# SWIFT 2025 – PAVEMENT TECHNICAL TRACK

## *A COMPARAISON OF TWO PAVEMENT DESIGN APPROACHES*

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COLAS

# SUMMARY


1 **Airfield vs. road pavements**

2 **Aircraft traffic and loading**

3 **Types of airfield pavements**

4 **Aircraft wandering**

5 **Platform/subgrade strength**

6 **Granular material properties**

7 **Bituminous materials mechanical properties**

8 **Pavement structural design**

9 **Fictitious airfield pavement calculation example**

10 **ACR/PCR calculation**

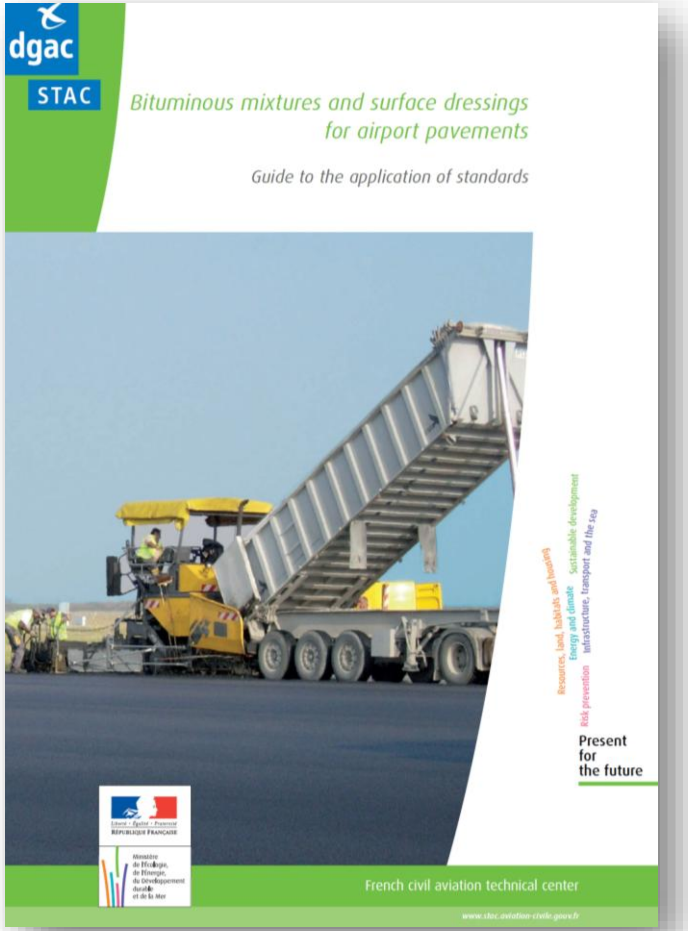

# 1

## Airport vs. road pavements

# AIRPORT VS. ROAD PAVEMENT
## DIFFERENCES

Table 2 – Characteristics and particular features of airport pavements

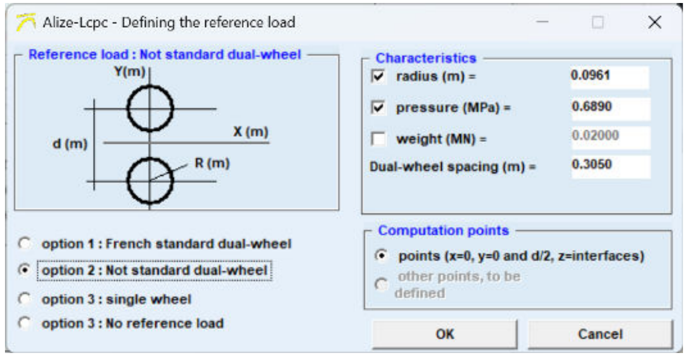
| Road pavements | Airport pavements |
|---|---|
| Loads applied | |
| ● loads are applied in a way that presents very low lateral dispersal (which could cause rutting) | ● on runways, traffic is dispersed (only the central third of the surface is occupied) and landing gear configurations vary from one aircraft to another. On taxiways, this dispersal is less marked |
| ● a large number of movements (up to 50,000 per day) of relatively light loads (42 t total weight, 4.2 t maximum wheel load), engendering fatigue mainly due to the high frequency of movements each causing small stresses | ● a very small number of movements (from very few to more than 100 per day) of differing loads (up to 550 t or more total weight, 45 t for a twin-wheel undercarriage and 115 t for a bogy), causing fatigue mainly due to infrequent movements each causing large stresses |
| ● tyre pressures must not exceed 0.8 MPa (8 bars) | ● tyre pressures may attain 1.7 MPa (17 bars) for certain aircraft |
| ● the most aggressive loads are applied at low speeds (less than 90 km/h) | ● speeds are highly variable :<br>- very low speeds, which can cause runtting phenomena<br>- very high speeds during takeoff and landing (over 300 km/h) |
| Particular features | |
| ● particular stresses which require good tyre contact to the pavement in order to provide the best possible roadholding and satisfactory braking performance for vehicles using it | ● geometrical and environmental conditions which expose pavement mixtures over long periods to the action of rain, sun etc. |
| ● surface evenness (with no surface defects) is largely related to passenger comfort | ● surface evenness is largely related to aircraft safety when taxiing at high speeds |
| ● roughness develops essentially as a result of a polishing phenomenon affecting aggregates over time | ● roughness develops progressively as a result of rubber deposits from tyres |
| ● traffic has sometimes to be diverted or stopped in the event of road works | ● the operating and safety constraints on traffic make it very difficult for traffic to be stopped or reduced when maintenance or renovation work has to be carried out |



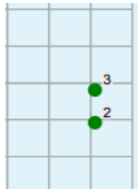
# AIRPORT VS. ROAD PAVEMENT

## TYPE OF LOAD AND CONTACT PRESSURE

### Uniform contact pressure

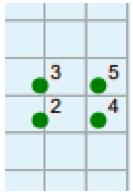



### Non uniform contact pressure



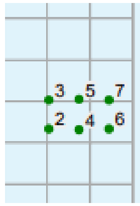

| Pression (MPa) |
|---|
| 1 |
| 1.3 |
| 1.3 |

| Maximum Ramp Weight (kg) | Maximum Take-off Weight (kg) | Maximum Landing Weight (kg) | Operational Empty Weight (kg) |
|---|---|---|---|
| 61 235 | 60 781 | 52 390 | 35 221 |




| Pression (MPa) |
|---|
| 0.92 |
| 1.24 |
| 1.24 |
| 1.24 |
| 1.24 |

| Maximum Ramp Weight (kg) | Maximum Take-off Weight (kg) | Maximum Landing Weight (kg) | Operational Empty Weight (kg) |
|---|---|---|---|
| 156 500 | 155 000 | 140 000 | 86 500 |




| Pression (MPa) |
|---|
| 1.22 |
| 1.52 |
| 1.52 |
| 1.52 |
| 1.52 |
| 1.52 |
| 1.52 |

| Maximum Ramp Weight (kg) | Maximum Take-off Weight (kg) | Maximum Landing Weight (kg) | Operational Empty Weight (kg) |
|---|---|---|---|
| 316 900 | 316 000 | 233 000 | 160 000 |

# AIRPORT VS. ROAD PAVEMENT
## TRAFFIC

**Roads**

Large number of passages (several million)

Wandering (Standard Deviation) 0.45 m

Aggressive loading applied at less than 90 km/h

**Airfields**

Runway movements medium hub airport - 50 to 300 per day

Wandering (total)

- Runway SD 0.75 m
- Taxiway SD 0.50 m
- Aprons SD 0.00 m

Speed 30 km/h to 300 km/h

# 2

## Aircraft traffic and loading

# DIFFERENCES IN TRAFFIC CONSIDERATION
## AIRCRAFT WEIGHTS

- Maximum ramp weight Mrw correspond to the maximum acceptable weight of the aircraft during maneuvers on the ground on aprons
- Maximum landing weight Mlw corresponds to the maximum acceptable weight of the aircraft when landing

# DIFFERENCES IN TRAFFIC CONSIDERATION

## DGAC RATIONAL DESIGN METHOD (2016) AND FAA ADVISORY CIRCULAR 150/5320-6G (2021)

### ALIZE 2.1.2

- Takeoff and landing weights are taken into consideration in the design of the pavement, for all the aircraft making up the traffic.
- Project traffic neglects the least aggressive aircraft in the design calculations
- "Equivalent Single Wheel Load" which relates to the pavement structure is used to check asphalt concrete fatigue. It relates to a load applied 10,000 times, with a circle footprint of a radius 0.20 m that causes the same fatigue damage of the asphalt concrete as the complete traffic mix.

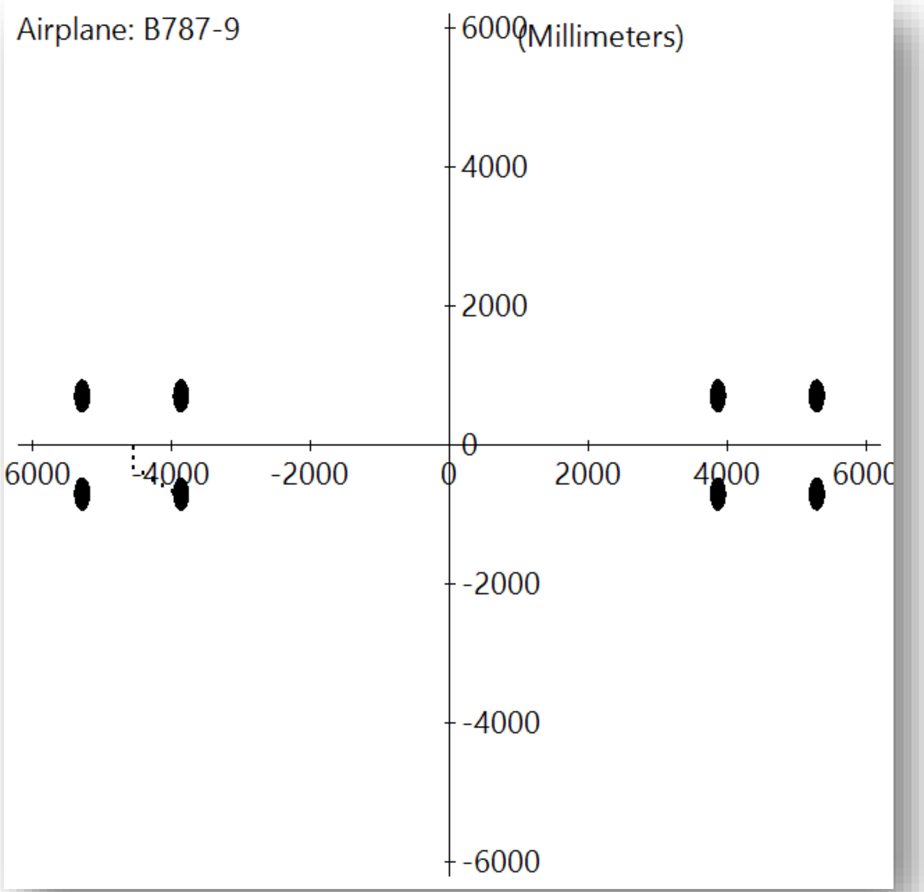
### FAARFIELD 2.1.1

- Airfield pavements are designed considering only aircraft departures.
- Where arrivals constitute 85% or greater of that runway's operations, and for high-speed exit taxiways, the use of aircraft landing weights for design is permitted.
- The design calculations use the entire traffic mix in the modeling of the pavement, however, most pavement designs are controlled by the operations of the most demanding aircraft in the traffic mix.
- The "Cumulative Damage Factor" method, it identifies those aircraft in the design mix that contribute the greatest amount of damage to the pavement.

# DIFFERENCES IN TRAFFIC CONSIDERATION

## TRAFFIC DATA

- Type of aircraft in the traffic mix
- The accumulated number of passages over the entire design period, making the distinction between takeoffs and landings
- The geometry of its landing gear and the loading conditions of its complete landing gear: the coordinates of the wheels in the horizontal plane, the weight supported by each wheel and the contact pressure between the tire and the pavement, which is usually assimilated to the tire pressure
- The maximum ramp weight Mrw (listed on the airworthiness certificate) for takeoffs, unless more precise information is available
- The maximum landing weight Mlw, unless more precise information is available
- The speed
- The wandering



