Runway Safety

Prevention of Runway Incursions

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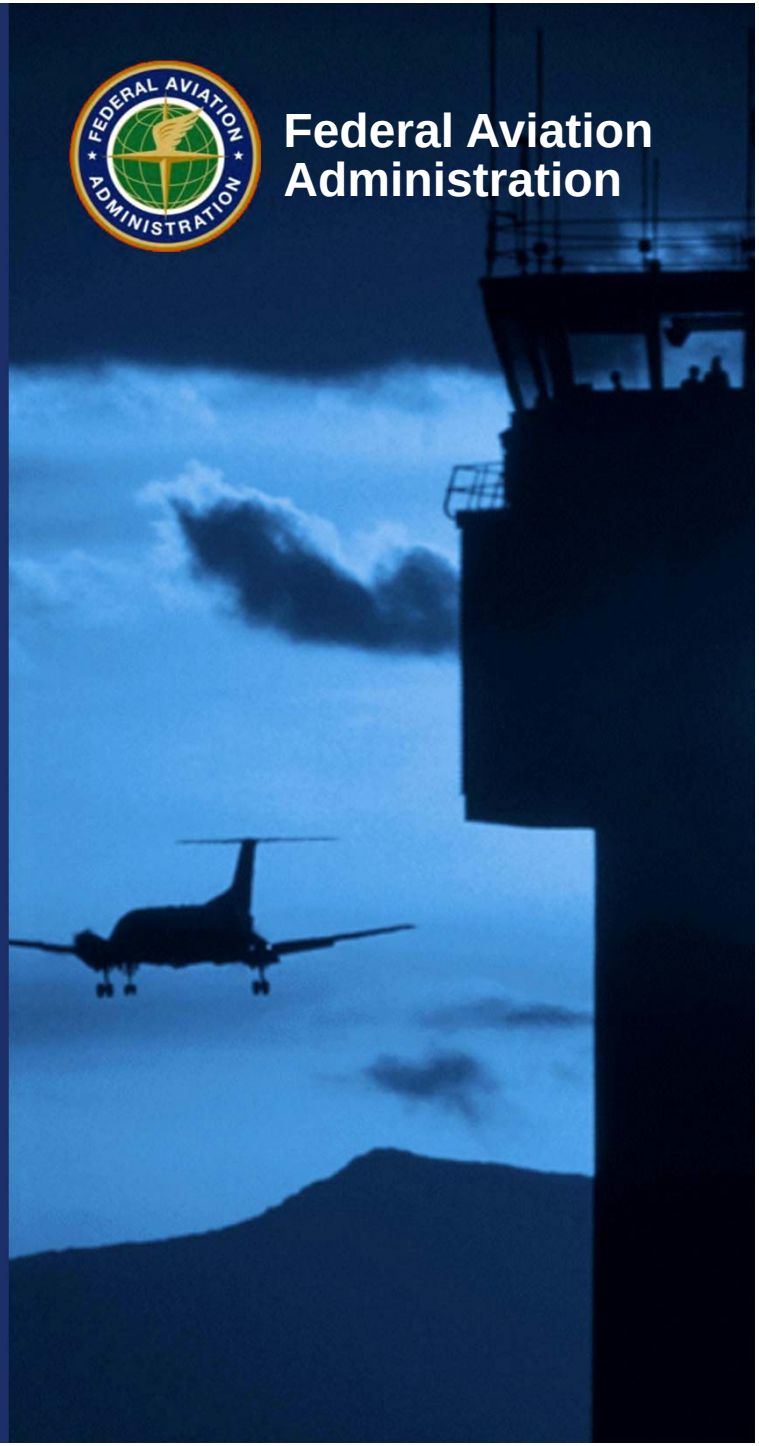


