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Gamuda's IBS precast concrete plant sets new standards in Malaysia

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Gamuda is a Malaysian Company based in Kuala Lumpur. The core businesses of Gamuda are Engineering and Construction, Property Development and Infrastructure Concessions. By doing this Gamuda is amongst the largest engineering and construction companies in Malaysia. Special strength is established in infrastructure projects, such as MRT and tunnel projects, highway construction as well as water regulation dam, water treatment and power plant projects. The second big part of Gamuda businesses is the property township development and housing construction projects. In this sector Gamuda was looking into developing a new way of building homes by implementing the concept of an Industrialized Building System (IBS) into their construction projects.

Project Development

In order to analyse and develop the feasibility and benefits of the implementation of an industrialized building system Gamuda has teamed up with Prilhofer Consulting from Germany end of 2014. In the first phase a feasibility study has been made where a process layout for the precast factory has been developed based on the expected demand of Gamuda to produce 1 million square meters of precast panels per year. In parallel several possible site locations for the new IBS factory have been looked at and basic site layouts have been developed for each location to support the decision making process. Within the feasibility study it was an important part to analyse the required capital investment not only for machinery and equipment but for the complete factory including construction cost for the factory building and all related infrastructure as well as investment in CAD and ERP software and required consulting and training on the software part of the factory. A second area for analysis was the expected efficiency of the precast factory and the efficiency benefits expected for the construction sites.

The outcome of this exercise convinced Gamuda to proceed with the IBS project. The benefits of IBS can be grouped into 4 main items:

1. Increased productivity
2. Reduction of construction period
3. Environmental sustainability
4. Increased quality



Gamuda F1 Aerial Picture

Increased Productivity

Using precast construction methods is reducing the dependency on manual labour for as much as 60%. This results in cutting construction cost on the one hand and on the other hand it is reducing the dependency on a high number of foreign workers. In Malaysia many of the workers typically come from neighbouring countries like Indonesia. Currency fluctuations of the Malay Ringgit can hit construction projects in case of depreciation of the Ringgit making it unattractive for the foreign workers to stay in Malaysia. A lot of foreign labour is a challenge in terms of accommodation issues and social impacts.

Less labour at the site means a significant improvement with regard to health and safety aspects. The reduced workforce is better manageable and accident rates are going down. The use of the IBS construction system supports Malaysia government's approach to half the accident rates at construction sites.

The productivity at the construction site is also increased by establishing a more reliable supply chain into the construction sites as a lot of the material handling and external supplies are eliminated with the supply of precast panels from the own factory. Less material handling at the construction site is helping to speed up the construction process.



RSKU Jade Hills Project

Reduction of construction period

The IBS allows to reduce typical construction period for high rise construction from 30 months to 12 months. The biggest advantage out of this is a significant minimisation of project risks caused by material price fluctuations for rebar steel, cement and others. Also oil price fluctuations can have an impact on the construction cost risk.

Secondly the reduction of the construction period is reducing cash flow and financing periods, which results in interest saving on both sides, the developer and the end customer.

Environmental sustainability

Using precast construction systems provide safer and cleaner work environment. Pre-fabrication of the structural parts of a building in a factory environment and by usage of robotic systems allow for perfect control of material usage and less creation of waste materials. At the construction site there will be less formwork required which means less material handling, more simple site logistics and less wastage.

Increased quality

Finally the prefabrication in the factory helps to significantly increase quality. Perfectly straight walls and slabs together with fully developed connection details provide a perfect quality of the construction. No more plastering at site is required after joint filling and paint can be applied right after.



Stockyard with high quality precast panels

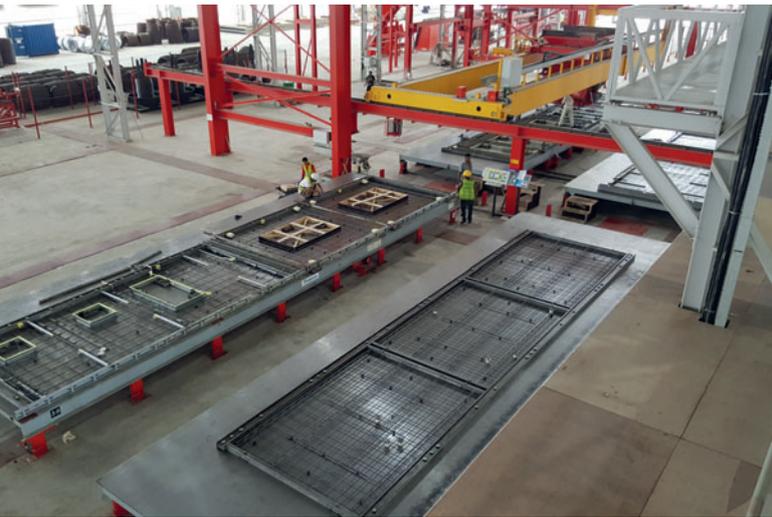
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Demoulding Preparation Zone

The Factory

The factory has been designed by Prilhofer Consulting for an annual output of 1 million square meters of solid walls and lattice girder half slabs with a high degree of automation involved. Gamuda had requested to develop the factory layout in such a way to enable a starting scenario with a capacity of 500,000 square meters of annual production to understand the impact on the initial capex for the project. A condition for this scenario was to enable future factory upgrades with as little impact on running production as possible.