# 3

## Type of airfield pavements

# TYPE OF AIRPORT PAVEMENTS
## RELATED TO SPEED

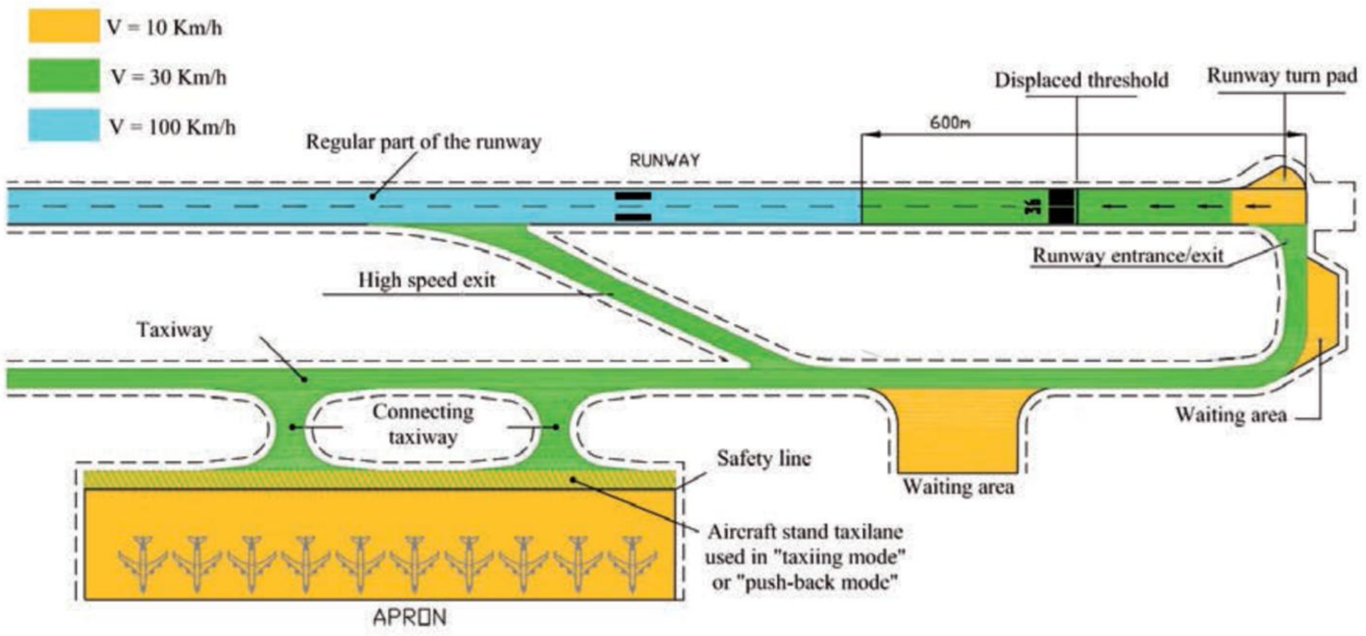
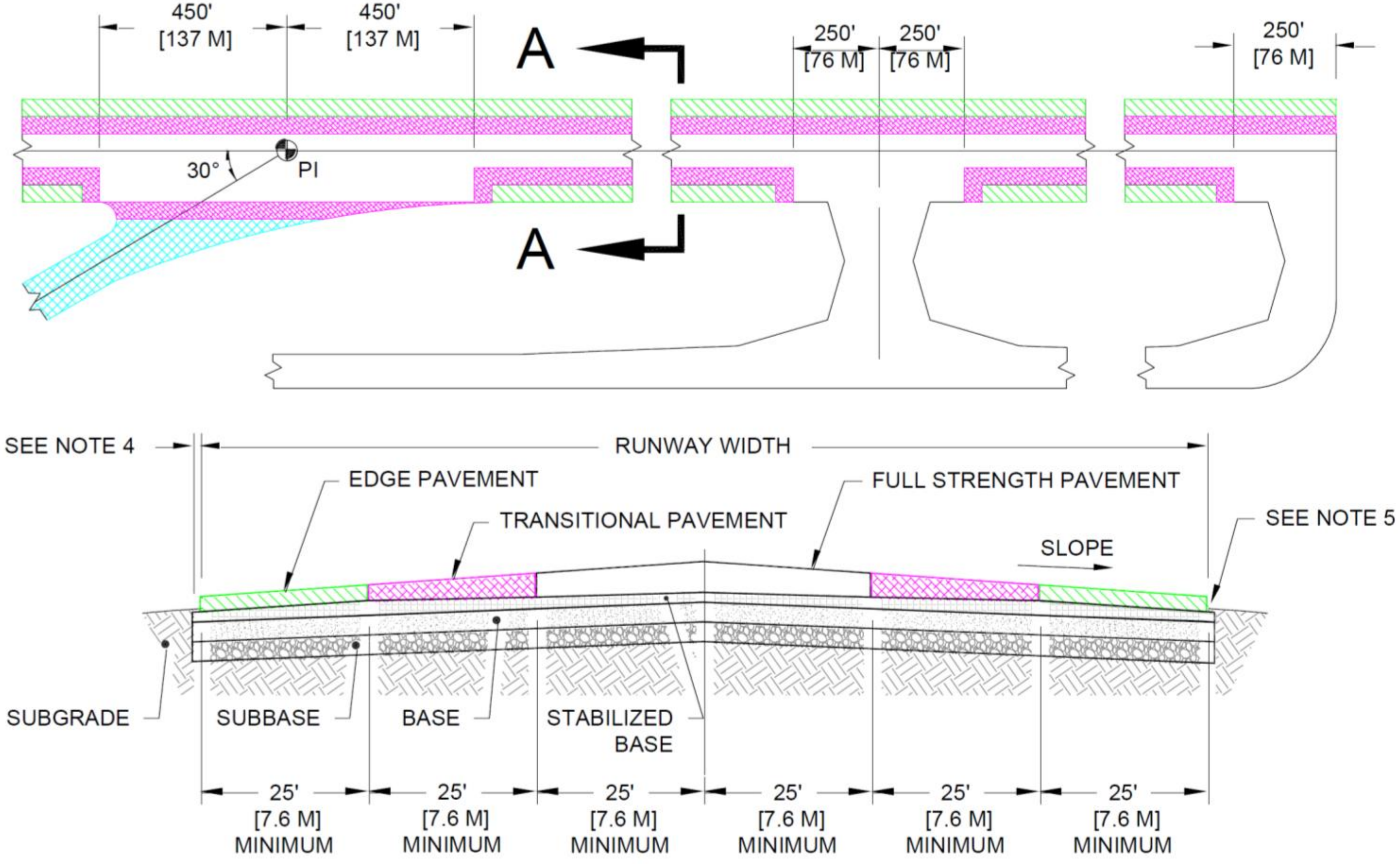
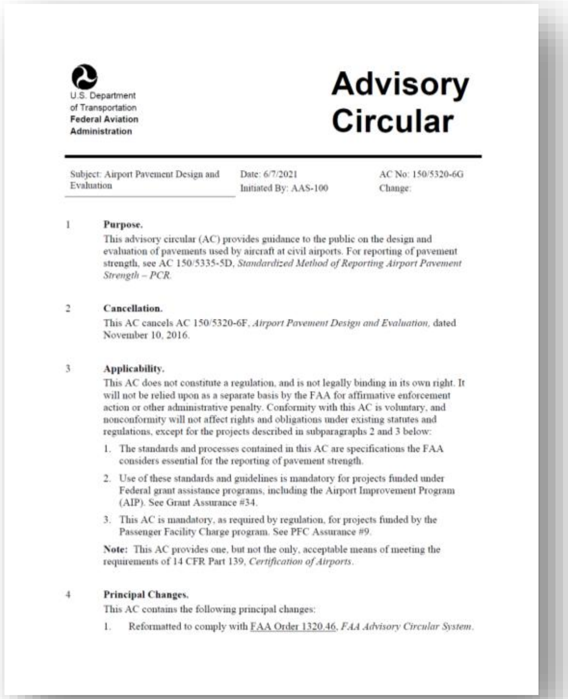



*Figure 5: map between the three families of sections taken into consideration for design purposes and the various usual airfield infrastructures*

# TYPE OF AIRPORT PAVEMENTS
## RELATED TO OCCUPANCY




SECTION A-A (FOR HMA)
NOT TO SCALE



U.S. Department of Transportation
Federal Aviation Administration

**Advisory Circular**

| | | |
|---|---|---|
| Subject: Airport Pavement Design and Evaluation | Date: 6/7/2021<br>Initiated By: AAS-100 | AC No: 150/5320-6G<br>Change: |

1 **Purpose.**
This advisory circular (AC) provides guidance to the public on the design and evaluation of pavements used by aircraft at civil airports. For reporting of pavement strength, see AC 150/5335-5D, *Standardized Method of Reporting Airport Pavement Strength – PCR.*

2 **Cancellation.**
This AC cancels AC 150/5320-6F, *Airport Pavement Design and Evaluation,* dated November 10, 2016.

3 **Applicability.**
This AC does not constitute a regulation, and is not legally binding in its own right. It will not be relied upon as a separate basis by the FAA for affirmative enforcement action or other administrative penalty. Conformity with this AC is voluntary, and nonconformity will not affect rights and obligations under existing statutes and regulations, except for the projects described in subparagraphs 2 and 3 below:

1. The standards and processes contained in this AC are specifications the FAA considers essential for the reporting of pavement strength.
2. Use of these standards and guidelines is mandatory for projects funded under Federal grant assistance programs, including the Airport Improvement Program (AIP). See Grant Assurance #34.
3. This AC is mandatory, as required by regulation, for projects funded by the Passenger Facility Charge program. See PFC Assurance #9.

**Note:** This AC provides one, but not the only, acceptable means of meeting the requirements of 14 CFR Part 139, *Certification of Airports*.

4 **Principal Changes.**
This AC contains the following principal changes:

1. Reformatted to comply with FAA Order 1320.46, *FAA Advisory Circular System*.

## NOTES

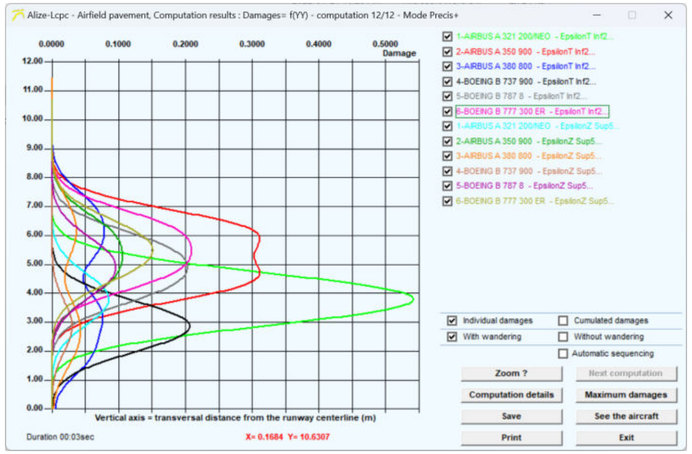
- *The full-strength keel section is the centre 15 m of a 60 m runway.*
- *Outer edge design using departure weights and 1% estimated frequency.*

# 4

## Aircraft wandering

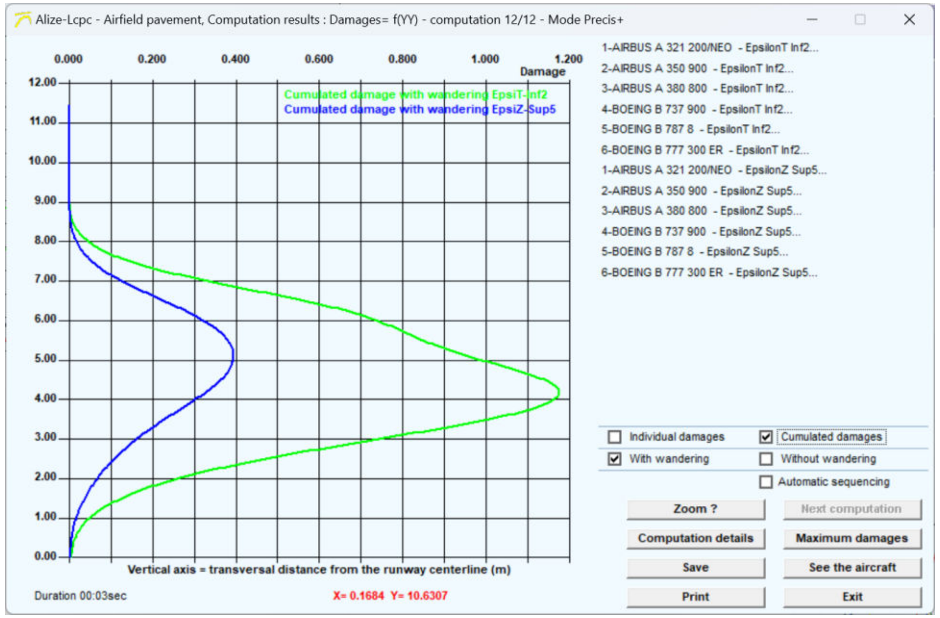
# AIRCRAFT WANDERING

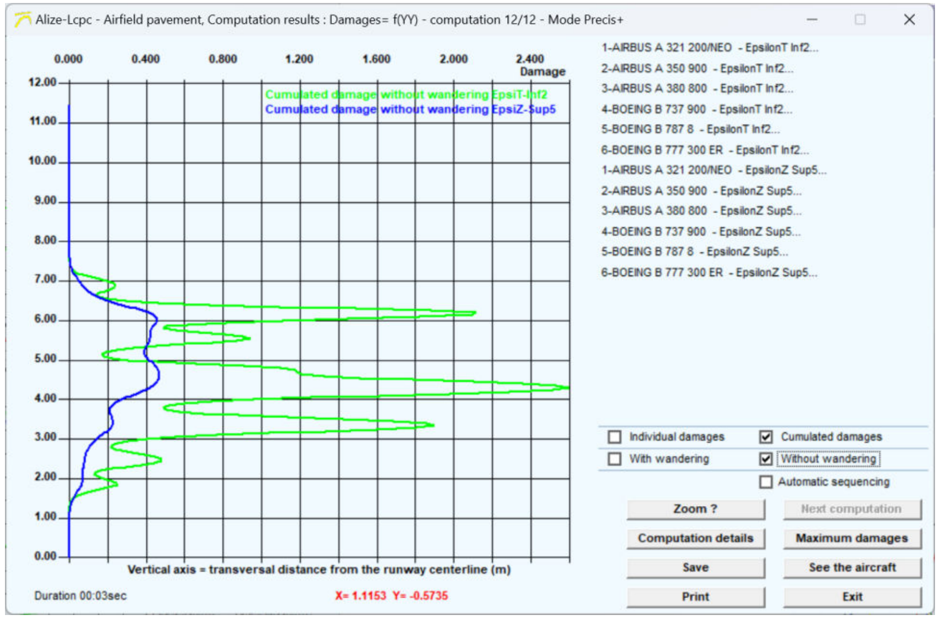
## ALIZE AIRFIELD MODULE 2.0 – DGAC RATIONAL METHOD




| *Pavement section* | *Standard deviation $S_{bal}$ (in m)* |
|---|---|
| *High-speed sections* | *0.75* |
| *Moderate-speed sections* | *0.5* |
| *Aprons and low-speed sections* | *0* |

