CHAPTER 8

- DESIGN METHODOLOGY: QUICK REFERENCE LISTS -

This Chapter is comprised of one diagram which brings together the elements of the Design Methodology.

It also contains six Attachments; each of which is a quick reference list for various parts of the Design Methodology.

ATTACHMENTS

C.8-0: High Level Project Checklist

C.8-1: Checklist – Writing the Reference Scenario

C.8-2: Checklist – Critical Review of Reference Scenario

C.8-3: Checklist – Performance Criteria

C.8-4: Checklist – Assumptions, Constraints & Enablers

C.8-5: Checklist – Design Concept Routes and Holds

C.8-6: Checklist – Design Concept Structures and Sectors

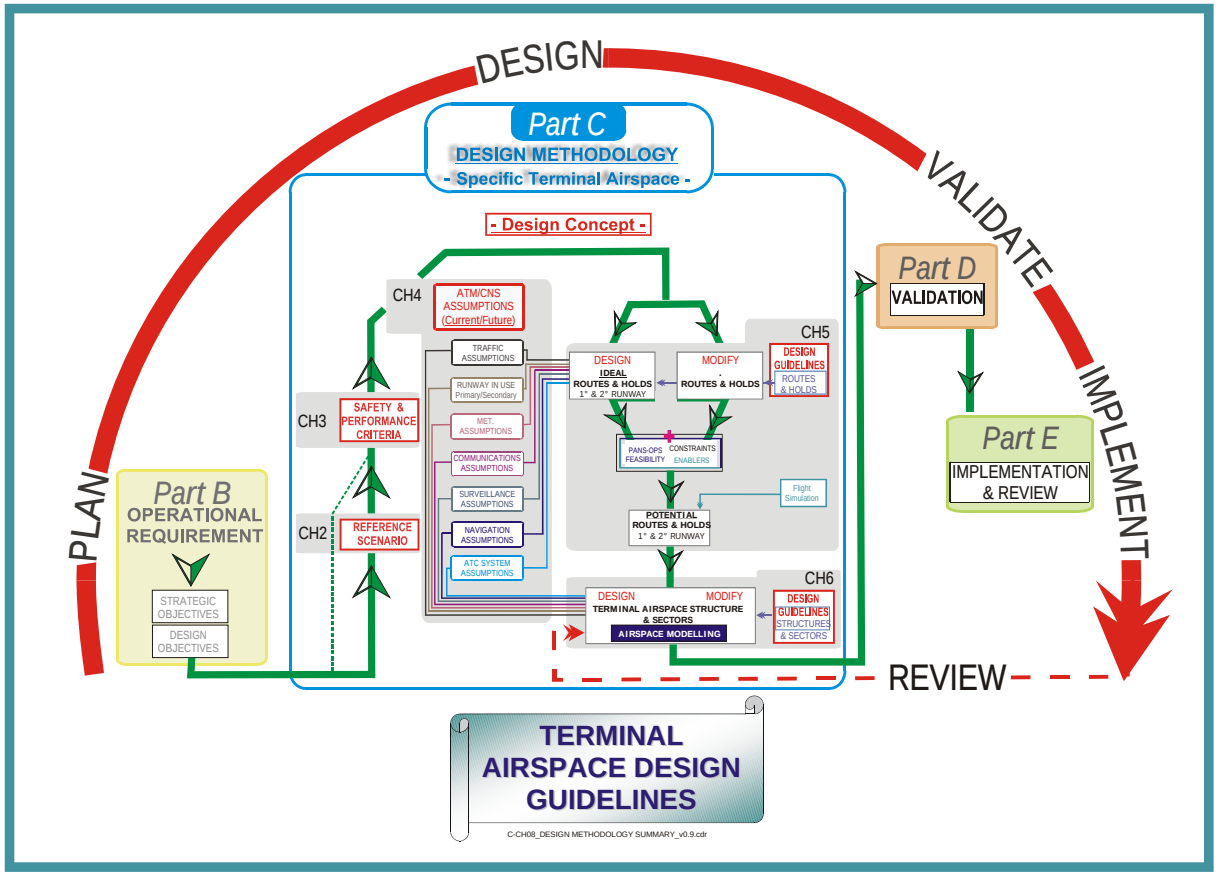

Figure 8- 1: Design Methodology

Attachment C.8-0

Sample High-Level Project Checklist for Terminal Airspace Projects

Note: For completeness, this form has been replicated from Part B because it forms the broad basis for the work schedule undertaken by the Terminal Airspace Design team.

