



RGS WG/5-PPT/4

Sudan Civil Aviation Authority  
Aviation Safety Department – Aerodromes standards & safety Directorate

# Airport Planning and Terminal Design

Presented By Sudan

# Reference



❖ RGS/W4

## AGENDA ITEM 3

Implementation of Aerodrome Safety Priorities and objectives in the MID Region conclusion 4/6 Regarding Airport Master Planning.

❖ Airport Manual (Doc. 9184.Part 1).

# Outline



- ❑ **An overview of Airport Master Planning based on ICAO planning guidelines.**
- ❑ **What an airport master plan entail.**
- ❑ **Emphasis on concepts and considerations from the executives' perspective.**

# Definition of Airport Master Plan



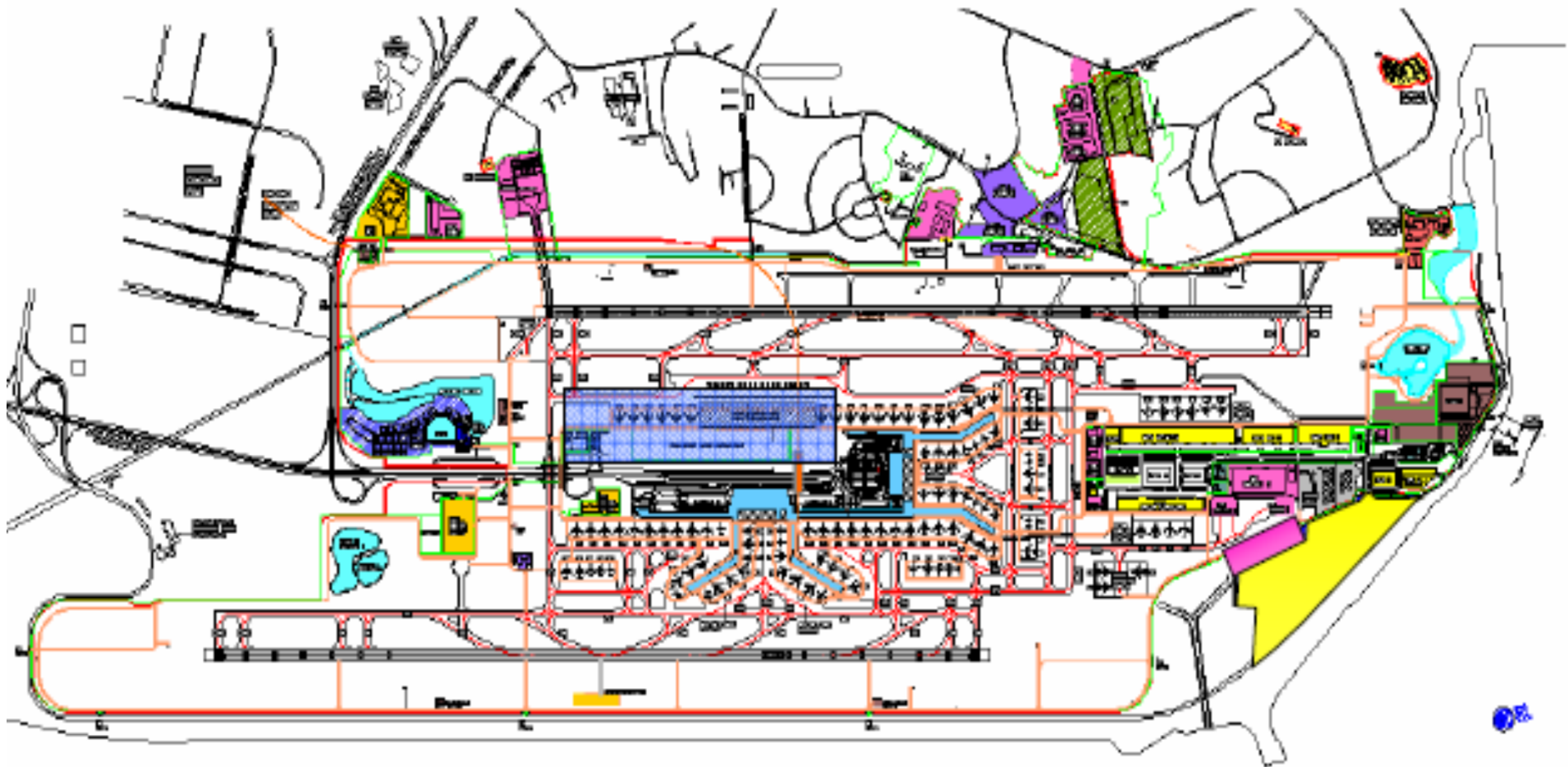
- ❑ Concept of the ultimate development of a specific airport, graphically presented with written report to effectively convey the research and logic from which the plan was evolved (ICAO Manual).
- ❑ Long-term development concept of an airport; an embodiment of the airport's strategic framework and concept depicted graphically and documents the data and logic upon which the plan is based.
- ❑ Guidelines for future airport development to satisfy aviation demands in a financially feasible manner, while addressing aviation, environmental and socioeconomic issues in the local community.

# Airport Master Plan



- ✓ Establishing short and long range policy/decision.
- ✓ Developing physical facilities of an airport – aviation non-aviation.
- ✓ Developing land uses surrounding airport.
- ✓ Determining environmental effects of airport construction and operation.
- ✓ Establishing access requirements of the airport.
- ✓ Identifying potential problems as well as opportunities.
- ✓ Securing financial aid.
- ✓ Establishing basis for negotiations of interests and needs among aerodrome authority, businesses and community.

# Changi Airport Master Plan



# Stakeholders of Airport Master Plan



- ❖ Airports are multi-faceted facilities, impacting a wide spectrum of people and businesses
- ❖ Need for consultation and coordination of planning with stakeholders concerned :
  - Airlines.
  - National and local government planners .
  - Government control authorities (immigration, customs, health).
  - National and local transport authorities.
  - Aircraft and equipment manufacturers.
  - International aviation agencies and businesses.
  - Concessionaires.
  - Local business and residential communities.

# Airport Master Planning Philosophy



- ❖ A *good* Airport Master Plan represents the most efficient framework with flexibility, expandability and optimum balance of all individual airport facilities/services to provide the required capacity for aircraft, pax, cargo and vehicular movements with max facilitation for pax, operator and staff at lowest capital and operating costs and max revenue.
- ❖ Generates higher capacity and efficiency through a series of compromises than would otherwise be attained without reconciliation of individual facilities plans.



