Catalog of airport pavements

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ABSTRACT
This dissertation offers an attempt to fill up a gap in the design of airport and aerodrome pavements in comparison to the existing references about road pavements.

The two most relevant methods of airport pavement design are described. The ACN/PCN method that informs of the capacity of an airport surface to receive traffic and the FAA method that describes how the thickness of a pavement is calculated.

Next, I describe the study of the pavement design for Teruel and Castellón airports made by their project engineers. Both airports are recent and situated on the east of Spain.

The catalogue is established following the steps of FAA method and the philosophy of the Spanish catalogue for roads. In this way, tables with layers' thickness and the materials that from it become available in function of the traffic volume and the foundation soil resistance.

In order to verify the validity of the catalogue I shall compare the obtained results here with those described in the two above mentioned airports built by Spanish project engineers.

By doing so, I intend to produce a catalogue that fulfills the objectives of this dissertation by permitting the obtaining of a structure for airport/aerodrome surfaces taking into account the expected amount of traffic as well as the foundation resistance. It will also permit to have a quick idea both of the costs of the construction and the rehabilitation of the airport pavements as well. Obviously, some refinements can be made by using different methods of design.

KEY-WORDS
Pavement; Airport/Aerodrome; Catalog of pavement structures, Air traffic, Structural Resistance

1 INTRODUCTION

1.1 Motivation
One of the major problems when planning a project and calculating an estimate for the pavements of an airport/aerodrome is evaluating the dimension of the expenses that correspond to the different zones on the air area, such as runways, run lanes, and parking platforms.

A catalogue that integrates solutions for roads pavements with different types of foundations, and traffic is already available for many administrations.

In this way, I intend to propose a catalogue for airport pavements taking into account the plan that is normally used for the making of catalogues for airport pavements with the help of the already existing methods of calculation.

1.2 Objectives and methodology
The main objective of my dissertation is to propose a catalogue of pavements building for airports/airdromes that permits a quick obtention of pavements structures adjusted to dimension of air traffic and airport foundation aimed at infrastructures and applicable to the different zones of an airport where the pavement is needed.

Methodologically speaking, a specific method of design, amongst the ones described in the dissertation, is going to be used and the structures for the different values of resistance of foundation and the airport traffic will also be established in an ample way so that it can be applicable in a great variety of occasions. To achieve this aim I have used two airports situated on the east of Spain as a reference. They have different dimensions. These airports will act as a reference to illustrate and underline the real possibilities of implementation of the catalogue as well as the utility and profit inferred.

2. METHODS OF CALCULATION AND EVALUATION OF PAVEMENTS

2.1 Method ACN/PCN
In order to unify and simplify the information to the airport authorities and airlines and with the intention of letting operators know the pavement resistance on which the will operate, the Manual of Aerodrome Project (part 3: pavements) and the Anex 14 recommends method ACN/PCN for the notification of resistance of pavements designated to airplanes with a superior weight to 5,700kg.

ACN (Aircraft Classification Number): It is a figure that indicates the relative effect of an
airplane upon a pavement for a standardized category of foundation.

PCN: (Pavement Classification Number): It is a figure that indicates the resistance of the pavement to be used without restrictions (ICAO, 2004).

It is absolutely necessary to bear in mind that the only aim of this method is the spreading of data about the resistance of pavements in the AIP (Publications of Aeronautical Information) as countries are allowed to use any method of evaluation or calculation.

To this aim it is given more importance to the evaluation of the ACN than to the pavements because the resistance of pavements is a function of classification at the time of loading the airplanes.

The structural resistance of the foundations and pavements is measured with the index CBR (California Bearing Ratio) for flexible pavements and with the module of reaction (k) for rigid pavements.

1) The method anticipates the register of the following information (Carrasco, 2002):

a) Type of pavement: flexible (F) or rigid (R).

b) Category of the land of foundation:

- High (A): CBR >13 o k > 120 MN/m\(^3\)
- Middle (B): 8 < CBR > 13 o 60 < k < 120 MN/m\(^3\)
- Low (C): 4 < CBR > 8 o 25 < k > 60 MN/m\(^3\)
- Super Low (D): CBR <4 o k < 25 MN/m\(^3\)

1) Maximum pressure of tyres

- High (W) with no pressure limit
- Middle (X): up to 1,50 MPa
- Low (Y): up to 1,00 MPa - Baja (Y): hasta 1,00 MPa
- Very low (Z): up to 0,50 MPa

d) Method of evaluation: technical evaluation or experience evaluation (plane in use).