*Table 5 : standard deviations according to the type of section*

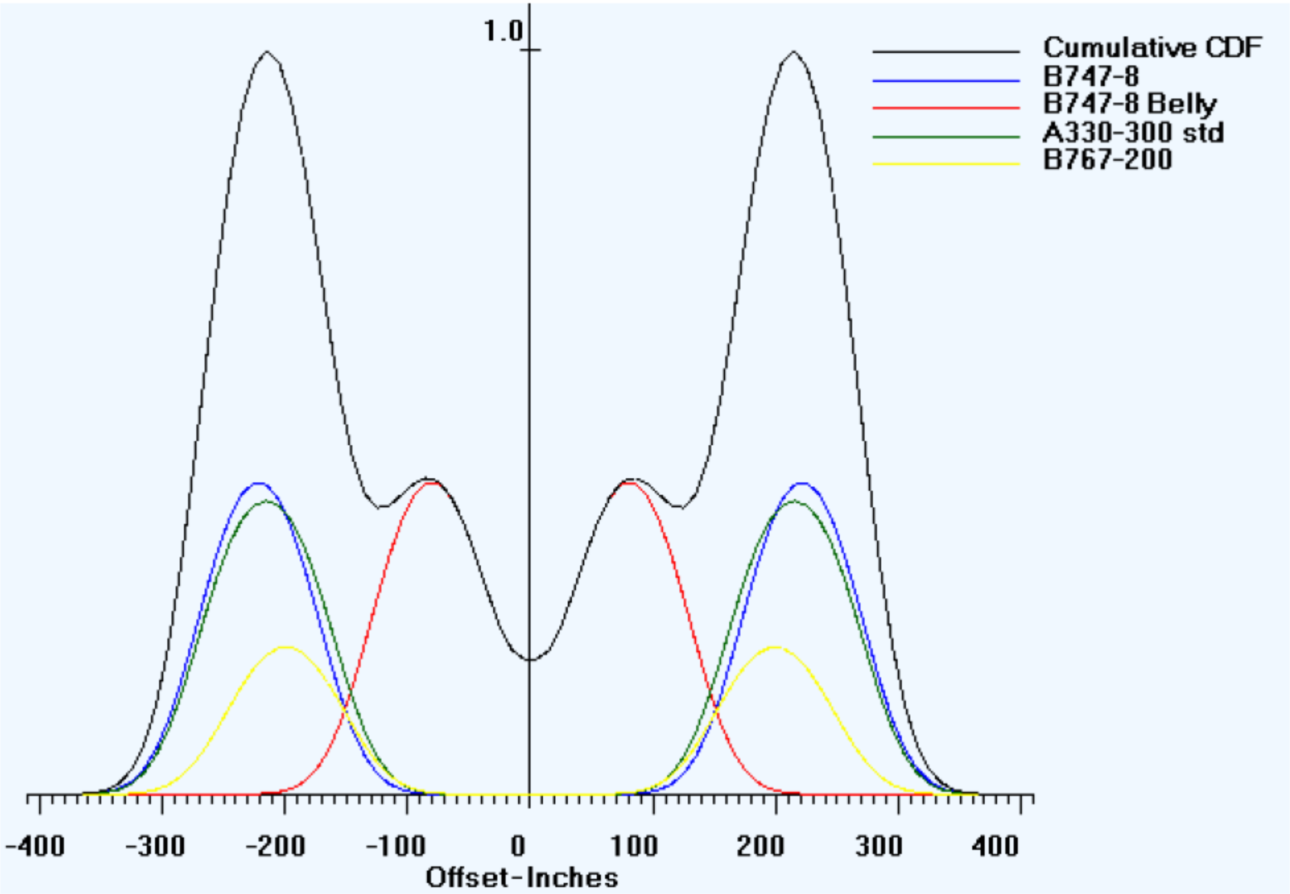



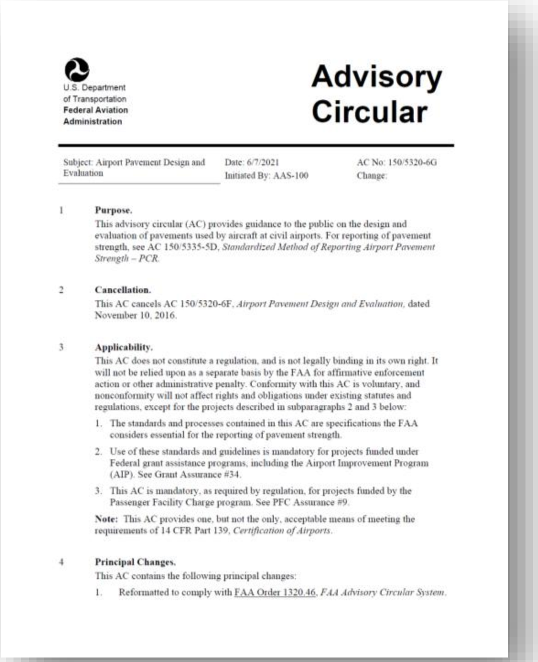



# PAVEMENT FUNCTIONALITIES

## FAARFIELD 2.1 – FAA ADVISORY CIRCULAR 150/5320-6G

Figure H-1. CDF Contribution for Aircraft Mix



U.S. Department of Transportation
Federal Aviation Administration

**Advisory Circular**

| | | |
|---|---|---|
| Subject: Airport Pavement Design and Evaluation | Date: 6/7/2021<br>Initiated By: AAS-100 | AC No: 150/5320-6G<br>Change: |

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**NOTE:**

» *FAA AC 150/5320-6G specify wander pattern standard deviation of 30.5 inches, (0.775 m).*

# 5

## Platform/subgrade strength

# PLATFORM/SUBGRADE STRENGTH

## DGAC RATIONAL DESIGN METHOD (2016) AND FAA ADVISORY CIRCULAR 150/5320-6G (2021)

### ALIZE 2.1.2

- The pavement design is calibrated by selecting the mechanical characteristics that corresponds to the least favourable hydrous conditions for the pavement and incorporating the effect any drainage system.
- Platform class:

| Platform class | PF2 | PF2qs | PF3 | PF4 |
|---|---|---|---|---|
| Modulus considered in the calculation (MPa) | 50 | 80 | 120 | 120 |

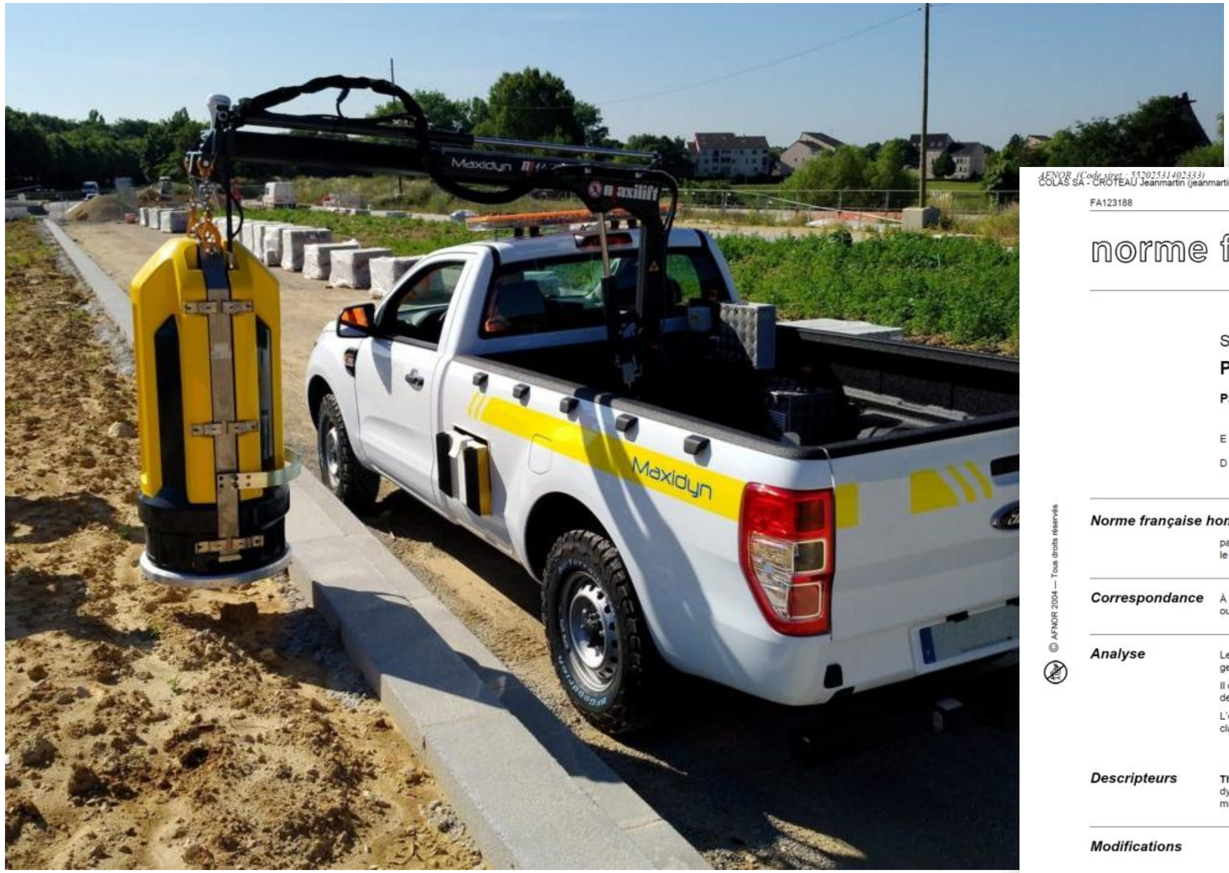
*Table 10: moduli associated with the long-term bearing capacity classes of the pavement foundation for the design of airfield pavements*

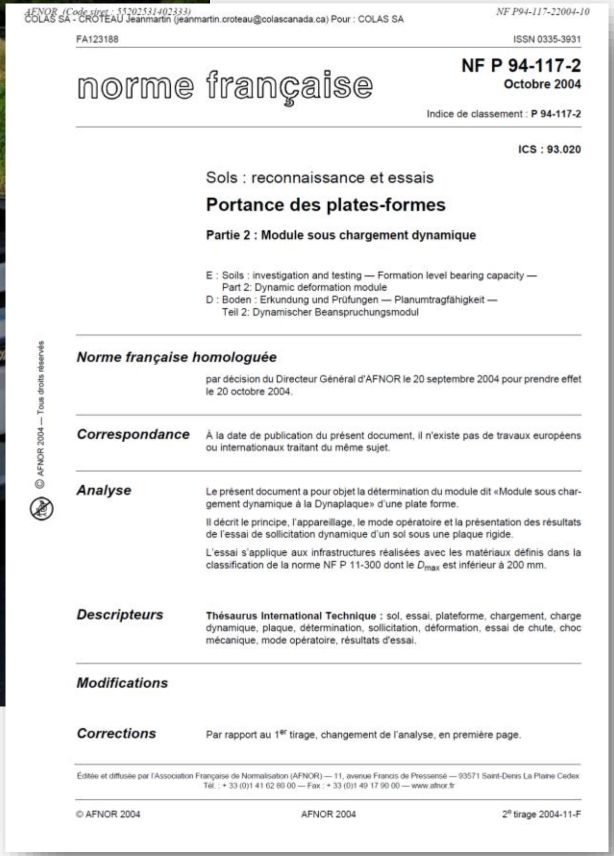
### FAARFIELD 2.1

- Subgrade strength value for design that is one standard deviation (sample) below the mean of laboratory tests.
- Soaked CBR tests simulating the condition of a pavement in service are used for design.
- Plate bearing test may also be used to determine the bearing capacity of the pavement platform/subgrade.
- The *k-value* obtained from the plate test may be converted into an estimated CBR value.
- Subgrade improvement is recommended when the mean CBR is lower than 5 and required when it is lower than 3.

# PLATFORM/SUBGRADE STRENGTH

## DYNAPLAQUE® OR MAXIDYN® BEARING CAPACITY DYNAMIC LOADING TEST (DGAC)

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NF P 94-117-2
Octobre 2004

Indice de classement : P 94-117-2

ICS : 93.020

Sols : reconnaissance et essais

**Portance des plates-formes**

**Partie 2 : Module sous chargement dynamique**

E : Soils : investigation and testing — Formation level bearing capacity — Part 2: Dynamic deformation module
D : Boden : Erkundung und Prüfungen — Planumtragfähigkeit — Teil 2: Dynamischer Beanspruchungsmodul

***Norme française homologuée***

par décision du Directeur Général d'AFNOR le 20 septembre 2004 pour prendre effet le 20 octobre 2004.

***Correspondance*** À la date de publication du présent document, il n'existe pas de travaux européens ou internationaux traitant du même sujet.

***Analyse*** Le présent document a pour objet la détermination du module dit «Module sous chargement dynamique à la Dynaplaque» d'une plate forme.

Il décrit le principe, l'appareillage, le mode opératoire et la présentation des résultats de l'essai de sollicitation dynamique d'un sol sous une plaque rigide.

L'essai s'applique aux infrastructures réalisées avec les matériaux définis dans la classification de la norme NF P 11-300 dont le $D_{max}$ est inférieur à 200 mm.

***Descripteurs*** **Thésaurus International Technique :** sol, essai, plateforme, chargement, charge dynamique, plaque, détermination, sollicitation, déformation, essai de chute, choc mécanique, mode opératoire, résultats d'essai.

***Modifications***

***Corrections*** Par rapport au 1er tirage, changement de l'analyse, en première page.

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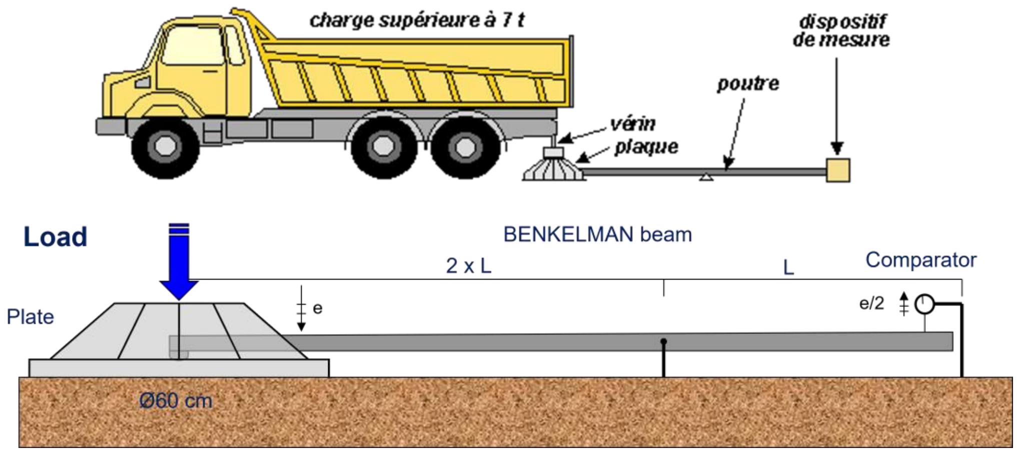
# PLATFORM/SUBGRADE STRENGTH
## PLATE BEARING TEST (DGAC)

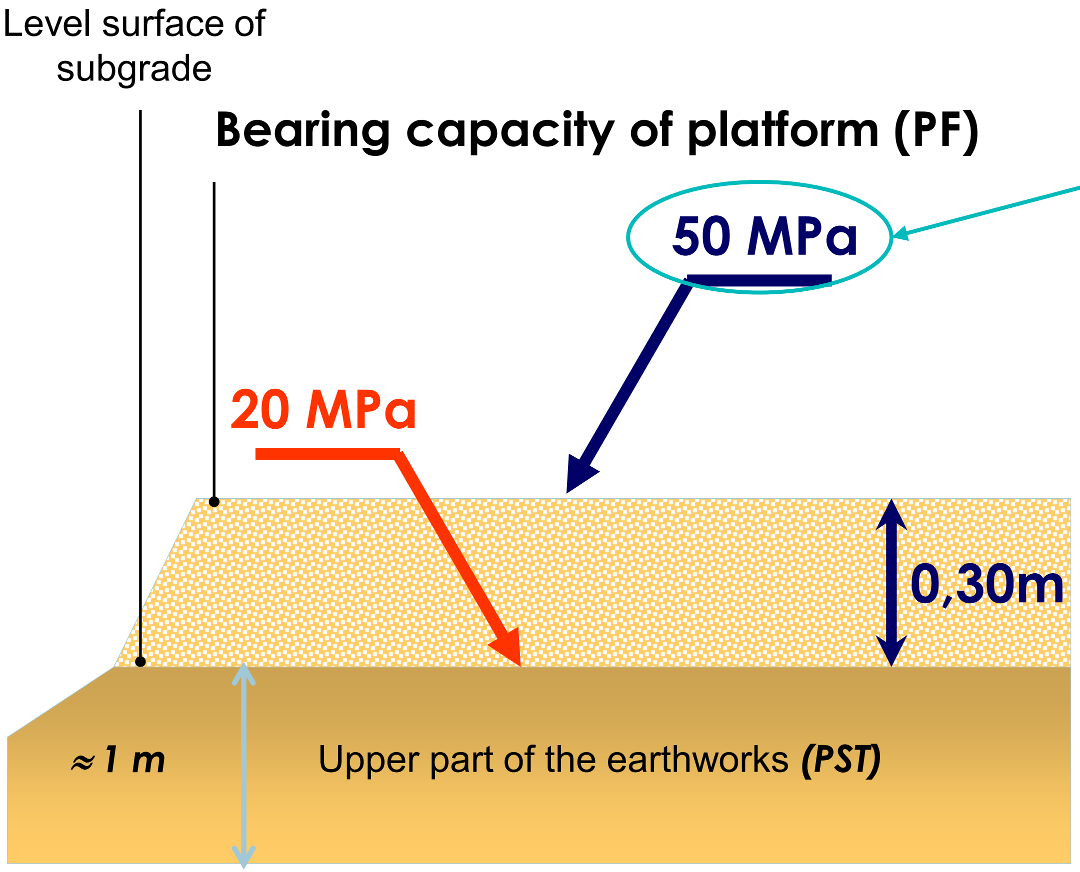
**NF P94-117-1 - Avril 2000**
Sols : reconnaissance et essais - Portance des plates-formes - Partie 1 : module sous chargement statique à la plaque (EV2)




A circular PLATE 60 cm in diameter is weighted down using a hydraulic jack supported under a truck, and its depth is measured using the BENKELMAN Beam.


