

A Study on the Master Planning in Airports

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Abstract—Airport provides a medium that helps people travel across countries and continents overcoming the geographical barriers and by providing a platform for economic opportunities and business enhancements. Over the past few decades, the airports have been drastically transformed to multi-platform zone that promotes to the economy of the country through tourism and by supporting the local citizens' business ventures. Airport Engineering deals with creative development of airport designs, planning and building and refurbishing of terminals, runways and navigational aids to provide the passengers a platform to explore. This literature is a comprehensive view of airport market planning and a sample standard designed airport master plan is laid out. Along with the technological advancements the proposed ideas are made assessing its environmental impacts. Airports connects people to countless parts of the world therefore it is necessary that the airports are designed to be convenient, environment friendly and adaptable to the evolving demands.

I. INTRODUCTION

Airport Planning has become a key aspect to make sure the Airport pick the right pace with the sudden transformation in this fast moving world. According to FAA, Airport Master Plan refers to "The goal of a master plan is to provide guidelines for future airport development which will satisfy aviation demand in a financially feasible manner, while at the same time resolving the aviation, environmental and socio-economic issues existing in the community." Finance is one of the main constraint when it comes to remodeling the infrastructure of the airport and another obstacle that is faced while these changes are happening is time as these changes do not happen overnight. The Airport Master Plan (AMP) is a layout of the necessary improvements and developments required in order to expand the possible horizons of the airport. The main agenda of the Airport Master Plan is to provide a protocol that guides the expansion of the airport to meet the essential and advanced changes in the aviation sector in the most viable and profitable means and also to improve the socioeconomic and environmental status of the region. The AMP portrays the ideas through a visual representation in the Airport Layout Plan (ALP) drawing set and communicate data and logic. The modelling for the Airport Master Plan are usually done using Computer Aided Software where the further editing and modification could be done mainly AutoCAD. All the explanatory contents like the model, graphical representation, excel sheets, AutoCAD models, GIS data in the software are included in the format specified such as Microsoft word, Excel, AutoCAD, FoxPro etc. The CD-ROM is considered the most viable and most

prioritized for containing deliverable media for integrating information and media. This specification must be considered in all scopes of work at the completion of individual projects, the updates to ALP drawing can be finished without making changes to the Airport Master Plan

II. PURPOSE OF AIRPORT MASTER PLAN

The purpose of Airport Master Plan is to deliver the Government and supervising bodies an overview of how the Airport would look like after refurbishing and to show what it has to offer for the next 20 years and beyond and all the changes that could be accommodated within the locality and most importantly how all these changes could be beneficial for them since it is finance is the main constraint.

One of the key purpose of the Airport Master Plan is to update the previous existing Master Plan according to the latest advances in technology in the field of aviation and construction. Then after deciding on the Master Plan, based on the land and space available, must decide on the development options for the airport such as automated check-in, automated security check, etc. To create an Airport Layout Plan that will help compare between the current and future airport conditions.

III. AIRPORT DATA SHEET

Federal Aviation Administration (FAA) dictates the specification and also provides how the data must be submitted in order to guide them through the security important information to the National Geodetic Survey (NGS) for corroboration and authentication. These were specified in AC 150/5300-18 General Guidance and Specifications for Proposal of Aeronautical Surveys to NGS: Field Data Collection and Geographic Information System (GIS) Standard.

The Airport Master Plan were finalized once the specification provided by the FAA is satisfied. These regulations are provided under the FAA Advisory Circular Airport Design.

The Airport Data Sheet generally contains simple Airport data and detailed versions of runway, taxiway and instrument approach system data. This data will contain the Airport Reference Code that can detect the aircrafts that are likely to operate at the Airport and ensure that it meets appropriate design standards.

