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AIRCRAFT-PAVEMENT CLASSIFICATION NUMBER (ACN-PCN) SYSTEM OF REPORTING

Abstract. This paper looks at the methods of reporting the load bearing strength of a runway using empirical approaches as recommended by the International Civil Aviation Organization (ICAO). The ICAO has adopted a pavement classification system for reporting airfield strength known as Aircraft Classification Number (ACN) and Pavement Classification Number (PCN). This report also looks at the methods of determination of ACN values using COMFAA and the limitations of the ACN-PCN system.

Keywords: Aircraft Classification Number (ACN), Pavement Classification Number (PCN), equivalent single wheel load (ESWL), California Bearing Ratio (CBR), subgrade, pavement.

Introduction. In 1977, ICAO set up a Study Group to develop a single international method of reporting pavement strengths. The study group developed one and in the early 1980s, ICAO and the member states(countries) agreed to adopt the Aircraft Classification Number-Pavement Classification (ACN-PCN) method of reporting pavement strength for airports with bearing strengths greater than 5700kg (12500pounds) as the single universal system for determining the weight limitation of aircraft operating on airport pavements.

Aircraft Classification Number (ACN) – is a number that expresses the relative effect of an aircraft at a given configuration on a pavement structure for a specified standard subgrade strength.

Pavement Classification Number (PCN) – is a number that expresses the load-carrying capacity of a pavement for unrestricted operations.

States are required to evaluate and publish the strength of pavements using ICAOs ACN-PCN system. This method concentrates on classifying the relative damage of aircraft. ICAO expects that each pavement authority will define a PCN by whatever means is considered to be suitable in order to indicate the support level of a particular pavement such that all aircraft with a published ACN is equal to or less than the reported PCN can use that pavement safely, without load bearing failure or undue damage to the structure.

Limitations of the acn-pcn system. It should be noted that the ACN-PCN method is meant only for the publication of pavement strength data so airport operators can evaluate acceptable operations of aircraft. It is not intended for design or evaluation of pavements, nor does it contemplate the use of a specific method by the airport authority either for design or evaluation of pavements. Unfortunately the fact that the method of calculating ACN utilizes two common design and analysis methods (the CBR equation and Westergaard theories) has led a surprising large number of people to assume that it is a design and evaluation method.

Determination of aircraft classification number. The aircraft manufacturers are required to publish properly computed ACN values for all of their aircraft . Computation of the ACN requires detailed information on the operational characteristics of the aircraft, such as maximum aft center of gravity, maximum ramp weight, wheel spacing, tire pressure, and other factors.

The ACN is computed as the ratio of a computed single-wheel load to a reference single-wheel load with tire pressure of

1.25 MPa (181psi)

For the purposes of determining the ACN, the behavior of a pavement is classified as equivalent to a rigid or flexible construction. For flexible construction, the US Corps of Engineers ESWL CBR method of design using alpha factors adopted by ICAO in October 2007 is used to calculate the pavement thickness required for 10,000 coverages for single wheel loads having 1250 kPa (181 psi) tyre pressure on four standard subgrade strengths.

The four standard subgrades used are based on California Bearing Ratio (CBR):

Subgrade Code A	high strength	CBR 15
Subgrade Code B	medium strength	CBR 10
Subgrade Code C	low strength	CBR 6
Subgrade Code D	ultra low strength	CBR 3

For rigid construction, the Portland Cement Association (PCA) Weestergaard interior stress method of design is used to calculate the concrete thickness required for 10,000 coverages at a concrete strength of 4.217MPa(620psi). The four standard subgrades are referenced to Westergaard's Modules of Subgrade Reaction, K:

Subgrade Code A	high strength	K = 150 MN/m^3
Subgrade Code B	medium strength	K = 80 MN/m^3
Subgrade Code C	low strength	K = 40 MN/m^3
Subgrade Code D	ultra low strength	K = 20 MN/m^3

Standard concrete working stress – 2.75 MPa(400psi)

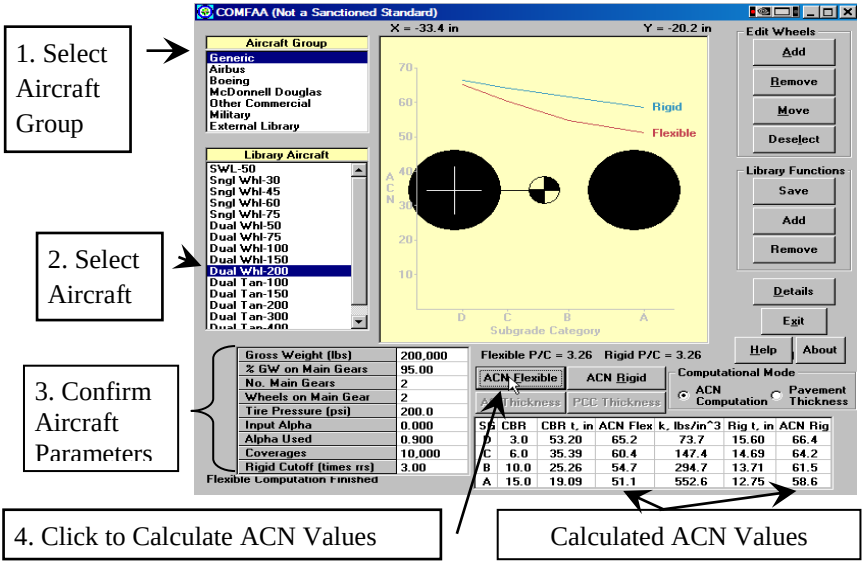
Determination of acn values using comfaa. The US FAA developed software called COMFAA for calculating ACN values in accordance with the ACN-PCN method. COMFAA was translated from the ICAO Aerodrome Design Manual and uses the rigid and flexible pavement design programs described therein. The COMFAA program enables computation of ACN values and calculates total flexible pavement thickness and rigid pavement slab thickness, however the user must remember that official ACN values are provided by the airplane manufacturer.

