

construction debris activities, pertaining to runways, taxiways, aprons, roads etc, extraction of construction materials, loading unloading, transportation and storage of the same and plying of construction vehicles on unpaved portions of the site. Also the emissions from trucks, dozers, tippers and other construction equipment will have to be controlled. The sources of impacts and mitigated measures are addressed in the environmental management plan.

During the operation phase, it is expected that the ambient air quality will deteriorate marginally in the operations area on both on the ground and air side. The impact of ambient air quality will arise at take offs landing and movement of aircraft, ground support vehicles, and the movement of the commercial and private vehicles carrying passengers and cargo to and from the airport. The impacts particularly from the ground side vehicular movement would be felt as far as National Highway No17 which will be subjected to an increased intensity of traffic generated by the airport. However, it is not expected that there will be any significant adverse impact due to movement of aircraft in air.

12.5.9. Ambient Noise Levels

Since the proposed airport is located sufficiently far away from any human settlements and wild life, no impact due to noise during construction is anticipated. The mitigative measures would consist of protecting the workers themselves. Those are addressed in the environmental management plan.

12.5.10. Impact on Ecology

The site itself has only grass and shrubs with a few trees. The landscaping activities will involve planting and growing many times more trees than are cut. It is not likely that any wild fauna inhabits the site except for some varieties of toads, lizards, frogs etc. Only effect the construction of airport will have on the wildlife is that migration paths of same avifauna may be affected. A detailed study will be made at the time of preparation of detailed project report and schedules of construction designed accordingly. The Sahyadri Ghats do have a variety of wild life. The effect of noise on the wild life during operation phase of the airport in terms of noise during take offs and approaches will be studied at detailed project report stage. As suggested mitigative measures, specific procedures for approaches that result in noise exposure reduction as well as trajectories for departure that will direct departing aircraft to turn westward as soon as possible will allow to reduce effect at noise on fauna.

12.6. Environmental Management Plan

An Environmental Management Plan (EMP) has been recommended in this Section. This EMP takes into account all the environmental issues and the corresponding mitigation measures proposed in Section 12.4. The EMP presented below includes specific actions to be taken vis-à-vis site-specific issues.

The EMP has been delineated for two stages viz., Pre-construction and Construction stages of the project and is presented in Tables 12.5, 12.6 and 12.7.

Table 12.5

Mitigation Measures

The entitlement framework to the Project Affected Persons (PAPs) shall be in accordance to the Rehabilitation Action Plan (RAP) of the project. It shall be ensured that all Relief & Rehabilitation (R&R) activities be reasonably completed as per Rehabilitation Action Plan (RAP), before the reconstruction activity starts.

Trees falling within the construction limits which are to be removed before commencement of construction shall be identified and approved.

Table 12.6

Mitigation Measures

The unpaved roads and unpaved portions of site if used shall be sprinkled with water at least once in a day to control the fugitive dust emissions.

All vehicles delivering material to the site shall be covered to avoid material spillage.

Construction site where actual excavations / filling is in progress to be watered periodically to minimize fugitive dust generation.

It shall be ensured that the transport vehicles used to ferry materials and dispose debris do not create hazardous conditions for general traffic using the NH-17.

All earthwork and construction material should be stored in such a manner to minimize generation of dust and spillage on roads.

Idling of delivery trucks or other equipment should not be permitted during periods of unloading or when they are not in active use. This practice must be ensured especially near sensitive receptors like places of worship.

Environmental Issue

- Resettlement and rehabilitation

- Ecological impacts due to tree cutting

Environmental Issue

- Plying vehicles on unpaved roads

- Material spill

- Watering to control dust at site

- Roads used for transport

- Earthwork

- Idling of vehicles

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Table 12.7

<u>Environmental Issue</u>	<u>Mitigation Measures</u>
• Air quality impact	- Ambient air concentrations of various pollutants shall be monitored as per the pollution monitoring plan. - Current vehicle emission norms shall be enforced.