# Airport Master Planning Philosophy Cont.



**IN ALL CASES, COMPROMISES  
DO NOT AFFECT SAFETY**

# Airport Master Planning Process



- ❖ Involves preparation of broad and specific policies, plans and programs.
- ❖ Goals of Planning process to:
  - Orderly and timely develop airport to meet present and future air transportation needs.
  - Coordinate local, regional and national plans.
  - Protect and enhance environment (noise, pollution).
  - Establish effective airport organisation for implementation.
  - Ensure compatibility with state/country aviation, ICAO and IATA standards.

# Airport Master Planning Process Cont.



- Coordinate national and regional airport systems.
- Coordinate plans for nav. facilities, airspace and air traffic control procedures.
- Optimize use of land and airspace resources .

## ❖ Policy/Coordinative Planning

- Project goals, objectives.
- Develop work programmes, schedules and budgets.
- Prepare and evaluation and decision format.
- Establish coordination and monitoring procedures.
- Establish data management and public information system.

# Airport Master Planning Process Cont.



## ❖ Economic Planning

- Prepare analysis of aviation market characteristics and forecasts of aviation activity.
- Determine representative benefits and costs associated with airport development alternatives.
- Prepare an assessment of impact on area economy of various alternatives.

# Airport Master Planning Process Cont.



- **Physical Planning**
  - Airspace and air traffic control provisions.
  - Airfield configuration (including approach zones).
  - Terminal complex.
  - Circulation, utility and communications networks.
  - Support and service facilities.
  - Ground access systems.
  - Over-all land use patterns.

# Airport Master Planning Process Cont.



- **Environmental Planning**
  - Prepare an assessment of natural environmental conditions associated with the airport “impact” area (plant and animal life, climate, topography and natural resources, etc).
  - Document present and projected development patterns of relevance to the impact area.
  - Determine community attitudes and opinions.

# Airport Master Planning Process Cont.



- **Financial Planning**
  - Determine airport funding source and constraints.
  - Prepare a financial feasibility study of various airport development alternatives.
  - Prepare preliminary financial plans and programmes for the finally agreed upon concept.

# Airport Master Planning Process Cont.



## ❖ Reviews

- Annually and adjust plans according to prevailing conditions.
- Thorough evaluation and modification every five yearly or more often if changes in economic, operational and environmental and financial conditions dictates.



# Steps in Planning Process



- ✓ Prepare work program and identify responsibilities.
- ✓ Inventory and document existing conditions.
- ✓ Forecast future air traffic demand.
- ✓ Determine facility requirements and preliminary time phased development.
- ✓ Evaluate existing and potential constraints.
- ✓ Prioritize considerations (constraints, airport type).
- ✓ Develop concepts.
- ✓ Assess operational, financial and environmental impact of concepts (reiterations).
- ✓ Select most acceptable and appropriate alternatives, modify and finalize.

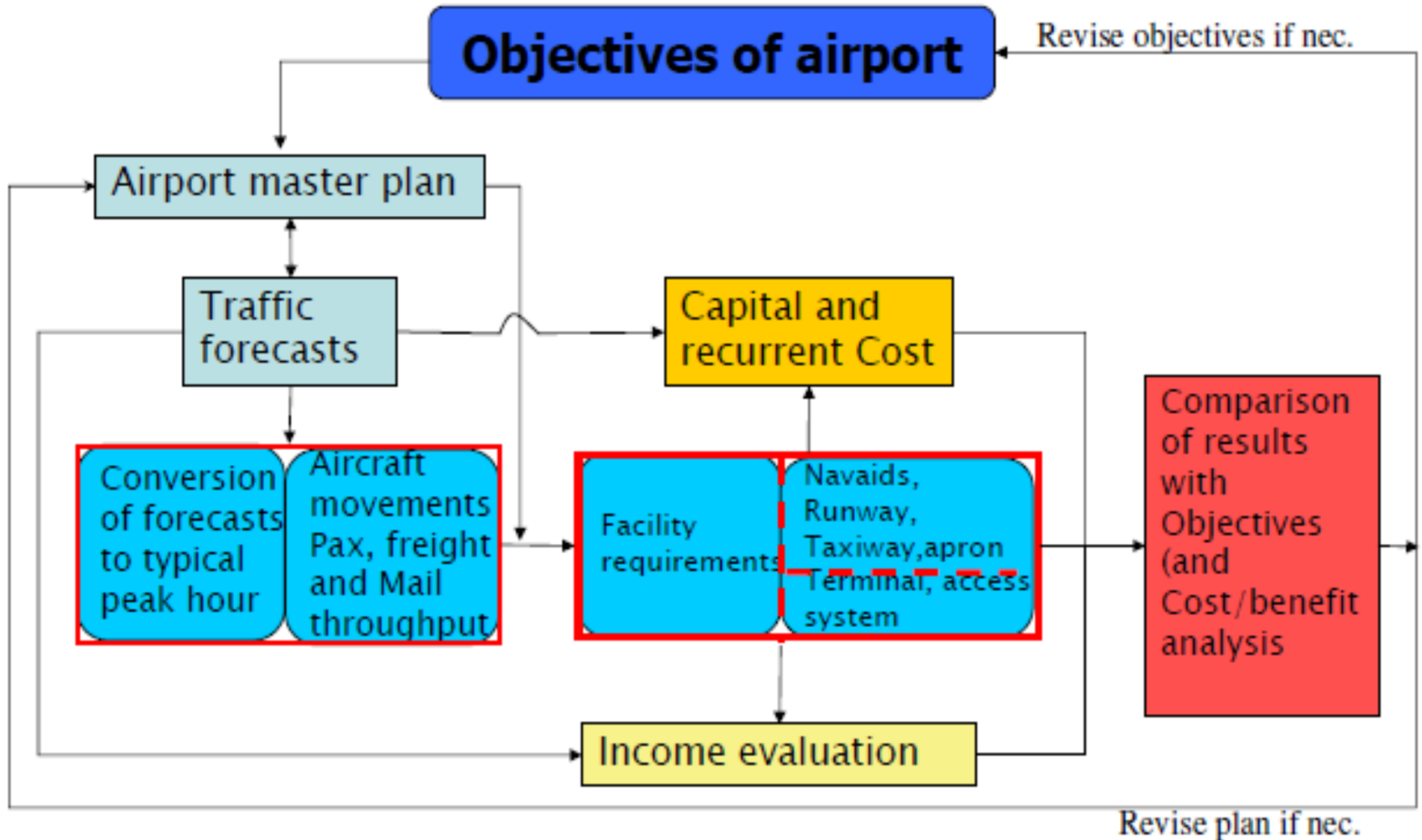
# Air Traffic Forecasts



## ❖ Forecasts parameters

- Annual pax, cargo, mail throughput (int'l/dom; scheduled/ non-scheduled; arrival/departure, transit/transshipment .
- Typical peak hour aircraft movements and pax, cargo, mail throughput (arrivals/departure/combined).
- Average day of peak month aircraft movements and pax, cargo, mail throughput.
- No. of airlines, fleet mix, load factors, route structures.
- No. of base aircraft (scheduled/non-scheduled/GA).
- No. of visitors and airport workers.