Presented to: **ANM Airports Conference**

By: **Mike Meigs, Runway Safety PM**

Date: **April 2012**

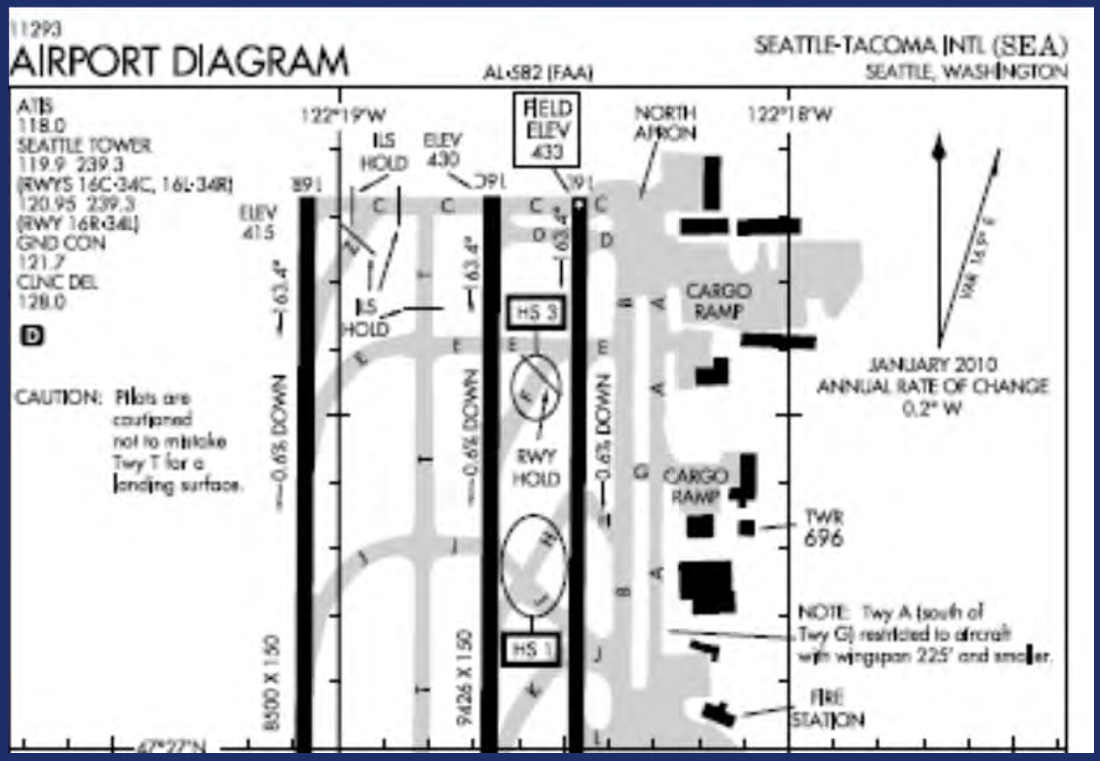
Discussion Topics

- **Runway Safety and Airports**
- **Geometry Issues and Runway Incursions**
  - Change 17 to AC 150/5300, Airport Design
  - Other issues – not covered by EB 7

Runway Safety and Airports

- **ANM Runway Safety office reviews each NRA airspace case**
  - Includes ALP changes, airport construction plans
  - Will review and comment on cases at all FAR Part 139 airports and all towered airports
  - Time permitting, will review and comment on changes at other airports
- **Geometry issues are a focus of RSATs**
  - ADOs are encouraged to participate in all RSATs, which happen every 12 months
- **Runway Safety has the lead to establish hot spots**
  - Come from RSATs, airport and pilot input

How do you know where Hot spots are?



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What is Runway Safety looking for in ALP review?

- Direct ramp to runway access
- Runway crossings/entrances that are not 90 degrees
- Runway crossings in high energy segment
- Extra wide pavement – especially next to a runway
- Extra runway entrances or crossings not needed by traffic level
- Complicated intersections

What is Runway Safety looking for in CSPP review?

