Navigation - Runways

Chap 2, Nolan
Topics

• Runway Markings
• Taxiway Markings
• Runway Lighting
• Approach Lighting
Runways

• Runways numbered to correspond to *magnetic* bearing
  – Runway 27 has magnetic bearing 270 degrees

• Active Runway selected for headwind greater than 5 knots
  – When no wind use runway closest to terminal (to minimize fuel burn in taxi)
Runway Configurations

• Single runway
  – Aligned with most common wind direction

• Parallel runways
  – Increase throughput

• Intersecting Runways
  – Typically right angles
  – Aligned with most common wind directions
Runway Terminology

- Runway Designator – magnetic bearing rounded
- Threshold – beginning of runway for landing
- Displaced Threshold – threshold not at beginning of paved area
  - Paved area behind threshold is used for taxi’ing for takeoff, landing rollout (not for touchdown)
- Stopway areas – surface beyond of runway that is paved but unusable
Runway Markings – Non-precision Runway

- Center-line marking
- Runway Designation
- Fixed Distance Marking
  - Runways 4000’ or longer
- Holding Position Marking
  - Taxiway intersections
  - Runway intersections
Runway Markings - Precision

- Center-line
- Runway designator
- Threshold Marker
- Fixed distance marker
  - 1000'
- Touchdown Zone Marker
  - 500'
- Side Stripes
- Holding position
  - Taxiway intersections
  - Runway intersections
  - ILS critical areas
Taxiway Markings

• Center-line
  – Continuous yellow line

• Edge
  – Two continuous parallel lines
  – Separated by 6”

• Hold Line
  – Two continuous lines AND Two dashed lines
  – Perpendicular to center-line
  – Sign
   • White numbers on a red background
Runway Markings
Uncontrolled Airports

• 12,000 (95%) out of 12,500 airports in U.S.
  – No Tower
  – Available for unrestricted public use
  – Two types
    • Multicom
      – No air-ground communication
      – Communication is strictly air-to-air using CTAF (Common Traffic Advisory Frequency = 122.9)
      – Keep other traffic informed of your intentions
    • Unicom
      – Non-government (Fixed Base Operator) mans radio
      – Unicom frequency – 122.8
      – Get wind direction, velocity, altimeter setting, reported traffic, active runway
Controlled Airport

• Airport has a control tower
• Radio contact must be established with the Tower before operating at the airport
Runway & Approach Lighting

• Runway Lighting
  – Runway Edge Lights
  – Runway Threshold Lights
  – Embedded-in-Runway Lighting
    • Touchdown Zone Lighting
    • Runway Centerline Lights
    • Taxiway Turnoff Lights

• Approach Lighting Systems
  – Instrument Approaches
    • ALSF-1
    • ALSF-2
    • Runway Alignment Indicator Lights (RAILs)
    • Simplified Short Approach Lighting System (SSALS)
    • Simplified Short Approach Lighting System with RAIL (SSALR)
    • Medium Intensity Approach Lighting System with RAIL (MALSР)
  – Visual Approaches
    • Runway End Identifiers (REILS)
    • Omnidirectional Approach Lighting System (ODALS)
    • Visual Approach Slope Indicator
    • Precision Approach Path Indicator
Runway Lights
Runway Edge Lights

• Runway edge lights
  – Located on either side of the runway to outline edges of the runway
  – Spaced 200ft apart
  – Elevated on short poles above grass, snow
  – Color - White
    • Covered with Fresnel Lens
      – Focus light on horizontal plane above the runway surface
  – Color – Half white/Half Amber
    • Runways used for instrument approaches
    • Last 2000 ft
    • Appear amber to landing aircraft to notify end of runway
Runway Edge Lights
Runway Threshold Lights

• Located at End of runway
• Red and Green split lenses
• Pilot approaching runway
  – Threshold lights on the landing end of runway appear green
  – Threshold lights on the departure end of the runway appear red
Embedded-in-Runway Lighting

• Touchdown Zone Lighting
  – Provide additional visual cues to pilot during landing
• Runway Center-line Lighting
  – Provide additional visual cues to pilot to steer down runway
• Taxiway Turnoff Lights
  – Aid pilots in turning off runways
• Taxiway Edge Lighting
  – Aid pilots in steering on taxiways
Touchdown Zone Lighting

• Runway edge lighting does not work well in low visibility conditions
  • Not sufficient visual cues in last phase of landing
  • Lights too far apart
• Embedded in runway
  • Sets of 3
  • Both sides of runway center-line
• Extend from Landing Threshold to 3000’ feet down the runway
Runway Center-line Lighting