# Forecast Relationship vs Master Plan



# Forecasts Techniques



## ❖ Informed judgement

Depends on experience and credibility of forecaster, subjective, immediate term.

## ❖ Trend extrapolation

Assumes all past factors influencing aviation traffic demand will continue to operate with same impact in future, best fit curve, short term.

# Forecasts Techniques Cont.



## ❖ Econometric modelling

- Based on derived quantitative relationship between traffic and important underlying factors affecting traffic.
- A few quantifiable major factors influencing air transport demand can explain most of traffic demand variation.
- Real economic growth, real air fares, real energy prices, tourism growth and consumer demographics deemed to be most important factors impacting aviation growth.
- Relatively effective for short and medium term forecasts.

# Forecasts Techniques Cont.



## ❖ Market survey (Cross Classification Method)

- Obtains primary data from source of airport demand.
- Surveys covering extensive user network to eliminate bias, expensive and needs proper structuring.
- Assumes stable relationship between travel pattern and socioeconomic characteristics.

# Airport Master Plan Objective



- ❖ Developing an airport plan with a layout that yields optimum airport capacity within available land to meet future demand and international operating standards.
- ❖ Delay and processing times associated with different facilities and components in the master plan impact capacity.

# Airport Master Plan Objective Cont.



- ❖ Factors that affects capacity include:
  - Airfield configuration (runway, taxiway , gates/parking positions).
  - Operating environment.
  - Navaids and ATC facilities (availability of nav aids, airspace, arrival and departure routes, extent of ATC facilities approach/departure control tower) .



# Airfield Configuration



- ❖ Runway Configuration.
  - Orientation..
  - Number of runways..
- ❖ Taxiway Layout.
- ❖ Terminal / Apron Area.
- ❖ Aircraft Parking Configuration.
- ❖ Cargo Terminal.

# Airfield Configuration Concept



## ➤ Runways

- ❑ No. of runways depends on volume of aircraft movements.
- ❑ Orientation of runway depends on direction of prevailing winds.
- ❑ Runway length is influenced by temperature, runway slope, airport altitude, MTOW, runway pavement condition, visibility.
- ❑ Airspace around airport should remain free of obstacles to permit safe aircraft operations.

# Airfield Configuration Concept Cont.



## ❖ Runway Orientation

- ❑ Aircraft are not directed over populated areas and avoid obstructions.
- ❑ Oriented in the direction of the prevailing wind and cross wind is not too excessive.

Reference field length	Allowable crosswind components
> 1500 m	20 knots
1200 – 1499 m	13 knots
< 1200 m	10 knots

# Airfield Configuration Concept Cont.



- ❑ Annex 14 specifies that runways should be oriented so aircraft may be able to land at least 95% of the time with cross wind components.
- ❑ Good visibility.

# Airfield Configuration Concept Cont.



## ❖ Runway Configuration

- Achieve safe aircraft operations, ensure:-
  - Adequate separation between air traffic streams..
  - Obstacle clearance..
  - Crosswind provision..
- Ensure least interference and delay to operations.
- Avoid noise and sensitive areas.

# Airfield Configuration Concept Cont.



## ➤ Single runway

preferable to locate terminal equi-distance to runway ends or shift it if there is predominant direction of operations

## ➤ 2-parallel runways (single orientation)

- Optimum capacity and best air traffic control efficiency
- Mid-field terminal between runways preferred
- Terminal on one side of runways lead to longer taxiing distances and runway crossing problems
- Runways may be staggered

# Airfield Configuration Concept Cont.



- **Runways with 2 alignments**
- Open configuration preferred with diverging operations used whenever possible.
- If intersecting configuration is unavoidable and there is predominant direction in aircraft operations, runways should have a rear intersection for that direction.
- Centrally located terminal to minimize taxi distance.

# Airfield Configuration Concept Cont.



## ❖ Taxiways

- Taxiways to be arranged to minimize interference between landing aircraft and aircraft taxiing to takeoff.
- Parallel taxiways increase runway capacity.
- Shortest taxi distance from passenger terminal apron to runway ends.



# Airfield Configuration Concept Cont.



## ❖ Taxiway Layout Guidelines

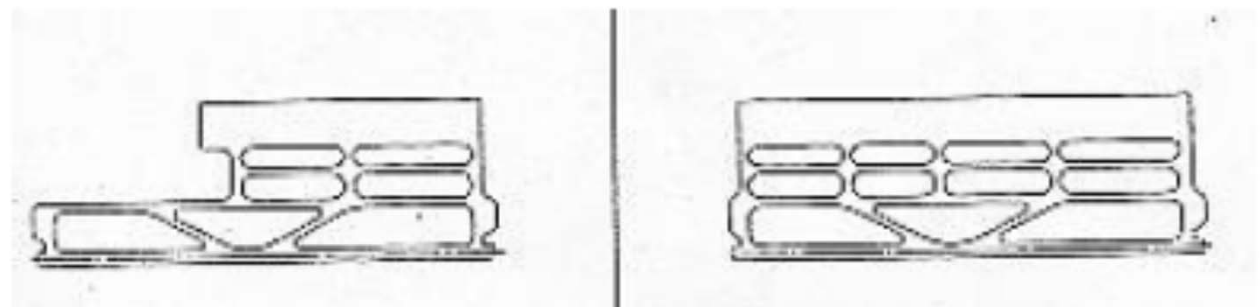
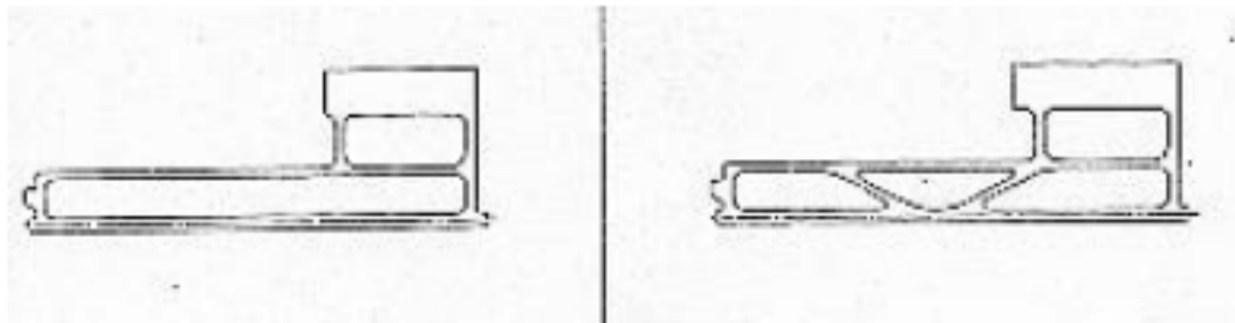
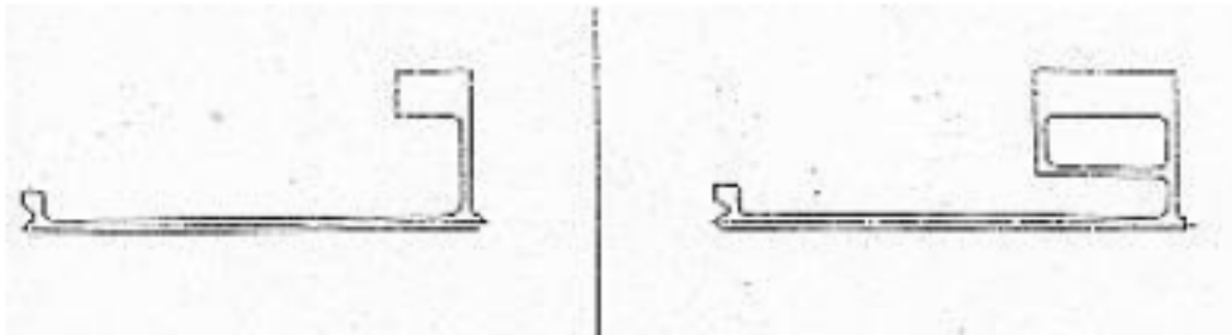
- Efficient connection between runways and terminal / service areas.
- Avoid conflicts between aircraft operations
  - Arriving and departing taxi routes..
  - Holding passes and bypasses..
- Avoid crossing of active taxiways over active runways.
- Minimize runway occupancy time of arriving aircraft (eg strategically located rapid exit taxiways enable landing aircraft to leave runway quickly for other aircraft).