These data are meant to determine which airplanes can airport agents admit and the possibility of guaranteeing manufacturers the compatibility between the airport pavement and future airplanes.

2) The ACN can be different for the same airplane depending on whether the pavement is rigid or flexible and it is calculated in the following way.

For rigid pavements (Castells, 2010):

a) The reference thickness is the thickness of a concrete slab loaded on its centre by the main landing gear of the airplane in question. It produces tensions of 2.75 N/mm\(^2\) on the concrete slab and on the ground with one of the standardized modules of reaction. Mathematical model of Westergaard.

b) The weight of a single wheel (DSWL) is calculated with a pressure of 1.25 MPa that provokes a request of flexion of 2.75 N/mm\(^2\) in slates of thickness “T”:

c) The ACN taking DSWL in kg will be:

\[
ACN = \frac{DSWL}{500}\quad(1)
\]

For flexible pavements (Castells, 2010):

e) The reference thickness (t) is calculated and, in this case, is the thickness that permits 10,000 repetitions of load of the main landing gear of the plane in question on a landing ground with a standard CBR (A, B, C or D). Equations of Boussinesq.

f) The weight of a single wheel (DSWL) is calculated with a tyre pressure of 1.25MPa that permits the same 10,000 repetitions of load on flexible pavement.

\[
DSWL = \frac{t^2}{0.878 \frac{C}{BR} - 0.01249}\quad(2)
\]

g) Once again, taking DSWL in kg.

\[
ACN = \frac{DSWL}{500}\quad(3)
\]

To conclude this section it can be said that it is important for an airport to have a pavement with the highest PCN possible to enable it to receive the highest number of planes.

2.2 Method FAA

The FAA of the USA adopted the method of calculating and notifying the resistance of airports by considering the MTOW (Maximum Take-Off Weight) for each type of landing gear.

The calculation of airport pavements is a rather complicated technical problem with a great
number of independent variables but, despite that, if we follow the instructions of Airport Pavement Design and Evaluation (FAA, 1995) and the Manual of Aerodrome Design: Part 3 Pavements (ICAO, 1983) we will have a full description of the procedure used by the FAA in the design of most Spanish airports.

1) The method is based on using some curves created by the FAA to obtain the different thicknesses of the pavement beds. These curves are obtained and are different for rigid or flexible pavements.

How these curves are obtained and what information they provide is described briefly here. Lines for five volumes of annual traffic can be found in them (1,200, 3,000, 6,000, 15,000 and 25,000 exits).

The calculation of the curves for flexible pavements is based on the essay CBR (ICAO, 1983). This method of obtaining is basically empiric and, in spite of that, was the object of numerous scrutiny and reliable correlations are admitted to exist. The configurations of landing gears of airplanes intervene in the calculation. These curves provide the total thickness required by the pavement that is needed to stand a specific weight of an airplane on a specific foundation ground.

The calculation of the curves for rigid pavements is based on the analysis of Westergaard (ICAO, 1983) about loads on the edges that was modified to simulate a joint edge condition. We can simply obtain the thickness of the concrete slab with the curves. The thickness of the sub-base layer is determined in a separate way.

2) The considerations relative to airplanes for the design of pavement are:

a) Load: the method of calculation is based on the MTOW.

b) Type of landing gear: the type of landing gear and its configuration determine the way in which the airplane weight is distributed on the pavement and establishes an answer from the pavement to the loads produced by the plane. So curves for the different types of landing gear are prepared: single wheel, twin wheels, bogie and for planes of large fuselage.

c) Volume of traffic: it is necessary to have predictions of the annual departures and types of airplanes for the sizing of the pavement.

3) It is necessary to find an airplane that represents all the traffic in an airport in order to calculate the thickness of the pavement for an airport. This plane is called calculation airplane.

And so, the calculation plane chosen must be the one that needs the maximum thickness of pavement from the total volume of traffic of the airport.

4) Equivalent departures. The prevision of traffic is a mixture of different airplanes that have different types of landing gear and different weights and so we must have in mind the effects of all the traffic equivalent in terms of the calculation plane.

First of all, all planes have to transform their landing gear to the same type as the calculation plane and to that aim factors of equivalency (FAA,1995) are used.