The main Airport Master Plan components are as follows:

- *Inventory*

This will contain all the complete list of work that took place and the items that were included such as raw material, stocks, part of the contents of building for construction, etc. The airport inventory and data collection task is a critical element of the Airport System Plan (ASP) since the data collected will not only be used to support this airport system plan, but will also help Aeronautics Division to easily identify, document, and understand its current and planned airport system assets. Specifically, the inventory survey effort conducted as part of the ASP will entail the collection of all relevant airport data through research of existing databases, personal interviews, and visits to each of Massachusetts public use airports. Data to be collected generally encompasses the following:

- General airport information
 - Airside facilities
 - Landside facilities
 - Environmental considerations
 - Airport operational and service levels
 - Airport outreach and education
 - Local airport related business activities
 - Airport pavement conditions
- *Aviation Activity Forecasts*

Aviation Activity Forecasts analyzes the present and impending airport motion of the Airport. Estimating offers an airport with an over-all idea of the magnitude of development, as well as variations in activity expected over the estimate period. They support the Airport in shaping current and strategic imminent facility requirements based on airport activity level approximations and forecasts. Forecasts try to improve a realistic approximation of coming variations.

Forecast schemes are grounded on a “snapshot” of a prevailing aviation trends and socio economic climate. As such, forecasting inclines to be a vibrant constituent of airport master planning. When conditions change intensely, forecasts should be revised and modernized accordingly to mirror the improved environment.

- *Demand or Capacity assessment*

Demand or Capacity assessment compares the projected demand and the existing capacity for the major elements of the Airport and establishes the facility requirements needed to bridge the gap between the existing capacity and future demand over the planning period.

The demand/capacity analysis helps determine the timing and degree to which additional or extended services will be required throughout the preparation period. It is substantial to note that when and how the Airport’s facility needs are addressed is a matter of Airport policy, and is contingent upon environmental and financial justification.

- *Facility Requirements Airport alternatives and development plan*

The Airport Facility Requirements are determined based on two different categories, namely: landside and airside. Facilities under landsides are Fixed Base Operator facilities, Aircraft Fueling, Aircraft Parking Apron, Surface access, Hangars, and automobile parking, and other services. While airside facilities include lighting systems, navigational aids, runways and taxiways.

The Facility Requirements assessment is used to classify the competence and insufficiency of present airport amenities and recognize what new services may be desirable during the preparation period based on forecast request. Probable opinions and initial costs for providing these facilities will be estimated in the Airport Development Replacements, to regulate the most cost effective and efficient means for meeting predictable facility needs.

By the end of development plan, the Airport authorities must ensure that full improvements to the Airport must be done as per mentioned in the Airport Layout Plan as well as there is phased development as per ALP and even relocate the airport if necessary.

- *Airport alternatives and development plan*

The purpose to develop alternatives and development plan is to advance a match of airport amenities which can convincingly incorporate the requirements levied on it. The master planning development is one of critical and necessary facility of the airport to carry out the forecast requirements. After capability necessities have been decided, a sequences of substitute resolutions to content them needs to be recognized and verified. Substitutes to be well-thought-out will involve replacements for giving supplementary runway length for the main runway; choices for the landside expansion chances; crosswind runway; and air cargo, general aviation, and airline terminal area expansion plans. There is no requirement for inspection or licensing (14-60.007, F.A.C.), the airport just needs to be revised for site sanction and register with FDOT.

- *Airport layout plan*

Airport Layout Plan depicts the existing and anticipated improvement for the 20 year expansion of the airport diagram based on the airport facilities in the form of a diagram. Although a descriptive portrayal of the airport location is an essential portion of an airport master plan catalogue, a graphical depiction is also obligatory.

The airport layout plan is an explicit demonstration to measure of prevailing and planned airport services and their sites, land uses, and the appropriate approval and parametric data necessary to display conformation with pertinent criteria. It displays the airport locality, approach areas, clear zones, and other ecological structures that influences impact airport procedure and extension competences.

The airport layout plan likewise recognizes services that are no more required and defines a proposal for their elimination.