# Airfield Configuration Concept Cont.

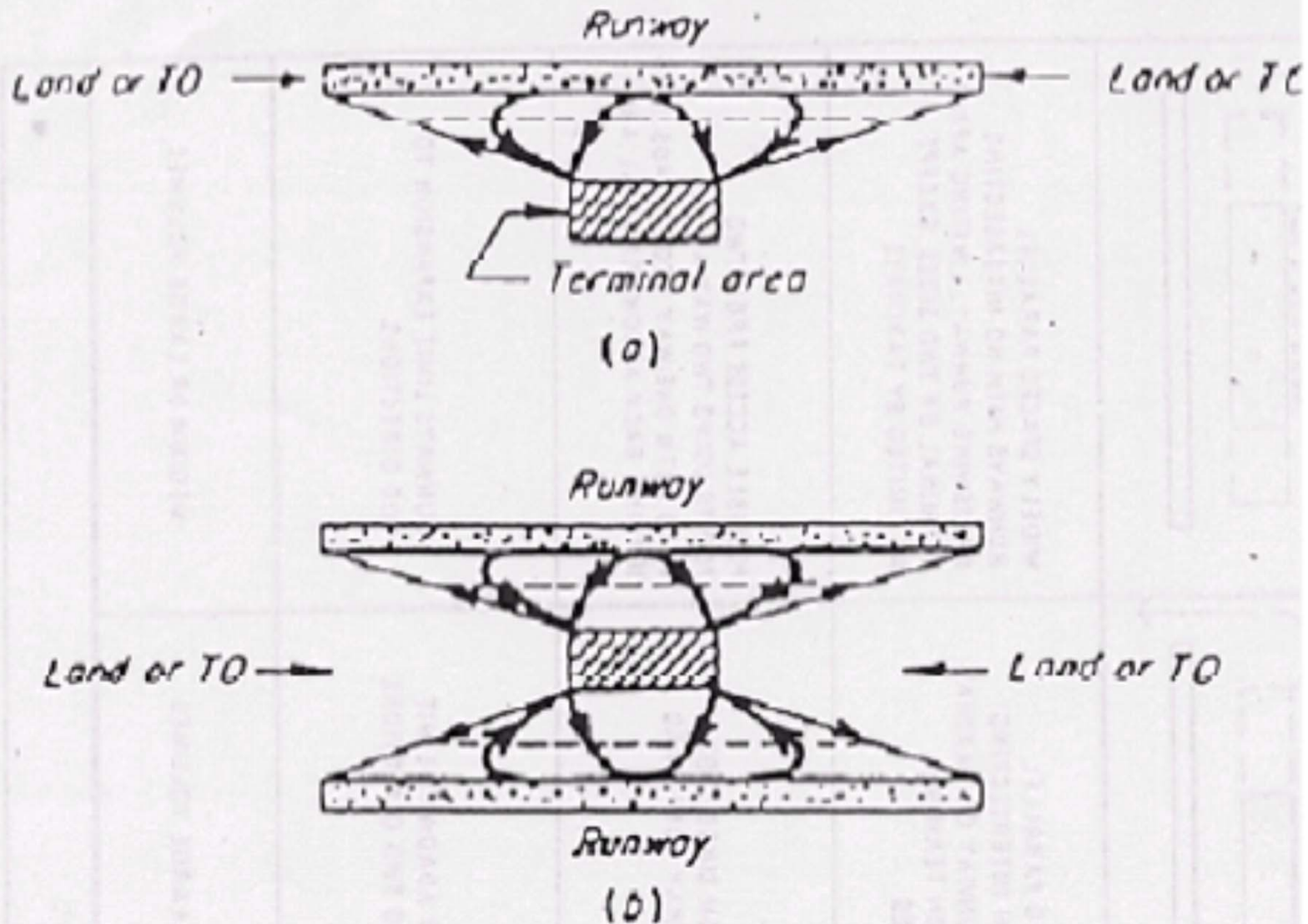


- Terminal/Apron location
  - Minimum taxiing distance to and from runways.
  - Avoid locations under aircraft approach or departure paths.