Source: EurocontrôleQualité

# PLATFORM/SUBGRADE STRENGTH
## CAPPING LAYER CONCEPT (DGAC)




| Platform class | PF2 | PF2$^{qs}$ | PF3 | PF4 |
|---|---|---|---|---|
| Modulus considered in the calculation (MPa) | 50 | 80 | 120 | 120 |

Table 10: moduli associated with the long-term bearing capacity classes of the pavement foundation for the design of airfield pavements

**Capping layer (Couche de forme)**

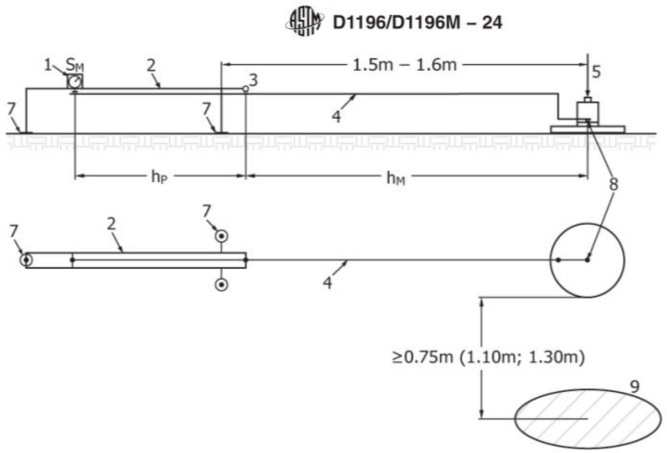
**Subgrade soil**

# PLATFORM/SUBGRADE STRENGTH

## PLATE BEARING TEST (FAA)

**AASHTO T 222-81 (Revised 2021)**
Nonrepetitive Static Plate Load Test of Soils and Flexible Pavement Components for Use in Evaluation and Design of Airport and Highway Pavements

**ASTM D1196/D1196M - 24**
Standard Test Method for Nonrepetitive Static Plate Load Test of Soils and Flexible Pavement Components for Use in Evaluation and Design of Airport and Highway Pavements




a) rotatable contact arm according to "weigh beam principle": measurement taking into account the lever ratio $h_P$:$h_M$


FIG. 2 Digital System Configuration

# 6

## Granular material mechanical properties

# GRANULAR MATERIAL MECHANICAL PROPERTIES
## DGAC APPROACH

| | | | |
|---|---|---|---|
| *Couche de fondation* | $E_{GNT}$ *{1} = k.*$E_{plate\text{-}forme\ support}$<br>$E_{GNT}$ *{sous-couche i} = k.*$E_{GNT}$ *{sous-couche (i-1)}*<br>*k variant selon la catégorie de la GNT* | | |
| *(GNT subdivisée en sous-couches de 0,25 m d'épaisseur)* | *Catégorie* | *1* | *2* |
| | *k* | *3* | *2,5* |
| | $E_{GNT}$ *borné par : 600 MPa pour une GNT de catégorie 1*<br>*400 MPa pour une GNT de catégorie 2* | | |

*Tableau 25 : Caractéristiques mécaniques des graves non traitées.*

Note: The variations in the values of the modulus over the total thickness of the untreated graded aggregate demonstrate their stiffening non-linear character (the modulus increases with the intensity of the average stress) and the efficiency of the compacting that increases as the sub-base is laid.

| Layer number | Thickness (m) | Modulus (MPa) | Nu (-) | Library | Material |
|---|---|---|---|---|---|
| 3 | 0.06 | 600 | 0.35 | NF P98-086 v2019 | gnt cg1 |
| Bonded | | | | | |
| 4 | 0.25 | 450 | 0.35 | NF P98-086 v2019 | gnt cg1 |
| Bonded | | | | | |
| 5 | 0.25 | 150 | 0.35 | NF P98-086 v2019 | gnt cg1 |
| Bonded | | | | | |
| 6 | Inf. | 50 | 0.35 | NF P98-086 v2019 | pf2 |

# GRANULAR MATERIAL MECHANICAL PROPERTIES

## MODULUS ASSIGNMENT AS PER FAA APPROACH

Assign a modulus value *E* to each sub-layer. Modulus values increase from bottom to top, reflecting the effect of increasing confinement of the aggregate material. Modulus values are given by the following equation:

*(Item P-209)* $$E_n = E_{n-1} * \{1 + log_{10}(t_n) * (10.52 - 2.0 * log_{10}(E_{n-1}))\}$$ *(10 inches lifts)*

*(Item P-154)* $$E_n = E_{n-1} * \{1 + log_{10}(t_n) * (6.88 - 1.56 * log_{10}(E_{n-1}))\}$$ *(8 inches lifts)*

| Lift thickness | "n" lift | Assigned modulus |
|---|---|---|
| 254 | 5 | 1065 MPa |
| 254 | 4 | 716 MPa |
| 254 | 3 | 333 MPa |
| 254 | 2 | 106 MPa |
| Subgrade | 1 | 30 MPa |

# 7

## Bituminous material mechanical properties

# BITUMINOUS MATERIAL MECHANICAL PROPERTIES

## STIFFNESS MODULUS AS PER DGAC APPROACH

Temperature depends on geographical area. The equivalent temperature is the temperature for which the damage over the year is equivalent to the sum of the daily damage.

| *Pavement section* | *Speed of movement in kph to be taken into consideration in the design calculations* |
|---|---|
| *High-speed sections* | *100* |
| *Moderate-speed sections* | *30* |
| *Aprons and low-speed sections* | *10** |

** a fictive values used in the calculation. See below « Special case of low-speed sections and aprons »*

*Table 4: speed of movement of aircraft according to the type of section*


$$f(Hz) = \frac{V(kph)}{10}$$

Alize-Lcpc - Mechanical computation, material library

File Material type Add-Remove

Standard material library : according to NF P98-086 (normative annex F)

Personal library : c:\users\CROTEAJ ...\...\... ents\Alize-Lcpc my files\Libraries\matuser.lib

Bituminous materials — Variations E(10Hz) = f(temperature)

| status | name | E (MPA) | Nu | Epsi6 (10°C) | -1/b | SN | Sh (m) | Kc | T -10 | T 0 °C | T 10 °C | T 20 °C | T 30 °C | T 40 °C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| system | eb-bbsg3 | 9310 | 0.35 | 100 | 5 | 0.25 | stdard | 1.1 | 16000 | 13500 | 9310 | 4690 | 1800 | 1000 |
| system | eb-bbme1 | 11970 | 0.35 | 100 | 5 | 0.25 | stdard | 1.1 | 17300 | 15400 | 11970 | 6030 | 3000 | 1900 |
| system | eb-bbme2 | 14630 | 0.35 | 100 | 5 | 0.25 | stdard | 1.1 | 19500 | 18200 | 14630 | 7370 | 3800 | 2300 |
| system | eb-bbme3 | 14630 | 0.35 | 100 | 5 | 0.25 | stdard | 1.1 | 19500 | 18200 | 14630 | 7370 | 3800 | 2300 |
| system | bbm | 7315 | 0.35 | / | / | / | stdard | 1.1 | 14800 | 12000 | 7315 | 3685 | 1300 | 1000 |
| system | bbtm | 4200 | 0.35 | / | / | / | stdard | 1.1 | 8500 | 7000 | 4200 | 1800 | 1000 | 800 |
| system | bbdr | 4200 | 0.35 | / | / | / | stdard | 1.1 | 8500 | 7000 | 4200 | 1800 | 1000 | 800 |
| system | acr | 7315 | 0.35 | / | / | / | stdard | 1.1 | 14800 | 12000 | 7315 | 3685 | 1300 | 1000 |
| system | eb-gb2 | 11880 | 0.35 | 80 | 5 | 0.3 | stdard | 1.3 | 22800 | 18300 | 11880 | 6120 | 2700 | 1000 |
| system | eb-gb3 | 11880 | 0.35 | 90 | 5 | 0.3 | stdard | 1.3 | 22800 | 18300 | 11880 | 6120 | 2700 | 1000 |
| system | eb-gb4 | 14300 | 0.35 | 100 | 5 | 0.3 | stdard | 1.3 | 25000 | 20000 | 14300 | 7700 | 3500 | 1200 |
| system | eb-eme1 | 16940 | 0.35 | 100 | 5 | 0.3 | stdard | 1 | 30000 | 24000 | 16940 | 11060 | 6000 | 3000 |
| system | eb-eme2 | 16940 | 0.35 | 130 | 5 | 0.25 | stdard | 1 | 30000 | 24000 | 16940 | 11060 | 6000 | 3000 |
| user | SP12.5 | 5107 | 0.350 | 141.0 | 5.77 | 0.28 | stdard | 1.000 | 16514 | 10570 | 5107 | 1581 | | |
| user | SP20 | 3201 | 0.350 | 206.0 | 6.48 | 0.23 | stdard | 1.000 | 12803 | 7806 | 3201 | 1005 | | |
| user | [illegible] | 7256 | 0.350 | 204.0 | 6.23 | 0.19 | stdard | 1.000 | 15396 | 12158 | 7256 | 3283 | 1111 | |
| user | Betoflex0/14V | 7578 | 0.350 | 165.0 | 5.16 | 0.23 | stdard | 1.000 | 18111 | 12988 | 7578 | 3458 | 1174 | |
| user | Betoflex0/14H | 5507 | 0.350 | 230.0 | 6.55 | 0.20 | stdard | 1.000 | 16914 | 10970 | 5507 | 1981 | 591 | |
| user | Betoflex0/10V | 7872 | 0.350 | 168.0 | 4.636 | 0.34 | stdard | 1.000 | | 13000 | 7872 | 3500 | | |

Teq= 10 °C Fr= 10 Hz Exit

Alize-Lcpc - Mechanical computation, material library

File Material type Add-Remove

Standard material library : according to NF P98-086 (normative annex F)

Personal library : c:\users\CROTEAJ ...\...\... ents\Alize-Lcpc my files\Libraries\matuser.lib

Bituminous materials — Variations E(10Hz) = f(temperature)

| status | name | E (MPA) | Nu | Epsi6 (10°C) | -1/b | SN | Sh (m) | Kc | T -10 | T 0 °C | T 10 °C | T 20 °C | T 30 °C | T 40 °C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| system | eb-bbsg3 | 7976 | 0.35 | 100 | 5 | 0.25 | stdard | 1.1 | 16000 | 13500 | 9310 | 4690 | 1800 | 1000 |
| system | eb-bbme1 | 10254 | 0.35 | 100 | 5 | 0.25 | stdard | 1.1 | 17300 | 15400 | 11970 | 6030 | 3000 | 1900 |
| system | eb-bbme2 | 12533 | 0.35 | 100 | 5 | 0.25 | stdard | 1.1 | 19500 | 18200 | 14630 | 7370 | 3800 | 2300 |
| system | eb-bbme3 | 12533 | 0.35 | 100 | 5 | 0.25 | stdard | 1.1 | 19500 | 18200 | 14630 | 7370 | 3800 | 2300 |
| system | bbm | 6266 | 0.35 | / | / | / | stdard | 1.1 | 14800 | 12000 | 7315 | 3685 | 1300 | 1000 |
| system | bbtm | 3598 | 0.35 | / | / | / | stdard | 1.1 | 8500 | 7000 | 4200 | 1800 | 1000 | 800 |
| system | bbdr | 3598 | 0.35 | / | / | / | stdard | 1.1 | 8500 | 7000 | 4200 | 1800 | 1000 | 800 |
| system | acr | 6266 | 0.35 | / | / | / | stdard | 1.1 | 14800 | 12000 | 7315 | 3685 | 1300 | 1000 |
| system | eb-gb2 | 10177 | 0.35 | 80 | 5 | 0.3 | stdard | 1.3 | 22800 | 18300 | 11880 | 6120 | 2700 | 1000 |
| system | eb-gb3 | 10177 | 0.35 | 90 | 5 | 0.3 | stdard | 1.3 | 22800 | 18300 | 11880 | 6120 | 2700 | 1000 |
| system | eb-gb4 | 12250 | 0.35 | 100 | 5 | 0.3 | stdard | 1.3 | 25000 | 20000 | 14300 | 7700 | 3500 | 1200 |
| system | eb-eme1 | 14512 | 0.35 | 100 | 5 | 0.3 | stdard | 1 | 30000 | 24000 | 16940 | 11060 | 6000 | 3000 |
| system | eb-eme2 | 14512 | 0.35 | 130 | 5 | 0.25 | stdard | 1 | 30000 | 24000 | 16940 | 11060 | 6000 | 3000 |
| user | SP12.5 | 4375 | 0.350 | 141.0 | 5.77 | 0.28 | stdard | 1.000 | 16514 | 10570 | 5107 | 1581 | | |
| user | SP20 | 2742 | 0.350 | 206.0 | 6.48 | 0.23 | stdard | 1.000 | 12803 | 7806 | 3201 | 1005 | | |
| user | [illegible] | [illegible] | 0.350 | 204.0 | 6.23 | 0.19 | stdard | 1.000 | 15396 | 12158 | 7256 | 3283 | 1111 | |
| user | Betoflex0/14V | 6492 | 0.350 | 165.0 | 5.16 | 0.23 | stdard | 1.000 | 18111 | 12988 | 7578 | 3458 | 1174 | |
| user | Betoflex0/14H | 4718 | 0.350 | 230.0 | 6.55 | 0.20 | stdard | 1.000 | 16914 | 10970 | 5507 | 1981 | 591 | |
| user | Betoflex0/10V | 6744 | 0.350 | 168.0 | 4.636 | 0.34 | stdard | 1.000 | | 13000 | 7872 | 3500 | | |

Teq= 10 °C Fr= 3 Hz Exit

# BITUMINOUS MATERIAL MECHANICAL PROPERTIES
## STIFFNESS MODULUS AS PER DGAC APPROACH


| | *Products* |
|---|---|
| *Wearing course* | *EB-BBA, EB-BBSG, EB-BBME, EB-BBM, BBTM, SMA, ESU, ECF, EP* |
| *Binder course* | *EB-BBA, EB-BBME, EB-BBM, EB-BBSG* |
| *Base course* | *EB-GB, EB-EME* |

*Table 14: products that can be used to for an airfield pavement*

| | *Conventional minimum values* | | *Maximum values* | | | |
|---|---|---|---|---|---|---|
| *Class* | *Modulus (MPa) at 15°C and 10 Hz* | *$\mathcal{E}_6$ (µstrain) at 10°C and 25 Hz* | *Modulus (MPa) at 15°C and 10 Hz* | *$\mathcal{E}_6$ (µstrain) at 10°C and 25 Hz* | *Fatigue parameter β* | *$S_N$* |
| 2 | 9 000 | 80 | 11 000 | 90 | 5 | 0.3 |
| 3 | 9 000 | 90 | 11 000 | 100 | 5 | 0.3 |
| 4 | 11 000 | 100 | 14 000 | 115 | 5 | 0.3 |

