

## **Development of the Tokyo International Airport**

Yoichi Watabe

*Leader of Soil Mechanics and Geo-environment Research Group*

*Port and Airport Research Institute, Yokosuka, Japan*

In Japan, there are some good examples of large man-made airport islands constructed by different technologies and with different materials including the followings:

- (1) The Tokyo International Airport (Figure 1): The airport was started with a small runway on a very small manmade island in 1931. Since then, the airport has been continuously developed toward the offshore side. The offshore expansion project, in which the airport was constructed on an ultra-soft clay deposit, was carried out from 1984 to 2004. The further expansion project with the fourth runway is under construction. The new runway will be a hybrid island of landfill and bridge.



Figure 1. An aerial photograph of the Tokyo International Airport (Haneda Airport)

- (2) The new Kita-Kyusyu Airport, constructed on an ultra-soft clay deposit, was inaugurated in March 2006. The construction technology was similar to the former offshore expansion project of the Tokyo International Airport.
- (3) The Central Japan International Airport: The airport was inaugurated in 2005. Some part of the island was reclaimed by dredged clay, but it was treated by cement with the pneumatic flow mixing method.
- (4) The Kansai International Airport (Figure 2): The first phase of the Kansai International Airport Project, which was inaugurated in September 1994, is a large man-made island located 5 km off from the shoreline. The second phase with a parallel runway is operational since August 2007. The reclamation technology is quite normal, but the estimated settlement is over 18 m.

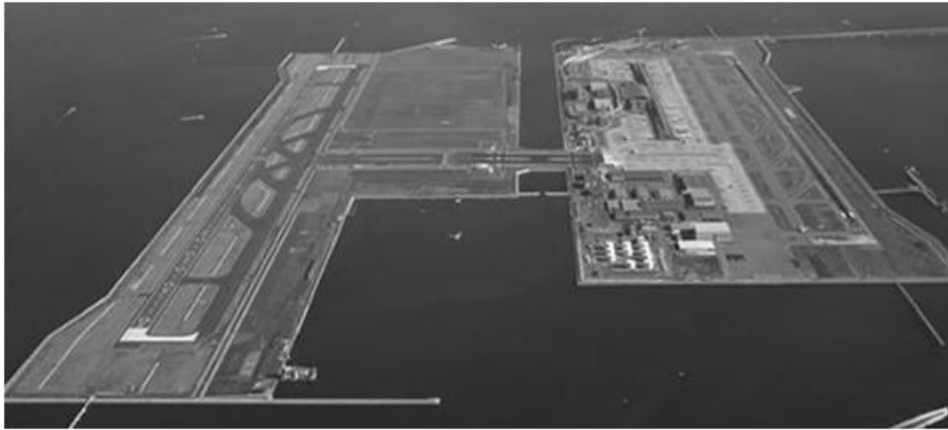


Figure 2. An aerial photograph of the Kansai International Airport

The reclamation technologies adopted in these big projects aimed to overcome various severe conditions such as thick soft clay deposit, large water depth, material shortage, short construction period, etc.

In the offshore expansion project in the Tokyo International Airport, some residual settlements during airport operation have been allowed, because it was constructed on an ultra-soft ground. Maintenance and repair have been premised, because some differential settlements which cause functional damages have been inevitable. We have to pay attention on the heterogeneous ground condition. Temporary seawalls and partitions, which had been used during a period of disposal facilities for construction waste soil/dredged soil, also cause differential settlements. Passive countermeasures for differential settlement were installed into the apron of the Tokyo International Airport. To adjust the unallowable differential settlement in the apron facilities, the prestressed concrete slabs were jacked up and the clearances were grouted.