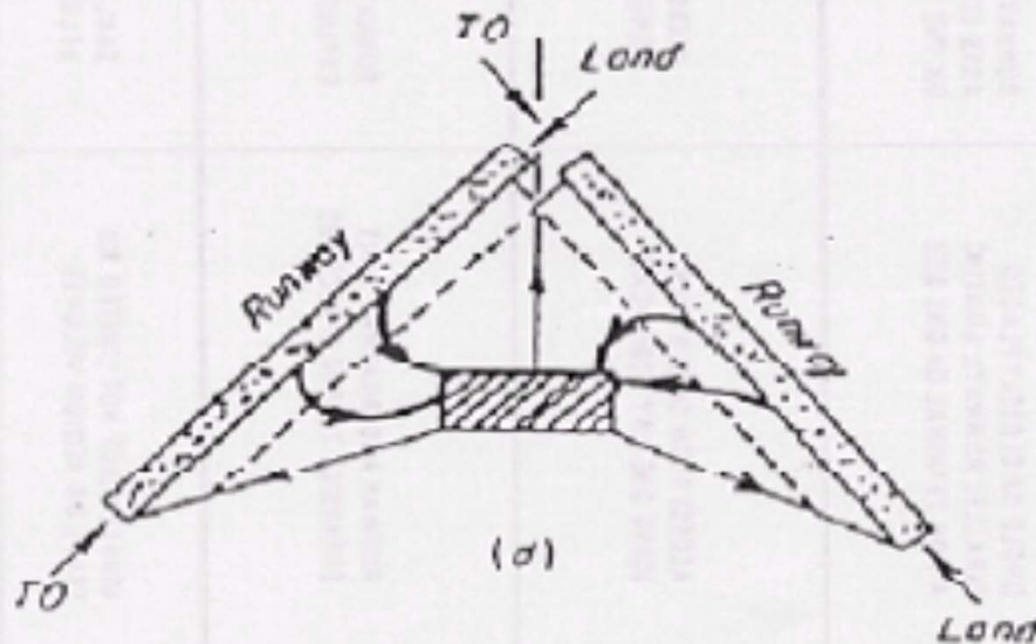
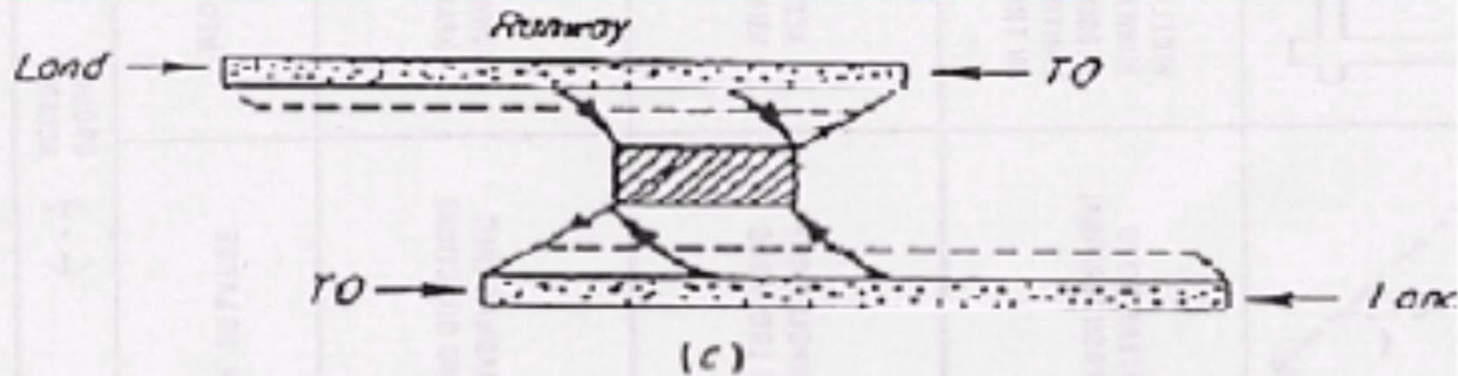
# Taxiway Layout



# Typical Airport Configuration



# Typical Airport Configuration



# Airfield Configuration Concept Cont.



## ❖ Aprons

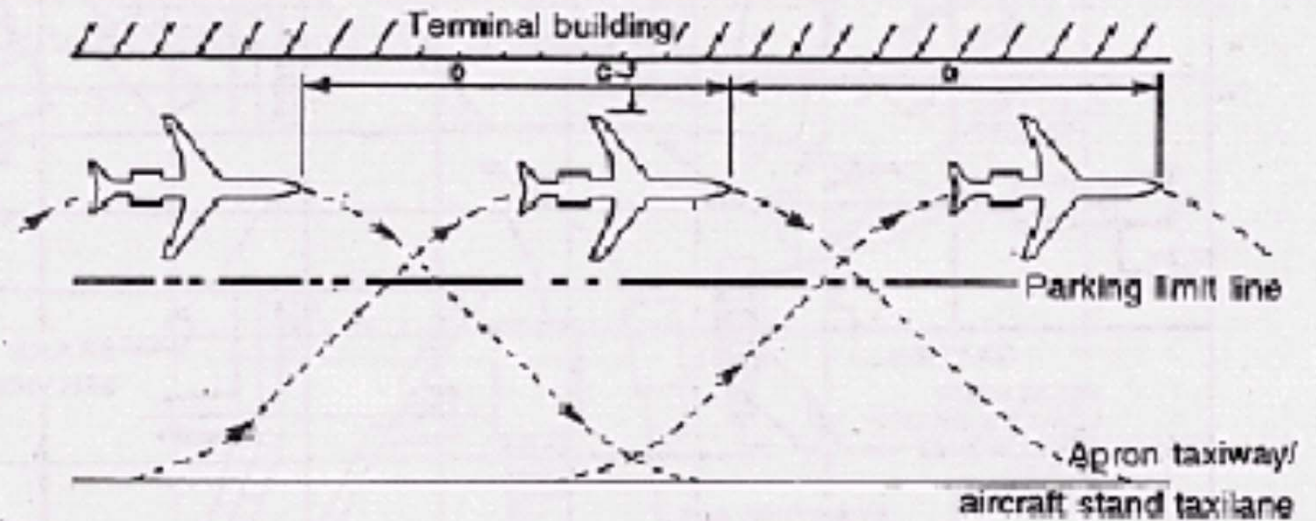
- Account for the safety procedures of aircraft maneuvering on the apron.
- Allow efficient aircraft movements and dispensing apron services.
- Flexible to accommodate different size of aircraft types and future expansion needs.



