Earthquake Risk Management of Airport Concession Holders – Consideration of Insurance –

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1. Introduction

The privatization of public facilities by the concession system under the Act on Airport Management Utilizing Private-Sector Capabilities (2013, Law No. 61) was given a concrete form at Sendai Airport. In the concession agreement for that airport, the concession holder had agreed to undertake certain recovery/seismic retrofitting works on his own account. On the other hand, the concession holder bears the financial stress associated with earthquake disasters, and bankruptcy can also be supposed. In this case, the basis for recovery/seismic retrofitting works will also be lost. Therefore, the risk of bankruptcy was evaluated by an analysis of the financial impact on the concession holder, an insurance policy design for shifting the risk to the insurer was presented, and the effects of insurance were calculated.

2. Financial impact analysis for concession holder and policy design

Assuming the financial situation shown in Table 2 (PL, BS), which considers the assets/indebtedness of the concession holder, the financial impact of a group of scenario earthquakes (top 100) was analyzed based on an inventory of financial loss and system model of the period of business stoppage. Earthquake loss functions were calculated for each factor (removal damage, loss of income, rebuilding cost), and a risk list showing the cash, cash equivalents, liquid ratio, etc. of the BS (90% probability of nonexceedance) was obtained for the scenario earthquakes. (Table 1 shows the top 25/100 earthquakes.)

No.	①	M	PBA (cm/s²)	④	⑤	⑥	⑦	⑧	⑨
1	(130.45 , 33.55)	M7.0	521	0.00001	0.00001		0.20	−7,485	–
2	(130.55 , 33.55)	M7.0	484	0.00001	0.00001		0.17	−5,548	–
3	(130.45 , 33.65)	M7.0	472	0.00001	0.00002		0.16	−4,882	–
4	②	M7.2	465	0.00062	0.00064		0.16	−4,527	–
5	(130.45 , 33.55)	M6.5	454	0.00001	0.00066		0.15	−3,896	–
6	(130.55 , 33.65)	M7.0	446	0.00001	0.00066		0.15	−3,496	–
7	(130.35 , 33.55)	M7.0	422	0.00001	0.00067		0.13	−2,204	–
8	(130.55 , 33.55)	M6.5	393	0.00001	0.00068		0.11	−642	0.13
9	(130.45 , 33.45)	M7.0	383	0.00001	0.00069		0.10	−165	0.21
10	(130.35 , 33.65)	M7.0	383	0.00001	0.00070		0.10	−148	0.21
11	(130.45 , 33.55)	M6.0	368	0.00003	0.00072		0.09	625	0.34
12	(130.45 , 33.65)	M6.5	367	0.00001	0.00074		0.09	669	0.34
13	(130.55 , 33.45)	M7.0	360	0.00001	0.00075		0.09	1,011	0.40
14	(130.65 , 33.55)	M7.0	349	0.00001	0.00075		0.08	1,601	0.50
15	(130.65 , 33.65)	M7.0	323	0.00001	0.00076		0.07	2,843	0.70
16	(130.55 , 33.65)	M6.5	322	0.00001	0.00077		0.07	2,883	0.71
17	(130.35 , 33.45)	M7.0	319	0.00001	0.00078		0.07	3,014	0.73
18	(130.45 , 33.75)	M7.0	303	0.00001	0.00079		0.06	3,746	0.85
19	(130.35 , 33.55)	M6.5	295	0.00001	0.00080		0.05	4,096	0.91
20	(130.55 , 33.75)	M7.0	289	0.00001	0.00081		0.05	4,314	0.95
21	(130.55 , 33.55)	M6.0	285	0.00003	0.00083		0.05	4,481	0.97
22	③	M7.3	282	0.00010	0.00093		0.05	4,623	1.00
23	(130.25 , 33.55)	M7.0	281	0.00001	0.00094		0.05	4,673	1.01
24	(130.65 , 33.45)	M7.0	278	0.00001	0.00094		0.05	4,763	1.02
25	(130.25 , 33.65)	M7.0	265	0.00001	0.00095		0.04	5,346	1.12

Fig. 1 Risk list (top 25/100)

① Earthquake hypocenter
② Kego fault zone, southeastern part
③ Nishiyama fault zone
④ Probability of occurrence / year
⑤ Probability of exceedance / year
⑥ 90% nonexceedance value
⑦ Loss ratio (rebuilding cost)
⑧ Cash/cash equivalents (million yen)
⑨ Liquid ratio

In the policy design, assuming bankruptcy in case of a liquid ratio of less than 0.9, cash, cash equivalents, etc. (① ¥4,096 million) before and after the event are read, and this is treated as an insurance deductible (lower limit of coverage). The worst-case earthquakes (names of earthquake hypocenters are shown by hatching) are designated, considering the probability of occurrence, and the amount of cash, bank deposit, etc. (② - ¥4,527 million) is read. The difference between ① and ② is the necessary funding for the worst-case earthquake.

These amounts are divided by the current replacement

cost, and based on this loss rate conversion, the necessary funding is defined as a (=0.11), the payment limit as b (=0.16) and the deductible as d. Because insurance payments are determined by subtracting the insurance deductible from the actual loss, if the policy is designed so as to cover the necessary funding with the minimum insurance premium, the deductible d = b – a, and d can be decided as 0.05.

3. Calculation of effect by financial function stress

Fig. 2 shows the earthquake loss functions for various liquid ratios. This is defined as the financial stress function. When earthquake risk is not considered, the liquid ratio is 1.59, and when earthquake risk is considered, the liquid ratio decreases as the earthquake intensity increases. If the concession holder takes out insurance, the curve bends so as to maintain 0.9. In other words, the concession holder receives an insurance payment which is calculated by deducting the deductible from the actual loss, and management can be maintained satisfactorily. The point where the curve turns downward again is the worst-case earthquake, and after this point, the necessary funding exceeds the amount of the insurance payment. However, from the management viewpoint, this can be disregarded as a rare event. In this way, the effect of insurance can be measured by the financial stress function. Moreover, because the insurance premium is quite small in comparison with revenue, its effect on finances is not considered.

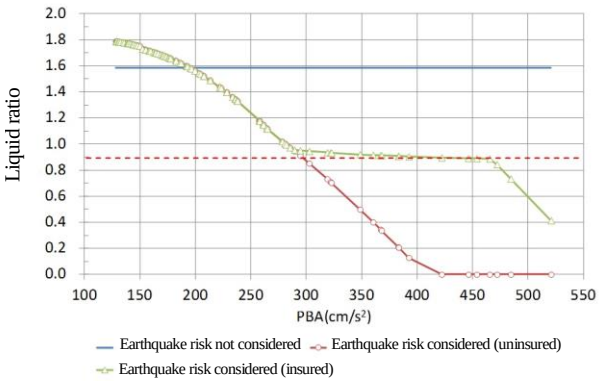

Fig. 2 Financial stress function

【Reference】

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