13. Appendix 1: Topographical survey

13.1. General

The Government of Goa proposes to set Goa International Airport on the Mopa Plateau in the Perrem Taluka of North Goa. The proposed land under acquisition is around 800 HA. As per the brief discussed detailed countour survey was carried out for carrying out Feasibility studies. Mopa Airport Cell, Department of Transport is the Nodal Agency on behalf of GOG has been entrusted with task of development of this land.

13.2. Award of Survey Work

Mopa Airport Cell, Department of Transport has identified 800.00 ha. of plateau land for development of Goa International Airport. For this purpose Topography survey and Geotechnical Investigations work is entrusted to M/s. Effective Architectural Services, Panaji GOA is awarded by the survey contract from Consultants.

13.3. Location of Site

The site is located on the Eastern side of the National Highway at Warkhand, Kasarvarne, Chandel, Mopa and Ugve villages 15 Km from the existing highway. The land is located on a major plateau location and the Table top main forms the area of survey.



13.4. Scope of Work

1. Establishment of reference bench mark through out the site and with respect to NH-17 Highway
2. Topography details of the entire area
3. Taking spot level at 10 x 10 m interval
4. Recording of TBM's used for the purpose of survey.
5. Submitting the topography and contour drawings

13.5. Mobilisation of Team

M/s. Effective Architectural Services mobilised all the key members of the team and equipment on 20.02.2005 to start the work. 1st stage work was completed on 10.03.2005. 2nd stage survey work for adjoining area started and completed on 18.03.2005

13.6. Equipment Deployed

1. TOTAL STATIONS

a)	Model	:	Lieca TC 407
	Accuracy	:	Angle 1"
	Range	:	Distance +/- 1 mm
b)	Model	:	2000m with Single Prism
	Accuracy	:	Sokkia Set3C
		:	Angle 2"
	Range	:	Distance +/- 1 mm
		:	1500m with Single Prism
2. AUTO LEVEL

	Model	:	Wild – Nak – 1
	Model	:	Carl Ziess CZ-OAI
3. PRISMATIC COMPASS

	Model	:	Lawrence & Mayo
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4. Hand Held GPS

		:	Garmin
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13.7. Methodology

- a) Traversing : Traversing was started from one side and closed at the same point with TOTAL STATION. All the traverse points were connected with Auto Level. From these traverse points spot level were taken for every 10 m x 10 m grid. As per ADPI requirement spot levels were taken at 50 m beyond the peripheral drop of the plateau which runs throughout the boundary.
- b) Flying of Levels : Leveling for the site was done by flying of levels from TS A-1 located near Dhangarwada. For this purpose leveling of TS station of the GTS survey was considered which is located at the North side Maharashtra Border. As per Transfer of Level from this TS, the R.L. of A-1 is + 172 m (GTS).
- c) Survey of Road : The reference points given by Directorate of Land Survey and Settlements obtained from SOI Bench Mark having an Elevation of +192M from MSL positioned on the Northern Boundary abutting the state of Maharashtra.
- d) Field Work: A base line and North South line (Magnetic North With Compass) was established considering the arbitrary coordinates as Easting 10000 and Northing as 5000 on the field approximately on highest elevation. The Electronic Total Station then mounted on traverse station indicated as A-1, after feeding the origin coordinates to the total station, proceeded for picking up spot levels, Nallah/stream centerline or bed of nallah, Road, Cart Track, well, Hutments trees, field bunds and any other isolated above ground detail. Before the Total station Survey double fly leveling was carried out using precise Auto Level instrument from GTS Bench Mark for varies locations in order to establish temporary Bench Marks for vertical control. Then during the total survey these benchmarks were crosschecked. Everyday, after the completion of day's field work, the data recorded in the Total Station will be downloaded in to computer with the help of Total Station software card reader. Then the downloaded information will be arranged and reconstructed in to excel format then these files will be saved and stored in *.CSV files. After saving the information in to *.CSV file then by using Auto plotter software and Lisp program *.CSV files were transferred to the Drawing software Auto Cad R14 version and the editing will be done. After downloading the information of the complete data, contours were drawn using Autoplottter Software. The after this editing work like detail text, text style and height etc complete.
- e) Drawings: The surveyed field charts were prepared on Auto Cad containing the survey details, names, descriptions, land mark description, contours, benchmarks and ground levels, contours at one meter interval were freeze on different layers. The entire area is presented in a standard sheet to the required scale.

