Title: Sheltered and Automated Construction System

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At the beginning of 21st century, construction markets are required to produce innovative construction systems and methods that will increase productivity, shorten construction time and improve safety. Efforts have also focused on improving the construction site environment, with due consideration to the immediate surroundings.

In order to meet the increasingly sophisticated requirements for the building construction projects in highly congested urban area, Penta-Ocean Construction began in 1993 to develop a comprehensive system that would facilitate building construction works in any weather conditions and with minimum disturbance to the surrounding neighborhood.

We introduce 2 types of "Sheltered and Automated Construction System" in this session.

FACES (Future Automated Construction Efficient System)

FACES is a fully integrated and self-contained construction system, which covers the entire building by a shelter called a lift-up frame. All works are carried out inside the shelter. When the works is completed in one floor, the lift-up frame will be raised to accommodate the construction of the next floor. This process is repeated until up to the top floor.

Fig.1 shows the flow of system's assembly, execution of work, and dismantling, while Fig.2 shows the overall configuration of FACES. Fig. 3 shows the overall view inside FACES.

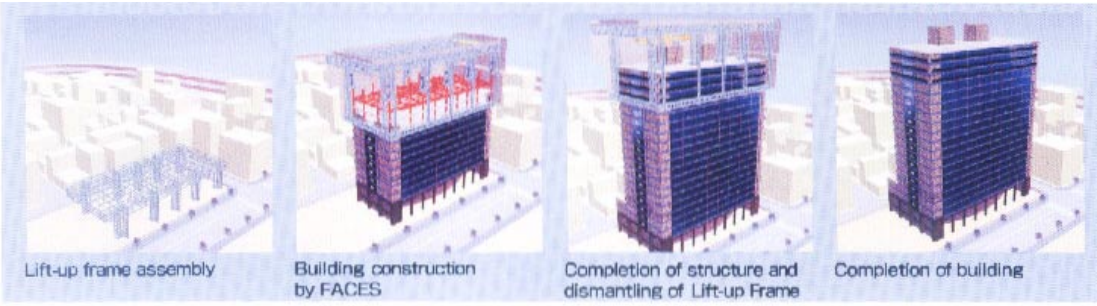

Fig.1 Operation Flow of FACES

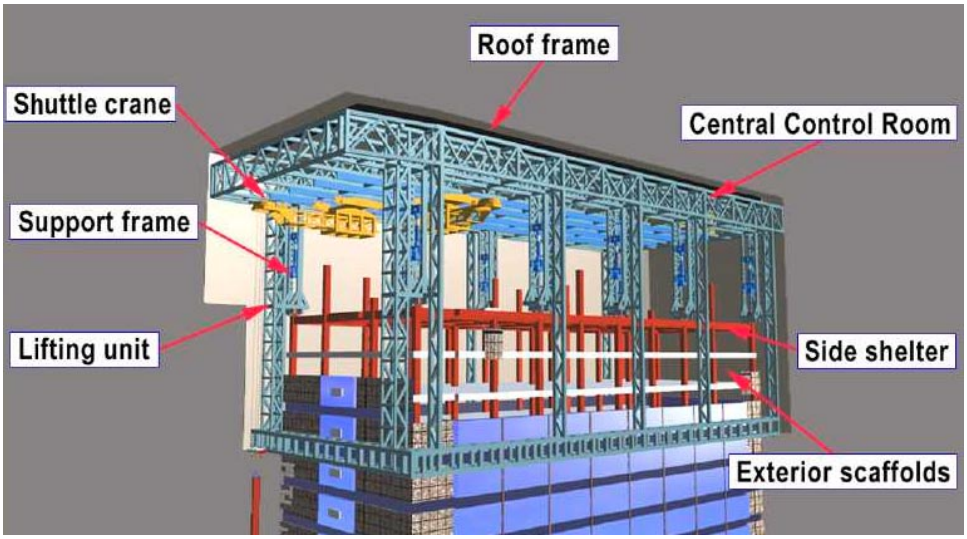