*Table 17: mechanical performances of base asphalt concrete*

| | | *Conventional minimum values* | | *Maximum values* | | | |
|---|---|---|---|---|---|---|---|
| | *Class* | *Modulus (MPa) at 15°C and 10 Hz* | *$\mathcal{E}_6$ (µstrain) at 10°C and 25 Hz* | *Modulus (MPa) at 15°C and 10 Hz)* | *$\mathcal{E}_6$ (µstrain) at 10°C and 25 Hz* | *Fatigue parameter β* | *$S_N$* |
| EB-BBA | 1 | 5 500 | 130 | 9 000 | 145 | 5 | 0.25 |
| | 2 | 5 500 | 100 | 9 000 | 115 | 5 | 0.25 |
| | 3 | 7 000 | 100 | 11 000 | 115 | 5 | 0.25 |
| EB-BBSG | 1 | 5 500 | 100 | 9 000 | 115 | 5 | 0.25 |
| | 2 or 3 | 7 000 | 100 | 11 000 | 130 | 5 | 0.25 |
| EB-BBME | 1 | 9 000 | 100 | 11 000 | 115 | 5 | 0.25 |
| | 2 or 3 | 11 000 | 100 | 14 000 | 130 | 5 | 0.25 |
| EB-BBM | all | 5 500 | Not applicable | | | | |

*Table 22: mechanical performances of asphalt concretes*

# BITUMINOUS MATERIAL MECHANICAL PROPERTIES

## STIFFNESS MODULUS AS PER FAA APPROACH

**Table 3-2. Allowable Modulus Values and Poisson's Ratios Used in FAARFIELD**

| Layer Type | FAA Specified Layer | Rigid Pavement psi (MPa) | Flexible Pavement psi (MPa) | Poisson's Ratio |
|---|---|---|---|---|
| Surface | P-501 Cement Concrete | 4,000,000 (30,000) | NA | 0.15 |
| | P-401/P-403[1]/P-404 Asphalt Mixture | NA | 200,000 (1,380)[2] | 0.35 |
| Stabilized Base and Subbase | P-401/P-403Asphalt Mixture | 400,000 (3,000) | | 0.35 |
| | P-306 Lean Concrete | 700,000 (5,000) | | 0.20 |
| | P-304 cement treated aggregate base | 500,000 (3,500) | | 0.20 |
| | P-220 Cement treated soil base | 250,000 (1,700) | | 0.20 |
| | Variable stabilized rigid | 250,000 to 700,000 (1,700 to 5,000) | NA | 0.20 |
| | Variable stabilized flexible | NA | 150,000 to 400,000 (1,000 to 3,000) | 0.35 |
| Granular Base and Subbase | P-209 crushed aggregate | Internal calculation by FAARFIELD[4] | | 0.35 |
| | P-208, aggregate | Internal calculation by FAARFIELD[4] | | 0.35 |
| | P-219, Recycled concrete aggregate | Internal calculation by FAARFIELD[4] | | 0.35 |
| | P-211, Lime rock | Internal calculation by FAARFIELD[4] | | 0.35 |
| | P-207 Recycled Asphalt aggregate base[3] | 25,000-500,000 | | 0.35 |
| | P-154 uncrushed aggregate | Internal calculation by FAARFIELD[4] | | 0.35 |
| Subgrade[5] | Subgrade | 1,000 to 50,000 (7 to 350) | | 0.35 |
| User-defined | User-defined layer | 1,000 to 4,000,000 (7 to 30,000) | | 0.35 |

**Notes:**

1. P-403 as surface when all aircraft less than 60,000 lbs (27,216 kg).
2. A fixed modulus value for hot mix surfacing is set in the program at 200,000 psi (1380 MPa). This modulus value corresponds to a pavement temperature of approximately 90°F (32°C).
3. The modulus of P-207 is dependent upon the quality and if any additional stabilizing material incorporated, e.g. asphalt, cement, fly ash. Perform geotechnical laboratory testing with field materials to determine appropriate value.
4. See FAARFIELD help file for discussion of calculations.
5. CBR values for chemically modified subgrades lessor of 50% of laboratory strength or CBR 20.

U.S. Department of Transportation
**Federal Aviation Administration**

**Advisory Circular**

Subject: Airport Pavement Design and Evaluation | Date: 6/7/2021 | AC No: 150/5320-6G
Initiated By: AAS-100 | Change:

1 **Purpose.**
This advisory circular (AC) provides guidance to the public on the design and evaluation of pavements used by aircraft at civil airports. For reporting of pavement strength, see AC 150/5335-5D, *Standardized Method of Reporting Airport Pavement Strength – PCR.*

2 **Cancellation.**
This AC cancels AC 150/5320-6F, *Airport Pavement Design and Evaluation,* dated November 10, 2016.

3 **Applicability.**
This AC does not constitute a regulation, and is not legally binding in its own right. It will not be relied upon as a separate basis by the FAA for affirmative enforcement action or other administrative penalty. Conformity with this AC is voluntary, and nonconformity will not affect rights and obligations under existing statutes and regulations, except for the projects described in subparagraphs 2 and 3 below:

1. The standards and processes contained in this AC are specifications the FAA considers essential for the reporting of pavement strength.
2. Use of these standards and guidelines is mandatory for projects funded under Federal grant assistance programs, including the Airport Improvement Program (AIP). See Grant Assurance #34.
3. This AC is mandatory, as required by regulation, for projects funded by the Passenger Facility Charge program. See PFC Assurance #9.

**Note:** This AC provides one, but not the only, acceptable means of meeting the requirements of 14 CFR Part 139, *Certification of Airports*.

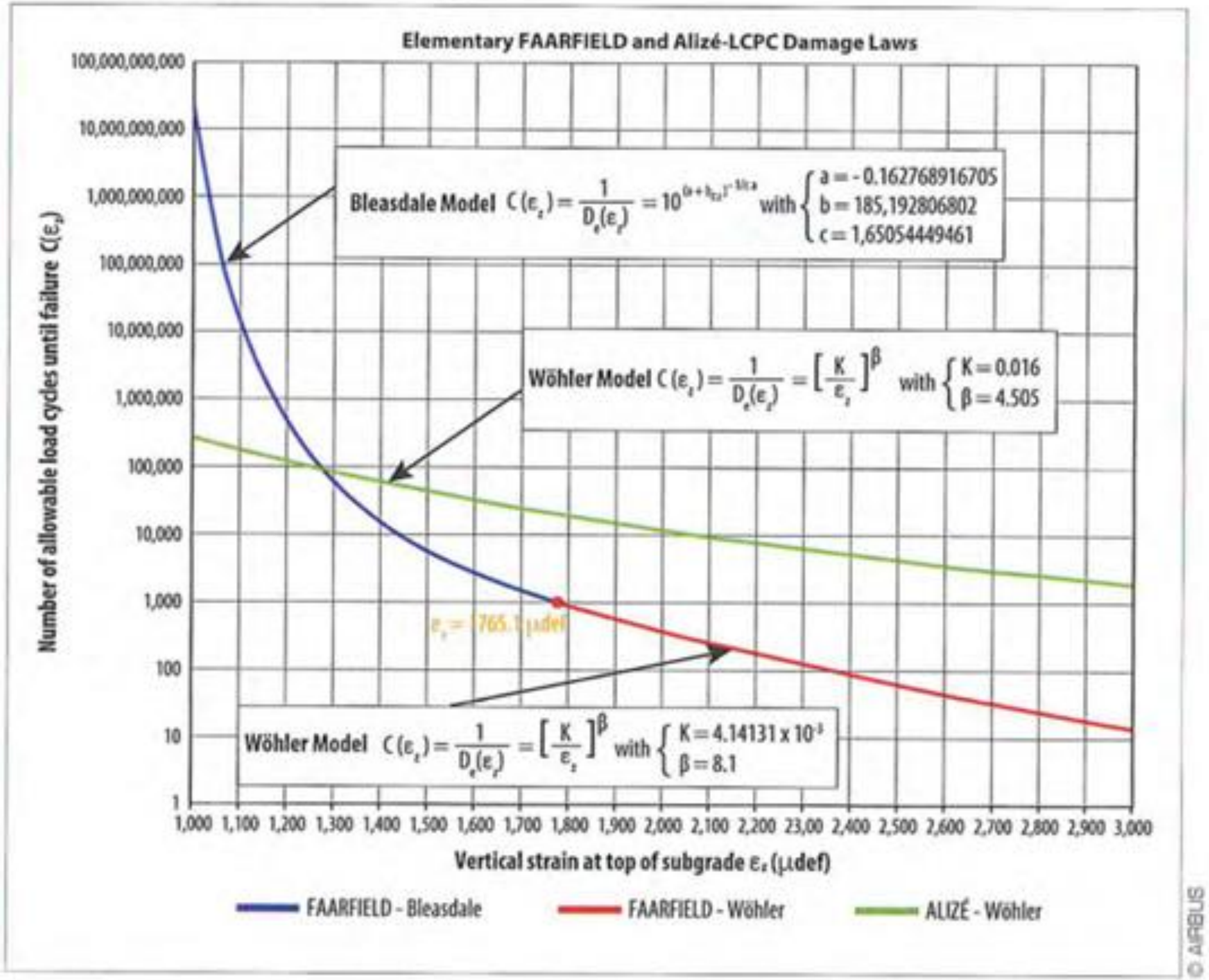
4 **Principal Changes.**
This AC contains the following principal changes:

1. Reformatted to comply with FAA Order 1320.46, *FAA Advisory Circular System*.

# 8

## Pavement structural design

# PAVEMENT STRUCTURAL DESIGN
## DAMAGE LAW FOR SUBGRADE/PLATFORM




### FAARFIELD 2.1.1

$\log_{10}(C) = \left(\frac{1}{-0.1638+185.19\times\varepsilon_v}\right)^{0.60586}$, when C > 1000 coverages; and

$C = \left(\frac{0.004141}{\varepsilon_v}\right)^{8.1}$, when C ≤ 1000 coverages

### ALIZE 2.1.2

$$C(\varepsilon_{zz\,max}) = \left(\frac{0.016}{\varepsilon_{zz\,max}}\right)^{4.505}$$

# PAVEMENT STRUCTURAL DESIGN
## DAMAGE LAW FOR ASPHALT LAYERS – FAA APPROACH

$$N_f = 0.4801 * PV^{-0.9007}$$

$$PV = 44.422 * \varepsilon_h^{5.140} * S^{2.993} * VP^{1.850} * GP^{-0.4063}$$

**$PV$ :** estimated value of the Ratio of Dissipated Energy Change (RDEC) plateau value, dimensionless

**$\varepsilon_h$ :** horizontal (tensile) strain at the bottom of the asphalt layer

**$S$ :** asphalt flexural stiffness in psi

**$VP$ :** volumetric parameter $VP = V_a / (V_a + V_{eb})$

**$GP$ :** gradation parameter $GP = (P_{NMS} - P_{PCS}) / P_{200}$

- **$V_a$ :** air voids
- **$V_{eb}$ :** volume of effective binder
- **$P_{NMS}$ :** percent of aggregate passing the nominal maximum sieve
- **$P_{PCS}$ :** percent of aggregate passing the primary control sieve
- **$P_{200}$ :** percent of aggregate passing the #200 sieve (0.075 mm)

# PAVEMENT STRUCTURAL DESIGN

## DAMAGE LAW FOR ASPHALT LAYERS – DGAC APPROACH

$$\varepsilon_t = \varepsilon_6(10°C; 25Hz) * \sqrt{\frac{E(10°C; 10Hz)}{E(\theta_{eq}; f_{eq})}} * \left(\frac{NE}{10^6}\right)^b * k_c * k_r * k_s$$

$$N(\varepsilon_{t\,max}) = \left(\frac{K}{\varepsilon_{t\,max}}\right)^\beta$$

$$K = k_{\theta f} * k_r * k_s * k_c * 10^{6/\beta} * \epsilon_6$$

- $\boldsymbol{\varepsilon_t}$ : horizontal (tensile) strain at the bottom of the asphalt layer
- $\boldsymbol{\varepsilon_6}$ : fatigue resistance at $10^6$ cycles measured at 10°C; 25Hz
- $\boldsymbol{b}$ : slope of the fatigue right $\left({}^{-1}/_{\beta}\right)$
- $\boldsymbol{E}$ : modulus
- $\frac{E(10°C;10Hz)}{E(\theta_{eq};f_{eq})}$ : permits to correct the $\varepsilon_6$ value according to the temperature and frequency $(k_{\theta f})$
- $\boldsymbol{NE}$ : number of coverage to failure $N(\varepsilon_{t\,max})$
- $\boldsymbol{k_c}$ : shift factor, corrects the difference between predictions and observations on real pavements
- $\boldsymbol{k_r}$ : risk coefficient, characterizes the probabilistic approach of the pavement lifetime taking into account the dispersions on the mechanical properties of materials and the thickness of the layer.
- $\boldsymbol{k_s}$ : bearing capacity factor, integrates eventual lack of uniformity in the bearing capacity of the subgrade