Some areas can be hired, traded or else castoff for profitable and manufacturing resolutions. The proposal is constantly efficient with all variations in land possessions lines; airfield arrangement including taxiways, aircraft parking apron size, runways and location; constructions; cargo areas; navigational utilities; auto parking; blockades; and departure ways. The airport layout plan sketch contains the subsequent articles: basic data table, the airport layout, location map, vicinity map, and wind information.

The airport layout is the major share of the sketch. It shows the prevailing and eventual airport expansion and land usages illustrated to measure and contains as a least of the following information:

- Major airport services like taxiways, blast pads, runways, extended runway safety areas, aprons, constructions, parking expanses, roads, NAVAIDs, lighting, pipelines, fences, main drainage facilities, runway marking, wind pointers, segmented circle, and beacons.
- Major natural and manufactured features such as streams, plants, a ponds, rock outcrops, ditches, railroads, power lines, and towers.
- Summary of revenue-producing non-aviation-related assets, extra or else, with present status and use stated.
- Regions set aside for prevailing and forthcoming aviation expansion and amenities like for overall aviation fixed-base operations, airport maintenance, heliports, and cargo facilities, etc.
- Regions preserved for non-aviation expansion, like motels, manufacturing regions, and likewise

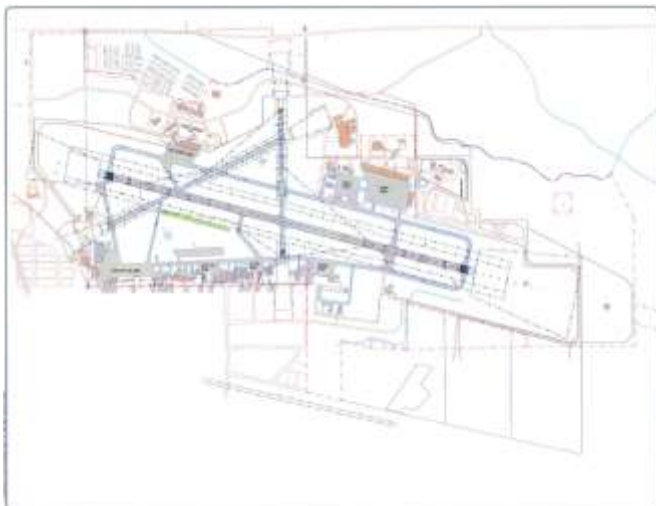


Fig. Airport Layout Plan of Helena Regional Airport.

- *Financial plan*

Airport Finance Plan is basically the revenue of the airport and how much the expense for the airport is every day and

how much it has to spend during renovation. Basically revenues are generated to clear airport's expenses.

In airport, there are two types of expenses which are:

1. *Capital improvement expenditures*

- Investment enhancement expenditures contain costs of main building schemes such as airfield & terminal development.

2. *Operation and Maintenance (O&M) costs*

- These costs contain expenses for unvarying basis & are essential to uphold the present maneuvers at the airport.
- For example: income of airport personnel, costs of services such as power (electricity), water & broadcastings.

Airport income is income that an airport obtains from its business accomplishments. Airports revenue maintenances airports expenditures & delivers for the actions, conservation, and investment enhancements. Airports produce income from its commercial happenings that have been classified into two classes:

- Aeronautical revenue is that from aviation events which trade with aircraft operations is. For example, fees aerobridge charges (paid by airlines) and lighting aircraft parking fees, and landing
- Non-aeronautical revenue is created from non-aircraft linked commercial happenings in the terminal building. For example, concessions, parking, rental car facilities, and advertising.

- *Public Involvement*

Public Involvement of the airport is mainly to help improve the connection between the Airport and the public. There is a Public Involvement Program (PIP) functions to define the public process in Master Plan update. The PIP was established with input from investors and the public proceeding to being concluded. We interconnected to the community how input from all investors shaped the conclusion of the resulting plan.