Fig.2 Overall Configuration of FACES

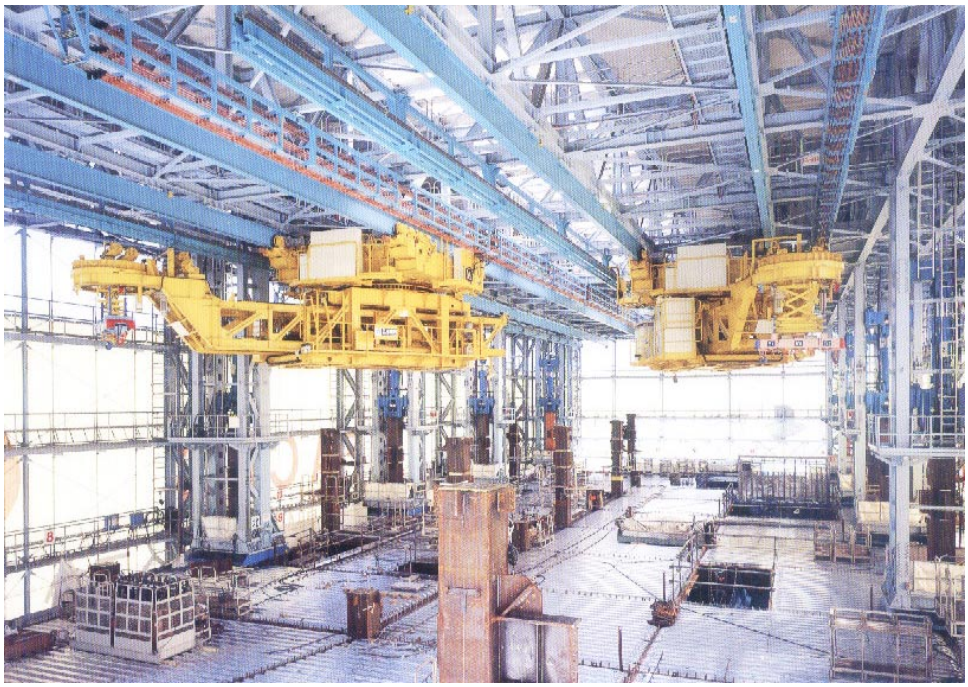

Fig.3 Overall View inside FACES

Development of FACES

We established the basic development concept of FACES in 1995, whose goals included the following items:

1) To create high quality infrastructure
   - Construction of high-quality buildings
2) To improve efficiency and achieve effective cost control
   - Shorten construction time and stabilize working schedule
   - Introduction of automation to increase productivity
   - Integration of information and labor management
3) To improve construction site environment
   - Creation of a comfortable and favorable climate for working environment
   - Improvement of safety standards
4) To confine construction site and activities
   - Producing less disturbance to the surrounding area
   - Enhance resource conservation and minimize industrial waste

We approached one of the potential clients to apply this system for a commercial building project in Tokyo. We worked with design consultants of the project since the basic design stage in order to achieve higher quality and productivity through more beneficial use of FACES.

Project outline

Project title: Nihonbashi-hamacho F Tower

Scope: 20 story high-rise office tower with 2 story penthouses of structural steel construction; 4 story lower building of reinforced concrete construction; and 2 level basement substructure of steel frame and reinforced concrete composite construction (building area - 2667 m^2; gross floor area – 34,876 m^2)

Schedule: Table 1 shows the development and application schedule of FACES.