13.8. Drawings

The final outcome of the survey is shown in following drawings. Out of these, drawing nos. under Cl. no.2.1, comply to the original scope of work as per work order.

Drg.no. EAS/AIR/CONT-DET/01: Drawing showing Road, Station Points & Dimensions Spot



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Levels on Site Contour Drawing at 1.0 m Contour Interval.

In this drawing all the topographical features are shown. The station points marked at various points of ground are also shown in this drawing. Traversing are starting from A-1 and A-2 marked on the North East side of Dhangarwada settlement near the unmetalled approach road. The value of S1 is considered as 5000 E., 10000 N. The plot is also divided into 100 m x 100 mm grid which is shown in this drawing. The purpose of these grids are to show average ground level and sections along the grid. In this drawing spot levels of site are shown at grids of 10 m x 10 m. As per clients requirement spot level beyond 10 m of peripheral drop is also shown. About 60% of boundary beyond peripheral drop is covered with dense bushes and shrubs. So it was difficult to take the spot levels in this part. From the spot levels contour drawing is generated with 1 m contour interval. Each contour level is assigned with different legends.

13.9. Salient features of topographic survey and related information

1	Lowest point level inside site area	:	139.00 m GTS
2	Highest point level inside site area	:	192.00 m GTS
3	Average level inside site area	:	2.85 m GTS
4	Total Area of site	:	957.21 Ha
	Total area of spot levels	:	742.26 Ha
9	High Tension Line :		
	No. of Lines on site	:	3 Settlements receiving Power Supply
10	Material of Strata	:	Hard Lateritic overburden with pockets of Murum (□ 1m) + Dark gray phyllitic clay.

13.10. Comments on survey conducted

The site is a plateau formation having undulations of on an average 15m over an general plateau level of 162m. There exists a valley having a Nallah on the Middle portion of the site. This Nallah is the major Depression on the site. The East West length of the plateau is about 4.6 kms and North South above the Valley is about 1.8 kms. There exist two settlement locations within the site one near TS A-1 is of about 10 Families and near the North a Settlement of about 3 Families.

13.11. List of drawings

Sl.No.	Drg. No.	Drawing Title
1.	EAS/AIR/CONT-DET/01 :	Topographical Drawing showing Road, Station Points and Dimensions.

14. Appendix 2: Preliminary Geotechnical & Material survey

14.1. Introduction

An investigation of site is essential for judging its suitability for the proposed engineering works and for preparing adequate and economic designs. Site investigation is equally necessary for analysing the safety of works, for selecting construction materials and for deciding upon the construction methods to be applied. In general, the purpose of a site investigation is to obtain necessary information about the soil and hydrological conditions at the site and to know the engineering properties of soil which will be affected. A timely and intelligently planned site investigation should be considered a pre-requisite for efficient, safe, economical design and construction.

The methods of site investigation are largely dependent upon the nature of the engineering project and the site. In general, any investigation should start with the collection and examination of the already existing data about the soil and geological conditions of the site. In many areas, the existing local knowledge, records of trial pits, bore holes, etc., in the vicinity, and the behaviour of existing structures, particularly if they are similar to the proposed ones, are very helpful. If the existing information is not sufficient or is inconclusive, the site should be explored in detail. The exploration should be preceded by site reconnaissance.