Public Involvement of Airports are considered based on the ongoing meeting between the county staff and airport staffs. Other meetings include meetings with:

- ▶ Stakeholder meetings
- ▶ Advisory committee meeting
- ▶ Public meeting
- ▶ Advisory committee meeting
- ▶ Board workshop
- ▶ Board action

The final board action are usually implemented by the end of that year, which is, around December or beginning of the next year in January.

- *Environmental overview*

Airport Development must also ensure that they meet all the environmental factors to make sure there are minimal effects on the environment. According to FAA, this is to ensure Airports follows National Environmental Policy Act and some Federal environmental regulations and principles.

This environmental outline was directed in accordance with FAA Order 5050.4B NEPA Executing Directions for Airport Actions, FAA Order 1050.1E and the FAA's Environmental Desk Reference for Airport Actions, which necessitates the analysis of the following environmental impression categories prior to project execution:

- Air Quality
- Biotic Resources/Federally listed Endangered and Threatened species
- Coastal Barriers/Coastal Zone Resources
- Compatible Land Use
- Construction Impacts
- Farmlands
- Floodplains
- Hazardous Materials
- Historical and Archeological Resources
- Light Emissions and Visual Impacts
- Noise
- Social Impacts
- Environmental Justice
- Solid Waste
- Water Quality
- Wetlands
- Wild and Scenic Rivers
- Induced Socioeconomic/Cumulative Impacts
- Energy Supplies, Natural Resources, and Sustainable Design

IV. AIRPORT MASTER PLAN FOR THE DESIGNED AIRPORT

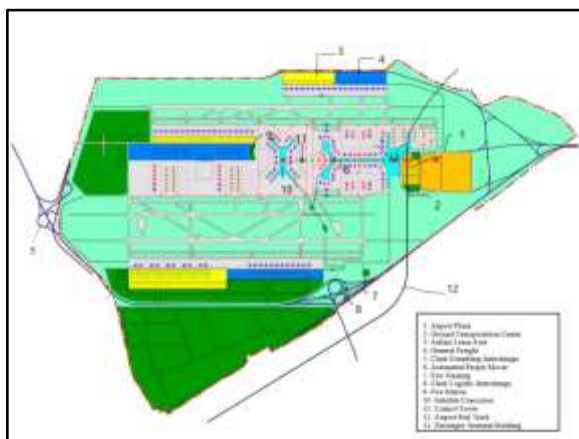


Fig. Airport Master Plan of Diosdado Macapagal International Airport (DMIA)

The picture above is the Airport MasterPlan of **Diosdado Macapagal International Airport (DMIA)** in Philippines. This is the perfect example of an Airport that was built around 20 years back and have undergone renovation and still successfully working and giving the passengers a good time.

In the Master Plan above the region shaded in gray depicts the portions where aircrafts operate and parked such as Airport Apron, Runway, Taxiway, etc. Upon completion of refurbishment, the runway length will be prolonged to 4 km so that the innovative advanced wide bodied aircrafts could be accommodated. The region shaded with blue depicts the terminal building. So far, there are only 2 terminal buildings but after the renovation they are expected to add 2 more terminal buildings which will see around 110 million passengers travel annually.

A. General

The airport had been established from an old United States Clark Airbase, that had been shut down in 1991 subsequent the explosion of Mount Pinatubo. After cleaning up remains and lava, the CSEZ was opened with DMIA airport in the middle. This international airport structures indistinguishable, parallel runways 02R/20L and 02L/20R, which are both 10,500ft-long concrete, and acknowledge the major commercial aircraft. The airport is situated 85km north west of the capital Manila, and is frequently used for business travel to and from the city.

B. Major Role of the airport

DMIA encompass several thousand acres. It has the same purposes and setup as a modern city with all developments and opportuneness to access assets easily for the passengers. Provide essential public amenities

Operating resources in the tens to hundreds of million dollars. Capital projects accounting for many millions or billions of dollars. Hundreds of tenants and concessionaires are involved in aeronautical and universal business producing revenues. Among the major public conveniences, DMIA play noteworthy roles in shaping economic of the societies they serve. Thus, airport management should responsible for leading DMIA definitely contributing to the local economy while minimizing the influences of airport to the environments.