Based on the mutually agreed process layout a detailed specification sheet for all required equipment and for both options of 1.0 and 0.5 million sqm has been set up and in May 2015 a very formal and well controlled tendering process started. At the end of the tendering process Gamuda decided to place orders for the 0.5 million sqm option to minimize project risks and to allow for a smoother start-up and learning curve of the factory. This decision was fully supported by Prilhofer Consulting as product development and design of the construction projects was still ongoing and a number of important decisions were still to be made during the simultaneous engineering phase in the beginning of the project.

Gamuda chose for the Progress Group companies Ebawe Anlagentechnik and Progress Maschinen & Automation as their key suppliers in this milestone project. Ebawe delivering all the equipment related to the pallet carousel and Progress taking care of mesh welding plant, lattice girder welding line and all ancillary rebar and mesh processing equipment. An Imer Oru batching plant and concrete shuttle system was selected to take care of the supply of concrete into the factory.

Orders were placed late August 2015. Production in the new factory started 10 months later with the first pallet poured with concrete on 15th June 2016. This short project period was only possible due to the very close cooperation of all parties

involved. Centralized handling of project information, document distribution and review and approval processes helped all project partners and committed, efficient project management team of Gamuda to proceed in the most efficient way in each stage of the project.

The software side of modern automated precast factories is to be considered to be at least as important as the factory hardware and equipment installed. The whole IBS system is software driven. Gamuda had been dedicated in the use of integrated full 3D Building Information Modelling (BIM) being the only way to make this factory and the IBS system deliver what it is supposed to.

Gamuda decided to work with the design software package of Precast Software Engineering, a Nemetschek Company. Not only has the software been procured from Precast Software Engineering but also an intense consulting package for training and implementation of the software tools. Gamuda's RSKU Jade Hills project, a 20 storeys social housing project and the first to be fully delivered by the IBS factory, was used to do training on the job of Gamuda engineers. The construction is done fully by load bearing walls and half slabs. No columns are required in the design. The design of an industrialized building system must follow a DFMA approach (Design for Manufacture and Assembly). This means the panel design must not only consider architectural and structural aspects and panel connections shall be designed for easy installation and assembly at the construction site but the design also needs to be adjusted to production needs for simple and efficient manufacture of the precast panels in the factory.

Prilhofer Consulting helped to keep a focus on developing design solutions easy to produce in the factory, simplifying the shuttering system required and keeping manual work content at the line under control. This DFMA process is a task

all precast companies need to run and it is not finished with one project but an ongoing exercise throughout the lifetime of a factory and all kind of construction projects coming up. Gamuda has set up a BIM Academy to support this requirement. Also in the other fields of business activities Gamuda's approach is always to go through a natural evolution process towards producing a highly skilled talent pool.

Data - Factory Interface

The outcome of the BIM modelling is to create production data in PXML file format to feed the precast factory. As all business processes were to be driven by the BIM model Gamuda required a fully BIM capable ERP and MES solution. These requirements have been fulfilled by introducing ERPbos®, a BIM ERP system designed by Progress Software Development (PSD). With this integrated solution all business and production processes can be managed in a single application, including sales, supply chain management, logistics, project and production planning, invoicing, cost accounting, BI (Business Intelligence), production control and production monitoring.

Conclusion

The Gamuda IBS Factory in Sepang is the first fully automated robotic IBS factory in Malaysia. With the implementation of IBS Gamuda has made a huge step to push and develop the construction industry in Malaysia. The government of Malaysia is supporting the IBS approach and wants to make it a standard for the Malaysian construction industry.

Gamuda is hoping others will follow and implement the IBS system in their projects as well. This will help to further develop and modernize the Malaysian construction industry with all parties involved experiencing a great benefit.

For Gamuda the outcome of the first project was very convincing. In January 2017 Gamuda has procured land for the 2nd IBS factory and placed a new consulting contract with Prilhofer Consulting. The 2nd IBS factory shall be operational by end of 3rd quarter 2018. Gamuda is of the opinion there is room for at least 6 to 7 own factories in Malaysia in the coming years. ■

FURTHER INFORMATION



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