- **Haul routes – where to they come close to runways (high energy segment)? Do they minimize crossings of taxiways/runways?**
- **Use of barricades – clear and umambiguous**
- **Effect on taxi routes - Backtaxi, Entrance or crossings in high energy portion of runway**
- **How are relocated thresholds, closed runways marked**
  - Cover up those numbers

Incursion

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Advisory Circular 150/5300 Change 17 dated September 30, 2011

- Airport Design means Safety First, then efficiency and capacity.
- Focus on mitigating airfield confusion, runway incursions and wrong runway takeoff and landings.
- Engineering Brief #75, “Incorporation of RW incursion Prevention into TW & Apron Design. http://www.faa.gov/airports/engineering/engineering_briefs/media/EB_75.pdf

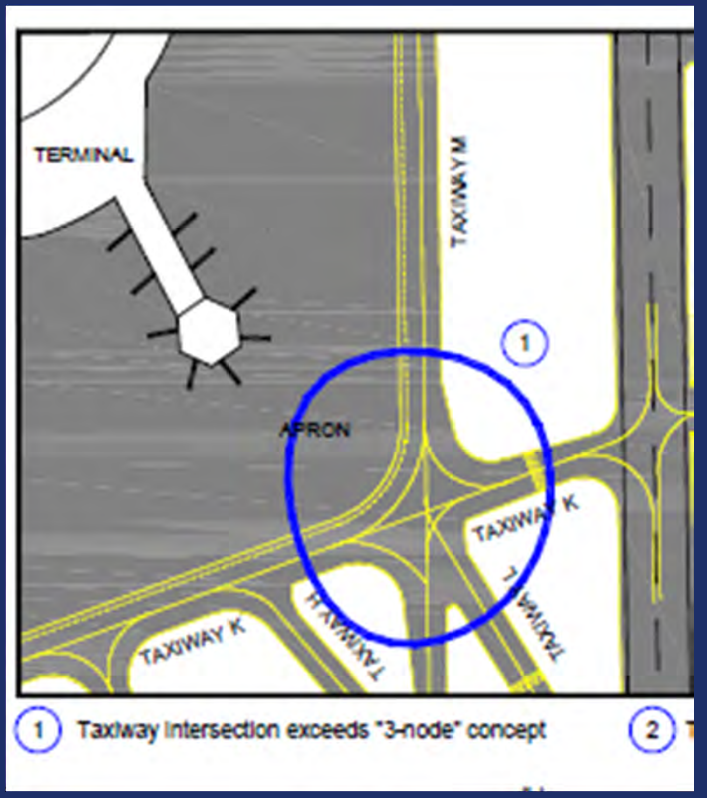
Chapter 4 – RW Safety Changes

- 3-Node Design Principal for taxiway intersections (406).
- Entrance TW (407)
- By pass TW (408)
- TW/RW Interface Principal (409)
- Deleted Judgmental Oversteering Design
- Added new figures on taxiway and runway geometry to avoid.

Taxiway Intersections – 3 Node Principal (406)

- TW Intersection with (at most) 3 directions to proceed beyond the intersection.
- This allows pilots to continue through an intersection; turn left or turn right
- This design reduces confusion, minimizes runway incursions and hot spots.
- All new AND existing taxiway intersections designated as “HS” are to be constructed in accordance with the “3 Node” Design Principle

3 Node Principal



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Taxiway Intersections – 3 Node Principal

- To the maximum extent practicable, all existing taxiway intersections should also be reconfigured in accordance with the “3-Node” design principle during the next capital project at that location
- Right-angle taxiways are preferred – **best visual perspective** to observe aircraft, signage and surface markings.
- Recommended to avoid geometry which require **excessive pavement fillets and taxiway width** since they force airfield signage farther from the taxiway centerline