*Note: This form is intended as a high-level quick reference list for Specific Terminal Airspace Projects. Its aim is to ensure that project objectives and scope are appropriately identified and the airspace improvements undertaken in accordance with the appropriate **Airspace Design Guidelines.***

TERMINAL AIRSPACE DESIGN PROJECT (ref. Part B)			
PROJECT NAME:	START: [date]		TARGET ↓IMPLEMENTATION↓
ESTIMATED EFFORT (TOTAL)	END: [DATE]		[DATE]
BACKGROUND & CONTEXT:			
INTERNAL DESIGN TEAM MEMBERS:	[NAME]	[NAME]	[NAME]
	[NAME]	[NAME]	[NAME]
EXTERNAL TEAM, MEMBERS:	[NAME]	[NAME]	[NAME]
INTERNAL REPORTS TO:	[NAME]	[NAME]	[NAME]

STRATEGIC CONSIDERATIONS
1. OBJECTIVES:

DESIGN CONSIDERATIONS	
1. OBJECTIVES:	2. SCOPE:
3. DEPENDENCIES:	4. RISKS: performance indicators
5. PERFORMANCE INDICATORS: Safety: Capacity: Environmental:	

A. WORKING ARRANGEMENTS	
➢ Members of Terminal Airspace Design Team ➢ Leader of Terminal Airspace Design Team, (if applicable) ➢ Operation Manager, (if applicable) ➢ Project Steering Group, (if applicable) ➢ Additional team members (recruit, latest, after Tasks are identified (see below)	
Number of days required to set up working arrangements	

B. POLICY AND REGULATORY MATERIAL	
➢ Safety Policy ➢ Environmental Policy. ➢ Safety Assessment requirements and guidelines ➢ Environmental guidelines ➢ Approved Airspace Design Methodology ➢ Approved Validation methods (that may be used to validate design) ➢ Relevant International material e.g. ICAO SARPs, PANS etc.	
Number of working days required to identify relevant Policy and Regulatory material	

C. PROJECT DEPENDENDCIES	
➢ Availability of ▪ ATC Training Facilities ▪ Simulation facilities (once validation method selected) ▪ Specialists to undertake specialist/technical studies e.g. Environmental Impact studies. ➢ Tentatively reserve facilities for ATC Training, Simulation; ➢ Prepare draft calls for tender w.r.t anticipated technical/specialist studies ➢ Content and Schedule of other airspace/airport projects ➢ PANS-OPS specialist (availability) ➢ Tentatively reserve services of PANS-OPS Specialist. ➢ AIRAC cycle dates(affects implementation)	
Number of working days required to identify project dependencies and complete (tentative) preparatory work	

D. PROJECT TASKS & RELATED /ACITIVITES

1. Propose design objectives
2. Feasibility Assessment (including Cost Benefit Analysis and Preliminary Safety Assessment)
3. Finalise Design Objectives and Scope
   a) Decide implementation date as a function of Tasks to be completed; or
   b) Tailor Scope/Objective to fit into available time.
4. Firm up Calls for tender w.r.t specialist/technical studies
5. Confirm reservation for ATC training facilities and Simulation
6. Cost Benefit analysis and Preliminary Safety Assessment
7. Statement and Critical Review of Reference Scenario
8. Selection of Performance and Safety Criteria
9. Identification of Assumptions, Constraints and Enablers
10. Development of Terminal Airspace design concept, including
    a) Routes and Holds
    b) Structures and Sectors
    c) Qualitative assessment of concept
    d) Impact assessment of proposed concept (e.g. Environmental impact study)
11. Select Scenario(s) to be Validated
12. Validation of proposed Scenarios and Safety Assessment
    a) Prepare simulation
    b) Run simulation
    c) Data analysis
    d) Write up final report of findings
13. Complete safety assessment documentation as per Safety Policy
14. Finalise outstanding reports
15. Obtain approval for implementation
16. Prepare for implementation
    a) PANS-OPS Specialist to design SIDs/STARs as per PANS-OPS Criteria
    b) AIP and other relevant Publications (NB AIRAC cycle dates)
    c) ATC Training
    d) Amend Letters of Agreement (if required)
    e) Amend local/national ATC Procedures, (if required)
    f) Amend local/national regulations, (if required)