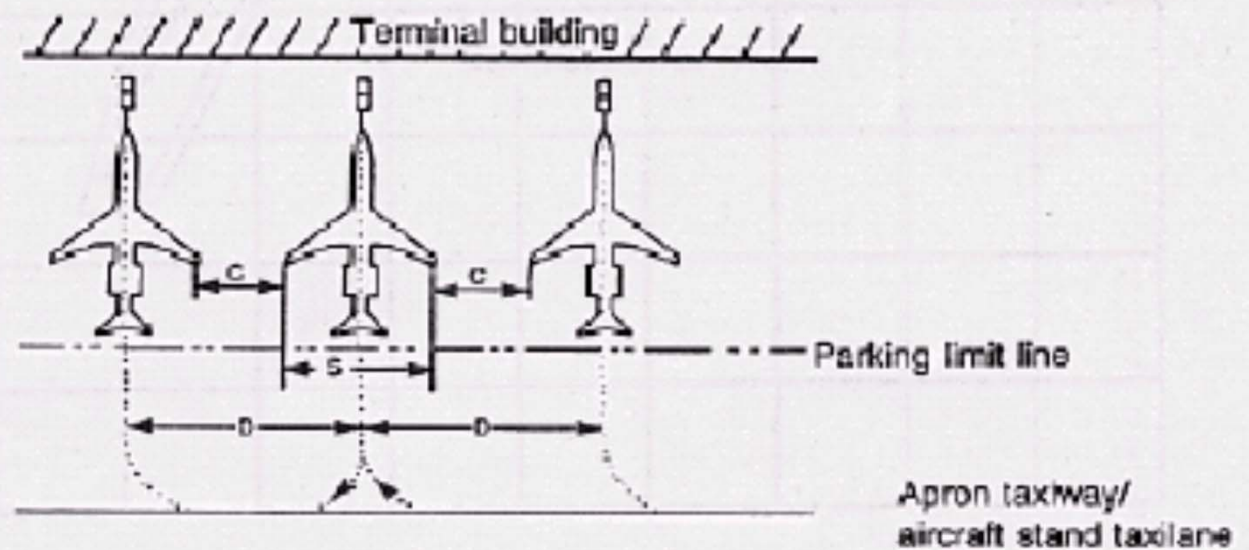
# Parking Configuration 1



c) Taxi-in/taxi-out  
(parallel parking)

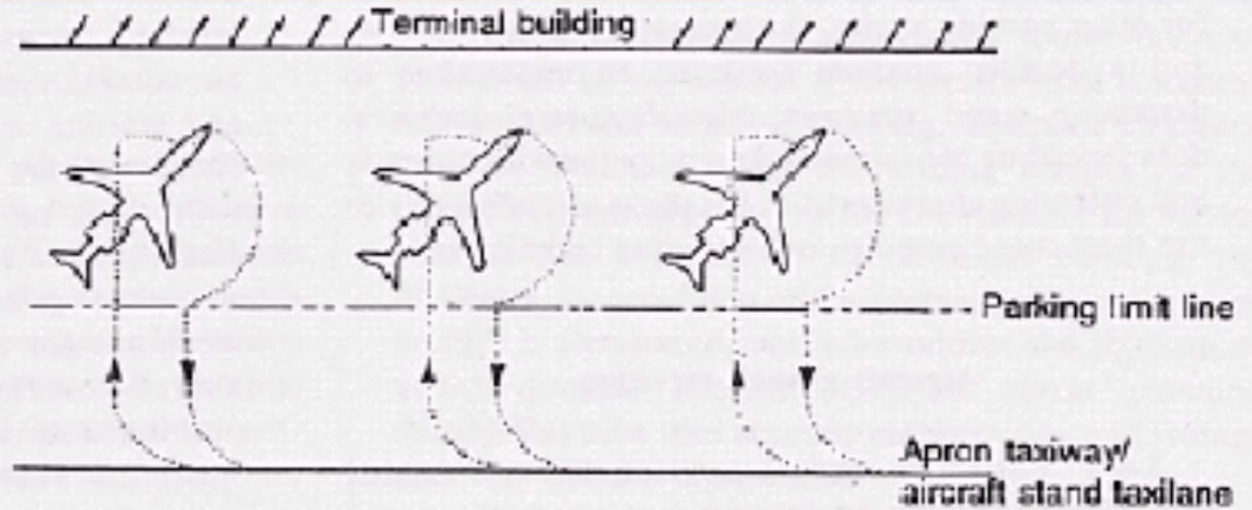


d) Taxi-in/push-out

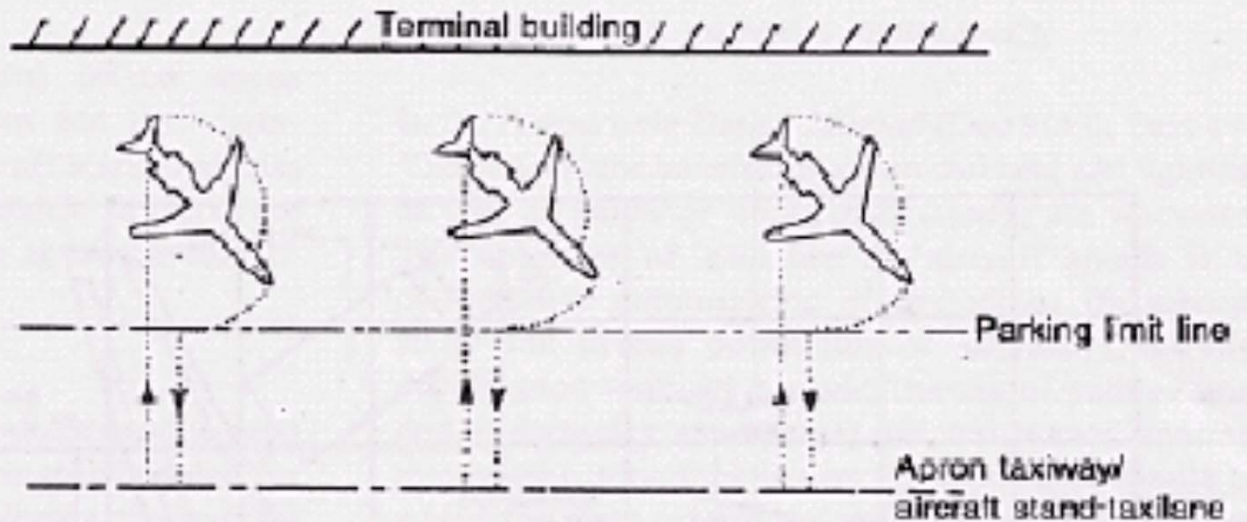


# Parking Configuration 2

a) Taxi-in/taxi-out  
 .(angled nose-in parking)



b) Taxi-in/taxi-out  
 (angled nose-out parking)





# Airport Site Selection



- Determine purpose for which airport is required .
- Consider forecast future demands (operational and economic) and quantity and type of traffic .
- Define type of airport and operational systems for forecast traffic .
- Major steps to consider :
  - Selection of site that provides adequate space and size and suitable locations to serve the residents and commerce .
  - Evaluation of feasibility of possible locations through the forecast period from economic, geographic, engineering and aeronautical standpoints .

# Airport Site Selection Cont.



- Factors influencing airport size:-
  - Performance characteristics and size of aircraft.
  - Anticipated volume and character of traffic.
  - Meteorological conditions like wind and temperature.
  - Elevation of airport site.
- Factors influencing airport location:-
  - Type and development of surrounding area.
  - Atmospheric and meteorological conditions (Fog, Haze, turbulence, heavy rainfall).
  - Accessibility to ground transport (existing highway).
  - Availability of land for expansion.