C. Runway Approach Surface Profile Drawing

The Profile drawing is used to depict the design plan and the whole system and structure of the runway approach that has been based on FAR part 77. It also gives us a much clarified image of the extended ground lines that are constructed using composite alone. A significant number of hindrance and clearances are also shown using the railroads in the drawing.

D. Inner Portion of the Approach Surface Drawings

The inside portions of Approach Surface Drawing majorly consists of the following for every initiated runway:

- scaled down depictions of runway safety area
- Obstacle free zone
- Obstacle free area
- Runway protection zone

The complete design plan and the planned profile view of all the prominent runway protection zone are shown to distinguish any hindrances and impediments that might be reflected on safety .since it is absolutely essential to discover and remove these obstacles in order to ensure the safety, a meticulous and coherent facility data information is also depicted along with it.

On-Airport Land Use Drawing – It primarily illustrates the land use commendations explicitly. When the times comes for the land use of the required design it must be carried out according to the prerequisite land use area that has been given in detail in this plan

Property Map - It consists mainly of accurate parameter and specifications of the land that is owned and is an interface to mapping all the land regions that is under the league of the airport. It also contains the already existing land that in under the control of the airport as well as the future properties.

- **Runway Transitional Surface:** The runway transitional surfaces are the ones that extend outward and skyward at perpendicular to the center line of all runways. The transitional surfaces have a slope in the ratio of 7:1. The Runway transitional surface has an elevation of 46 m above airport’s field elevation and joins to the runway horizontal surface. This surface is necessary for precision instrument approach surfaces.
- **Horizontal Surface:** An oval is formed by connecting the two ends of the primary surface from which a radii of 3048 m is drawn, that is the level surface. This horizontal surface is constructed as a smooth plane on top of the airfield with a slope of 46 m .The major hindrances spotted are trees and present off the property of the airport.

E. Runways described in the Layout

The runway length obligatory is centered on criteria existing in FAA AC 150/5300-13, Airport Design, Chapter 3 and FAA AC 150/5325-4A, Runway Length Necessities for Airport Project. The suggested length for a main runway at an airport is decided by bearing in mind either the clan of aircrafts having comparable presentation features, or a precise airplane necessitating the lengthiest runway. This requirement is based on the airplane or clan of airplanes that use the airfield on an unvarying basis, where consistent basis is classically

demarcated as a least 500 itinerant tasks per year. Further features deliberated contain major airplane approach velocity, its extreme certificated takeoff weight, length of drag, and useful load, the airfield raise above sea level, the average day-to-day extreme temperature at the airport field, and characteristic runway surface conditions, such as slippery and wet. The runway length examination for UUU was attained using FAA Airport Design Computer Program 4.2D and procedures outlined in FAA AC 150/5300-13. The platform contains an aircraft fleet profile intended to be illustrative of the small and large aircraft that encompass the over-all aviation aircraft fleet.

The CIA has two 4 km runways. Runway 02R/20L is 3,200 m long and 61 m wide, while runway 02L/20R is of the same length but 45 m wide.

Category 1 comes under the primary runway, assessment for accuracy approach and is armed with navigational aids and lighting amenities. The secondary runway was decommissioned because it was not fully armed and not acquiescent with Visual Flight Regulations

Airfield Component	B-II Dimensional Standards	Existing Condition	Meets Standard
Runway Width - 16/34 - 04/22	75' 75'	75' 75'	Yes Yes
Runway Centerline to: - 04/22 to Taxiway A - 04/22 to Taxiway C - 16/34 to Aircraft Parking Apron	240' 240' 250'	250' 250' 250'	Yes Yes Yes
Taxiway Width - Taxiway A - Taxiway B - Taxiway C	35' 35' 35'	40' 40' 40'	Yes Yes Yes

Source: FAA AC 150/5300-13 Airport Design and Consultant Calculations

Table: Runway and Taxiway Specification.