# PAVEMENT STRUCTURAL DESIGN

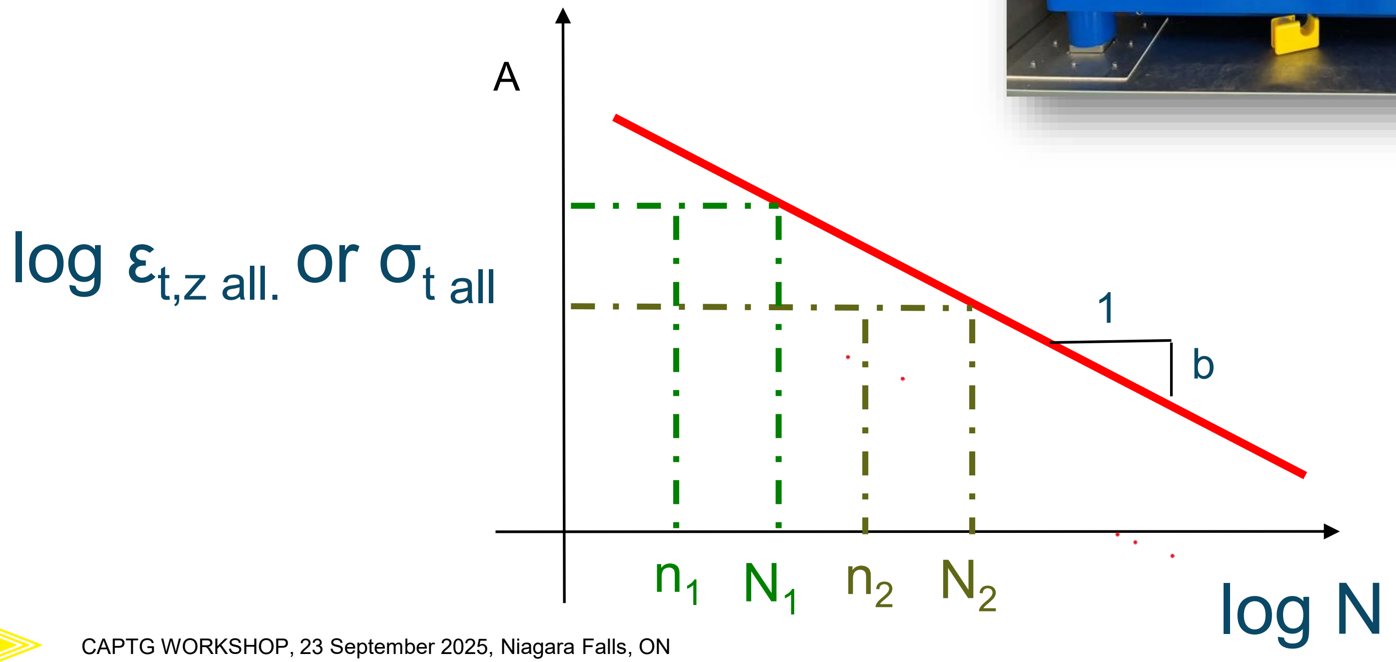
## DAMAGE LAW FOR ASPHALT LAYERS – DGAC APPROACH

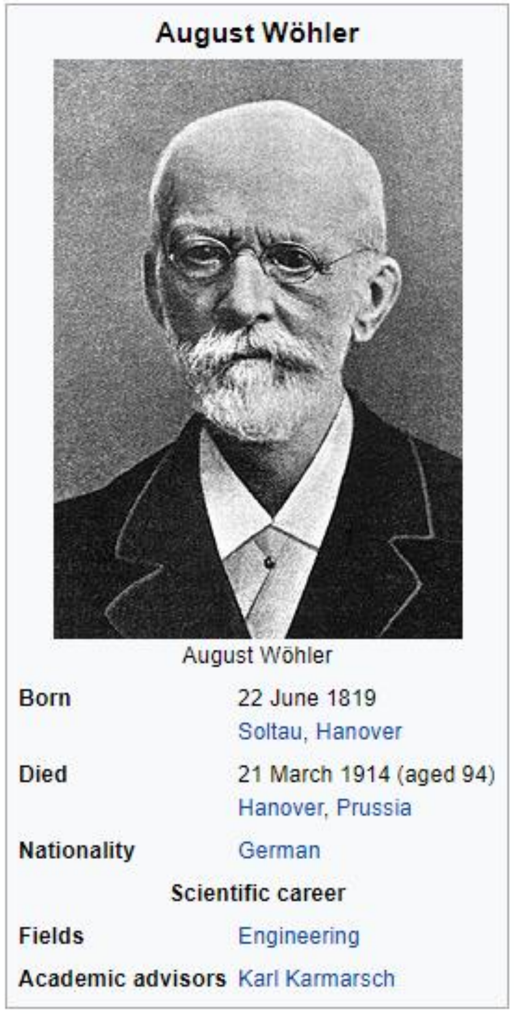
**Wöhler fatigue curves**

$$\log(\varepsilon_{t,z\ all.}\ \text{or}\ \sigma_{t\ all.}) = A - b \cdot \log(N)$$

**Miner's rule of cumulative damage**

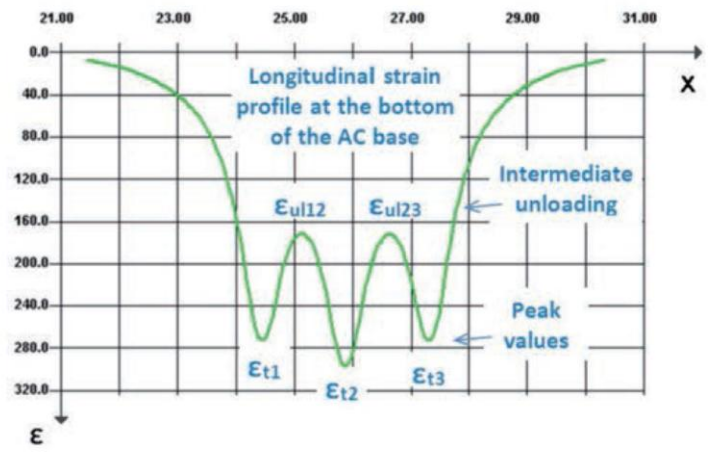
$$n_1/N_1 + n_2/N_2 + \ldots + n_i/N_i \leq 1$$



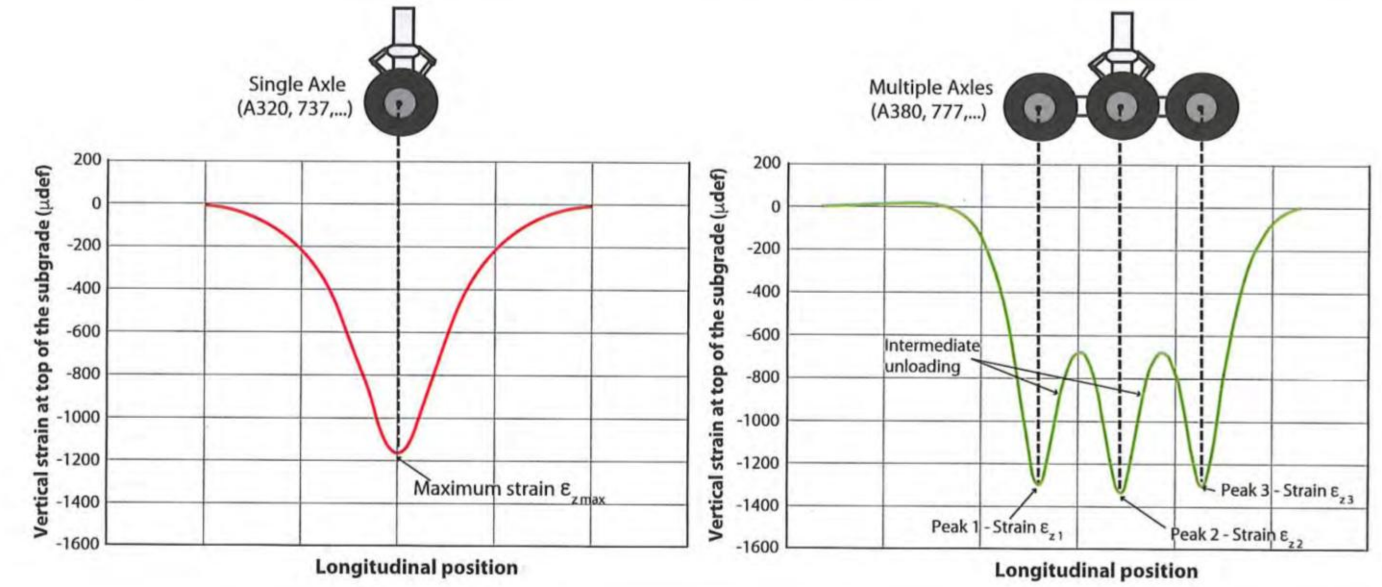



# PAVEMENT STRUCTURAL DESIGN
## DAMAGE LAW FOR COMPLEX BOGIES – DGAC AND FAA APPROACHES

**The damage is calculated using the entire strain signal for single axle and for complex bogies**




Asphalt layers




©AIRBUS

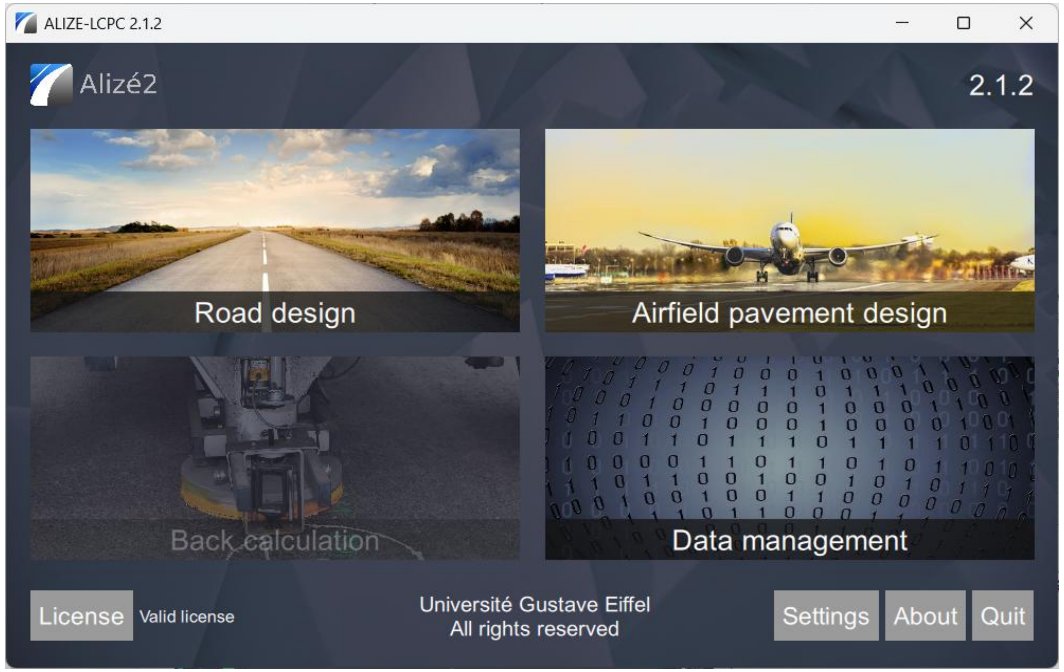
Subgrade/Platform

# 9

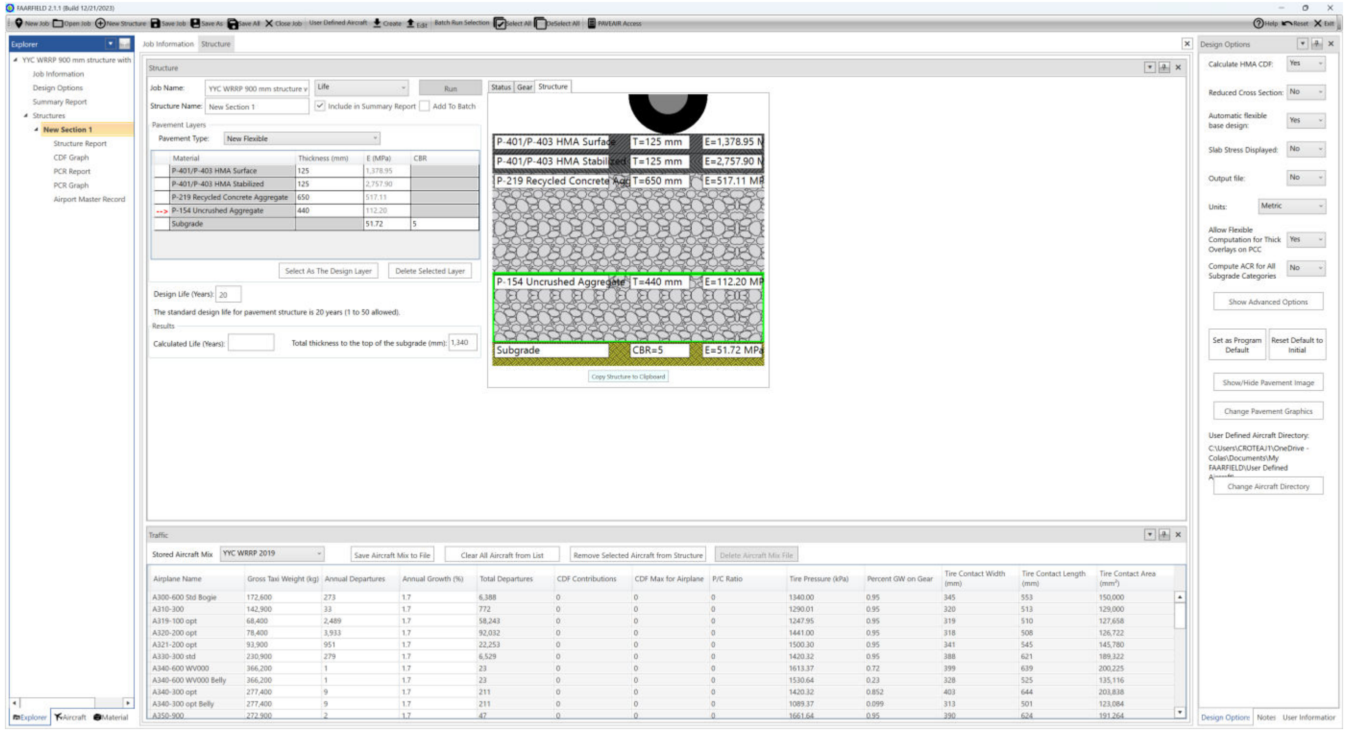
## Fictitious airfield pavement calculation example

# FICTITIOUS AIRFIELD PAVEMENT CALCULATION EXAMPLE
## SOFTWARE AVAILABLE

### ALIZE 2.1.2




### FAARFIELD 2.1.1



# ALIZE 2.1.2 – INPUT DATA

**Calculation period, traffic, speed, wandering and temperature assumptions**

**Both take-off and landing passages are taken into account**

Calculation period (years) : 20

| Manufacturer | Type | Model (Code OACI) | Weight | | Aircraft passes | | | | Other parameters | | | ACR | Show |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Type | Value (kg) | Number | Unit | Ta (%) | Cumulated traffi | Wandering (m) | Speed (km/h) | Theta eq. | | |
| Boeing | B747 | 8 F (B748) | Mrw | 449056 | 1615 | Total | 0 | 1615 | 1.5 | 100 | 10 | 1047.2 | ☐ |
| Boeing | B747 | 8 F (B748) | Mlw | 346091 | 1615 | Total | 0 | 1615 | 1.5 | 100 | 10 | 639.1 | ☐ |
| Boeing | B777 | 300 ER (B77V | Mrw | 352442 | 913 | Total | 0 | 913 | 1.5 | 100 | 10 | 1228.1 | ☐ |
| Boeing | B777 | 300 ER (B77V | Mlw | 251290 | 913 | Total | 0 | 913 | 1.5 | 100 | 10 | 626.8 | ☐ |
| Boeing | B787 | 8 (B788) | Mrw | 228383 | 23400 | Total | 0 | 23400 | 1.5 | 100 | 10 | 905.8 | ☐ |
| Boeing | B787 | 8 (B788) | Mlw | 172365 | 23400 | Total | 0 | 23400 | 1.5 | 100 | 10 | 568.7 | ☐ |
| Boeing | B787 | 9 (B789) | Mrw | 254692 | 46800 | Total | 0 | 46800 | 1.5 | 100 | 10 | 974.3 | ☐ |
| Boeing | B787 | 9 (B789) | Mlw | 192776 | 46800 | Total | 0 | 46800 | 1.5 | 100 | 10 | 623.4 | ☐ |
| Boeing | B777 | 200 LR (B77L | Mrw | 348358 | 749 | Total | 0 | 749 | 1.5 | 100 | 10 | 1181.0 | ☐ |
| Boeing | B777 | 200 LR (B77L | Mlw | 223168 | 749 | Total | 0 | 749 | 1.5 | 100 | 10 | 496.3 | ☐ |