Number of working days required for each identified Task/Activity	

E. TASK ALLOCATION			
Task No:	Responsible Person/s	Due date (Draft Report)	Due Date (Final Report)
1			
2			

ESTIMATED TOTAL NUMBER OF DAYS (A+B+C+D+E)	

Attachment C.8-1

Checklist – Writing the Reference Scenario

WRITING THE REFERENCE SCENARIO (ref. Part C 2.2, 2.3)	
1. Runways	
	Which runways are in use?
2. Traffic Types and Distribution	
	• What is the quantity of the traffic in terms of Arrival, Departure and Transit Traffic in combination with different traffic types? • What are the Traffic Mix in categories (H/M/L) and Navigation Capabilities (Conventional / NAV)?
3. Terminal Airspace	
	• What are the lateral dimensions of the Terminal Airspace? • What are the Airspace Classifications in, and if deemed of interest, outside the Terminal Airspace? • What is the Transition Altitude in the Terminal Airspace? • Are there Airspace Reservations (military/VFR corridors/ recreational flying)? • Are there Airspace Restrictions that have an impact on the Terminal Airspace? • Are there Holding Areas and is there a Minimum Safe Altitude? • Are there Approach procedures published and to what extent are they used? • Are there Departure and Arrival procedures published? • Are there Radar Vectoring Patterns & MRVA defined and/or published?
4. Traffic Management	
	• How is the airspace surrounding the TMA organised? Are there adjacent ACC Sectors, ACC Sectors above and/or adjacent Terminal Airspace(s) and what is their relation with the TMA? • How is the Arrival Traffic managed? • How is the Departure Traffic managed? • How is the Transit Traffic managed? • If applicable, how are Military, VRF and Recreational Traffic managed?
5. Technical Support Infrastructure	

	• What are the System Capabilities and Availability for: Radar Data Processing, Flight Data Processing and HMI? • What are the System Capabilities and Availability for Voice Communication Systems i.e. Radio and Phone? • What are the System Capabilities and Availability for Navigation and Landing Aids?
6. Weather and Terrain	
	• What does the terrain in, and surrounding the TMA Look like? • What are the Weather patterns / thunderstorm activities? • What is the impact of low pressure on FL availability in Terminal airspace (Transition level)?
7. Environmental Constraints	
	• Are there Environmental Constraints in terms of Noise restrictions (time/location/level)?

Outstanding Actions/Issues

Action	Due date	Responsible

Reports

REPORT TYPE	DUE DATE	RESPONSIBLE	CONSULTATION PERIOD
DRAFT REPORT			
REVIEW			
FINAL REPORT			

Attachment C.8-2

Checklist - Critical Review of Reference Scenario

Note 1: The statement of the (Pseudo) Reference Scenario (at A, above) forms the basis of the Critical Review.

Note 2: The first two questions as regards every item of the Reference Scenario could be:

- *Does this {element} work well?*
- *What doesn't work (about this particular {element})?*

*Note 3: **Project design objectives** as well as the **Design Guidelines** for Routes, Holds, structures and Sectors can be used as the benchmark for the Critical Review i.e. to decide whether a particular item is un/satisfactory. To this end, some (additional) sample questions are provided.*