14.2. Site reconnaissance

On inspection of the site and study of topographical features is often helpful in getting useful information about the soil and ground water conditions and in deciding the future programme of exploration. On going over the site, a study of the following features were conducted : local topography, excavations, evidence of erosion or land slides, fills, water levels in wells and streams, and drainage pattern, etc. Site does not have any previous workings.

JOB:	Soil Investigation for Goa International Airport, Mopa Goa			
LOCATION:	In the villages of Mopa, Kasarvarne, Yarkhand and Chandel	BOUNDARIES		Peripheral expose of the plateau
VILLAGE:	As Above		North	Maharashtra state and Mopa RF
TALUKA:	Salcette		East	Chandel Village and RF
DISTRICT:	South Goa		South west	Kasarvarne RF
STATE:	Goa			Yarkhand, Khajane and KRC Track
TOPOGRAPHICAL DESCRIPTION:	Medium Level Undulating Forms on Plateau. General Strata Consists of Various Layer of Laterite rock Varying from Hard to Soft formations.			
VEGETATIVE COVER:	Nil, Except Seasonal Grass Cover.			
LOCAL TOPOGRAPHY:	Site is Generally sloping into 3 streams as shown in site plan. The site is at an intersection of two Geological areas. Small Hillock to an Elevation of Approx. 20M Above the average plateau level is in the middle of the site. Towards South East of Site. Towards the South western Side of the Site there exists a Natural Nallah having Slope in West /South direction.			
EXCAVATIONS:	No Excavations present site, Except for couple of trial pits mainly in the central area of the site. There are expose of laterite formed on the slope intersecting with the streams.			
CUTTINGS:	NA			
QUARRIES:	There exist some Metagrawacke quarries on the East and the South east peripheries of the site			
EVIDENCE OF EROSION / LANDSLIDES:	Slight Evidence of Erosion of Top Rock Cover On Nallah running Centre to South west and West ward flowing nallah on the Site			
WATER LEVELS:	NA			
a) WELLS	NA			
b) STREAMS	There exists two perineal streams on the East side towards Chandel and the other on the South west side at Nanachepani and towards Yarkhand.			
c) FLOOD MARKS	NA			
DRAINAGE PATTERN:	As Shown on Plan Attached Herewith			

14.3. Investigation report

14.3.1. Introduction:

An Airport is planned to be setup and the above mentioned site for which feasibility studies are carried out. In order to conduct feasibility studies a preliminary soil investigation of the above site is conducted.

In order to get adequate data, regarding the sub soil conditions at site, required for the design and construction of proposed Airport, Soil exploration programme comprising of Rotary Drilling and the associated field tests was taken up.

These investigations were made to establish the stratigraphy at site and to determine the physical and engineering properties of soil at critical depths.

14.3.2. Scope of works :

1. Sinking four bore holes through soil / rock up to eight metres depth.
2. Conducting field investigations such as Standard Penetration Tests.
3. Excavation of four nostril pits.
4. Preparing a report, furnishing all test data, along with discussions and recommendations for foundations for construction of proposed Industry.

14.3.3. Field investigation :

The investigation is being carried out at the proposed site for the Goa International Airport. Four bore holes have been drilled at the specified locations in proposed site plot at Mopa GOA area where the proposed airport is to be established were drilled up to about eight meter depth and terminated.

Each bore hole was drilled and terminated at specified depths mentioned below :

Bore Hole No.	Location	Termination Depth Below GL (m)
B 1.	2 nd Left on Runway	7.70
B 2.	4 th Left on Runway	7.54
B 3.	1 st Left on Parallel Taxiway	7.80
B 4.	Upper left of Terminal Building	7.60
B 5	Left side of Runway	7.90
B 6	Center of Parallel Taxiway	7.70
B 7	Right side of Parallel Taxiway	7.60

Four trial pits were dug to verify immediate Strata and Rock Qualities. The Top Layer of Rock indicates well formed rock of Medium hard Density.

