

Fundamental Analysis of Airport Operation and Capacity in Disaster

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1. Introduction

Issues of the Great East Japan Earthquake

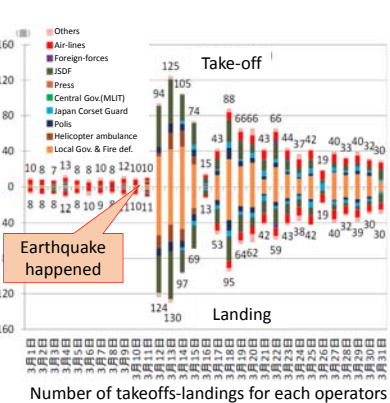
- Large number of Aircrafts were operated for rescue and transport missions, but...
- Many aircrafts concentrated in local airports with poor facilities.
- Flight has been restricted by airport congestion.
- Aircrafts were often forced to wait for a long time to refueling.

➔ Airport capacity affects the ability of disaster response activities by aircrafts.

Limitation of the existing airport capacity model

- Existing models are designed for congested airport used by scheduled flights.
- ➔ Existing model can not be expressed about characteristics of helicopters and the operation under the limited facilities of local airports.

➔ Existing models are not suitable to evaluate airport capacity in disaster.



▲ In disaster, Apron was crowded with helicopters



▲ Cooperation of fixed-wing acft. and helicopter

2. The purpose of this study

- To propose the airport capacity estimation method that considers the specialty airport operations during large-scale disasters.
- To assess the impact of special ground facilities operations on airport capacity.

In order to investigate the actual operations, we did the interview surveys to airport-office and aircraft operators.

Image of EXISTING airport capacity model

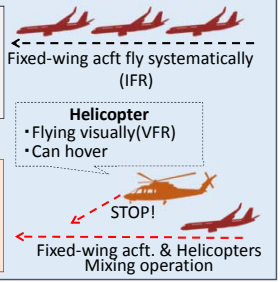


- Congested (Large scale) Airport**
- ATC using radar
 - Parallel taxiway
 - Enough apron spaces

Usage of airport in disaster (image)



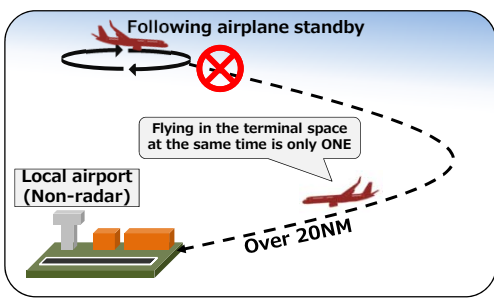
- Local Airport**
- Limited ATC service (Non-radar)
 - No parallel taxiway
 - Limited apron spaces



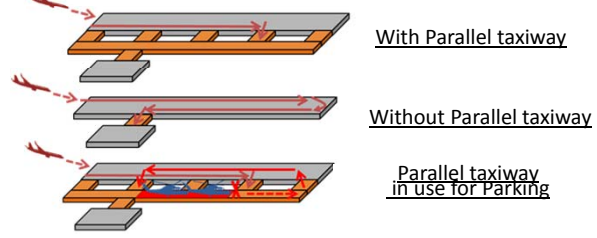
3. The important factors that affect the airport capacity in disaster

① Flying separation

- Large scale airport**
Flying position around airport can be identified by ASR = The aircraft can land or take-off at small separation.
- Non-radar airport**
Traffic controllers cannot identify the position of the aircraft.
= The flying separation is very large. (see right figure)



② Taxiway Operations



General rule of Airfield Usage: Only one acft. can use runway at same time.
= If there is no parallel TWY or it is use for parking, runway occupancy time increases.

4. Estimation model & Results

Features of our model

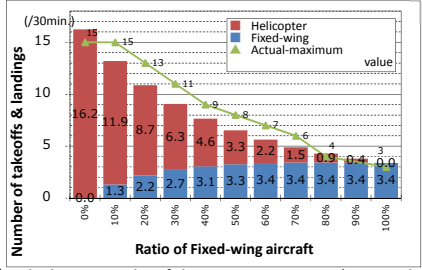
- Considering a flexible separation (in VFR)
- Applicable to Non-radar situation (local airport)
- Applicable to No parallel taxiway (large ROT)

$$CAP = \frac{1800}{\sum_{i,j=Fa1,Fd1,Ha1,Ha2,Hd1,Hd2} P_i P_j T_{i,j}}$$

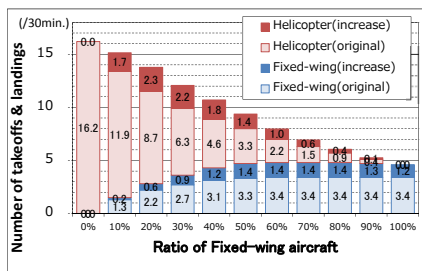
CAP=Runway capacity
F=Fixed-wing, H=Helicopter
a=Arrival, d=Departure
1=Apron1, 2=Apron2

Example of "T_{ij}" in Hanamaki Airport(Iwate pref.)

Preceding aircraft i		T _{ij} ; Runway occupancy time(sec) (include airspace occupancy time)	Following aircraft j					
			Arrival			Departure		
			Fixed-wing (Fa1)	Helicopter1 (Ha1)	Helicopter2 (Ha2)	Fixed-wing (Fd1)	Helicopter1 (Hd1)	Helicopter2 (Hd2)
Arr.	Fixed-wing (Fa1) (A)	609	946	946	946	946	946	
	Fixed-wing (Fa1) (B)	181	518	518	518	518	518	
Helicopter1(Ha1)	Helicopter1(Ha1)	81/74	81/74	81/74	81/74	81/74	81/74	
	Helicopter2(Ha2)	108/62	108/30	108/30	108/62	108/62	108/62	
Dep.	Fixed-wing(Fd1)	290	178	178	290	178	178	
	Helicopter1(Hd1)	141	141/30	141/30	141	141/80	141/80	
	Helicopter2(Hd2)	113	113/30	113/30	113	113/80	113/80	



▲ Calculation Results of the runway capacity (Hanamaki)



▲ Construction effect of the parallel taxiway (Hanamaki)

Calculation result of runway capacity

- Estimated runway capacity is nearly consistent with actual-maximum value.
- = **Runway capacity affected the airport capacity.**

• If the ratio of fixed-wing aircraft increase, a runway capacity decrease.
= Take-off and landing of **fixed-wing aircraft reduces the airport capacity largely.**

Effect of the parallel TWY construction

- Hanamaki Airport built a parallel TWY after the earthquake = Capacity was Increased by the construction
- In disaster, taxiway can be operated as additional parking space(apron).
- = **Airport operator should consider the reduction of capacity by this kind of special operation.**