Secondly, it is necessary to use the conversion for the equivalent annual departures that are determined with the following equation:

$$\text{Log}(R1) = \text{Log}(R2) * \left( \frac{W2}{W1} \right)^{0.5}$$

being R1: the annual departures equivalent to the calculation plane, R2: annual departures of the traffic airplane expressed in terms of the landing gear of the calculation plane, W1: load on the wheel of the calculation plane, W2: load on the wheel of the analyzed plane.

5) Calculation for flexible pavements. In order to use the calculation curves we need a value of CBR for the foundation ground, a value of CBR of the sub-base, the MTOW and the number of annual equivalent departures. We must take into account that the base layer requires a minimum thickness that depends on the total thickness of the pavement and the values of CBR of the foundation.

For pavements that receive airplanes with an MTOW superior to 45,400 kg, the base and sub-base layers must be stabilized. The thickness of the layers is reduced with this stabilization and this is done by means of some factors of equivalence designed by the FAA.

6) Calculation of rigid pavements. The above mentioned curves are used and are separated for each type of landing gear. These curves require four parameters of entrance:

a) Characteristic resistance within 90 days of the flexion concrete.
b) Module of reaction of the foundation ground.

c) MTOW of the calculation plane.

d) Annual equivalent departures.

For pavements that receive planes with an MTOW superior to 45,400 kg, the sub-base layer must be stabilized.

7) For a volume of heavy traffic, that is, higher than 25,000 annual departures, the thickness of the resulting pavement must be corrected with the following equation:

$$T_{Total} = T_{25000} \left( 1 + 0.133 \times \log \left( \frac{N}{25000} \right) \right)$$

being N: the number of departures, $T_{25000}$: the thickness for 25,000 departures, $T_{Total}$: final corrected thickness.

The thickness of the wear layer must be increased by 3 cm.

3 PROPERTIES AND MATERIALS OF THE PAVIMENTS

In this dissertation we understand that pavement is the structure built on the foundation ground that stands the loads coming from the air traffic. This pavement redistributes these loads for the infrastructure and provides satisfactory conditions of comfort and security to the people who use the structure in the most economical way.

In the field of airports two types of pavement are normally used. The rigid pavement for parking platforms and the flexible pavement for runways and lateral run roads.

1) Flexible pavements

They are built with an upper layer of bituminous mixtures and are usually integrated in the wear layer, the binding layer and the base layer and it rests on a granular base. A sub-base granular layer is added when conditions of the foundation ground require it.

a) The upper layer has a thickness that ranges between 10 and 16 cm and it is generally formed by bituminous asphalt.

AGE: Material granular formed by aggregates treaty with granulometry é of extensive type

b) The granular base layer is formed by AGE and it is possible to cover its stabilization treatment by using hydraulic or bituminous binders. A minimum CBR of 80 is demanded and its thickness is between 10-30 cm.

c) As for the sub-base layer, materials such as selected floors, natural AGE or added floors with hydraulic binders are used. A minimum CBR of 20 is required and its thickness ranges between15-20 cm.

d) The stabilizations are carried out following the USA rules (FAA, 1995). Cement or bituminous binding is used for the base and cement for the sub-base. The FAA name these materials as:

- P-209: Sub-base treated with cement
- P-304: Base treated with cement
- P-401: Base treated with bituminous binder

2) Rigid pavements

They are generally formed by a cement concrete slab that rests on a sub-base layer.

a) The concrete slab is formed by cement, aggregates (with extense granulometry of various fractions and a size of aggregate of 40 mm), water and additives. It has a water/cement relation between 0.4 and 0.45.

b) The granular sub-base layer is formed by treated or untreated AGE. A CBR of 20 with thickness between 15-50 cm.

c) The loads transmitted by airplanes to pavements arrive in different ways, as it is shown in Picture 1.

![Picture 1 - Distribution of tensions transmitted to the foundation ground for flexible and rigid pavements (Picado, 2001)](image)

4 AIRPORTS OF REFERENCE

The way in which the sizing of two airports on the east of Spain has been done by their own project engineers is described in this section. These project designers will serve as validation
for the applicability of the catalogue of airport pavement.

