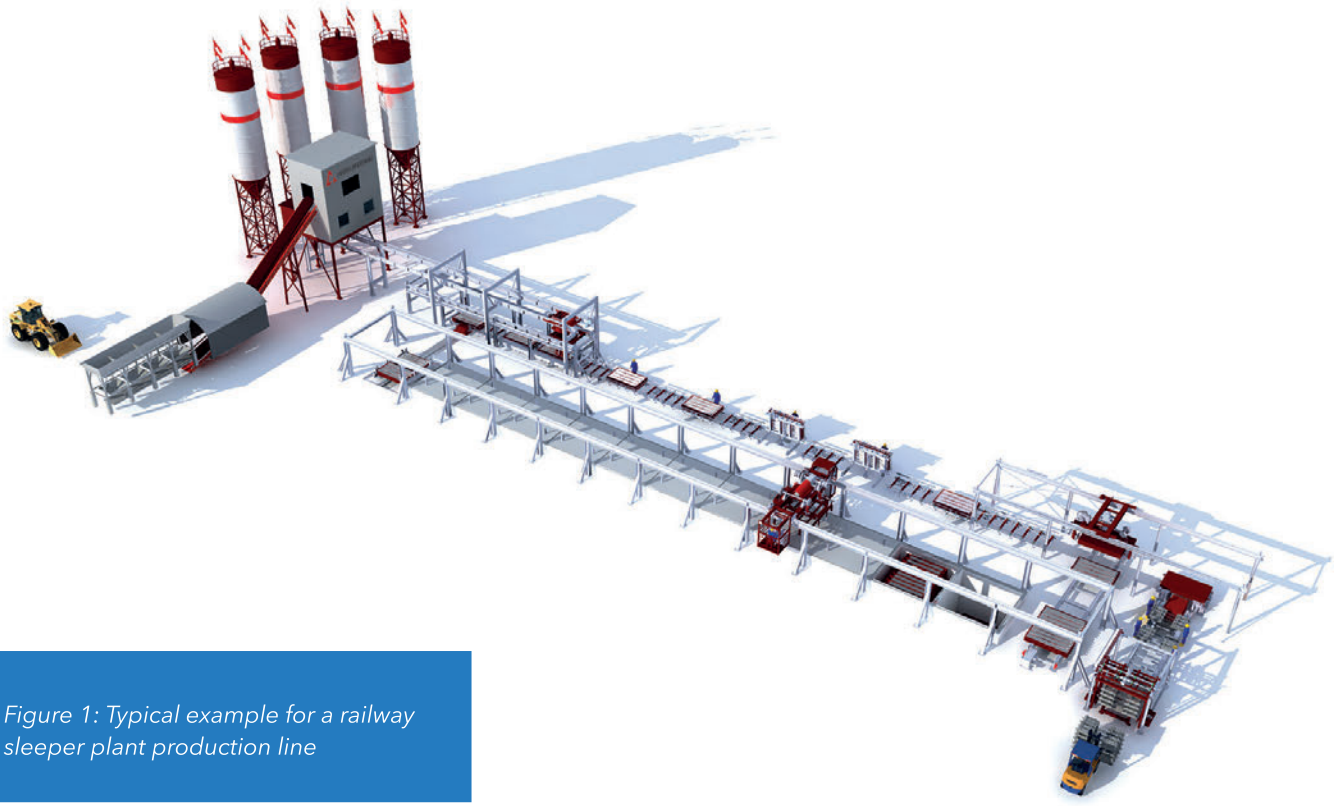

*Figure 1: Typical example for a railway sleeper plant production line*

*Figure 2: Modern carousel line system – First project of China Railway 12th Bureau, Lanxin Daban City*