# Airport Site Selection Cont.



- Factors influencing airport location (con't):-
  - Presence of other airports and availability of airspace.
  - Traffic flow patterns of airports (restricted airspace).
  - Surrounding obstructions (around airports particularly for approach and departure paths, obstacle limitation surfaces).
  - Economy of construction.
  - Availability of utilities (electricity, fuel, water supply etc).
  - Proximity to aeronautical demand.

# Environmental Studies



## ❖ Noise Pollution

- Proper planning of land use for areas surrounding airport.

## ❖ Air Pollution

- Aircraft engine, exhaust, fuel venting, auxiliary power unit, fuel storage and ground service tanks, motor vehicles, construction operations.

## ❖ Water Pollution

- Sanitary wastes, storm water, maintenance wastes and industrial wastes .
- Waste water may be treated before discharging, removing spilled oil by containment and spill recovery (absorbent etc).

# Environmental Studies Cont.



- ❖ Archaeological considerations.
- ❖ Seismic considerations.
- ❖ Inclement weather.

# Financial Plan



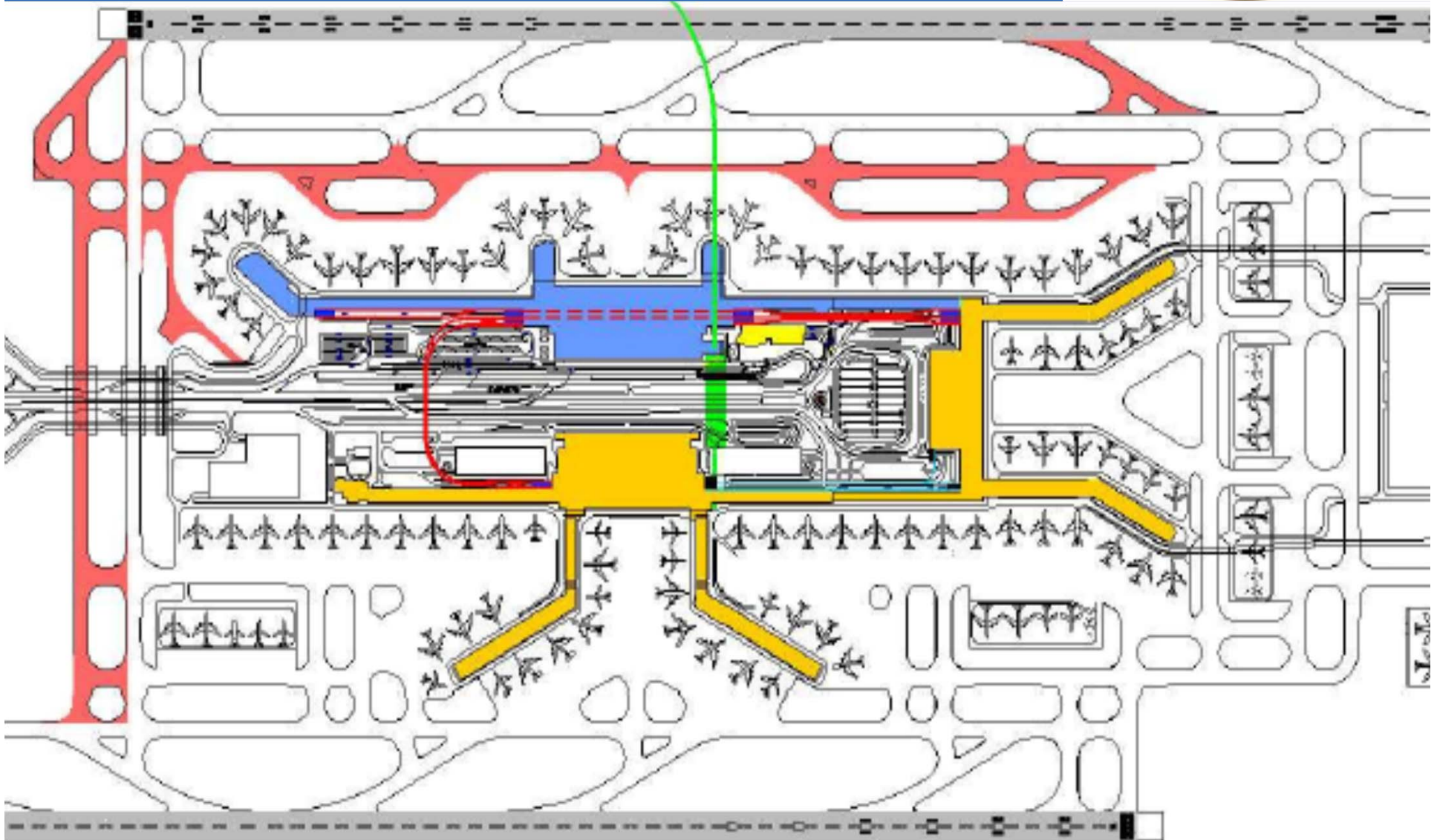
- ✓ Economics and Financial Feasibility.
- ✓ Economic and financials models of alternative master plans (iterative process).
- ✓ Master Plan should be targeted to generate sufficient revenues to cover annual costs of capital, traffic, operations and maintenance expenses.
- ✓ Cost benefit analysis .