4.1 Teruel Airport
1) Introduction
   a) This airport is situated on the east of Spain, to the south of Aragón, near the town of Teruel.

   b) This airport can be considered as an aeronautical industrial platform as it does not offer commercial traffic services. It is mainly destined to long stay parking as well as recycling and servicing airplanes.

   c) It offers diverse services: long stay for airplanes, recycling of airplanes, servicing, paint and refurbishment, school for pilots, etc.

   d) It has the following installations: runway with north-south orientation, with an extension of 2.825 metres and a width of 60 m. It has also a parking platform with servicing facilities, another platform to park long stay airplanes, fire brigade premises and an industrial area with more than 33 hectare.

2) Flexible pavement that is used on runways. The calculation data are the following:
   - Calculation airplane: B-747
   - MTOW: 396.000 kg
   - CBR of foundation ground: 20
   - Annual departures: 3.000
   - Landig gear: COM

The Project engineer with these data and using the FAA method obtains the following results:

   ➢ Upper layer of bituminous mixture: 13 cm
   ➢ Granular base layer stabilized with bituminous binder: 24 cm

3) Rigid pavement is used in the parking platform. The calculation data are the following:
   - Calculation airplane: B-747
   - MTOW: 396.000 kg
   - Concrete characteristic resistance: 5 MPa
   - Module of reaction of the foundation ground: 82 MN/m²
   - Annual departures: 3.000

The Project engineer with these data and the FAA method obtains the following results:

   ➢ Concrete slab: 32 cm
   ➢ Sub-base granular layer with CBR=80:10 cm

4) The resistance of the pavement according to method ACN/PCN is:
   ➢ Flexible pavements: PCN 52/F/A/W/T
   ➢ Rigid pavements: PCN 46/R/B/W/T

4.2 Castellón airport
1) Introduction
   a) This airport is situated on the east of Spain, to the north of the Valencian Community, near the town of Castellón

   b) This airport has a private character and it is intended for commercial traffic. The total area covers 542 hectare

   c) The installations have a runway of 2.7000 metres length and 45 metres width, a platform for parking of 55.000 square metres and a tow storey terminal building for passengers.

2) Flexible pavement that is used for the runway. The calculation data are the following:
   - Calculation airplane: B-737
   - MTOW: 70.800kg
   - CBR of the foundation ground: 20
   - Annual departures: 6.000
   - Landing gear: RG

The project engineer with these data and using the FAA method obtains the following results:

   ➢ Upper layer of bituminous mixture: 10 cm
   ➢ Granular base layer stabilized with cement: 24 cm

3) Rigid pavement is used on the parking platform. The calculations are the following:
   - Calculation airplane: B-737
   - MTOW: 70.800kg
   - Concrete characteristic resistance: 4.725MPa
   - Module of reaction of the foundation ground: 90 MN/m³
   - Annual departures: 3.000

The project engineer obtains the following results with these data and using the FAA method:

   ➢ Concrete slab: 32cm
   ➢ Sub-base granular layer with CBR=80:10cm
5 CATALOGUE OF PAVEMENTS

The objective of this catalogue is the establishment of basic criteria that must be considered in the projects of pavements for aerodromes/airports newly built. It is intended to simplify and facilitate the work of the project engineer.

There is a catalogue for the sections of road construction in Spain. It is published through Norm 6.1 –IC.

The road catalogued is followed as a reference to carry out the airport catalogue, essentially regarding its philosophy. Method FAA is used as base for the calculation for thickness in the pavement layers.

By doing so, the foundation ground, in divided into categories according to the CBR they have and the traffic according to the damage caused on the pavement.

5.1 Runways

As it has been stated before, flexible pavement is used on this zone of the airport.

1) Foundation ground divided following method ACN/PCN and four categories are obtained. One more category is added for the CBR=20 (see Table 1)

Table 1 – Classification of the foundation ground for the catalogue of flexible pavements.

<table>
<thead>
<tr>
<th>Foundation</th>
<th>CBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>3</td>
</tr>
<tr>
<td>F2</td>
<td>6</td>
</tr>
<tr>
<td>F3</td>
<td>10</td>
</tr>
<tr>
<td>F4</td>
<td>15</td>
</tr>
<tr>
<td>F5</td>
<td>20</td>
</tr>
</tbody>
</table>

2) Airplane traffic: A mixture of air traffic that it is believed to represent the movements of the current world traffic is obtained when observing the mixture of airplanes for the design of reference airports and after adding some of the most common airplanes.