- Wide range of projects and different types of products / sleepers (double block sleepers, pre-stressed sleepers, elastic support block (heavy loads), subway short mold and various other products such as water channels, cover plates, barriers, grids etc.)
- Flexible degree of automated operation
- Adaptability to future requirements (degree of automation, production, capacity)
- Reduced manpower requirement
- Increased product quality and accuracy / stability as well as production safety due to:
  - smaller size and weight of molds,
  - automated production and quality control (e.g. exact concrete dosing, vibration control, smooth de-molding process, automated embedded parts installation systems)
- Optimized operating and lifecycle costs due to reduced labor cost
- Short cycle times down to 3 min. with increased production efficiency / reduced energy consumption per sleeper
- Compact footprint for the workshop / complete plant

A key aspect of Hess Langfang in designing a sleeper production plant is the flexibility of the plant from the process to the products according to individual project requirements. Generally, a railway sleeper production plant will typically be composed of the following process steps:

1. raw material delivery and storage
2. batching and mixing station
3. concrete distribution, casting and vibrating station
4. mold handling system (wet side)
5. curing station
6. demolding system
7. sleeper handling system
8. mold handling system (dry side) incl. cleaning and installation of embedded parts
9. tensioning and de-tensioning station

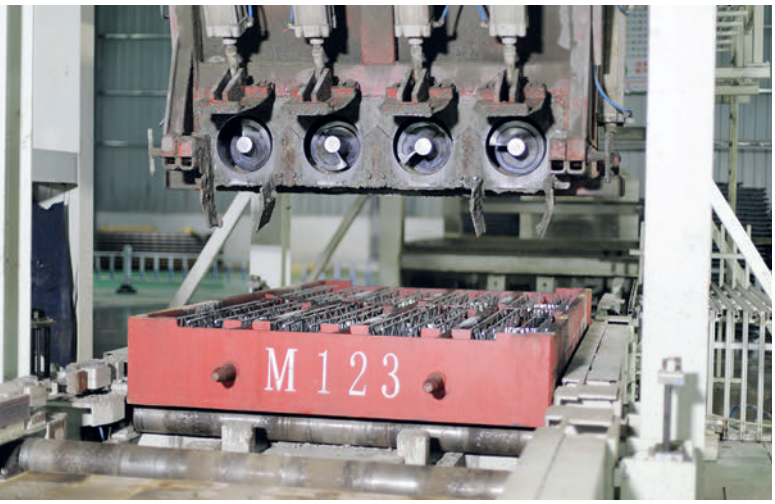


*Figure 3: Automated casting and vibration station*

*Figure 4: Mold stacking device for handling of molds and curing pit covers*

Additional process steps, not necessarily being part of the main production line, are the preparation of the embedded parts like reinforcement steel, the steam generation required for the curing process, compressed air generation or a secondary natural curing of the sleepers in storage.

The raw material delivery is the first process step to decide on the degree of automation or the need of manpower. From manual handling by front-end loaders to automatic truck or train unloading with respective handling of the different raw materials, the process will be designed according to individual requirements.

After batching and mixing the concrete will typically be transported by skip car to the casting & vibrating station with its distribution hopper. In the casting and vibration process precise casting of concrete into the molds should be regulated e.g. by screw conveyors in the casting hopper, followed by several vibrating stations (figure 3). The vibration mode is controlled and optimized depending on the characteristics of the product and mold design. Frequency controlled vibration motors are adopted to minimize the casting and vibrating and therefore the cycle time.

The subsequent handling of the molds filled with concrete and equalized is carried out by various different handling machines like roller conveyors, chain conveyor, and transport trolley or crane systems (figure 4). A respective automatic operation allows for improved production efficiency due to smooth and safe handling in shorter time in comparison to labor usage.

The sleepers will then be treated in the curing pits. The concrete curing requires a quality specific temperature treatment with a temperature increase by steam injection in the covered pits. The temperature increase, the time and temperature on a constant temperature level and the following temperature reduction shall be precisely controlled for quality assurance. After the curing process the sleepers and the molds will be separated again at the demolding station. The demolding requires to turn the mold by 180 degrees and releasing needs to be enhanced by an up and down movement. Special equipment such as a mold turning device and a pneumatically operated demolding table are applied (figure 5).