Trial Pit No.	Location	Remarks
TP1	1 st Left on Main Runway	Medium Hard without any major faults
TP2	2 nd Left on Main Runway	-Do-
TP3	5 th Left on Main Runway	Medium Hard without any major faults
TP4	Lower bottom of Terminal	-Do-

14.3.3.1. Standard penetration tests

Standard penetration tests were conducted at various depths of bore holes as per relevant I.S. code. The test was conducted using standard split spoon sampler and number of blows were counted. The respective 'N' values are presented in the bore log sheets attached. As per the I.S. code 2131, if the penetration was found to be less than 2.5cms per 50 blows, the 'N' value have been reported as > 100. Standard corrections to the 'N' value have been applied as required.

14.3.3.2. Water table

Water table was not encountered in this area upto the depth of termination of bore hole.

14.3.3.3. Sampling

Disturbed and undisturbed samples were collected during the boring operation, for laboratory testing. Rock core samples were collected during the boring operation. Since the rock / boulders were of the vesicular and jointed nature, full length cores could not be obtained in spite of the fact that double barrel type of sampler was used. The percentage recoveries are indicated in the bore log sheets attached.

14.3.4. Laboratory testing

All the laboratory tests were carried out as per relevant I.S. codes. The undisturbed and representative samples were collected, labeled and sent for laboratory testing. The following specified laboratory tests, as appropriate for the type of soil and the samples, were conducted.

- A. Dry density test.
- B. Rock compression test.
- C. Porosity test

14.6.1. Type and depth of foundation :

The depth of foundation is recommended at 1.0 m. depth below the ground level. Open foundations in the form of isolated footings or strip footing are recommended.

14.6.2. Safe Bearing Capacity

The safe bearing capacity is recommended as 33.3 ton/sq.m.

14.6.3. Important General Recommendations

The allowable bearing pressure value is based on the strata anticipated to be encountered. It is recommended that after actual excavation for foundation, the stratum at the foundation level be inspected and if weak pockets or seams are observed, the loose or weak material should be removed and replaced by lean concrete.

LABORATORY TEST RESULTS (Rock Core)

Sample No.	UD1/1 1.5 m	UD1/2 2.0 m	UD1/3 1.0 m	UD1/4 1.0 m	UD1/5 2.7m	UD1/6 2.74m	UD1/7 2.5m
Unconfined comp. Strength Kg/cm ²	50.9	56.6	56.0	56.6	42.6	42.1	44.5

Porosity of Rock %	23	21	23	21	28	30	31
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Dry density	2.76	2.76	2.78	2.78	2.62	2.61	2.55
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14.7. Bulk Construction materials

The availability of bulk construction materials for construction is as follows :

There are three quarries located within and closed to the Airport boundary. These quarries will be able to supply weathered rocks (mumum) and soil for filling material.

Sand is available in adequate quantities and proper quality at Colvale River above 4 K.M. from site.

There are manganese mines in operation within 20-40 Kms. Mining soils in the form of weather rock soil and boulders are available in unlimited quantities free of charge.

14.4. General description of strata:

It is based on the data obtained from the four bore holes at specified locations, commenced at respective ground levels and terminated at about 8 meter from the ground level.

(A) Soft to medium hard lateritic rock :

The lateritic rock is jointed and vesicular (with pores). The vesicles are filled up with soft lateritic soil or limonitic (light yellow) or phyllitic / white yellowish or pink) clay. At some places, the rock is found to contain seams filled up with lateritic soil. Although the parent lateritic rock material can be identified as medium hard to hard, the overall formation of this stratum is soft or soft to medium hard, due to presence of vesicles, joints and thin seams.

This stratum is comparatively better for laying foundations. This layer was encountered upto 2.74m in bore hole 1, 2.00m in bore hole 2, 3.00m in bore hole 3 and 2.5m in bore hole 4.

(B) Soft lateritic rock / boulders :

This layer was encountered below the soft to medium hard lateritic rock layer and continued up to the depth of termination of bore holes. This soft rock is highly vesicular and jointed. The core recovery was comparatively very less in this layer which is weaker in comparison with the one above.