Extra Wide Intersection

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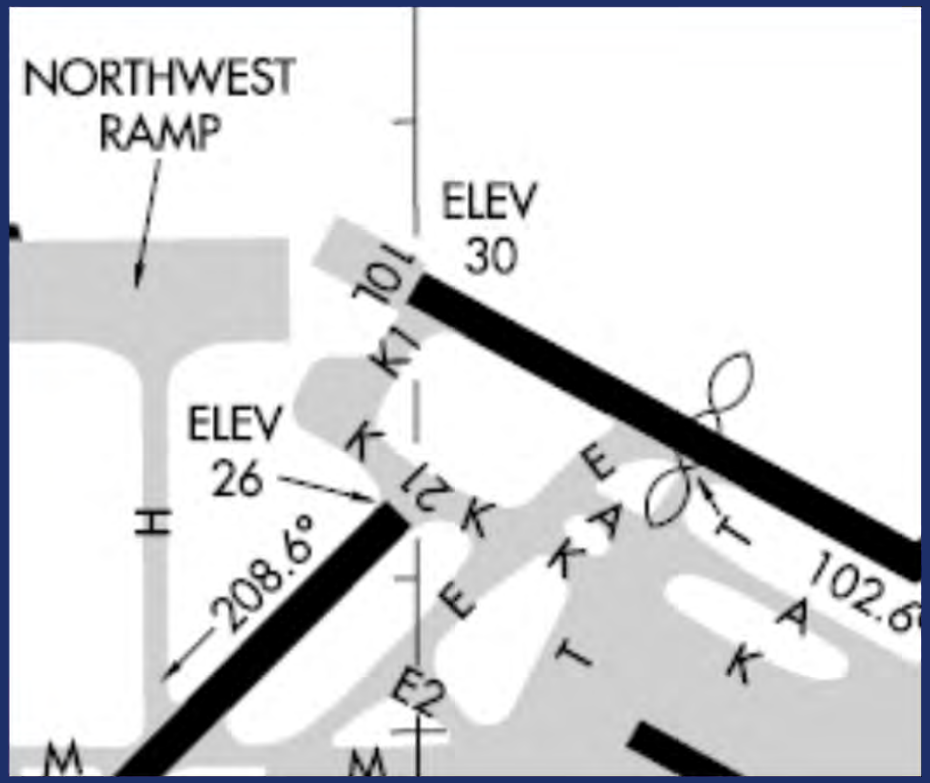
Entrance Taxiways (407)

- New AND existing entrance taxiways (designated as a HS) **MUST** be perpendicular to the runway centerline.
- To the maximum extent possible, all existing entrance taxiways (not designated as “hot spots”) should also be reconfigured to be perpendicular to the runway centerline.
- Entrance taxiways should not be constructed beyond the runway end.
- The design length of a perpendicular taxiway entrance leading to a runway should permit the longest fuselage to fully line-up perpendicular to the runway.

Notice the difference in “Must” and “Should”

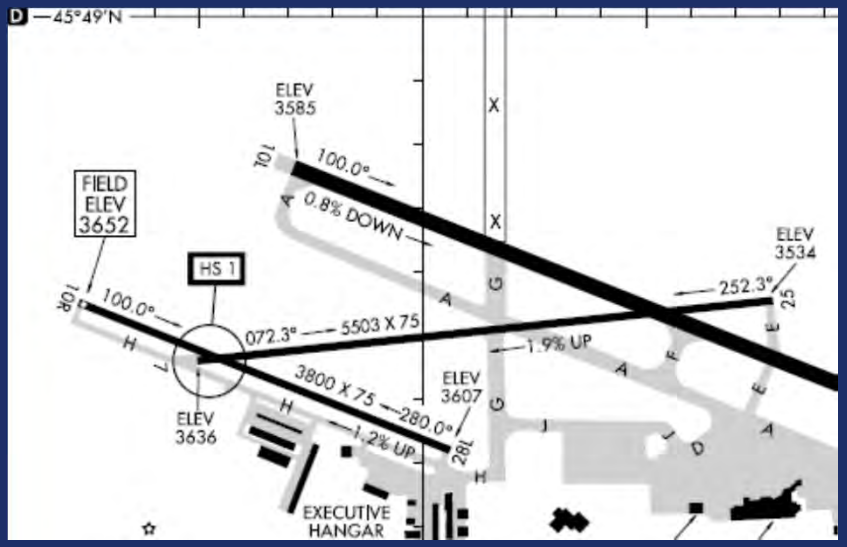
Taxiway off end of runway

- Taxiway Kilo crosses the safety area for Rwy 21
- From twy centerline to threshold – approx 150 feet
- Kilo is painted as taxiway
- Pilots don't see white paint, runway numbers