*Figure 5: De-molding system with mold turning device and demolding table*


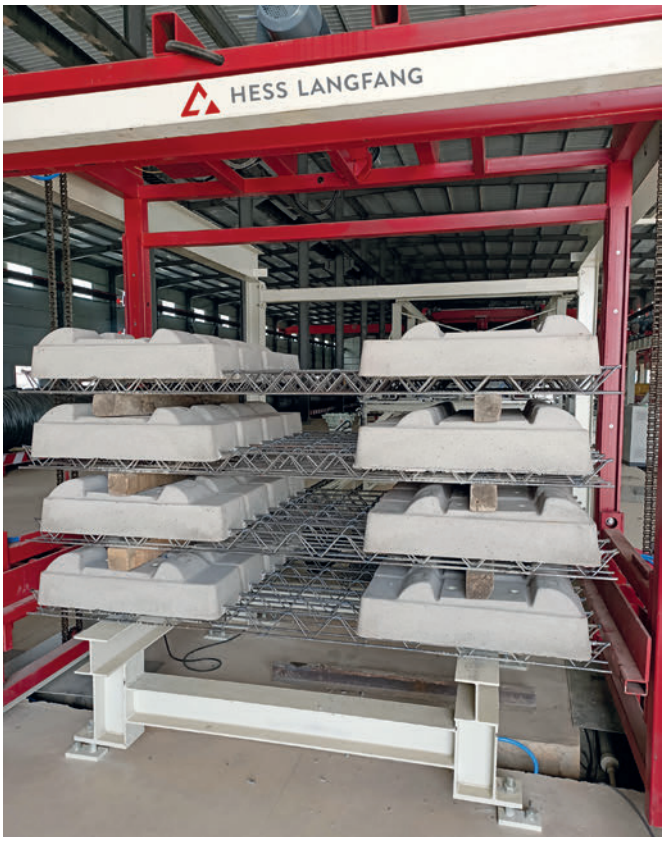


*Figure 6: Automated sleepers stacking device*

After this 'divorce' the mold is turned again and conveyed to cleaning and preparation for the next casting process. This preparation consists of the spraying of a mold release agent and the installation of all embedded parts like reinforcement steel or screw anchors. This process steps are typically carried manually.

On the other hand, the sleepers are now removed from the demolding station and stacked either by forklift or supported by a sleeper stacking device (figure 6).
Quality and safety issues will define the use of sensors, instruments, mold design, general equipment design and machine capacities (requirement of reinforcements, guiding bars),

*Figure 7: Automated railway sleeper steel reinforcement installation station*

*Figure 8: Automated railway sleeper steel reinforcement installation station*

degree of automation etc. High demands on the sleepers such as for high-speed application or heavy freight loads require high and uniform product quality with tight tolerances which also leads to a limited size of the single molds with a limited number of sleepers per mold. With the limited weight of such molds and further supported by automated process steps, also impacts of the molds with the process equipment are minimized, avoiding potential damages being more likely the larger and heavier the molds and the more manual labor is required. With high lifting accuracy, e.g. contact with the inner wall of the curing pits is avoided allowing for less reinforcement, no guide bars and therefore reduced investment costs for the pits.

Another criterion for production efficiency is the cycle time per sleeper. By achieving short cycle times such as 3 minutes, the overall footprint of the plant can be minimized referring to a specific production capacity. Short cycle times are realized by automated and precise process steps.

Considering all such aspects the railway sleeper plant is customized according to each project's requirement with typical modern carousel line solutions shown in figure 1 and 2 with a combination of automated mold handling, turning, demolding and manual mold cleaning and installation of embedded parts as well as automated sleeper stacking.

In 2019, after already more than 40 railway sleeper production plants installed with different levels of automation and products produced, HESS Langfang received an order from Fuxia Railway of China Railway 16th Bureau Group Co., Ltd with even further challenges.

This railway sleeper project was special in every aspect due to the unique request of high automation grade of the whole production plant – Keyword: Robot integration in the production plants for high-speed railway sleepers. With the highly automated production system for high-speed railway sleepers the requirement for labor forces could be minimized resulting in a major decrease of production costs and the highest level of product quality. The entire production line was developed and produced by Hess Langfang.