CRITICAL REVIEW OF THE REFERENCE SCENARIO (ref. Part C 2.4)	
1. Runways	
	Which runways are in use?
	• *What are the Primary and Secondary Runways in Use in main & adjacent TA?* • *Is the mode of operation of the existing runways likely to change prior to the implementation of the existing project?* • *Are additional runways likely to be in use prior to the implementation of the existing project? If so, in what mode?* • *When was the mode of use for the runways implemented?* • *Have other modes of use been considered – and discounted? If so, why?*
2. Traffic Types and Distribution	
	What is the quantity of the traffic in terms of Arrival, Departure and Transit Traffic in combination with different traffic types?
	• *What is the geographic distribution of the traffic (in %)?* • *What is the time distribution of the traffic (seasonal/daily)?* • *What is the ratio between Arriving and Departing Traffic during peak hours?* • *What is the ratio between IFR/VFR, Military/Civil?* • *Do recreational-type-flying activities take place in the Terminal Airspace?* • *For items (1) to (5) on left, does the future traffic sample deliver the same results as the existing traffic sample used?*
	What are the Traffic Mix in categories (H/M/L) and Navigation Capabilities (Conventional / NAV)?
	• *Does the future traffic sample deliver the same results as the existing traffic sample used?*
3. Terminal Airspace	
	What are the lateral dimensions of the Terminal Airspace?
	• *Are all IFR Flight paths contained inside controlled airspace?*

	What are the Airspace Classifications in, and if deemed of interest, outside the Terminal Airspace?
	• *Does the airspace classification meet current operational requirements?* • *Is there a high incidence of unauthorised penetrations of the Terminal Airspace? If so, why?*
	What is the Transition Altitude in the Terminal Airspace?
	• *Is the Transition Altitude too low or too high?*
	Are there Airspace Reservations (military/VFR corridors/ recreational flying)?
	• *Are all of these Reserved Airspaces used? If so, Frequently?*
	Are there Airspace Restrictions that have an impact on the Terminal Airspace?
	• *Is each of these Airspace Restrictions still valid?*
	Are there Holding Areas and is there a Minimum Safe Altitude?
	• *What are the minimum holding levels of each hold?* • *What are the maximum holding levels of each hold?* • *Are the holding areas located where they are most needed?* • *What factors have determined these minimum and maximum holding levels? Are these reasons still valid?* • *Would the holding patterns be better placed inside (or outside) the Terminal Airspace?*
	Are there Approach procedures published and to what extent are they used?
	• *To what extent are Approach Procedures used?* • *Why are some Approach Procedures not used?*
	Are there Departure and Arrival procedures published?
	• *Do all SIDs have a common initial published level restriction?* • *Does the initial published level restriction coincide with the transition altitude?* • *Why are some SIDs/STARs not used?* • *Do SIDs/STARs cover all requirements e.g. sufficiently service major traffic flows?* • *Ref. 1, are difficulties created by different initial level restrictions?* • *If the answer to 2 is 'Yes', is there a high incidence of level busts?*
	Are there Radar Vectoring Patterns & MRVA? Defined and/or published?
	• *Is the MRVA chart complex?* • *Can the MRVA be depicted on the Radar Display?* • *Does the MRVA chart need updating?* • *Can it be simplified?*
4. Traffic Management	
	How is the airspace surrounding the TMA organised? Are there adjacent ACC Sectors, ACC Sectors above and/or adjacent Terminal Airspace(s) and what is their relation with the TMA?

	• *Are the crossing points of routes too close to any of the sector boundaries?* • *Does traffic transit unnecessarily through too many sectors?*
	How is the Arrival Traffic managed?
	• *To what extent are existing STARs/Holds used?* • *To what extent are existing CDAs used?* • *Are transfer of control arrangements between adjacent sectors and the Terminal Airspace generally similar? (I.e. does transfer generally occur at a level, or at a point?)* • *Where transfer of control arrangements are affected with an adjacent State, is this covered by an Inter-centre Letter of Agreement?* • *Are there incidences of Level busts?* • *To what extent to Low Visibility procedures impact upon the runway acceptance rate?* • *Why are some STARs or CDAs not used?* • *Can transfer of control arrangements be standardised?*
	How is the Departure Traffic managed?
	• *To what extent are SIDs used?* • *Are there many 'special' SIDs e.g. for use by low performance aircraft or for use in particular circumstances?* • *Are transfer of control arrangements between Terminal Airspace and adjacent sectors generally similar? (I.e. does transfer generally occur at a level, or at a point?)* • *Where transfer of control arrangements are affected with an adjacent State, is this covered by an Inter-centre Letter of Agreement?* • *Are there incidences of Level busts?* • *Why are some SIDs not used?* • *Can transfer of control arrangements be standardised?*
	How is the Transit Traffic managed?
	• *Do transit flights in the TMA operate on published ATS routes?* • *Where transfer of control arrangements are affected with an adjacent State, is this covered by an Inter-centre Letter of Agreement?* • *Why are some published ATS routes in the TMA not used?*
	If applicable, how are Military, VRF and Recreational Traffic managed?
	• *Are parts of the Terminal Airspace 'switched on' (and off) to accommodate the requirements of different users?* • *Are there frequent unauthorised airspace penetrations of the Terminal Airspace? Transfer procedures and LoAs?* • *Does the airspace classification outside the Terminal Airspace affect the incidence of unauthorised airspace penetrations?*
5. Technical Support Infrastructure	
	What are the System Capabilities and Availability for: Radar Data Processing, Flight Data Processing and HMI?