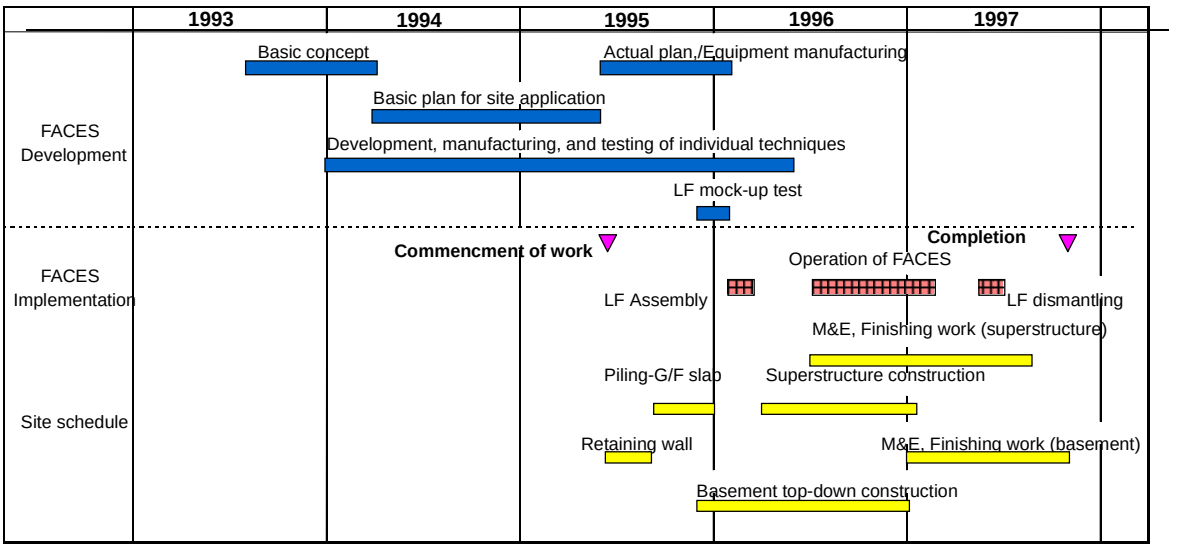

Table 1. FACES Development and Application

Configuration of FACES

1) Lift-up frame

The lift-up frame is composed of roof frame, support frames, side shelters, roof covering, and other essential components. The lift-up frame with the shelters creates a comfortable and all-weather working space throughout the entire duration of a project.

2) Central control room

The central control room is located under the roof frame and acts as the 'brain' of the system, controlling lifting phases, telemetry control for frames, and various other tasks.

3) Lifting system

The lifting system is composed primarily of 250-ton oil-hydraulic cylinders, upper and lower clamps, and oil-hydraulic units. The cylinders, which are incorporated into the support frames, raise the frame by reacting upon approximately 1/3 of the building columns. These are referred to as supporting columns.

Leveling of the frame during lifting operation is controlled by limiting the stroke difference with 5mm among cylinders. At a lifting speed of 2mm/sec the lift-up frame can be raised to the next floor level in approximately one hour. Lifting procedure is shown in Fig.4.

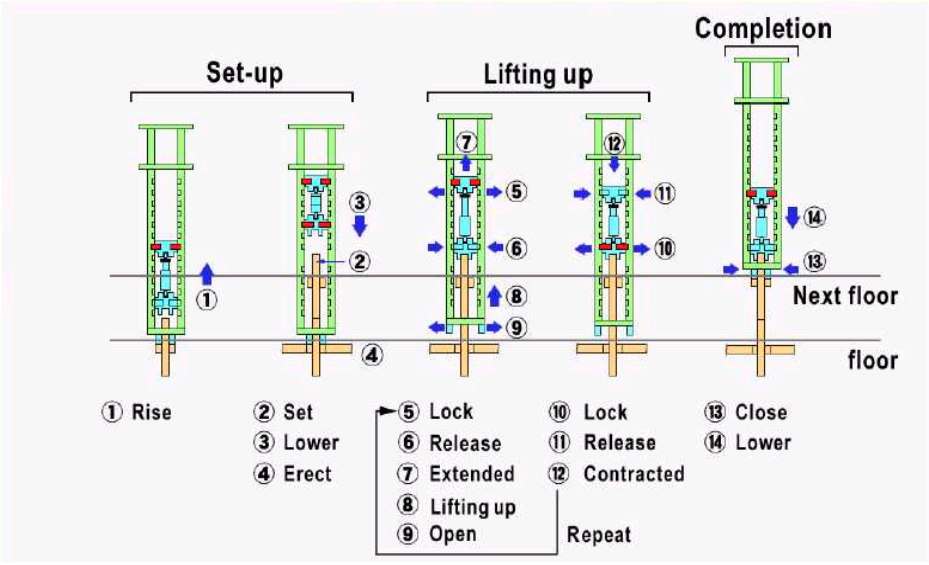

Fig.4 Lifting-up Procedure