- Provide visual cues for pilot to steer down runway
- Placed at 75ft intervals down center-line
- Colors
  - White – first part of runway
  - Alternate Red/White – 3000’ to 1000’ to end of runway
  - Red – 1000’ to end of runway
Taxiway Turnoff Lights

- Maximizing runway utilization requires pilots to get aircraft off runway as fast as possible
- Delineate path pilot should use to exit runway
- 50 ft intervals
- From runway center-line to intersecting taxiway
- Color - green
Taxiway Edge Lighting

- Identify sides of taxi-ways
- Color - blue
Approach Lighting Systems

• Instrument approaches
  – Transition from Instruments to Visual
    • Pilots must:
      – Locate runway
      – Line aircraft to runway center-line
      – Coordinate aircraft descent-rate
      Note: 2000’ at 200 knots = 20 seconds
  – Approach Lighting Systems
    • ALSF-1
    • ALSF-2
    • Runway Alignment Indicator Lights (RAILs)
    • Simplified Short Approach Lighting System (SSALS)
    • Simplified Short Approach Lighting System with RAIL (SSALR)
    • Medium Intensity Approach Lighting System with RAIL (MALSR)
Approach Light System
Sequenced Flashing Lights (ALSF-1)

- ILS – Category 1
  - Series of High-intensity lights
  - From Runway Threshold to 2400’/3000’ before runway
  - 5 lights
  - 100 ft apart
  - Lights more than 1000’ from runway additional flashing light
    - Appear to pilot to be moving to runway (“rabbit”)
  - Triple set of lights at 1000’ from runway
  - Runway threshold
    - Series of four red light bars
    - Line of green threshold lights
ALSF-2

• ILS Cat II and III
  – Pilot has less than 20 secs to get bearing

• ALSF-1 + additional lights
  – White light bars 500’ from runway
  – Red light bars on both sides of center-line during last 1000’ to runway
Approach Light Bar
Others

- Runway Alignment Indicator Lights (RAILs)
  - Sequenced flashing lights only
  - 200 ft apart (not 100ft)

- Simplified Short Approach Lighting System (SSALS)
  - ALSF-1
    - 200 ft apart (not 100 ft)
    - 1200’ (not 2400’/3000’)

- Simplified Short Approach Lighting System with RAIL (SSALR)
  - SSALS with RAIL

- Medium Intensity Approach Lighting System with RAIL (MALSR)
  - 2400’ from runway
  - 200 ft apart (not 100 ft)
SSALS

• Simplified Short Approach Lighting System (SSALS)
  – ALSF-1
    • 200 ft apart (not 100 ft)
    • 1200’ (not 2400’/3000’)

[Diagram of runway and lighting system]
SSALR

- Simplified Short Approach Lighting System with RAIL (SSALR)
  - SSALS with RAIL
  - ALSF-1
    - 200 ft apart (not 100 ft)
    - 1200’ (not 2400’/3000’)
    - RAIL 2400’/3000’
MALSR

• Medium Intensity Approach Lighting System with RAIL (MALSR)
  – RAIL 2400’ from runway
  – Light bars 200 ft apart (not 100 ft)
  – Light bars from 1400’ from runway
Approach Lighting System

• Visual Approaches
  • Runway End Identifiers (REILS)
  • Omnidirectional Approach Lighting System (ODALS)
  • Visual Approach Slope Indicator
  • Precision Approach Path Indicator
Runway End Identifiers (REILS)

- Provide pilots with indication of end of runways
- Located at either end of runway (approach and takeoff)
- Synchronized to flash 2/sec
- Runway End Identifiers (REILS)
Omnidirectional Approach Lighting System (ODALS)

- Identifies flight path to be used by pilot for a runway
- Flash in sequence
- Approach to runway (or further out)
Visual Approach Slope Indicator (VASI)

- Vertical guidance to approach flight path (3°)
- Visible upto 2 miles from runway
- Installed on side of runway
  - At threshold, +700, +1200
- Narrow beam of light
  - Above glidepath – WHITE
  - Below glidepath - RED
- Installed on runways without ILS
Visual Approach Slope Indicator (VASI)
Precision Approach Path Indicator (PAPI)

• Single row of lights
• Each light in row emits white and red beam at progressively higher angle
• Operation
  – Above glide path – 4 white
  – As descend see red light from light closest to runway
  – On glidepath 2 red/2white
  – Below glidepath – 4 red
Homework

• Draw concept maps for:
  • Runway/Taxiway Markings
  • Runway/Approach Lighting

• Prepare for in-class quiz