EAC

No. 139-61

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EAC 139-61 Drainage characteristics of the movement area and adjacent areas

1 . General

(a) Rapid drainage of surface water is a primary safety consideration in the design, construction and maintenance of movement area and adjacent areas. The objective is to minimize water depth on the surface by draining water off the runway in the shortest path possible and particularly out of the area of the wheel path. There are two distinct drainage processes taking place:

(i) Natural drainage of the surface water from the top of the pavement surface until it reaches the final recipient such as rivers or other water bodies; and

(ii) Dynamic drainage of the surface water trapped under a moving tire until it reaches outside the tire-to-ground contact area.

(b) Both processes can be controlled through:

(i) Design;

(ii) Construction; and

(iii) Maintenance. of the pavements in order to prevent accumulation of water on the pavement surface.

2 . Design of pavement

(a) Surface drainage is a basic requirement and serves to minimize water depth on the surface. The objective is to drain water off the runway in the shortest path. Adequate surface drainage is provided primarily by an appropriately sloped surface (in both the longitudinal and transverse directions). The resulting combined longitudinal and transverse slope is the path for the drainage runoff. This path can be shortened by adding transverse grooves.

(b) Dynamic drainage is achieved through built-in texture in the pavement surface. The rolling tire builds up water pressure and squeezes the water out the escape channels provided by the texture. The dynamic drainage of the tire-to-ground contact area may be improved by adding transverse grooves provided that they are subject to rigorous maintenance.

3 . Construction of pavement

(a) Through construction, the drainage characteristics of the surface are built into the pavement. These surface characteristics are:

(i) Slopes;

(ii) Texture

(A) Micro texture;

(B) Macro texture;

(b) Slopes for the various parts of the movement area and adjacent parts are described in Subpart F and figures are given as per cent. Further guidance is given in EAC 139-9 , Chapter 5.

(c) Texture in the literature is described as micro texture or macro texture. These terms are understood differently in various part of the aviation industry.

(d) Micro texture is the texture of the individual stones and is hardly detectable by the eye. Micro texture is considered a primary component in skid resistance at slow speeds. On a wet surface at higher speeds a water film may prevent direct contact between the surface asperities and the tire due to insufficient drainage from the tire-to-ground contact area.

(e) Micro texture is a built-in quality of the pavement surface. By specifying crushed material that will withstand polishing micro texture, drainage of thin water films are ensured for a longer period of time. Resistance against polishing is expressed in

terms of the Polished Stone Values (PSV) which is in principle a value obtained from a friction measurement in accordance with international standards. These standards define the PSV minima that will enable a material with a good micro texture to be selected.

(f) A major problem with micro texture is that it can change within short time periods without being easily detected. A typical example of this is the accumulation of rubber deposits in the touchdown area which will largely mask micro texture without necessarily reducing macro texture.

(g) Macro texture is the texture among the individual stones. This scale of texture may be judged approximately by the eye. Macro texture is primarily created by the size of aggregate used or by surface treatment of the pavement and is the major factor influencing drainage capacity at high speeds. Materials shall be selected so as to achieve good macro texture.

(h) The primary purpose of grooving a runway surface is to enhance surface drainage. Natural drainage can be slowed down by surface texture, but grooving can speed up the drainage by providing a shorter drainage path and increasing the drainage rate.

(i) For measurement of macro texture, simple methods such as the "sand and grease patch" methods described in the EAC 139-19 were developed. These methods were used for the early research on which current airworthiness requirements are based upon, which refers to a classification categorizing macro texture from A to E. This classification was developed, using sand or grease patch measuring techniques, and issued in 1971 by the Engineering Sciences Data Unit (ESDU).

Runway classification based on texture information from ESDU 71026:

Classification	Texture depths (mm)
A	0.10 – 0.14
B	0.15 – 0.24
C	0.25 – 0.50
D	0.51 – 1.00
E	1.01 – 2.54

(j) Using this classification the threshold value between micro texture and macro texture is 0.1 mm mean texture depth (MTD). Related to this scale the normal wet runway aircraft performance is based upon texture giving drainage and friction qualities midway between classification B and C (0.25 mm). Improved drainage through better texture might qualify for a better aircraft performance class. However such credit must be in accordance with aero plane manufacturers documentation and agreed by the ECAA. Presently credit is given to grooved or porous friction course runways following design, construction and maintenance criteria acceptable to the ECAA. The harmonized certification standards of some States refer to texture giving drainage and friction qualities midway between classification D and E (1.0 mm).

(k) For construction, design and maintenance, States use various international standards. Currently ISO 13473-1: Characterization of pavement texture by use of surface profiles -- Part 1: Determination of Mean Profile Depth links the volumetric measuring technique with non contact profile measuring techniques giving comparable texture values. These standards describe the threshold value between micro texture and macro texture as 0.5 mm. The volumetric method has a validity range from 0.25 to 5 mm MTD. The profilometry method has a validity range from 0 to 5 mm mean profile depth (MPD). The values of MPD and MTD differ due to the finite size of the glass spheres used in the volumetric technique and because the MPD is derived from a two-dimensional profile rather than a three-dimensional surface. Therefore a transformation equation must be established for the measuring equipment used to relate MPD to MTD.

(l) The ESDU scale groups runway surfaces based on macro texture from A through E, where E represents the surface with best dynamic drainage capacity. The ESDU scale thus reflects the dynamic drainage characteristics of the pavement. Grooving any of these surfaces enhances the dynamic drainage capacity. The resulting drainage capacity of the surface is thus a function of the texture (A through E) and grooving. The contribution from grooving is a function of the size of the grooves and the spacing between the grooves. Aerodromes exposed to heavy or torrential rainfall must ensure that the pavement and adjacent areas have drainage capability to withstand these rainfalls or put limitations on the use of the pavements under such extreme situations. These airports should seek to have the maximum allowable slopes and the use of aggregates providing good drainage characteristics. They should also consider grooved pavements in the E classification to ensure that safety is not impaired.

4 . Maintenance of drainage characteristics of pavement

(a) Macro texture does not change within a short time span but accumulation of rubber can fill up the texture and as such reduce the drainage capacity, which can result in impaired safety. Furthermore the runway structure may change over time and give unevenness which results in ponding after rainfall. Guidance on rubber removal and unevenness can be found in EAC 139-19. Guidance on methods for improving surface texture can be found in EAC 139-20.

(b) When grooving is used, the condition of the grooves should be regularly inspected to ensure that no deterioration has occurred and that the grooves are in good condition. Guidance on maintenance of pavements is available in EAC 139-19 — Pavement Surface Conditions and Part 9 — Airport Maintenance Practices and Doc 9157, Part 2 EAC 139-10.