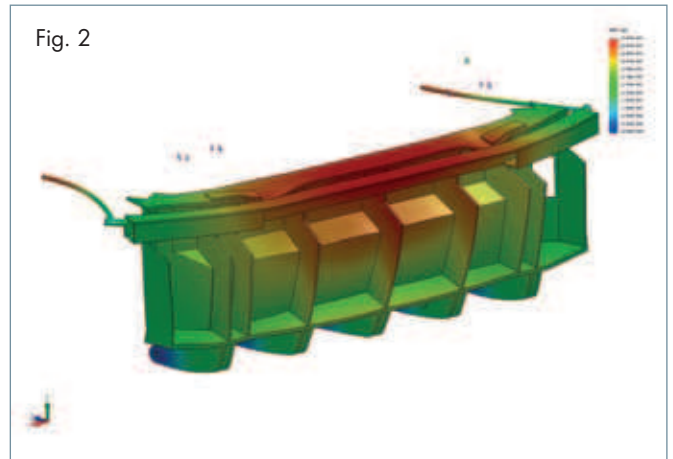
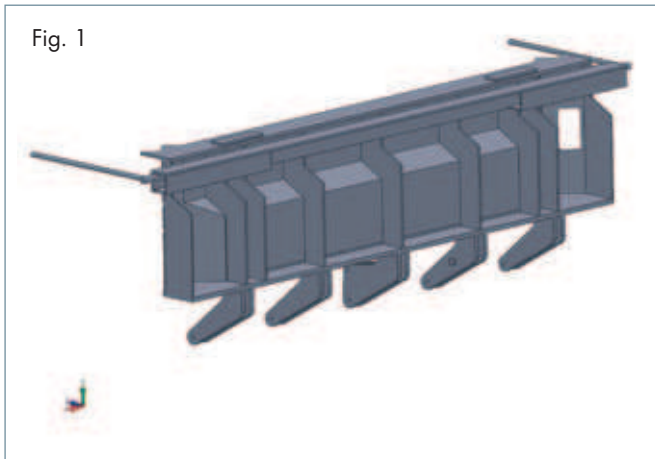


Toyota Kohki Co., Ltd., Tokio, 183-0035 Japan

Mould analysis technology

It is invisible for force and thermal and it only can be done by mechanical calculation until several years ago for the engineers to know how will be the structure deformed when how much load is applied. However this calculation can only show you the local result and the rough behavior for the total structure. The moulds used for manufacturing precast concrete are normally against the really harsh working condition. Violent vibration when pouring concrete, heavy concrete weight and pressure, heavy loading on lifting point when moving, weight load when the mould are multi stacked, heating with curing steam, cooling with the cold air when stripping in the winter, etc.



Analysis result when one mould is stacked on another and the side-jacket deformation of the underneath mould

Despite such hard condition, moulds are required to continually produce high-quality concrete products. That is why it is necessary to predict the possible problems of the mould and prevent them during the design process in advance.

However, it is almost impossible to make a trial mould and experiment when it comes to custom-made with small quantity and short lead time.

Therefore Toyota Kohki uses 3D finite element method (FEM) during or after finished

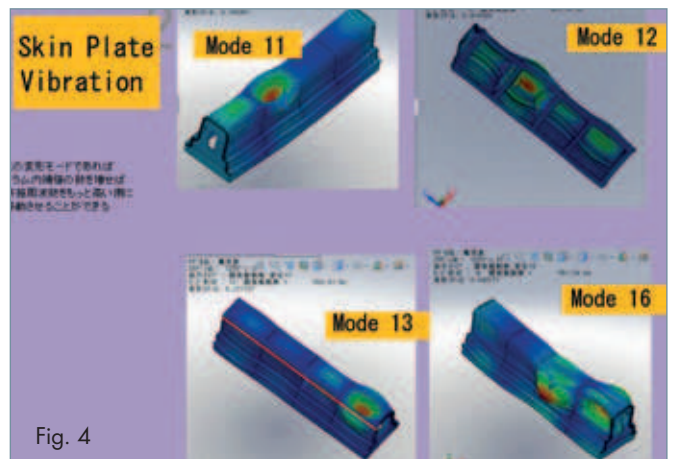
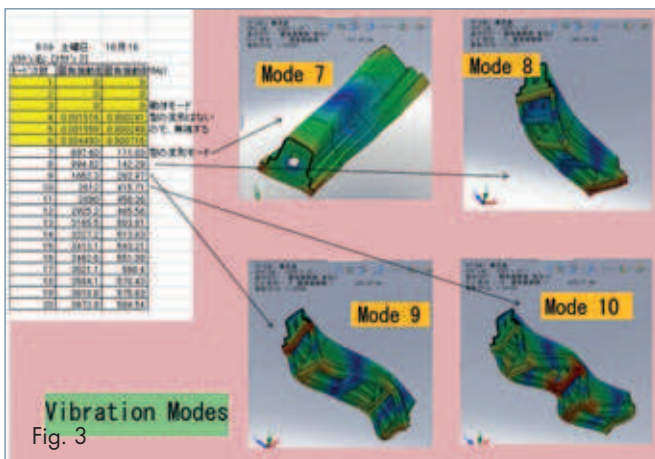
the mould designing to analyze the safety, make the behavior of the structure visible and prevent the problems.

