Studies on the effect of reducing the stress in the ground by aircraft

NAKASHIMA Susumu, Head
KATO Mitsuru, Deputy Head
SASHOU Tomoyuki, Researcher
Airport Department　Airport Construction Systems Division

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1, Introduction

Traditionally, stress in the ground vertical direction acting on underground structures by aircraft load has been calculated by the method of load distribution (Law of Boston code). However, in recent years, it has become possible to calculate under appropriate conditions to take into account the pavement by the generalized multi-layer elastic analysis program.
In this study, using the multi-layer elastic analysis, we calculated the vertical stress in the ground which includes underground structure and is paved with the material such as concrete slab which have high load dispersion effect. And we confirmed the effect of reducing the vertical stress by comparing it to the vertical stress in the homogeneous isotropic (no pavement) ground.

2, Relationship of stress due to the presence or absence of pavement

As a cross-section calculated by a standard design of pavement conditions in major domestic airports (20,000 times cyclic design action, LA-1 segment design load, 25MN/m3 of K value or CBR10%), for the three cases: asphalt pavement (AS pavement : 15cm base layer), prestressed concrete pavement (PC pavement: 24cm thick plate), and unreinforced concrete pavement (NC pavement: 42cm thick plate), we calculated the maximum value of the vertical stress in the ground by multi-layer elastic analysis program (GAMES) for 40 models of domestic aircraft and compared to homogeneous isotropic (no pavement) ground stress. Figure 1 shows an example of the result. If the pavement exists, the higher the stiffness of the pavement, the smaller the stress is. (As Pavement (16° C) < PC pavement <NC pavement) And the shallower the depth of the ground, the bigger the difference becomes in the case of no pavement. With the NC pavement, there was a reduction of about 40% to 80% stress compared to the case without a pavement.(Fig. 2), and reduction rate was increased, especially in the shallower than 1.5m.

3, Conclusion

In this study, we were able to confirm the effect of reducing the vertical stress in the ground considering the pavement. Thus, the structure embedded in the ground under the pavement of high rigidity enables the cross-section structure to design economically. Therefore, for revision procedure, we show some examples of specific calculation methods, and we plan to create a rough draft which is considered the efficiency of the design.

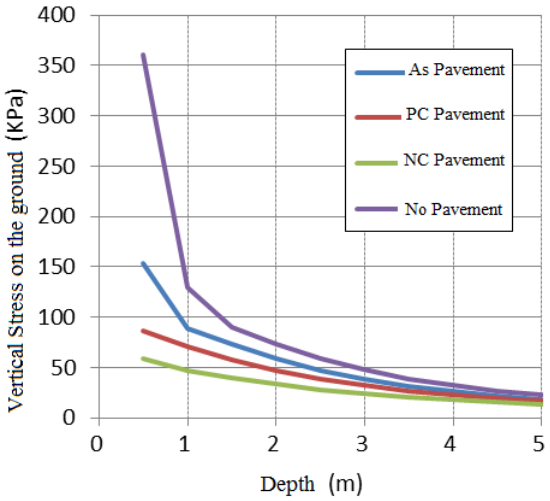

Fig.1 Vertical stress in the ground (B777-300)

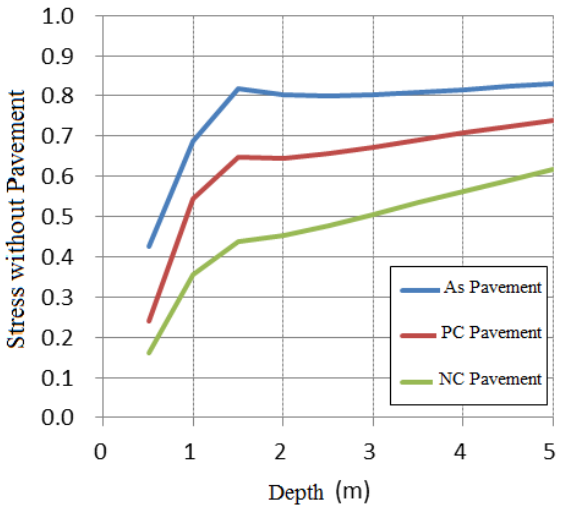

Fig.2 Effects of pavement / no pavement (B777-300)

【References】

Civil Aviation Bureau Ministry of Land, Infrastructure and Transport・Edited by National Institute for Land and Infrastructure Management : Civil structural design guidelines and a design example airport facility, Service Center of Port Engineering, 2012