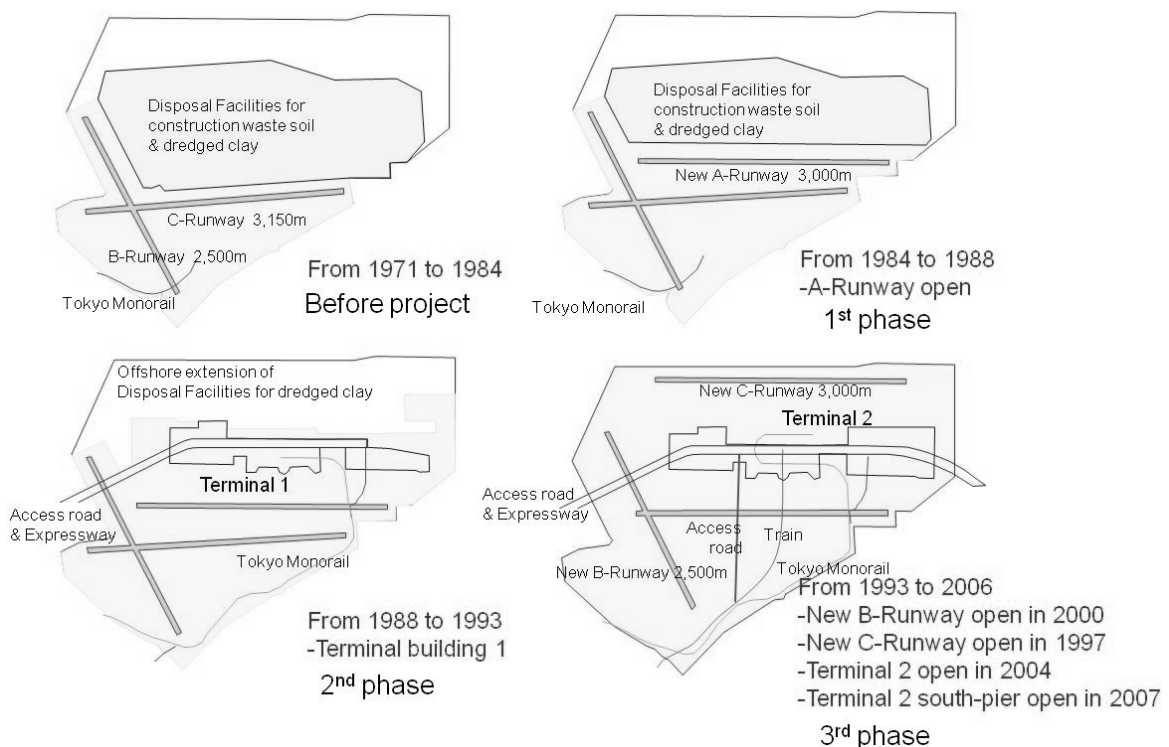


Figure 3. History of the offshore expansion project of the Tokyo International Airport.

The history of the Tokyo International Airport is the history of reclamation. The development history from 1971 to 2007 is summarized in Figure 3.

In order to respond the increasing passengers demand, the 4th runway construction (Figure 4) was started in March 2007. The construction site is located south of the main airport island. The following three features of this project are notable:

- (1) A bridge structure is adopted to ensure the flow rate in case of flood, because the location of the new runway is in the river mouth. However, the bridge section is limited only in the river mouth, because this technology requires a longer construction period and a higher construction cost than the reclamation technology. Thus, the runway is constructed as a hybrid structure of “bridge” and “reclamation”.
- (2) Because the east end of the runway is very close to the shipping route of the Tokyo Port, the elevation of the east end of the runway has to be higher than 17.1 m so that the airplane can fly over a large container ship.
- (3) The construction period is only 2.5 years, which is approximately a half of a normal construction project in Japan. This short construction period is decided to respond the increasing passenger demand.



Figure 4. An image of the 4th runway island in the Tokyo International Airport.

In the reclamation part, a large amount of cement treated clay and air-foam treated lightweight clay will be used in order to assure the stability of the seawall.

The most difficult part in this construction is the interface between the two different structures; i.e. the reclamation section and the bridge section. We have to consider the interaction between these two structures in terms of not only the static stability but also the seismic stability. The construction was started in March 2007, and we are planning to inaugurate the runway in the end of year 2010. Today, the Tokyo International Airport is mainly used for domestic flights; however, the ministry is planning to attract many international flights for Asian countries and areas.