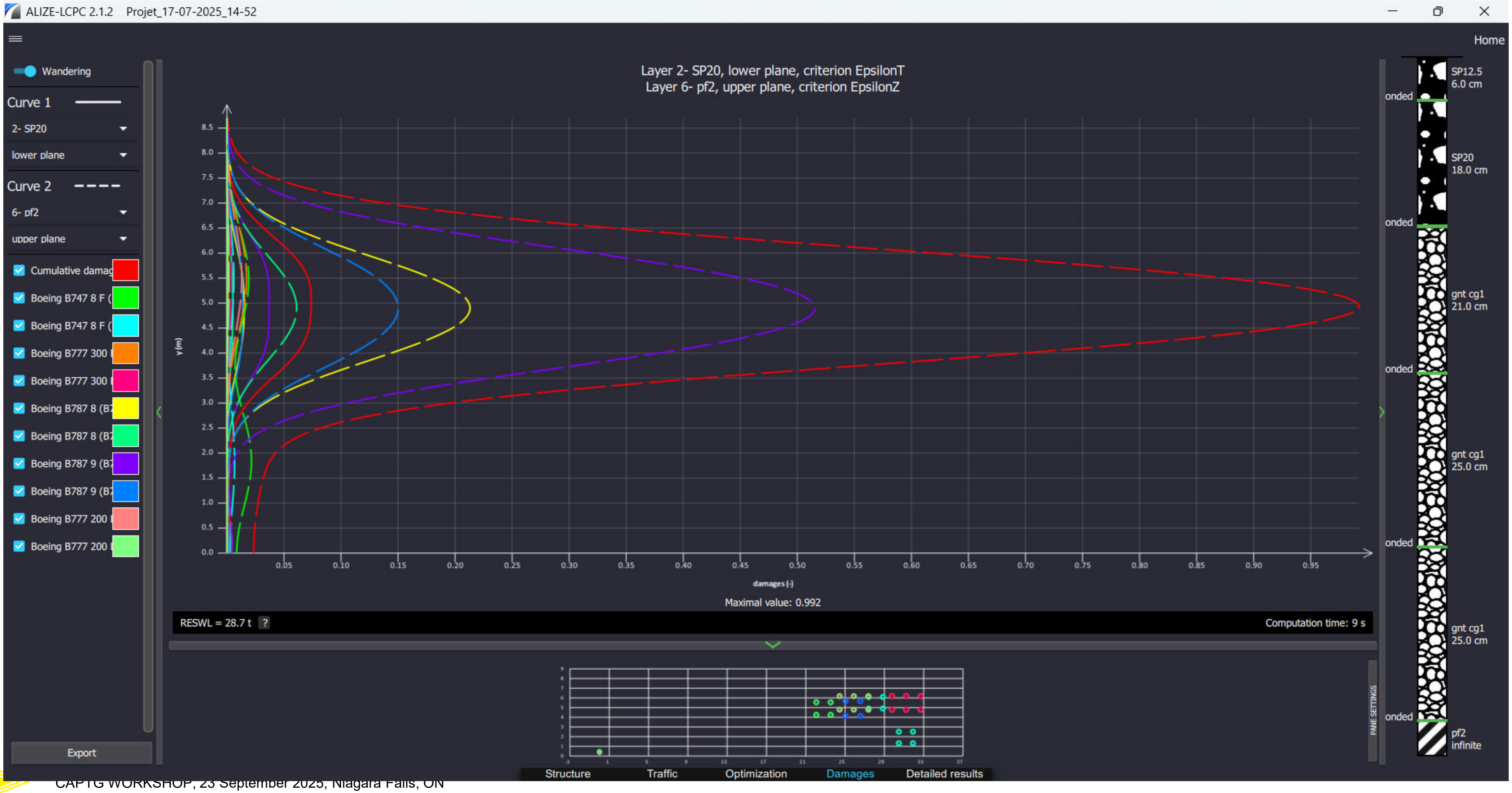
# FICTITIOUS AIRFIELD PAVEMENT CALCULATION EXAMPLE

## ALIZE 2.1.2 – PROPOSED STRUCTURE

| Layer number | Thickness (m) | Modulus (MPa) | Nu (-) | Library | Material |
|---|---|---|---|---|---|
| 1 | 0.06 | 5107 | 0.35 | NF P98-086 v2019 | SP12.5 |
| Bonded | | | | | |
| 2 | 0.18 | 3201 | 0.35 | NF P98-086 v2019 | SP20 |
| Bonded | | | | | |
| 3 | 0.21 | 600 | 0.35 | NF P98-086 v2019 | gnt cg1 |
| Bonded | | | | | |
| 4 | 0.25 | 450 | 0.35 | NF P98-086 v2019 | gnt cg1 |
| Bonded | | | | | |
| 5 | 0.25 | 150 | 0.35 | NF P98-086 v2019 | gnt cg1 |
| Bonded | | | | | |
| 6 | Inf. | 50 | 0.35 | NF P98-086 v2019 | pf2 |

# FICTITIOUS AIRFIELD PAVEMENT CALCULATION EXAMPLE

## ALIZE 2.1.2 – DAMAGE PROFILES



# FICTITIOUS AIRFIELD PAVEMENT CALCULATION EXAMPLE

## ALIZE 2.1.2 – DAMAGE PER AIRCRAFT

### CDF on Bituminous Material

**5-1-1 Layer 2 - SP20, lower plane, EpsilonT**

| | | | Damage | |
|---|---|---|---|---|
| **Manufacturer** | **Type** | **Model** | **Absolute (-)** | **Relative (%)** |
| Boeing | B747 | 8 F (B748) | 0.001 | 1.4 |
| Boeing | B747 | 8 F (B748) | 0.000 | 0.5 |
| Boeing | B777 | 300 ER (B77W) | 0.001 | 1.0 |
| Boeing | B777 | 300 ER (B77W) | 0.000 | 0.3 |
| Boeing | B787 | 8 (B788) | 0.015 | 20.5 |
| Boeing | B787 | 8 (B788) | 0.005 | 7.0 |
| Boeing | B787 | 9 (B789) | 0.037 | 50.1 |
| Boeing | B787 | 9 (B789) | 0.014 | 18.4 |
| Boeing | B777 | 200 LR (B77L) | 0.001 | 0.7 |
| Boeing | B777 | 200 LR (B77L) | 0.000 | 0.1 |
| **Whole traffic** | | | **0.074** | |

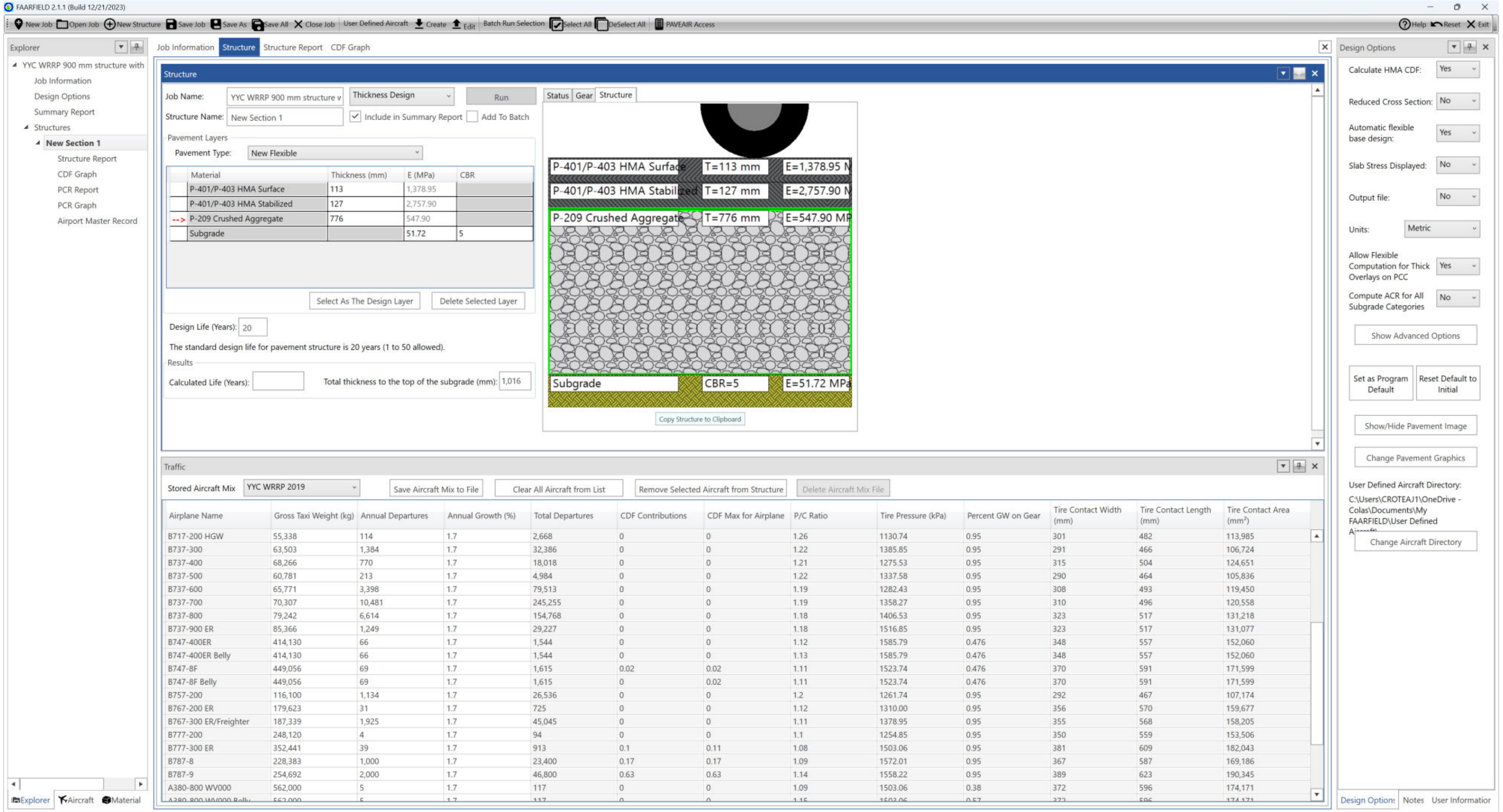
### CDF on Subgrade

**5-1-2 Layer 6 - pf2, upper plane, EpsilonZ**

| | | | Damage | |
|---|---|---|---|---|
| **Manufacturer** | **Type** | **Model** | **Absolute (-)** | **Relative (%)** |
| Boeing | B747 | 8 F (B748) | 0.017 | 1.7 |
| Boeing | B747 | 8 F (B748) | 0.005 | 0.5 |
| Boeing | B777 | 300 ER (B77W) | 0.015 | 1.5 |
| Boeing | B777 | 300 ER (B77W) | 0.003 | 0.3 |
| Boeing | B787 | 8 (B788) | 0.213 | 21.5 |
| Boeing | B787 | 8 (B788) | 0.061 | 6.2 |
| Boeing | B787 | 9 (B789) | 0.515 | 51.9 |
| Boeing | B787 | 9 (B789) | 0.150 | 15.1 |
| Boeing | B777 | 200 LR (B77L) | 0.011 | 1.2 |
| Boeing | B777 | 200 LR (B77L) | 0.002 | 0.2 |
| **Whole traffic** | | | **0.992** | |

# FICTITIOUS AIRFIELD PAVEMENT CALCULATION EXAMPLE

## FAARFIELD 2.1.1 – INPUT DATA AND PROPOSED STRUCTURE

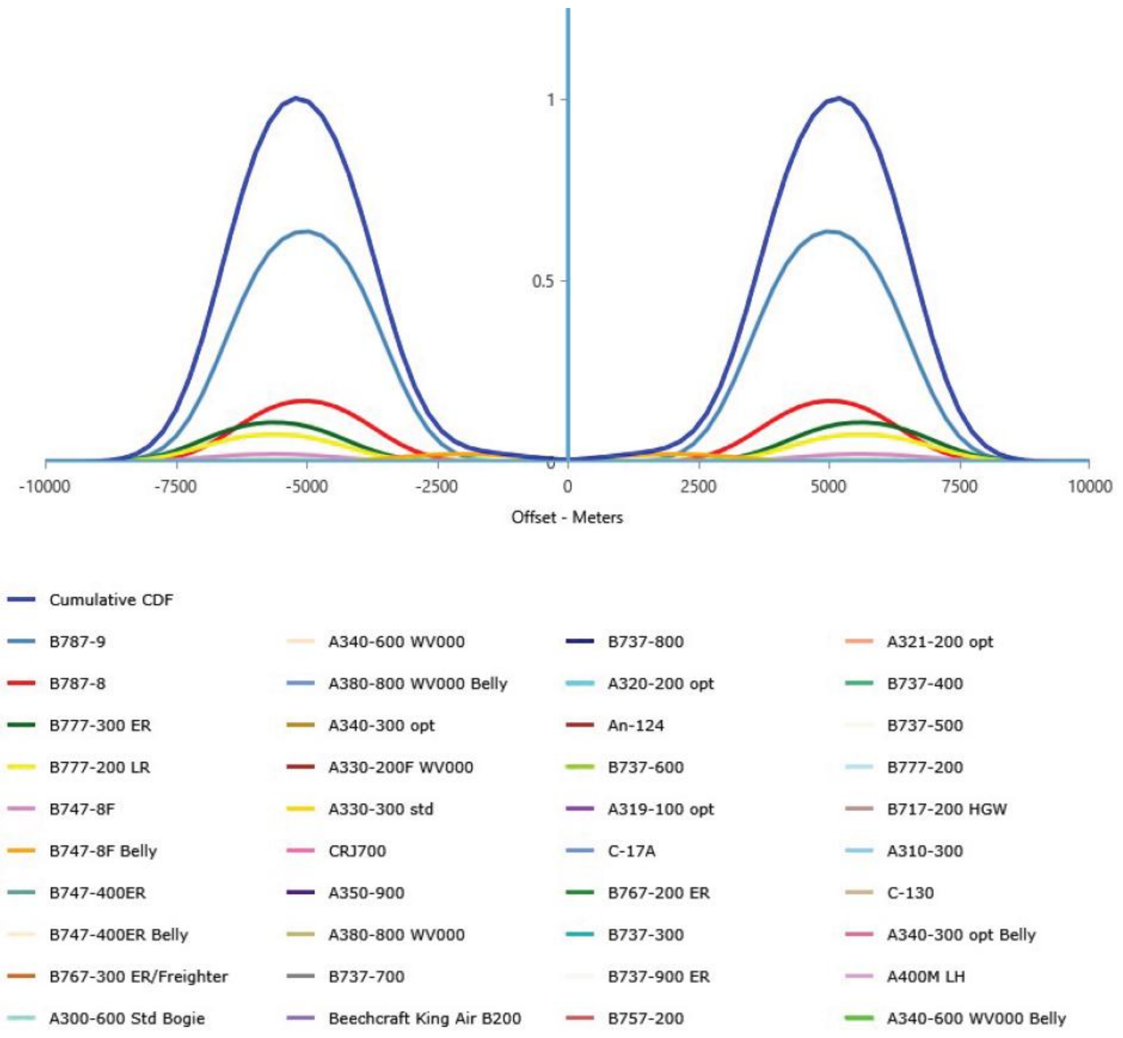



| | Material | Thickness (mm) | E (MPa) | CBR |
|---|---|---|---|---|
| | P-401/P-403 HMA Surface | 113 | 1,378.95 | |
| | P-401/P-403 HMA Stabilized | 127 | 2,757.90 | |
| --> | P-209 Crushed Aggregate | 776 | 547.90 | |
| | Subgrade | | 51.72 | 5 |