# Hong Kong International Airport



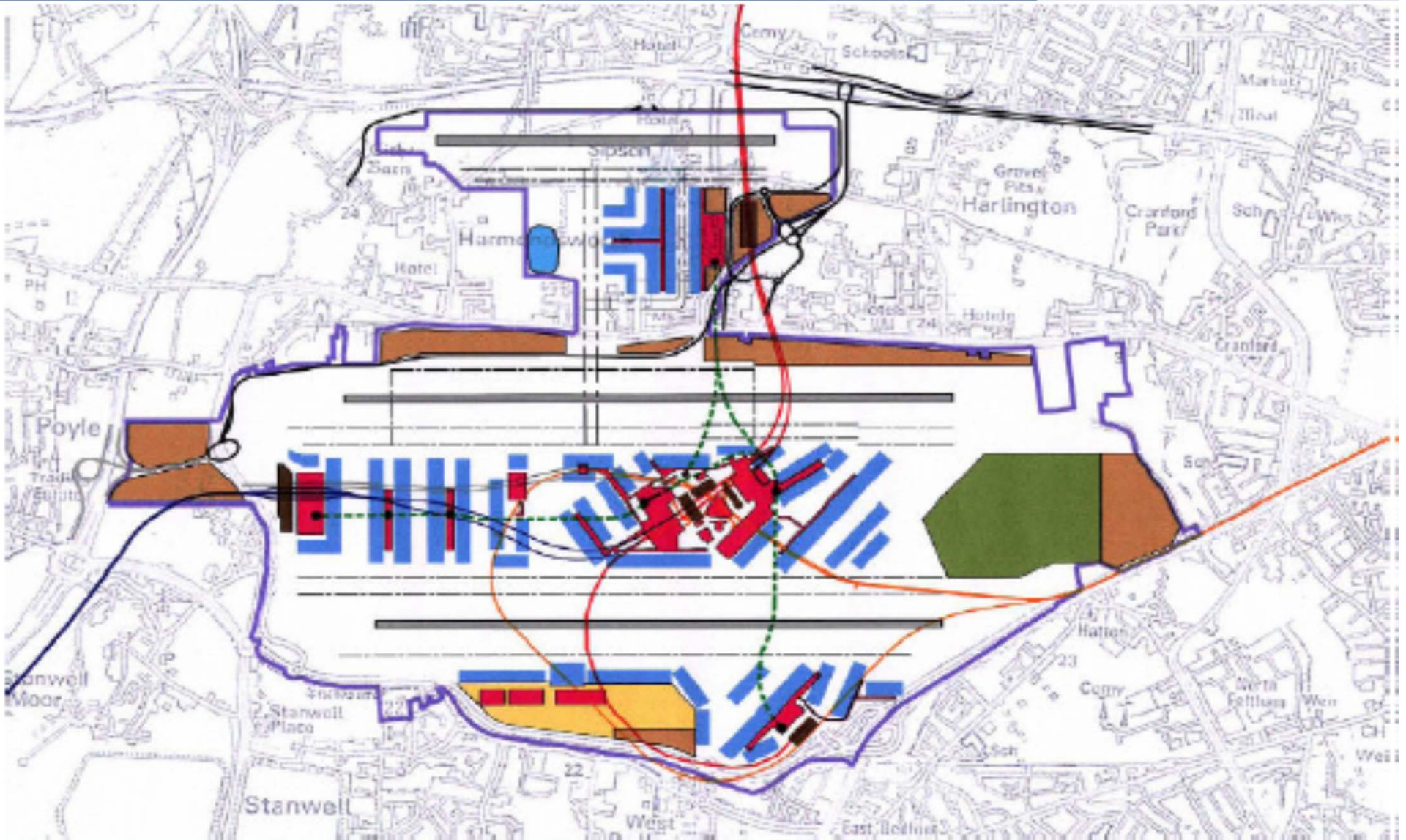


# Changi Airport Terminal 3 completion - 2007





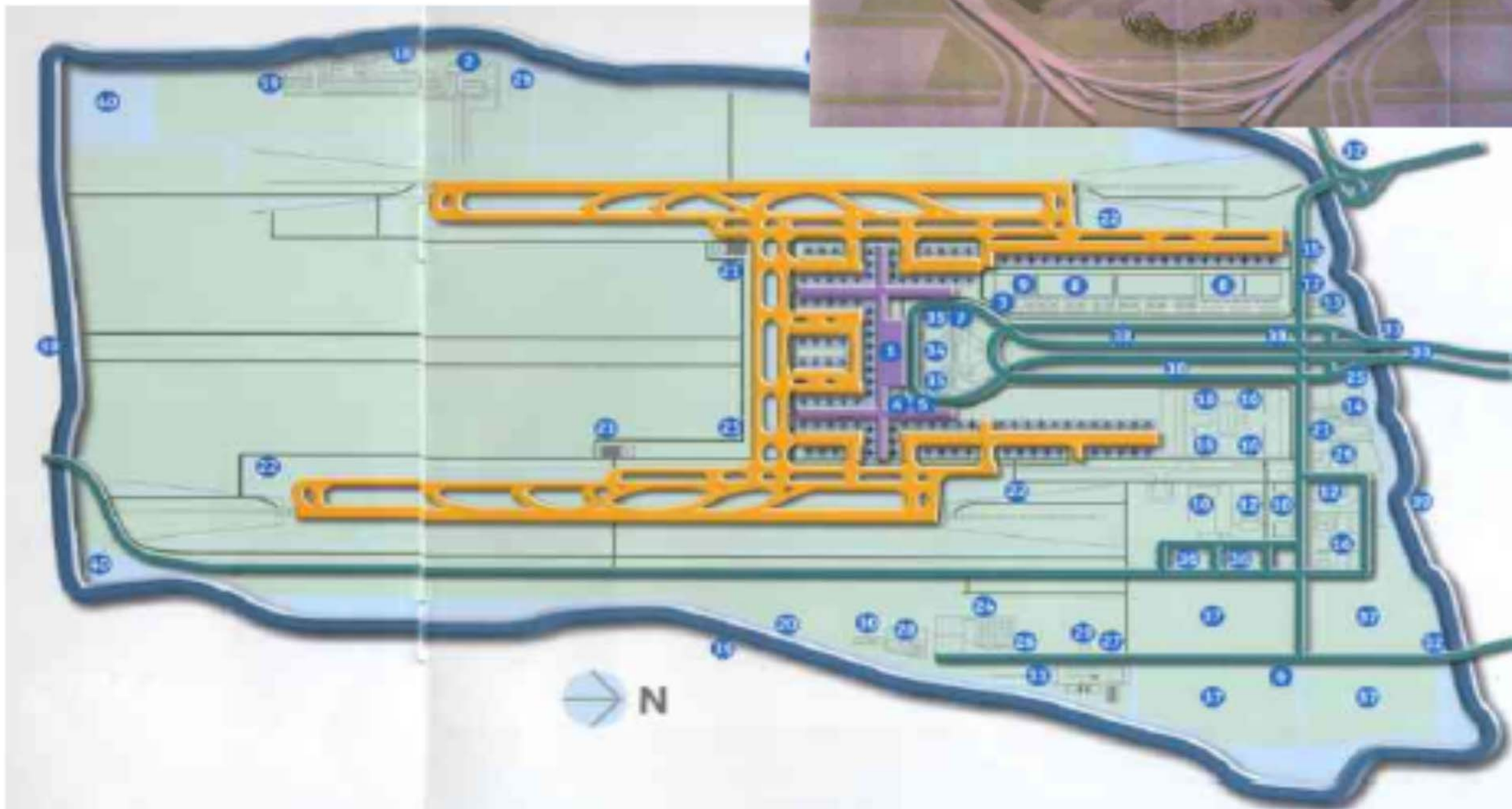
# Heathrow Airport (Interim Master Plan Alt)



# Thailand International Airport



## SUVARNABHUMI AIRPORT (BKK)





**thank you!**