With this information five prototype airplanes are chosen. They must represent the whole group basin on their ACN. They represent the traffic categories as well. These are divided in four categories according to the number of departures (see Table 2)

Table 2 – Categories of traffic for flexible pavements from the catalogue

<table>
<thead>
<tr>
<th>Prototype airplane</th>
<th>Categoria</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATR-72</td>
<td>A1</td>
</tr>
<tr>
<td></td>
<td>A2</td>
</tr>
<tr>
<td></td>
<td>A3</td>
</tr>
<tr>
<td></td>
<td>A4</td>
</tr>
<tr>
<td>Focker-100</td>
<td>B1</td>
</tr>
<tr>
<td></td>
<td>B2</td>
</tr>
<tr>
<td></td>
<td>B3</td>
</tr>
<tr>
<td></td>
<td>B4</td>
</tr>
<tr>
<td>B737-800</td>
<td>C1</td>
</tr>
<tr>
<td></td>
<td>C2</td>
</tr>
<tr>
<td></td>
<td>C3</td>
</tr>
<tr>
<td></td>
<td>C4</td>
</tr>
<tr>
<td>B-747-400</td>
<td>D1</td>
</tr>
<tr>
<td></td>
<td>D2</td>
</tr>
<tr>
<td></td>
<td>D3</td>
</tr>
<tr>
<td></td>
<td>D4</td>
</tr>
<tr>
<td>A380-800</td>
<td>E1</td>
</tr>
<tr>
<td></td>
<td>E2</td>
</tr>
<tr>
<td></td>
<td>E3</td>
</tr>
<tr>
<td></td>
<td>E4</td>
</tr>
<tr>
<td>Annual departures</td>
<td></td>
</tr>
<tr>
<td>3.000</td>
<td></td>
</tr>
<tr>
<td>6.000</td>
<td></td>
</tr>
<tr>
<td>15.000</td>
<td></td>
</tr>
<tr>
<td>25.000</td>
<td></td>
</tr>
</tbody>
</table>

4) Method of calculation: As it was said previously, the FAA method is used as referent, considering as calculation airplanes the prototype planes with equivalent departures that, in this case, are the ones previously mentioned.

First of all, it is necessary to design each of the thicknesses (see Picture 2) in cm. and then we have to move to the curves of calculation (FAA, 1995) and obtain thickness T and T1. We also need to obtain an auxiliary thickness T4 that is calculated with the same curves for a CBR=20 for the foundation ground and with the traffic data.

Once we have T, T1 and T4, we can obtain T2=T4-T1 and T3=T-T4. Having done this, we have to verify that the norm of minimum thickness of the base (ICAO, 1983) is obeyed. If the norm is obeyed the final thickness is the indicated. If it is not obeyed we must substitute T2 for the minimum base thickness and, keeping that thickness, we must reduce the T3 thickness.

For prototype airplanes that have an MTOW higher to 45,000 kg, it is necessary to stabilize the base and sub-base layers, and so, after doing

- Base layer: AGE without binder or stabilized with asphalt (EST-1) is used.
- Sub-base layer: Natural AGE with a minimum CBR of 20 or this material stabilized with cement (EST-2).
what has been described in the previous paragraph, we have to apply equivalent factors from Table 3 that reduce thickness.

Table 3 – Factors of equivalence relative to the stabilization

<table>
<thead>
<tr>
<th></th>
<th>Factors of equivalence</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>1.4</td>
<td>P-401</td>
</tr>
<tr>
<td>Sub-base</td>
<td>1.7</td>
<td>P-209</td>
</tr>
</tbody>
</table>

These calculations are carried out for the different foundation ground and traffic categories, obtaining result tables that, after making some adjustments, are used to design the pictures on the catalogues.

5.2 Parking platforms
Rigid pavement is used on these zones of airports, as it was previously remarked.

1) Following the steps carried out for flexible pavements the foundation ground is divided in four categories (see Table 4) (method ACN/PCN as a reference) but this time according to the reaction module (k).

Table 4 – Classification of the foundations of rigid pavements for the catalogue

<table>
<thead>
<tr>
<th>Foundation</th>
<th>k (MN/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>20</td>
</tr>
<tr>
<td>F2</td>
<td>40</td>
</tr>
<tr>
<td>F3</td>
<td>80</td>
</tr>
<tr>
<td>F4</td>
<td>150</td>
</tr>
</tbody>
</table>

2) Five prototype airplanes are obtained with the same mixture of traffic as for flexible pavements (see Table 5).