Using the COMFAA program to calculate ACN values is visually interactive and intuitive. The user selects the desired airplane, confirms the physical properties of the airplane and clicks on the ACN Flexible or ACN Rigid button to determine the ACN for the four standard sungrade conditions. The program also includes a help file to assist the user. Details of the operation of the COMFAA program are shown below.

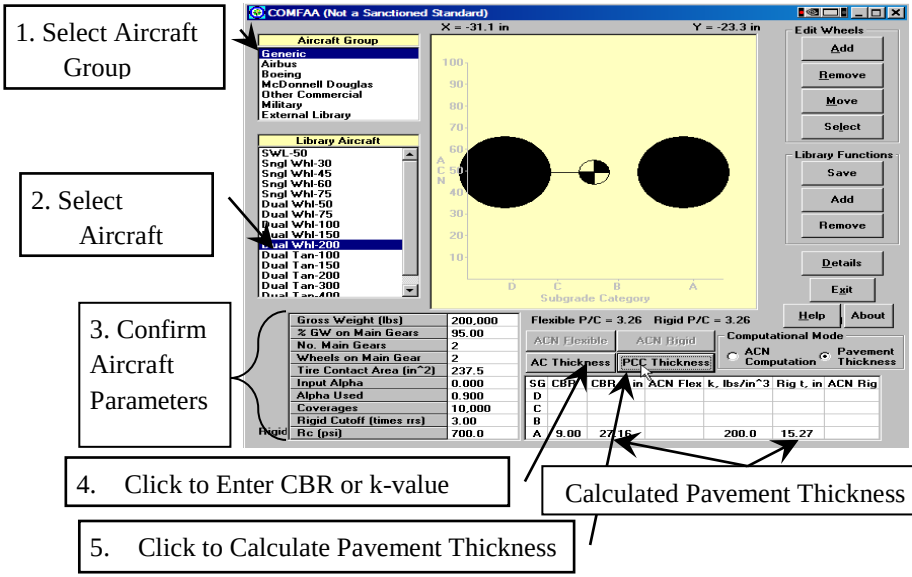
Determination of pcn numerical value. Pavement rating determination in terms of PCN is a process of:

- determining the ACN for each aircraft considered to be significant to the traffic mixture operating of the subject pavement;

- reporting thee ACN value as the PCN for the pavement structure.



Operation of the COMFAA Program in ACN Mode



Operation of the COMFAA Program in Pavement Thickness Mode

Under the above conditions, any aircraft with an ACN equal to or less than the reported PCN value can safely operate on the pavement subject to any limitations on tyre pressure. PCN values determined in accordance with this AC depends upon the traffic model used to determine the PCN value. Airports should re-evaluate their posted PCN value if significant changes to the original traffic model occur.

The determination of the numerical PCN value for a particular pavement is determined using one of the following procedures: the "Using" aircraft method or the "Technical" evaluation method.

The "Using" aircraft method is a simple procedure where ACN values for all aircrafts currently permitted to use the pavement facility are determined and the largest ACN value is reported as the PCN. This method is easy to apply and does not require detailed knowledge of the pavement structure and is often conservative. Application of this method is discouraged on a long – term basis due to the inaccuracies that may arise.

In the "Technical" evaluation method, the accuracy of a technical evaluation is better than that produced with the Using aircraft procedure but requires a considerable increase in time and resources. Pavement evaluation may require a combination of on-site inspections, load-bearing tests, and engineering judgment. It is common to think of pavement strength rating in terms of ultimate strength or immediate failure criteria. However, pavements are rarely removed from service due to instantaneous structural failure. A decrease in the serviceability of a pavement is commonly attributed to increases in surface roughness or localized distress, such as rutting or cracking. Determination of the adequacy of a pavement structure must not only consider the magnitude of pavement loads but the impact of the accumulated

effect of traffic volume over the intended life of the pavement.

The reporting of PCN values is done in a coded format using five parts separated by "/". This information includes:

- numerical PCN value
- pavement type (F= flexible, R = Rigid)
- subgrade strength category (A, B, C, or D)
- allowable tyre pressure (X≤1.5MPa = 218psi)
- PC evaluation method (U = Using, T = Technical)

Conclusion: The ACN-PCN system, though meant only for the publication of pavement strength data so airport operators can evaluate acceptable operations of aircraft and not intended for design or evaluation of pavements, makes certain that both the aircraft and pavement can be utilized to their maximum extent without inimical effects.

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Аннотация. В настоящем документе рассматриваются методы представления прочности нагруженной взлетно-посадочной полосы с помощью эмпирических подходов в соответствии с рекомендациями Международной организации гражданской авиации (ИКАО). ИКАО приняла систему представления прочности покрытий аэродромов известную как классификационное число воздушного судна (ACN) и классификационное число прочности покрытия (PCN). В этом докладе также рассматриваются ограничений ACN-PCN системы и методы определения значений ACN с использованием программного комплекса COMFAA.