| Airplane Name | Gross Taxi Weight (kg) | Annual Departures | Annual Growth (%) | Total Departures | CDF Contributions | CDF Max for Airplane | P/C Ratio | Tire Pressure (kPa) | Percent GW on Gear | Tire Contact Width (mm) | Tire Contact Length (mm) | Tire Contact Area (mm²) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B717-200 HGW | 55,338 | 114 | 1.7 | 2,668 | 0 | 0 | 1.26 | 1130.74 | 0.95 | 301 | 482 | 113,985 |
| B737-300 | 63,503 | 1,384 | 1.7 | 32,386 | 0 | 0 | 1.22 | 1385.85 | 0.95 | 291 | 466 | 106,724 |
| B737-400 | 68,266 | 770 | 1.7 | 18,018 | 0 | 0 | 1.21 | 1275.53 | 0.95 | 315 | 504 | 124,651 |
| B737-500 | 60,781 | 213 | 1.7 | 4,984 | 0 | 0 | 1.22 | 1337.58 | 0.95 | 290 | 464 | 105,836 |
| B737-600 | 65,771 | 3,398 | 1.7 | 79,513 | 0 | 0 | 1.19 | 1282.43 | 0.95 | 308 | 493 | 119,450 |
| B737-700 | 70,307 | 10,481 | 1.7 | 245,255 | 0 | 0 | 1.19 | 1358.27 | 0.95 | 310 | 496 | 120,558 |
| B737-800 | 79,242 | 6,614 | 1.7 | 154,768 | 0 | 0 | 1.18 | 1406.53 | 0.95 | 323 | 517 | 131,218 |
| B737-900 ER | 85,366 | 1,249 | 1.7 | 29,227 | 0 | 0 | 1.18 | 1516.85 | 0.95 | 323 | 517 | 131,077 |
| B747-400ER | 414,130 | 66 | 1.7 | 1,544 | 0 | 0 | 1.12 | 1585.79 | 0.476 | 348 | 557 | 152,060 |
| B747-400ER Belly | 414,130 | 66 | 1.7 | 1,544 | 0 | 0 | 1.13 | 1585.79 | 0.476 | 348 | 557 | 152,060 |
| B747-8F | 449,056 | 69 | 1.7 | 1,615 | 0.02 | 0.02 | 1.11 | 1523.74 | 0.476 | 370 | 591 | 171,599 |
| B747-8F Belly | 449,056 | 69 | 1.7 | 1,615 | 0 | 0.02 | 1.11 | 1523.74 | 0.476 | 370 | 591 | 171,599 |
| B757-200 | 116,100 | 1,134 | 1.7 | 26,536 | 0 | 0 | 1.2 | 1261.74 | 0.95 | 292 | 467 | 107,174 |
| B767-200 ER | 179,623 | 31 | 1.7 | 725 | 0 | 0 | 1.12 | 1310.00 | 0.95 | 356 | 570 | 159,677 |
| B767-300 ER/Freighter | 187,339 | 1,925 | 1.7 | 45,045 | 0 | 0 | 1.11 | 1378.95 | 0.95 | 355 | 568 | 158,205 |
| B777-200 | 248,120 | 4 | 1.7 | 94 | 0 | 0 | 1.1 | 1254.85 | 0.95 | 350 | 559 | 153,506 |
| B777-300 ER | 352,441 | 39 | 1.7 | 913 | 0.1 | 0.11 | 1.08 | 1503.06 | 0.95 | 381 | 609 | 182,043 |
| B787-8 | 228,383 | 1,000 | 1.7 | 23,400 | 0.17 | 0.17 | 1.09 | 1572.01 | 0.95 | 367 | 587 | 169,186 |
| B787-9 | 254,692 | 2,000 | 1.7 | 46,800 | 0.63 | 0.63 | 1.14 | 1558.22 | 0.95 | 389 | 623 | 190,345 |
| A380-800 WV000 | 562,000 | 5 | 1.7 | 117 | 0 | 0 | 1.09 | 1503.06 | 0.38 | 372 | 596 | 174,171 |

# FICTITIOUS AIRFIELD PAVEMENT CALCULATION EXAMPLE

## FAARFIELD 2.1.1 – DAMAGE PROFILES



# FICTITIOUS AIRFIELD PAVEMENT CALCULATION EXAMPLE

## FAARFIELD 2.1.1 – DAMAGE PER AIRCRAFT

Additional Airplane Information

Subgrade CDF

| No. | Name | CDF Contribution | CDF Max for Airplane | P/C Ratio |
|---|---|---|---|---|
| 1 | A300-600 Std Bogie | 0.00 | 0.00 | 1.16 |
| 2 | A310-300 | 0.00 | 0.00 | 1.17 |
| 3 | A319-100 opt | 0.00 | 0.00 | 1.17 |
| 4 | A320-200 opt | 0.00 | 0.00 | 1.17 |
| 5 | A321-200 opt | 0.00 | 0.00 | 1.16 |
| 6 | A330-300 std | 0.00 | 0.00 | 1.08 |
| 7 | A340-600 WV000 | 0.00 | 0.00 | 1.07 |
| 8 | A340-600 WV000 Belly | 0.00 | 0.00 | 1.13 |
| 9 | A340-300 opt | 0.00 | 0.00 | 1.07 |
| 10 | A340-300 opt Belly | 0.00 | 0.00 | 1.18 |
| 11 | A350-900 | 0.00 | 0.00 | 1.27 |
| 12 | An-124 | 0.00 | 0.00 | 1.15 |
| 13 | A400M LH | 0.00 | 0.00 | 1.19 |
| 14 | B717-200 HGW | 0.00 | 0.00 | 1.26 |
| 15 | B737-300 | 0.00 | 0.00 | 1.22 |
| 16 | B737-400 | 0.00 | 0.00 | 1.21 |
| 17 | B737-500 | 0.00 | 0.00 | 1.22 |
| 18 | B737-600 | 0.00 | 0.00 | 1.19 |
| 19 | B737-700 | 0.00 | 0.00 | 1.19 |
| 20 | B737-800 | 0.00 | 0.00 | 1.18 |
| 21 | B737-900 ER | 0.00 | 0.00 | 1.18 |
| 22 | B747-400ER | 0.00 | 0.00 | 1.12 |
| 23 | B747-400ER Belly | 0.00 | 0.00 | 1.13 |
| 24 | B747-8F | 0.02 | 0.02 | 1.11 |
| 25 | B747-8F Belly | 0.00 | 0.02 | 1.11 |
| 26 | B757-200 | 0.00 | 0.00 | 1.2 |
| 27 | B767-200 ER | 0.00 | 0.00 | 1.12 |
| 28 | B767-300 ER/Freighter | 0.00 | 0.00 | 1.11 |
| 29 | B777-200 | 0.00 | 0.00 | 1.1 |
| 30 | B777-300 ER | 0.10 | 0.11 | 1.08 |
| 31 | B787-8 | 0.17 | 0.17 | 1.09 |
| 32 | B787-9 | 0.63 | 0.63 | 1.14 |
| 33 | A380-800 WV000 | 0.00 | 0.00 | 1.09 |
| 34 | A380-800 WV000 Belly | 0.00 | 0.00 | 1.15 |
| 35 | CRJ700 | 0.00 | 0.00 | 1.28 |
| 36 | B777-200 LR | 0.07 | 0.08 | 1.08 |
| 37 | C-130 | 0.00 | 0.00 | 1.55 |
| 38 | C-17A | 0.00 | 0.00 | 1.02 |
| 39 | Beechcraft King Air B200 | 0.00 | 0.00 | 1.55 |
| 40 | A330-200F WV000 | 0.00 | 0.00 | 1.08 |

# FICTITIOUS AIRFIELD PAVEMENT CALCULATION EXAMPLE

## RESULTS SUMMARY

### ALIZE 2.1.2

- Structure

  60 mm of surface course
  180 mm of base course
  710 mm of granular material
  50 MPa subgrade/platform

- Controlling aircrafts on subgrade/platform (CDF)

  Boeing 787-9 Mrw → 0.515
  Boeing 787-8 Mrw → 0.213
  Boeing 787-9 Mlw → 0.150
  Boeing 787-8 Mlw → 0.061

### FAARFIELD 2.1.1

- Structure

  113 mm of binder/surface course
  127 mm of base course
  776 mm of granular material
  52 MPa subgrade/platform

- Controlling aircraft on subgrade/platform (CDF)

  Boeing 787-9 → 0.63
  Boeing 787-8 → 0.17
  Boeing 777-300ER → 0.11
  Boeing 777-200LR → 0.07

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## ACR/PCR calculation

# ACR/PCR CALCULATION

## ALIZE 2.1.2

PCR = 1232.3 F/D/W/T

| Plane | Weight (kg) | ACR |
|---|---|---|
| Boeing / B747 / 8 F (B748) | Mrw / 449056 | 1047.2 |
| Boeing / B747 / 8 F (B748) | Mlw / 346091 | 639.1 |
| Boeing / B777 / 300 ER (B77W) | Mrw / 352442 | 1228.1 |
| Boeing / B777 / 300 ER (B77W) | Mlw / 251290 | 626.8 |
| Boeing / B787 / 8 (B788) | Mrw / 228383 | 905.8 |
| Boeing / B787 / 8 (B788) | Mlw / 172365 | 568.7 |
| Boeing / B787 / 9 (B789) | Mrw / 254692 | 974.3 |
| Boeing / B787 / 9 (B789) | Mlw / 192776 | 623.4 |
| Boeing / B777 / 200 LR (B77L) | Mrw / 348358 | 1181.0 |
| Boeing / B777 / 200 LR (B77L) | Mlw / 223168 | 496.3 |

# ACR/PCR CALCULATION
## FAARFIELD 2.1.1

Results Table 2. PCR Value

| No. | Aircraft Name | Critical aircraft Total equiv. departures | Max allowable Gross Weight of critical aircraft (kg) | ACR Thick at max. MGW (mm) | PCR/F/D |
|---|---|---|---|---|---|
| 1 | B777-300 ER | 263 | 370,903 | 1,173 | 1364.4 |

Results Table 3. New Flexible ACR at Indicated Gross Weight and Strength

| No. | Aircraft Name | Gross Weight (kg) | Percent Gross Weight on Main Gear | Tire Pressure (MPa) | ACR Thick (mm) (D) | ACR/F/D |
|---|---|---|---|---|---|---|
| 1 | A300-600 Std Bogie | 172,600 | 95 | 1,340.00 | 940 | 803.2 |
| 2 | A310-300 | 142,900 | 94.4 | 1,290.01 | 818 | 566.9 |
| 3 | A319-100 opt | 68,400 | 91.39999 | 1,247.95 | 704 | 387.8 |
| 4 | A320-200 opt | 78,400 | 92.8 | 1,441.00 | 765 | 474.2 |
| 5 | A321-200 opt | 93,900 | 94.6 | 1,500.30 | 848 | 620.6 |
| 6 | A330-300 std | 230,900 | 95.8 | 1,420.32 | 935 | 791.7 |
| 7 | A340-600 WV000 | 366,200 | 93.5 | 1,613.37 | 970 | 867.3 |
| 8 | A340-300 opt | 277,400 | 93.9 | 1,420.32 | 925 | 770.3 |
| 9 | A350-900 | 272,900 | 94.8 | 1,661.64 | 978 | 885.3 |
| 10 | An-124 | 397,995 | 95 | 1,337.58 | 897 | 719.9 |
| 11 | A400M LH | 141,400 | 93.8 | 917.00 | 622 | 299.1 |
| 12 | B717-200 HGW | 55,338 | 94.4 | 1,130.74 | 699 | 380.1 |
| 13 | B737-300 | 63,503 | 90.8 | 1,385.85 | 704 | 388.7 |
| 14 | B737-400 | 68,266 | 93.8 | 1,275.53 | 747 | 446.8 |
| 15 | B737-500 | 60,781 | 92.2 | 1,337.58 | 693 | 373.7 |
| 16 | B737-600 | 65,771 | 91.6 | 1,282.43 | 701 | 384.6 |
| 17 | B737-700 | 70,307 | 91.8 | 1,358.27 | 729 | 421.2 |
| 18 | B737-800 | 79,242 | 93.6 | 1,406.53 | 785 | 507.1 |
| 19 | B737-900 ER | 85,366 | 94.6 | 1,516.85 | 820 | 571.3 |
| 20 | B747-400ER | 414,130 | 93.6 | 1,585.79 | 988 | 906.8 |
| 21 | B747-8F | 449,056 | 94.4 | 1,523.74 | 1,052 | 1051.4 |
| 22 | B757-200 | 116,100 | 91.2 | 1,261.74 | 742 | 447.6 |
| 23 | B767-200 ER | 179,623 | 90.8 | 1,310.00 | 871 | 664 |
| 24 | B767-300 ER/Freighter | 187,339 | 92.4 | 1,378.95 | 902 | 727.8 |
| 25 | B777-200 | 248,120 | 93.8 | 1,254.85 | 853 | 630.2 |
| 26 | B777-300 ER | 352,441 | 92.4 | 1,503.06 | 1,125 | 1231.7 |
| 27 | B787-8 | 228,383 | 91.39999 | 1,572.01 | 988 | 908.1 |
| 28 | B787-9 | 254,692 | 92.2 | 1,558.22 | 1,016 | 968 |
| 29 | A380-800 WV000 | 562,000 | 95 | 1,503.06 | 988 | 906.6 |
| 30 | CRJ700 | 33,112 | 95 | 979.06 | 533 | 197.9 |
| 31 | B777-200 LR | 348,358 | 91.6 | 1,503.06 | 1,105 | 1181.8 |
| 32 | C-130 | 70,307 | 95 | 723.95 | 665 | 340.3 |
| 33 | C-17A | 265,351 | 95 | 951.48 | 909 | 742.9 |
| 34 | Beechcraft King Air B200 | 5,711 | 95 | 675.69 | 208 | 32 |
| 35 | A330-200F WV000 | 233,900 | 94.6 | 1,420.32 | 935 | 792.8 |

# ACR/PCR CALCULATION
## RESULTS SUMMARY

### ALIZE 2.1.2

- PCR

  1232.3 F/D/W/T

- ACR

  Boeing 777-300ER Mrw → 1228.1

  Boeing 777-200LR Mrw → 1181.0

  Boeing 747-8F Mrw → 1047.2

  Boeing 787-9 Mrw → 974.3

  Boeing 787-8 Mrw → 905.8

### FAARFIELD 2.1.1

- PCR

  1364.4 F/D/W/T

- ACR

  Boeing 777-300ER → 1231.7

  Boeing 777-200LR → 1181.8

  Boeing 747-8F → 1051.4

  Boeing 787-9 → 968.0

  Boeing 787-8 → 908.1

  A380-800 WV000 → 906.6

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