	• *What is the Availability and coverage of the Radar system?* • *What is the Availability of the Flight Data Processing system?* • *What is the Availability of the HMI?* • *Are outages frequent? Is this due to maintenance or technical difficulties?* • *Does the system provide consistent and easy manageable environmental data?* • *Does the system provide timely and accurate flight plan distribution?* • *Does the system provide for tools for sectorisation management?* • *Does the system provide for automatic co-ordination?* • *Does the system provide for Code/ Call-sign correlation?* • *Do maintenance slots affect traffic management?* • *Is there a need to change the maintenance slots?* • *Does the system have a fallback capability?*
	What are the System Capabilities and Availability for Voice Communication Systems i.e. Radio and Phone?
	• *What are the Radio Facilities and what is the coverage?* • *Are downtimes frequent? Is this due to maintenance or technical difficulties?*
	What are the System Capabilities and Availability for Navigation and Landing Aids?
	• *What are the Availability of navigation and landing aids and coverage e.g. VOR/DME/ILS Categories?* • *Are downtimes frequent? Is this due to maintenance or technical difficulties?*
6. Weather and Terrain	
	What does the terrain in <u>and</u> surrounding the TMA Look like?
	• Is the obstacle catalogue up to date?
	What are the Weather patterns / thunderstorm activities?
	• Are the weather trends described?
	What is the impact of low pressure on FL availability in Terminal airspace (Transition level)?
	• *Does low pressure occur more frequently than in the past?* • *Is this a trend?*
7. Environmental Constraints	
	Are there Environmental Constraints in terms of Noise restrictions (time/location/level)?
	• *Are there noise curfews?* • *Are there noise sensitive areas that require conditions for over-flight?* • *Are there limitations on holding areas and lowest available holding level due to environmental requirements such as visual intrusion?* • *Are the noise curfews still valid?*
8. **Specific Questions relating to published regulatory material**	

	• *ICAO SARPs: Has ICAO been notified of non-compliance with SARPs where required by the Convention?* • *AIS: Have any inconsistencies/errors been found in AIP/Supplements to AIP e.g. outdated material or wrong co-ordinates. If so, list.* • *LoAs:* • *Have any errors been detected in LoAs, if so list these.* • *Do all parties to LoAs have the same version of the LoA? If not, note this.* • *Local ATC Instructions: Have any inconsistencies/errors been detected in these instructions? If so, list.*

Outstanding Actions/Issues

Action	Due date	Responsible

Reports

REPORT TYPE	DUE DATE	RESPONSIBLE	CONSULTATION PERIOD
DRAFT REPORT			
REVIEW			
FINAL REPORT			

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Attachment C.8-3

Checklist – Performance Criteria

Checklist: PERFORMANCE CRITERIA (ref. Part , Ch.3)	
ASSESSMENT AND MEASUREMENT (ref. Part C 3.2)	
	• Is the chosen Assessment methodology (qualitative vs. quantitative) the correct methodology for the required measurement? • Do the people that are assigned to the assessment have the suitable background and support tools to do the assessment? • Is the assessment done by people from the project team or by external parties? • Is the assessment done repetitive during the design process?
SAFETY CRITERIA (ref. Part C 3.3)	
	• What has been the motivation to decide on either relative or absolute measurement of safety? • What is the chosen frequency approach on safety assessment (phased vs. once-only) and why was this approach chosen? • What is the chosen support to substantiate the safety assessment; simulations (fast- real-time), analysis and/or expert judgement? • What is the "benchmark" used in the determination of safety criteria?
PERFORMANCE CRITERIA (ref. Part C 3.4, 3.5)	
	• Are the design objectives met? • Depending on the objectives were quality and or quantity measured in order to determine if the objectives are met? • Are there measurement tools used, that would normally be outside the scope of the design project, to measure if the objectives are met (e.g. noise modelling tools)?

