

### 1. Introduction

With the increasingly serious problem of global warming in recent years, attention is now focused on the environmental performance of buildings. Buildings have a controlling effect on long-term energy efficiency and environmental impacts, and those in the industrial sector to which manufacturing industries belong are no exception.

For companies, industrial buildings such as factories and warehouses support everyday operations, and are not only basic infrastructure which forms the working environment of employees, but also affect operating costs, including energy costs, maintenance costs, etc., which steadily accumulate each year.

In comparison with buildings in other sectors, the designability and design quality of industrial buildings are seldom noticed, but for a company which aims to coexist with its local community and secure excellent human resources, while continuing to develop in the global economy, the design of factory architecture is an important element which symbolizes/publicizes the company's corporate culture and workplace environment, and inspires trust in the community and attracts human resources. The high design quality which can be seen in the factory architecture of the leading companies in Europe and the United States is already well known, but Japan has also entered an era when high design quality is demanded in factory architecture.

"Metal Building" is a pre-engineered metal building technology for industrial sector (non-residential sector) buildings which JFE Civil Engineering & Construction is developing throughout Japan. Based on the background outlined above, JFE Civil Engineering & Construction has also begun efforts to expand the use of "Metal Building," which is superior in environmental performance and design, in order to make a multi-faceted contribution to the sustainability of the business of manufacturing companies. This report describes the history of "Metal Building" to date, together with future development efforts.

### 2. History and Development of "Metal Building"

#### 2.1 Introduction and Development of Cladding

"Metal Building" is a technology which JFE Civil Engineering & Construction introduced from the United States and began marketing in 1972 as the first pre-engineered metal building system in Japan. Although the mainstream in industrial buildings at the time was light-gauge steel framing with slate cladding, this all-metal pre-engineered metal building technology in which the steel frame, roofing, walls, and building accessories were completely standardized had a major impact on the field of industrial architecture.

Since "Metal Building" was introduced, JFE Civil Engineering & Construction has accumulated a sales record totaling more than 13 million square meters, with companies in manufacturing industries and logistics as its main clients, and has earned an excellent reputation as a pioneer in pre-engineered metal buildings which anticipate the needs of the times. In particular, adoption of "Metal Building" has centered on factory architecture for the dynamic local companies which support Japan's manufacturing industry.

The most important reason why "Metal Building" had steadily accumulated a record of sales, while earning a high evaluation from clients, is its unique cladding system, which is both environment- and people-friendly, providing superior heat insulation and sound insulation performance, and anticipates the needs of the times. This is realized by using double-coated, double-baked pre-painted steel sheets which feature excellent durability, low maintenance cost, and beautiful d4(d)-12(o)-1ct, auoakedkngkne

and high thermal insulation performance, and is available in mat thicknesses up to a maximum of 150 mm.

and regulatory system, beginning with the New Aseismic Design Code of 1981.

In recent years, various new technologies have reached practical application, including NeoFrame<sup>1)</sup>, which is a steel frame erection method using all bolt connections, the NeoBase shallow foundation method, which shortens the time required for construction, the “Ichi-Ichi Kiso” Non-Footing Colum Pile Joint<sup>2)</sup> (

To ensure that the cladding of “Metal Building” is compatible with the natural environment of Japan, various improvements which are unique to Japan were made, including enhanced water resistance by improvements in the ridge part and lapped splices of “K Roof 21,” improved wind resistance by reinforcing the eave parts and the roof edge region, and response to demand for large-scale, long roofs by development of a site forming method. From the introduction of “KB Panel Series” and “K Roof 21” up to the present, both have been mainstay cladding components of “Metal Building.”

## **2.2 Development of Structural System**

At the time of introduction, the structural system of “Metal Building” was tapered steel (welded H-shape steel with a comparatively thin cross section, in which the height changes corresponding to the stress gradient). This was the same as in pre-engineered metal buildings in other countries. However, the range of applications was expanded from one-story building to multilevel buildings by using rolled H-shapes, which were continuing to gain acceptance in Japan, in the main members, and unique Japanese technologies were developed in accordance with the requirements of the Japanese legal

which can be called the standard in conventional factory architecture, and “Metal Building.”

**Beam (a) Effect on Indoor Climate** Buildings is generally affected by the size of the building, its sitting conditions, and other factors, the size of the air-