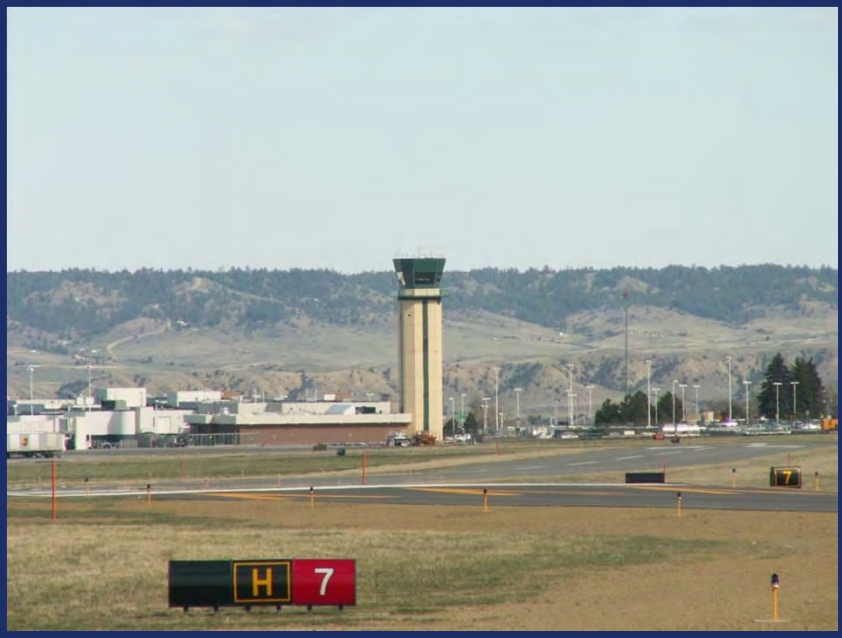
PDX Twy Kilo

Billings Rwy 7 – Hold Line



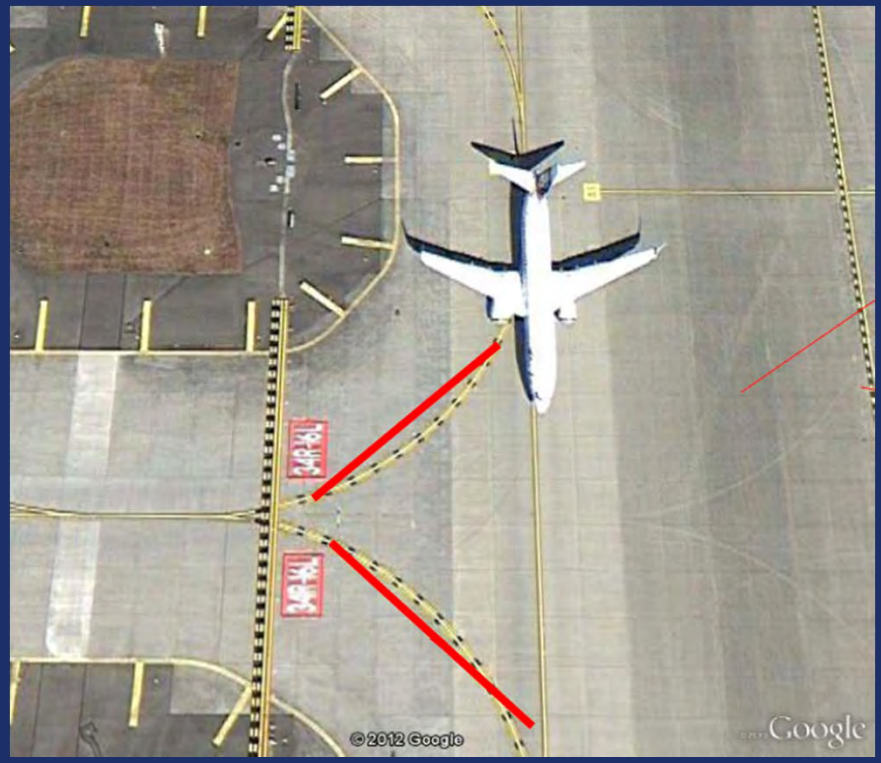
Billings Twy H approaching hold line

On Taxiway Hotel



Aircraft alignment - Taxiway Quebec

- **5 PD Runway Incursions since December 2008**
  - 3 daytime
  - 2 night
  - 1 turboprop, 4 narrow body
- **Common crossing point for departures on 34C**
- **Intersection departure point for Rwy 34R**
- **Close proximity to ramp (275 feet to ramp)**



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Taxiway Q – Taxi Example

Entrance TW
Mitigation of runway incursions

- Avoid the construction of wide expanses of pavement at entrance taxiways.