Fig. 1 and Fig 2 show the analysis result when one mould is stacked on another and the side-jacket deformation of the underneath mould. This kind of the analysis called Static Analysis.

Since mould is a complicated structure, even if it's a simple loading condition, there could be potential risks on unexpected place depending on the force transmission route.

The deformed location can be easily understood by the visible computer displayer and the optimal design is possible by the improvement and the re-analysis. It is especially important to pay attention to the parts to be affected to the safety of the mould during operation.

Fig. 3 and Fig.4 show the dynamics analysis. Usually, vibration is inevitable for moulds. Each structure has several natural frequencies when it is vibrated. When frequency is equal or very close to the natural frequency of the mould, the resonance



Dynamics analysis

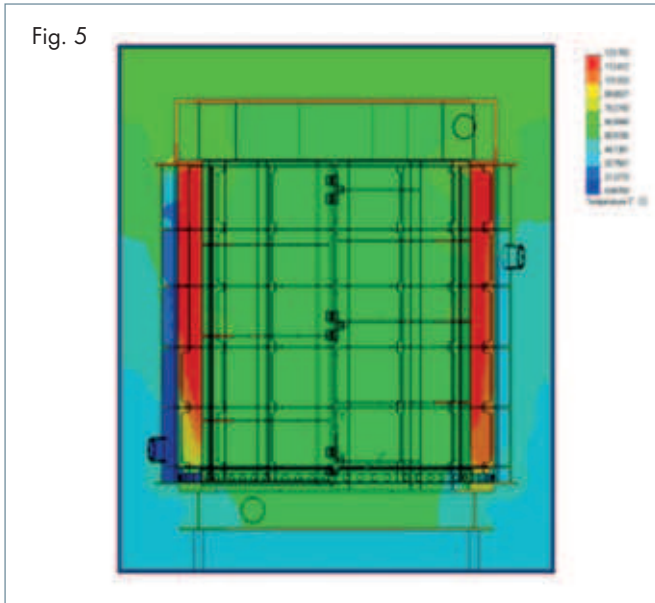


Fig. 5

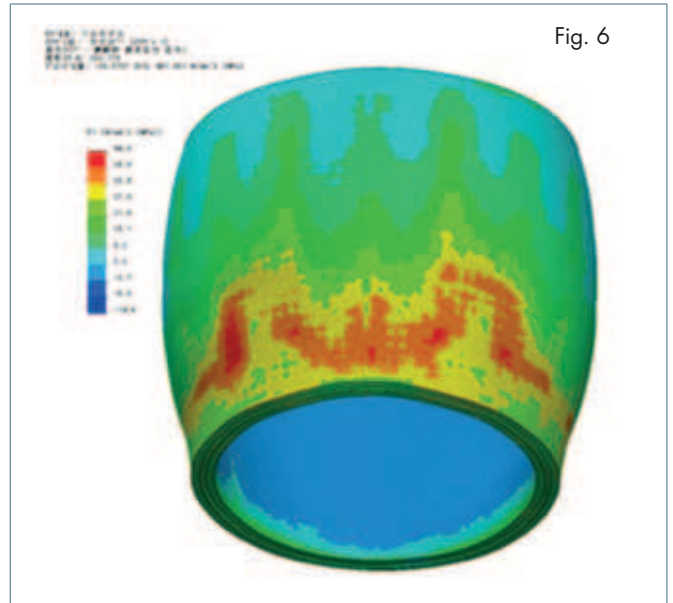


Fig. 6

Examples of the thermal analysis

occurs and it accrues to a large amplitude oscillation which could break the mould. The reinforcement will be added or the position will be modified in such case to prevent the resonance phenomenon. The Dynamics Analysis made it possible to figure out the improvement method.

