**AIRPORT PAVEMENT DESIGN SYSTEM IN JAPAN (paper title)**

top margin 80mm (1st page)

header 25mm (1st page)

left margin 25mm

(blank)

14pt., all capitals, bold, center-justified

(blank)

Kenji HIMENO (author-1)

12pt., left-justified

Professor, Department of Civil Engineering, Chuo University

1-13-27, Kasuga, Bunkyo-ku, Tokyo 112-8551, Japan

khimeno@civil.chuo-u.ac.jp

(blank)

Yasushi TAKEUCHI (author-2)

Professor, Department of Bio-production and Environment Engineering,

Tokyo University of Agriculture

1-1-1, Sakuragaoka, Setagaya-ku, Tokyo 156-8502, Japan

bamboo@nodai.ac.jp

(blank)

Yoshitaka HACHIYA (author-3)

Director for Special Research (Airport & Environment), Port and Airport Research Institute

1-1, Nagase 3, Yokosuka 239-0826, Japan

hachiya@ipc.pari.go.jp

(blank)

(blank)

12pt., bold, left-justified

ABSTRACT

The purpose of pavements is to let vehicles pass smoothly and safely. Different from road pavements, airport pavements are characterized as that they must sustain the extremely heavy load of huge aircraft such as Jumbo Jets and Air Buses. To accomplish this, the important engineering issues are shown below

max. 10 lines

1) preparation of foundation and subgrade,

12pt., left-justified

2) reasonable design of pavement structure and

3) pavement construction as designed

(blank)

12pt., bold, italic, left-justified

*KEY WORDS*

*pavement, airport, design, structure*

12pt., italic, left-justified

max. 5 words

bottom margin 25mm

right margin 25mm

footer 15mm

10pt., center-justified

INTRODUCTION (1ST LEVEL HEADING)

12pt., all capital letters, bold, left-justified

NO HEADER (even pages)

top margin 25mm

(2nd and later)

In the paper, structural design methods of airport pavements that are currently adopted in Japan are briefly described.(MAIN BODY)

12pt., left-justified

(blank)

The structural design of permeable composite pavement that has enough durability for heavy traffic was investigated. The pavement was designed by multi layer elastic theory. This permeable composite pavement consists of two layers of permeable asphalt concrete, a porous cement concrete base and permeable stabilized subgrade. In order to validate the materials used, the structural design method and the construction procedure, a field trial was conducted. The performance of the pavement in the field trial was verified and the following conclusions were obtained.

(blank)

REF. CITATION

12pt., bold, left-justified

**Airport pavement types (2nd level heading)**

upper, right parenthesized

Airport pavements are classified into two structure types1).

(blank)

1) asphalt pavement (flexible pavement)

2) concrete pavement (rigid pavement)

(blank)

The load and the running speed of the aircraft, and the frequency of the traffic vary widely in the areas of the airport. Therefore, it is rational divides the pavement areas into several sections in the structure design. Currently, the airport pavement areas are divided into five categories as shown in **Figure 1**.

bold

(blank)

****

bold

FIGURE CAPTION

**Figure 1** Classification of pavement areas

center-justified

(blank)

***Asphalt pavement (3rd level heading)***

12pt., bold, italic, left-justified

Asphalt pavement is of multi-layer composition, such as wearing course, binder course, base course and subbase. The questions to be worked out regarding the structural design of the asphalt pavement are firstly, to select the materials and secondly, to determine the thickness of each layer.

(blank)

Generally, the undercarriage load at the time of takeoff having the maximum weight (fully loaded) is used as the design aircraft load. Because lighter aircraft have less influence on the pavement, the traffic volume of the design aircraft load is calculated using the following expression.

10pt., all capitals, bold, center-justified

EXPRESSION

line

authors’ name

HEADER (odd pages- except 1st page)

header 15mm

(blank)

NO. OF CITATION

 (1)

centered

flush right

where,

: traffic volume converted to the design aircraft load,

: traffic volume of a certain aircraft,

: ESWL (explained later) of a certain aircraft, and

: ESWL of the design aircraft load.

(blank)

**Table 1** shows an example of this calculation. In the table, Wi is the number of main wheels in the transverse direction of each aircraft and  is the coefficient to consider the transverse distribution of traffic.

center-justified

bold

bold

(blank)

TABLE CAPTION

**Table 1** Example of Coverage Calculation

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Aircraft | *I/D\** | *T/L\** | *ni* | *Pi* | *P*0 |  |  | *Wi* |  |
|  | *I* | *T* | 10,000 | 56.6 | 56.6 | 1.0 | 10,000 | 8 | 80,000 |
| B-747 |  | *L* | 10,000 | 40.9 | 56.6 | 0.850 | 2,510 | 8 | 20,080 |
|  | *D* | *T* | 80,000 | 42.9 | 56.6 | 0.871 | 18,560 | 8 | 148,480 |
|  |  | *L* | 80,000 | 40.9 | 56.6 | 0.850 | 14,720 | 8 | 117,760 |
| DC-10 | *D* | *T* | 23,000 | 39.8 | 56.6 | 0.839 | 4,550 | 4 | 18,200 |
|  |  | *L* | 23,000 | 38.0 | 56.6 | 0.819 | 3,750 | 4 | 15,000 |
| A-300 | *D* | *T* | 50,000 | 44.7 | 56.6 | 0.889 | 14,990 | 4 | 59,960 |
|  |  | *L* | 50,000 | 39.7 | 56.6 | 0.838 | 8,620 | 4 | 34,480 |
| A-320 | *D* | *T* | 35,000 | 28.0 | 56.6 | 0.703 | 1,570 | 4 | 6,280 |
|  |  | *L* | 35,000 | 27.2 | 56.6 | 0.693 | 1,410 | 4 | 5,640 |
| DC-9 | *D* | *T* | 60,000 | 22.2 | 56.6 | 0.626 | 980 | 4 | 3,920 |
|  |  | *L* | 60,000 | 19.8 | 56.6 | 0.591 | 670 | 4 | 2,680 |
|  | | | | | | | | | 512,480 |
| Number of coverage on runway used for large-sized jet aircraft (=0.03) | | | | | | | | | 15,370 |
| Number of coverage on taxiway used for large-sized jet aircraft (=0.04) | | | | | | | | | 20,500 |

\**I*: international, *D*: domestic, *T*: takeoff, *L*: landing

(blank)

**CONCLUSIONS**

The following conclusions were obtained from this study2).

(blank)

1. Membrane curing can decrease the long term drying shrinkage strain to 90% of that with conventional mat curing.
2. Flexural strength with membrane curing is 80%, 90% and 95% of that of conventional mat curing in seven, twenty-eight and ninety-one days, respectively.
3. Concentration of the membrane curing compound affects the drying shrinkage strain, while the influence of concentration on flexural strength is not clear.
4. In situ drying shrinkage strain with membrane curing is 2 times in the early days, and 1.2 times in the long term, that of conventional mat curing.
5. The temperature difference and gradient in the slab are larger with membrane curing than with conventional mat curing in the early days, but become nearly the same in the long term.

(blank)

REFERENCES

1. Civil Aviation Bureau, Ministry of Transport: *Design Criterion for Concrete Pavements in Airport* (in Japanese), pp.9-11, 1990.
2. Yoshitaka Hachiya and Yukitomo Tsubokawa: A Study on Applicability of Membrane Curing Compound to Airport Concrete Pavement, *China/Japan Workshop on Pavement Technologies*, pp. 107-116, 2001.