Table 5 – Categories of traffic from the catalogue for rigid pavements

<table>
<thead>
<tr>
<th>Prototype airplane</th>
<th>Categoria</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATR-72</td>
<td>A1</td>
</tr>
<tr>
<td>Focker-100</td>
<td>B1</td>
</tr>
<tr>
<td>B737-800</td>
<td>C1</td>
</tr>
<tr>
<td>B-747-400</td>
<td>D1</td>
</tr>
<tr>
<td>B-777-300</td>
<td>E1</td>
</tr>
<tr>
<td>Annual Departures</td>
<td>3000</td>
</tr>
<tr>
<td></td>
<td>6000</td>
</tr>
<tr>
<td></td>
<td>15000</td>
</tr>
<tr>
<td></td>
<td>25000</td>
</tr>
</tbody>
</table>

3) The materials used for the two layers are: a concrete slab with a resistance of flexotraction to 90 days of 4.9 MPa and for the AGE granular base either natural or stabilized with cement (EST-3) is used.

4) To calculate the thickness for this type of pavement for the catalogue the following information is needed: resistance of the concrete slab to flexotraction, the module of reaction of the foundation ground, the MTOW and the departures of the prototype airplane (also the type of landing gear).

In the case of rigid pavements (see Picture 3), a thickness for the sub-base layer is fixed (T2) 10,16 or 20cm. Later a test drilling is carried out to determine the optimum thickness for the sum of thicknesses because the price of the concrete slab is not the same as the sub-base and the less expensive option must be sought.

Picture 3 – Thicknesses rigid pavement

5.3 Use of tables in the catalogue
In this large summary one of the tables of the catalogue is presented and the way in which they must be used is explained.

First of all, the information about the characteristics that influence the calculation must be obtained: the calculation airplane, the number of annual departures and the CBR of the foundation ground. And then enter these data into the tables.

For instance, if we have an airplane with an MTOW of 20,000 kg with 6,000 annual departures and with a foundation ground with a CBR=10 and we wish to obtain the thickness of the flexible pavement layers then we must enter in the catalogue the category of traffic A2 and the foundation ground (see Picture 4).

And the following results are obtained: for the upper layer of bituminous mixtures 10cm and for granular base 22cm.

5.4 Verification of results
In order to verify the validity of the catalogue we compare the results obtained by the project engineers for the reference airports with the results that are obtained using the catalogue.

In tables 6 and 7 the comparison of results is shown:

The verified differences are minimum and the values obtained for the catalogue are placed on the side of security (they are bigger). This fact
gives the necessary confidence to admit that the work done is applicable directly.

Table 6 – Comparison of results for flexible pavement

<table>
<thead>
<tr>
<th>Layers</th>
<th>Teruel</th>
<th>Catálogo</th>
<th>Catállón</th>
<th>Catálogo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper (cm)</td>
<td>13</td>
<td>13</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Base (cm)</td>
<td>24</td>
<td>28</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

Table 7 – Comparison of results for rigid pavement

<table>
<thead>
<tr>
<th>Layers</th>
<th>Teruel</th>
<th>Catálogo</th>
<th>Catállón</th>
<th>Catálogo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete slab (cm)</td>
<td>32</td>
<td>33</td>
<td>32</td>
<td>35</td>
</tr>
<tr>
<td>Sub-base (cm)</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

6 CONCLUSIONS

This dissertation was carried out with the intention of obtaining a catalogue for airport pavements, taking as a referent the format of norm 6.1C in the catalogue in order to permit a quick obtaining of pavement structures in accordance with the required dimension of the airport infrastructure.

The objective was reached (see Annex III) and its applicability has been proved by comparing the catalogue results to the reference airport results. In reality the values obtained with the catalogue for thicknesses of pavements are perfectly valid showing that the developed catalogue follows the necessary procedure that permits its utilization.

In summary, thicknesses of different layers that form the pavement of the different areas of the air zone can be obtained in a quick and efficient way with the work that has been done and knowing the main characteristics of the airport. These pavements have the capacity to be able to bear the traffic loads sufficiently.

6.1 Future works

The following future works are suggested on the basis of the described work to bring improvements to different sections of this dissertation:

1) Introducing another calculation method for thicknesses of pavements in the catalogue and using the most applicable in each case to obtain the thicknesses. For instance, the French method or the Canadian method (ICAO, 1983)

2) Obtaining the results of the calculations of more reference airports to obtain a more full-scale verification to validate the catalogue.

7 REFERENCES


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Picture 4 – Example Catalogue