Already from the very beginning when China's high-speed railway construction boom started, Hess Langfang took a leading position in the development of China's railway sleeper production lines. Based on original production lines, Hess Langfang has newly developed various tailor-made innovations to achieve this unique degree of automation.
These further developments include (figures 7 – 13):

*Figure 9: Robots screwing-in spring elements into the railway sleeper molds – fully automated*

*Figure 10: Feeding system for screw anchors to be installed automatically by robots*

- automated robot cleaning of the molds
- automated robot mold spraying with release or demolding agent
- automated robot handling and installation of embedded parts, steel reinforcements, steel girders, screw anchors into the mold system
- automated movements of the molds in and out of the curing pits
- automated oil protection of sleepers
- automated cap installation

At the annual Chinese national railway and rail transit conference, which was held on October 13, 2020 in Fuzhou – China, Hess Langfang was invited to present their newly developed railway sleeper production system to an audience of more than 150 experts. The participants were well impressed by the outstanding performance of the high automated railway sleeper production line from Hess Langfang at the location of the customer in Futian. The system is operating with optimum cycle times and requires a minimum of manpower:

Based on the experience with this new fully automated sleeper production plant design, Hess Langfang can customize the plant according to the customers' requirements with different degrees of automation for each process step of the complete line. This allows the client to define the optimum compromise of investment and operational costs, react to the availability and costs of labor with the different necessary skills.

Consequently, in 2020 Hess Langfang received another challenging project from Shandong Highspeed Co. Ltd. In this project also many robots had to be integrated in the production line of the plant.

*Figure 11: Palletizer system with accurate position sensors for efficient steel girder handling*

*Figure 12: Fully automated installation of embedded parts / steel reinforcement*

Specialty: For this project Hess Langfang had to design & to produce various complex molds which can be applied to the same production line in just one system. Consequently, the customer can produce different types of concrete elements besides the railway sleepers such as water channels, cover plates, special concrete blocks or barriers with just one production plant.

Hess Langtang's advanced technology, being part of Hess Group in Germany, is highly appreciated by Chinese customers and furthermore considered as one of the leading production companies for high-speed railway sleeper production lines in general. Certainly, on demand and in case of interest (using the international company network of Hess Group and Topwerk Group), railway sleeper projects can also be realized in your country (on the global market and anywhere outside of China). ■

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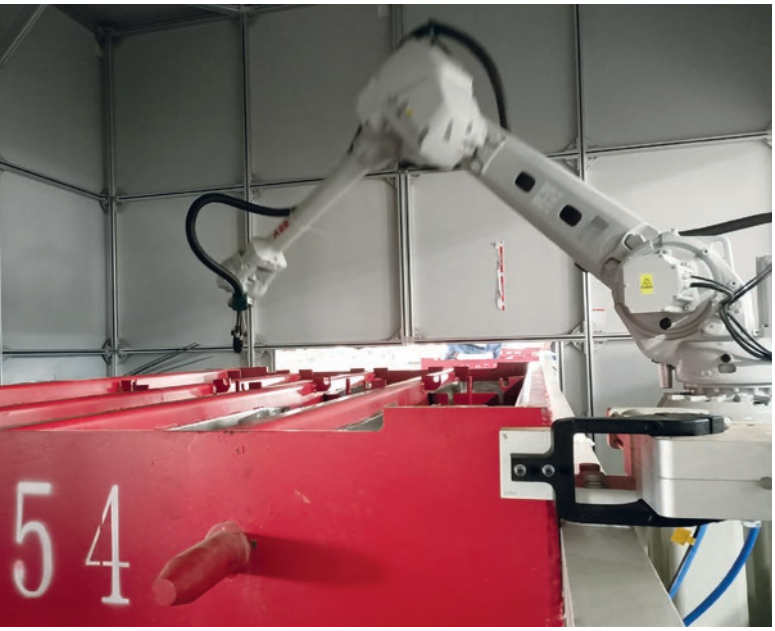

*Figure 13: Mold spraying of release agent by robots*

## FURTHER INFORMATION

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