Outstanding Actions/Issues

Action	Due date	Responsible

Reports

REPORT TYPE	DUE DATE	RESPONSIBLE	CONSULTATION PERIOD
DRAFT REPORT			
REVIEW			
FINAL REPORT			

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Attachment C.8-4

Checklist – Assumptions, Enablers, Constraints

Checklist ASSUMPTIONS, CONSTRAINTS & ENABLERS

(ref. Part C , Ch.4)

1. What are ASSUMPTIONS, CONSTRAINTS & ENABLERS (ref. Part C 4.2)

- Are all the assumptions established after verification with experts on the subject of the assumptions?
- Are there assumptions that are based on factors beyond ATM/CNS e.g. weather phenomena?
- Is there a sufficient level of confidence in the project team that the assumptions were established cautiously?
- Is the traffic sample chosen as the baseline for the design considered as representative?
- Are all the enablers that are identified as outside the design scope, adapted by the ANSP and defined as functional requirements?
- If the functional requirements derived from design enablers are defined as functional requirements, is action taken to fulfil these requirements (thereby creating the enabler).
- Does the planning/project of a functional requirement meet the design project planning (if not, the constraint that is to be mitigated by the requirement/enabler becomes a negative constraint)?
- Are all possible ways to mitigate constraints investigated?
- Are all the Assumptions Constraints & Enablers derived from the reference scenario?

2. Selecting ASSUMPTIONS, CONSTRAINTS & ENABLERS (ref. Part C 4.3)

- Are all the assumptions established after verification of publications in state originated documents such as the Aeronautical Information Publication (AIP)?
- Are the Assumptions, Constraints & Enablers linked to a certain date (where appropriate)?
- When choosing a representative traffic sample, was the traffic distribution over time taken into consideration?
- When choosing a representative traffic sample, was the geographic traffic distribution taken into consideration?
- Is the option considered to create two (or more) sets of Terminal Routes to accommodate significant changes in traffic density or distribution?
- Is it considered as necessary to sort the geographic traffic distribution by origin and destination so as to identify the raw demand (this is only necessary when doubt exists that the current En-Route ATS route network is not sufficiently refined)? (note: see next bullet)
- Has there been a “raw-demand” investigation done by En-Route airspace designers within the greater EUR ARN in the course of a project that is connected to the TMA design project? If so, the previous bullet has become obsolete.
- Has there been an assessment of the relative certainty of “triggering event” that may influence Forecast Traffic Samples?

3. When to identify ASSUMPTIONS, CONSTRAINTS & ENABLERS (ref. Part C 4.4)

- Where the Assumptions, Constraints & Enablers identified, reviewed and verified at the different stages of the design process as suggested in the guidelines?