High 'N' value appears to be because of presence of boulders and is not truly representative of overall strata.

14.5. Special field observations

1. Except for general vesicular and jointed nature of rock, no other features were observed.
2. Core recovery and 'N' values have been reported in Bore log sheets.
3. Clay layer/s not encountered.
4. No water table was encountered (however possible inundation and saturation has been considered).

14.6. Recommendations

The recommendations are based on soil investigation carried out by boring at four specified locations. The major portion consists of lateritic rock in the form of jointed vascular rock stratum near ground surface can be considered as a satisfactory founding material. Due to presence of soft lateritic rock stratum at lower levels, it has become necessary to recommend that foundation may not be taken deeper than 1.6 m.

Safe bearing capacity is recommended based on crushing strength of rock core and SPT values.

Fig 14.1: Location of boreholes

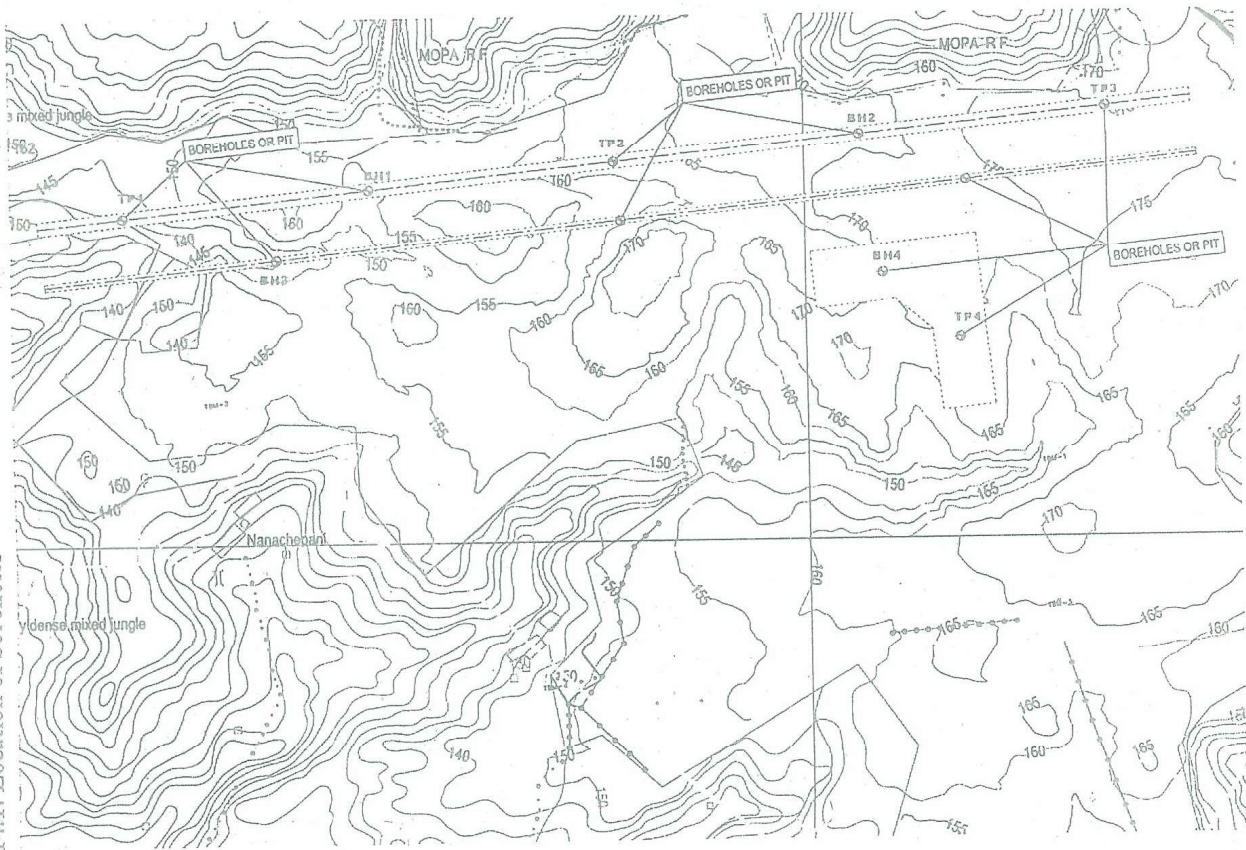
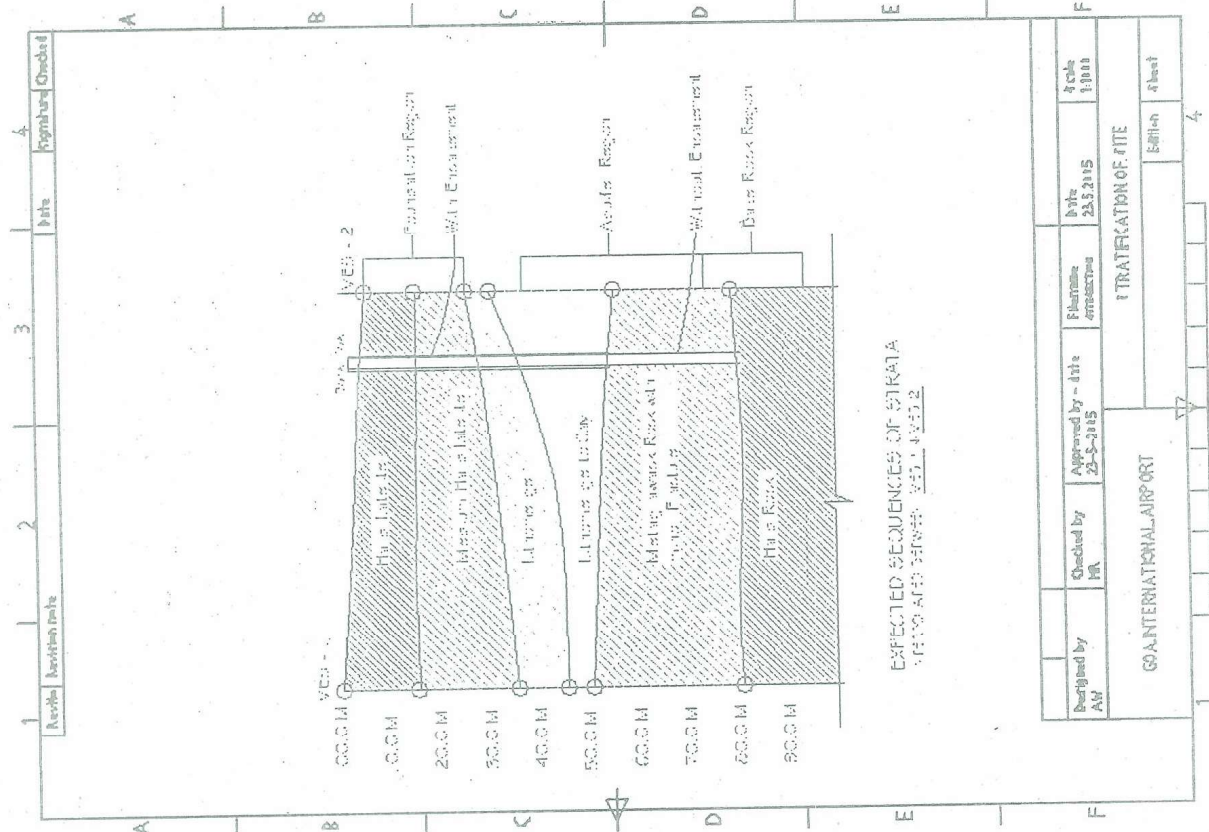


Fig 14.2: Expected sequence of strata.



15. Appendix 3: Runway and Taxiway Longitudinal Profiles

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