F. Taxiways described in the Layout

The Airport was labelled a B-II in previous development so much of the infrastructure has been developed and built to encounter B-II standards. The current runway and taxiway building and departure necessities happen or surpass the mandatory standards. Forthcoming pavement reintegration schemes and/or new construction will be built to the mandatory standards.

Airfield Component	Rehabilitated	Comments
Runway 4/22	1990	Good Condition except for intersection of runways ³
Runway 16/34	NA	Fair Condition – Frost Heaves on R/W 16 winter 2006
Runway Intersection	NA	Fair Condition – When rebuilding consideration must be given to minimize the airport closure time.
Taxiway A	2000	Good Condition – Consider realignment
Taxiway B	NA	Good Condition
Taxiway C	2007	Good Condition (Project under construction)

Table: Runway and Taxiway Condition.

G. Terminal Area For commercial purpose

At the Conventional hangar the GA terminal is built towards the north side. The terminal area includes roughly 3,500 sq. ft. This region holds the office space of all other businesses and Landmark Aviation sited by DMIA. An innovative method will be required at one point after the development period. The Region for possible expansion/improvement will be recognized in the replacements analysis. The FAA has come up with new methods of approximating general aviation terminal necessities. The method found in Airport Design gives the crowning period action to the scope of practical regions contained by the building.

H. Hangars described in the layout.

Hangar space necessities are mainly based on the decision made by the aircraft proprietor's inclination to contain their airplane. Further necessities are grounded on the category of airplanes and number of based aircraft. Typically bigger and relatively costlier airplanes are stored in the Hangar. Currently, has only two conventional type hangars. Presently there are two t-hangars are in airport. The following are the two types of hangars:

- Traditional hangar (approximately 8,500 sq.ft.) which is located at the western side of the airport; and
- Hangar mainly meant for short-term purposes (approximately 1,400 sq.ft.) located to the south of the traditional hangar.

I. Changes after Renovation

In the final phases, new Terminal building will be added which could handle up to 8 million passengers a year. The services will then be capable to take an annual total of 110 million travelers. These ideas will possibly lead to the airport becoming a chief hub in Asia. The plans will also include recreational facilities keeping the passengers' satisfaction in mind. Business lounges will have spa facilities, restaurants for dining and relaxation.

J. Suggestions for development

- Solar panels can be installed to reduce power consumption
- Automated Check-in
- Automated customs clearance
- Increase the runway area to accommodate bigger aircrafts
- Installation of Electronic gates to avoid the hassle
- Install noise abatement zones
- Afforestation around the airport premises
- Business lounges and spa facilities can be inbuilt in the airport

-Boutiques and Gaming centers can be opened to spend some leisure time

V. CONCLUSION

Airports are now the primary component for urbanization as it has become an integral part of economic well-being. Airports provide an enormous range of useful networks to accommodate the wide range of aeronautical as well as non-aeronautical progresses across the functional requirements and economic opportunities. Airports have structural growth projects and surveys planned to align funds with requirements and the measurements taken to provide the service for customer satisfaction. This industry has a direct and indirect influence on the nation's economy and development in terms of job opportunities and business ventures.

The future expansion, set-up and upkeep of utilities missions shall be sustained by the unceasing enhancement route in quality management design, concentrated on unified and collective agenda for organizing, improvement and conservation of structural properties is done in accordance with the strategic track of the organization.

In this study methods have been suggested for phase 3 improvement of DMIA airport which is due after phase 2 renovation, i.e., by 2025. These suggested methods could help in delivering passengers keeping their security, safety as the prior concern and airport experiences met. Apart from that while these suggestions were made their impact on the nature was calculated and the best possible methods were proposed that promotes the environmental sustainability and safety.

EXTERNAL LINKS USED

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