Outstanding Actions/Issues

Action	Due date	Responsible

Reports

REPORT TYPE	DUE DATE	RESPONSIBLE	CONSULTATION PERIOD
DRAFT REPORT			
REVIEW			
FINAL REPORT			

Attachment C.8-5

Checklist – Design Concept Routes and Holds

Checklist ROUTES & HOLDS (ref. Part C, Ch.5)	
1. General	
	• Is there a general consensus on the "geographic" location of a STAR in the flight profile i.e. what is the general approach on where STARS begin and end in relation to the Terminal Airspace? • Are the STARS in the design to be considered Open or Closed?
2. Terminal Routes (ref. Part C 5.4.2)	
	• Are all Arrival and Departure routes as much as possible laterally segregated? • Are all Arrival and Departure routes as much as possible vertically segregated as a function of aircraft performance? • Are all Arrival and Departure routes as much as possible laterally segregated as soon as possible after departure? • Are the missed approach tracks segregated as much as possible from each other and of terminal departure routes? • Are all terminal routes consistently connected with the ATS route network? • Are all terminal routes consistently connected with the ATS route network irrespective of the runway in use? • Are all terminal routes compatible with routes in adjacent terminal airspaces (where applicable)? • Are all terminal routes compatible with routes in adjacent terminal airspaces (where applicable) irrespective of the runway in use? • Is the impact of a change of the runway in use on the operational complexity to the terminal route structure as minimal as possible? • Are the terminal routes merged progressively as they approach the terminal airspace?
3. Holding Areas (ref. Part C 5.4.3)	
	• Are the holding patterns, serving a terminal airspace, located either at an entry point or outside the terminal area? • Are the locations of the holding patterns as such that they create minimum operational complexity for both En-route and terminal airspace and where applicable for adjacent terminal airspaces? • Do the locations of the holding patterns remain constant irrespective of the runway in use? • Are the inbound tracks of the holding patterns closely aligned with the subsequent arrival routes?

Outstanding Actions/Issues

Action	Due date	Responsible

Reports

REPORT TYPE	DUE DATE	RESPONSIBLE	CONSULTATION PERIOD
DRAFT REPORT			
REVIEW			
FINAL REPORT			

Attachment C.8-6

Checklist – Design Concept: Structures and Sectors

Checklist STRUCTURES AND SECTORS (ref. Part C, Ch.6)	
1. Terminal Airspace Structures (ref. Part C 6.4.2)	
	• Are all terminal routes, holding patterns and their associated protected airspaces contained within controlled airspace? • Does the upper limit of the terminal airspace coincide with the lower limit of the superimposed controlled airspace in order to continuous protection of IFR flight paths? • Is the terminal airspace compatible with the routes and holds that are to be contained within it? • Are both vertical and lateral dimensions of the terminal airspace structure compatible with aircraft flight profiles? • Have obstacle clearances been taken into account while determining if both vertical and lateral dimensions of the terminal airspace structure compatible with aircraft flight profiles? • Is the lateral airspace designated to the terminal airspace restricted to the airspace necessary to contain terminal routes (in order not to constrain the operation of non-participating flights? • Is the lower limit of the airspace designated to the terminal airspace restricted to the necessary airspace to contain terminal routes (in order not to constrain the operation of non-participating flights)? • Is the possibility investigated to fuse adjacent terminal airspaces into one terminal block so as to reduce the operational complexity? • Is flexible use of airspace implemented or envisaged in the design (activation and de-activation of parts of the TMA subject to real-time operational requirements of different airspace users)? • Are buffers incorporated or envisaged in the design with respect to airspace reservations outside the terminal airspace in order to ensure that ATS can provide an adequate margin of safety?
2. Sectors (ref. Part C 6.4.3)	
	• Are the lateral and vertical dimensions of sectors designed as such that stepped level clearances, especially over short distances are avoided to the extent possible? • Are the protected airspaces surrounding holding patterns included in single geographically defined sectors? • Is the design of each sector done in accordance with the design of adjacent, subjacent and superimposed sectors? • Does the design of sectors meet the rationale that crossing points of terminal and/or other routes should not be placed too close to a boundary of a geographically defined sector as so to allow the receiving controller sufficient anticipation time to resolve conflicts? • Is the fact considered that the vertical limits of a geographically defined sector need not be uniform i.e. fixed at one upper level or one lower level, nor need these vertical limits coincide with the vertical limits of (horizontally) adjoining sectors? • Are buffers incorporated or envisaged in the design with respect to airspace reservations outside the terminal airspace in order to ensure that ATS can provide an adequate margin of safety? • Are all potential sector combinations taken into account when determining the sector configuration? • Are the geographically defined pre-defined sequencing sectors designed to encompass the main arrival flows designed with a view to merging arrival traffic progressively as they approach the terminal area? • Is it operationally required that the upper limit of a sector coincides with the lower limit of superimposed sectors in order to provide protection for IFR flights?

Outstanding Actions/Issues

Action	Due date	Responsible

Reports

REPORT TYPE	DUE DATE	RESPONSIBLE	CONSULTATION PERIOD
DRAFT REPORT			
REVIEW			
FINAL REPORT			

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