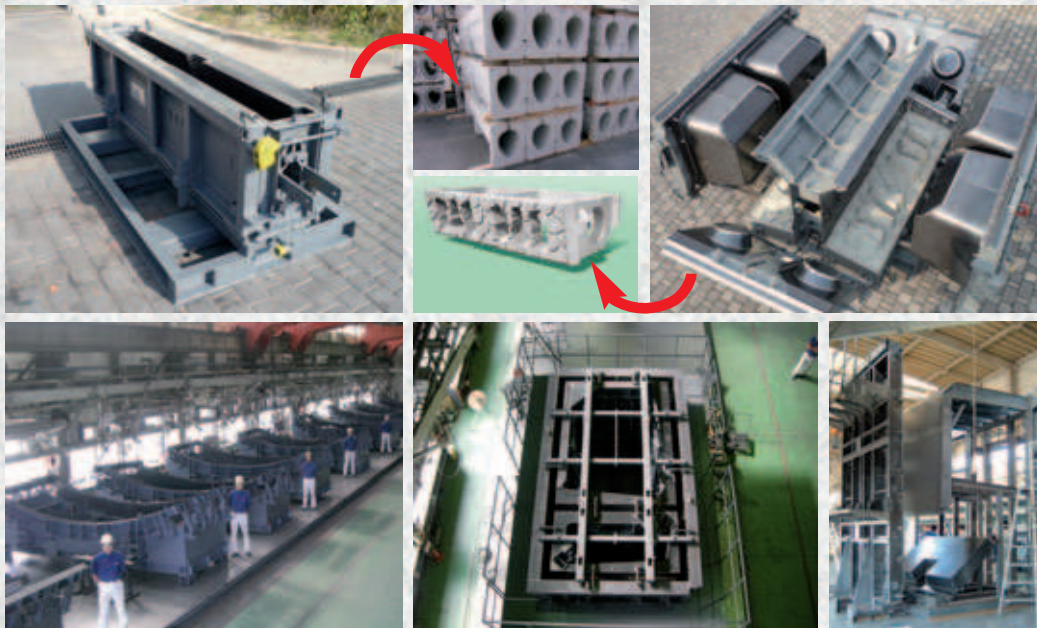
Fig. 5 and Fig.6 are the examples of the thermal analysis. Mould and concrete product are normally heated with steam for curing in Japan. Temperature variation occurs according to the size and shape of the concrete product when it cools down and may result in crack by the temperature stress. It is

possible to catch the tendency by using the thermal analysis.

It especially has to pay attention to the products which have the convexo-concave surface or with large section, because they are easier to get influenced by the thermal stress.

TOYOTA FORMS

Molds for Precast Concrete

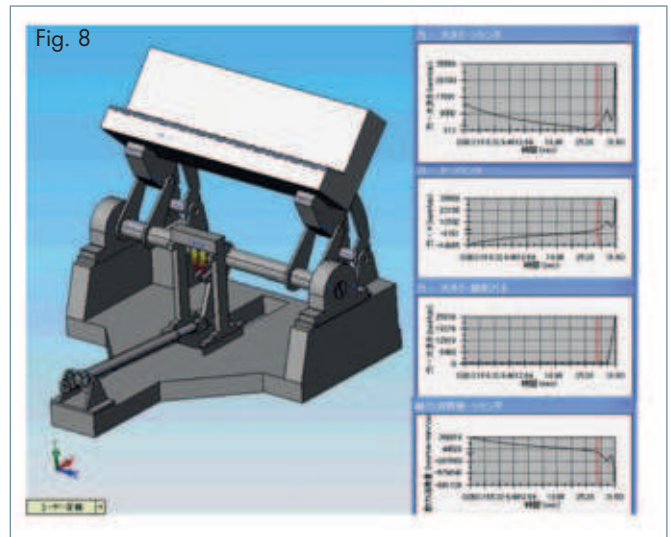
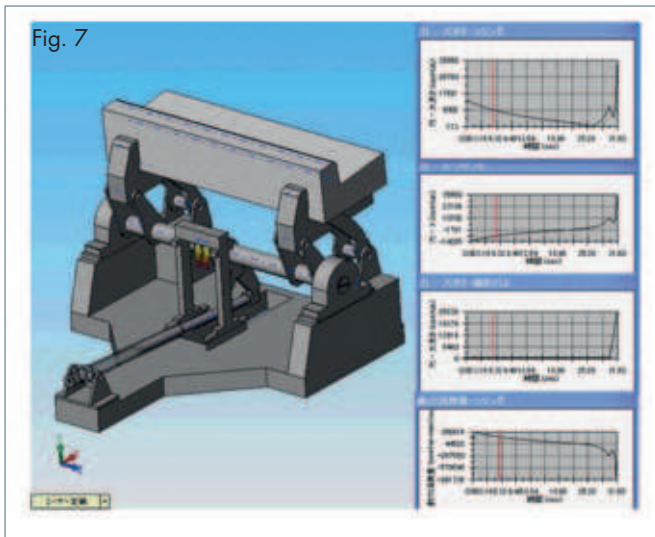


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Mechanism analysis.

Fig. 7 and Fig.8 show the mechanism analysis. It is used when design an equipment that is with the multi-parts which are geared together and do a complex movement. It is done to figure out how much of force is exerted on each part and the amount of force which will be needed to move these multi-parts.

As explained above, it becomes common knowledge of engineers for these unknown field so far with the aid of these analyses. Recently, the approximate life of the mould

can be calculated by analyzing the stress value and stress-strain measurements. Toyotaforms is evolving from day to day with the advanced calculation and verification capability.

FURTHER INFORMATION



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