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Planning of Airport and Design of Runway Pavement in Marine Clay

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Abstract—*The paper shows the importance of planning of an airport. It includes the planning and location of various components of an airport such as Runway, Taxiway, Hangar, Aprons, Terminal building, etc. The planning of these components is done on the basis of calculations which are also shown in this paper. A part of this paper also includes the design of runway pavement in marine clay. The tests which are needed to be conducted for determining the nature of soil i.e. its geology, stratification are shown in the paper. Also the different soil consolidation methods are also been described.*

Keywords—Planning of airport,Runway Design For 4F Aircrafts, Test on the Soil ofthe Runway. ICAO, design of pavement in Marine Clay, Consolidation

I. INTRODUCTION

Airport planning in its own sense is a vast phenomenon. The installation of an airport facility not only improves the way of communication for the local people but also increases the economy of the nation by increasing the inflow of foreign tourists. Therefore the planning of an airport for the proper flowing of air traffic is of utmost importance. Not only the runway for the landing and takeoff of an aircraft is of prime importance in an airport but the value of taxiway, hangars, aprons, terminal building for the Maneuvering of aero planes ,their parking and maintenance, as well as for the loading and unloading of the big sized Boeings cannot be neglected.
For the governing, planning and design of an Airport facility various organizations and agencies have put forth safety and necessary standards .These standardizing agencies are as follows

1. International civil aviation organization (ICAO).

2. Federal aviation organization (FAA).

3. Airport authority of India (AAI).

The planning of the different airport components have been carried out by us under the standards of these agencies.

1.1 PLANNING OF AN AIRPORT

1.1.1 RUNWAY

As the runway in marine clay comes under 4F category it can accommodate an Airbus A380.
ICAO gives standards for runway falling under 4F category as
Minimum width = 45m.
Maximum width-should not exceed 75m.
Runway end safety areas

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1 The runway must extend 90m to the end of runway strips to mitigate over runs and undershoots which result from adverse operational factors.
2 Distance of at least 240m beyond runway strips for code number 3 or 4 Runway strips (field length more than 1200m)
3 Basically 240m for space and other development must be provided ahead of the runway.
4 If not an arrest or bed or other mitigating measures must be used.

1.1.2 TAXIWAY

As per ICAO
For code letter E runways
Minimum width-23m
For code letter F runways
Minimum width-25m
Width should not exceed 6om for F category Runway.

1.1.3 HANGAR AND APRON (To accommodate Airbus A380)

Length of an Airbus A380 aircraft-73m+7m clearance from both side=87m.
Wingspan of an Airbus A380=80m+7.5m clearance on both wings=95m.
Hence to accommodate 10 such aircrafts an area of 950mx87m will be required per bay. Bays are the areas in which aircrafts are parked.
Taking reference from Chattrapati Shivaji Maharaj international airport Mumbai
1million m² area is provided for each bay.

II METHODOLOGY

2.1 DESIGN OF RUNWAY

2.1.1 CALCULATIONS FOR RUNWAY.(ACTUAL RUNWAY LENGTH)

Data collected for 4F class of runway:
1. Runway length-2900m

2. Airport reference temperature-32 degree Celsius

3. Effective gradient-1.59for runway lengths greater than 2100m

4. Elevation -11m

Solution- 1.correction for elevation=7/100x2900x11/300
=7.44m
Therefore, length=2900+7.44
=2907.4m
2. Determination of standard atmospheric temperature at taken elevation
=15°-0.0065x11=14.92°c
3. Correction for temperature
In temperature=32-14.92=17.08°c
Correction=496.59m
Therefore corrected length=2907.4+496.59=3404.03m
4. Check for total correction for elevation plus temperature
=3404.03-2900/2900x100=17.38%
According to ICAO, this should not exceed 35%.
5. Correction for gradient=20/100x3404.03x0.15=102.12m
Therefore, corrected length=3404.03+102.12=3506.15m

2.1.2 TAXIWAY CALCULATIONS

Data collected:
1. Velocity= 80kmph (high turnoff speed by using a compound curve)

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2. Coefficient of friction=0.13
3. Runway width= 45m (For F class runways)

1. Radius of central curve
R2= /125f= //125x0.13=394m
2. Length of entrance curve= /45.5xCxR2= /45.5x0.39x394=73.23m
3. Deflection angle of entrance curve
D1=180XL1/πXR1=180X73.23/πX731=5.75m
4. Length of central curve
Deflection angle of central curve=D2=35°-5°45=29°15=29.25m
L2=πX394X29.25/180=201.14m
5. Stopping distance
S.D.= /25.5d= /25.5=250.98=251m
This distance is to be measured from edge of runway pavement along the exit OF taxiway.
6. Separation clearance:
Assuming a major airport installation with instrument landing facilities,
The separation clearance as per ICAO=198.70m
7. Available length of exit taxiway=198.7/sin30°-(45+25/2sin30)=327.4m

2.2 DESIGN OF RUNWAY PAVEMENT IN MARINE CLAY

The runway to be designed in marine clay faces many problems since the soil such as soft clay, silt, etc. is expansive soil which is weaker in nature. The soil of this type is subjected to periodic and continuous settlements which are undesirable to have as a pavement supporting soil. For avoiding such conditions which are likely to occur tests are conducted on soils such as triaxle compression tests, atterberg's limits, unconfined unconsolidated tests etc. to check the nature of soil and the degree of consolidation required

Various consolidation techniques for improving soil strengths are as follows
1. Blast furnace slag
2Preloading Method
3 Prefabricated Vertical drain
4 Sand Drain Method
5 Vacuum Method

III CONCLUSION

In this research paper planning of the basic components of an airport is been done. For this we have done the calculation for actual length of the runway, main taxiway and exit taxiway and the basic details of hangars have been dealt with. For these calculations the ICAO (International Civil Aviation Organization) specifications and standards are considered and referred by us. Since we are dealing with design of runway pavement in marine clays we have mainly concentrated on the runway class 4F which can accommodate an airbus A380 which is one of the largest aircraft exist. The design of the runway pavement in the marine clay will be conducted by us in the later part of the project for which we will be conducting several tests on the pavement material and the soil on which the runway would be resting. Test such as CBR (California Bearing Ratio) for determining the sub grade strengths of our desired runway pavement will be performed and the method for stabilization of expansive soil will be recommended by us by the detail study and the research.

The results to be obtained are as follows,
1) Solution for reducing air traffic in existing Mumbai International Airport
2) Use of lime cement for stabilization of marine clay
3) Increase in the UCS of soil.
4) CBR value is to be improved up to 80% – 85%
5) Decrease in void ratio of marine clay & plasticity index.

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