Should:

•paint the excess pavement green or use artificial turf

•Each distinct taxiway entrance shall have it's own taxiway designator, marking and elevated signage

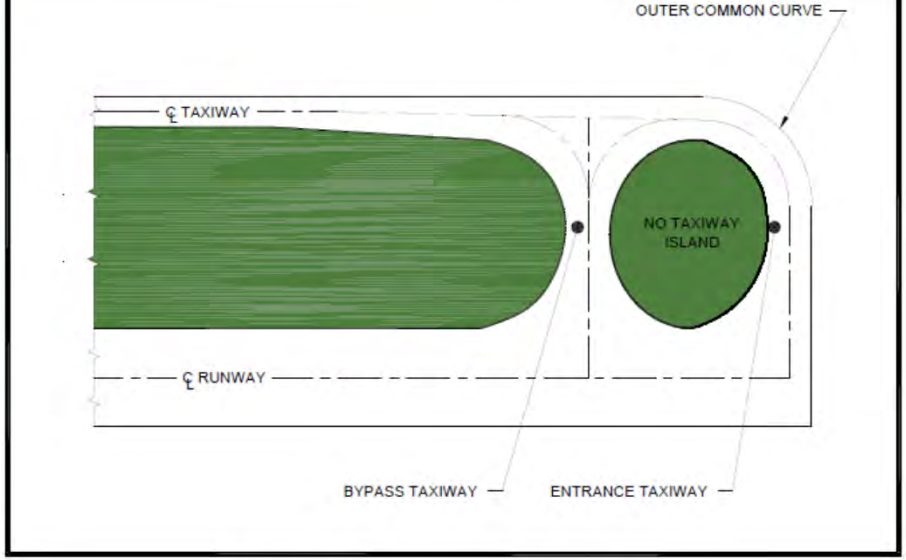

Figure 4-6. Bypass taxiway & Entrance Taxiway

Green Islands

- **Often used to**
  - Reduce width of taxiways
  - Block direct access to runways
- **Use of paint alone to protect areas not always effective**

d. **Mitigation of runway incursions.** Avoid the construction of wide expanses of pavement at entrance taxiways since this design has encountered runway incursions. Airports with existing wide expanses of pavement should paint the excess pavement green or use aviation grade artificial turf to make the entrance taxiway more distinctive (figure 4-6). Each distinct entrance taxiway shall have its own taxiway designator, marking and elevated signage. To minimize the landing on a parallel

Green Island – LAX Twy M

Green Island – Twy M

TW and RW Interface (409)

- Should intersect at a right-angle with the runway.
- Intersecting angles less than 45 degrees are not recommended.
- Config that shall not be designed and that contribute to incursions and wrong runway takeoffs:
  - Y-shaped taxiway crossings,
  - taxiways crisscrossing a high-speed exit,
  - aligned taxiways between two closely spaced runway ends
  - taxiway serving V-shaped runways
- Airport operators should remove such confusing geometry to the greatest extent possible.
- **AVOID taxiways that provide direct access from the apron to the runway**

Distractions

Straight ahead to Runway

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TW and RW Interface (409)

- **Taxiway strategies to reduce the number of active runway crossings and their locations should be considered**
- **Avoid taxiways that provide direct access from the apron to the runway.**
- **Crossings in the first third and last third of the runway are recommended.**
  - First two thirds of runway known as high energy segment
  - Aircraft landing in first two thirds may not be able to stop, departure not airborne yet
  - Crossing right at threshold, and last third is safest

Crossing in Middle of Runway

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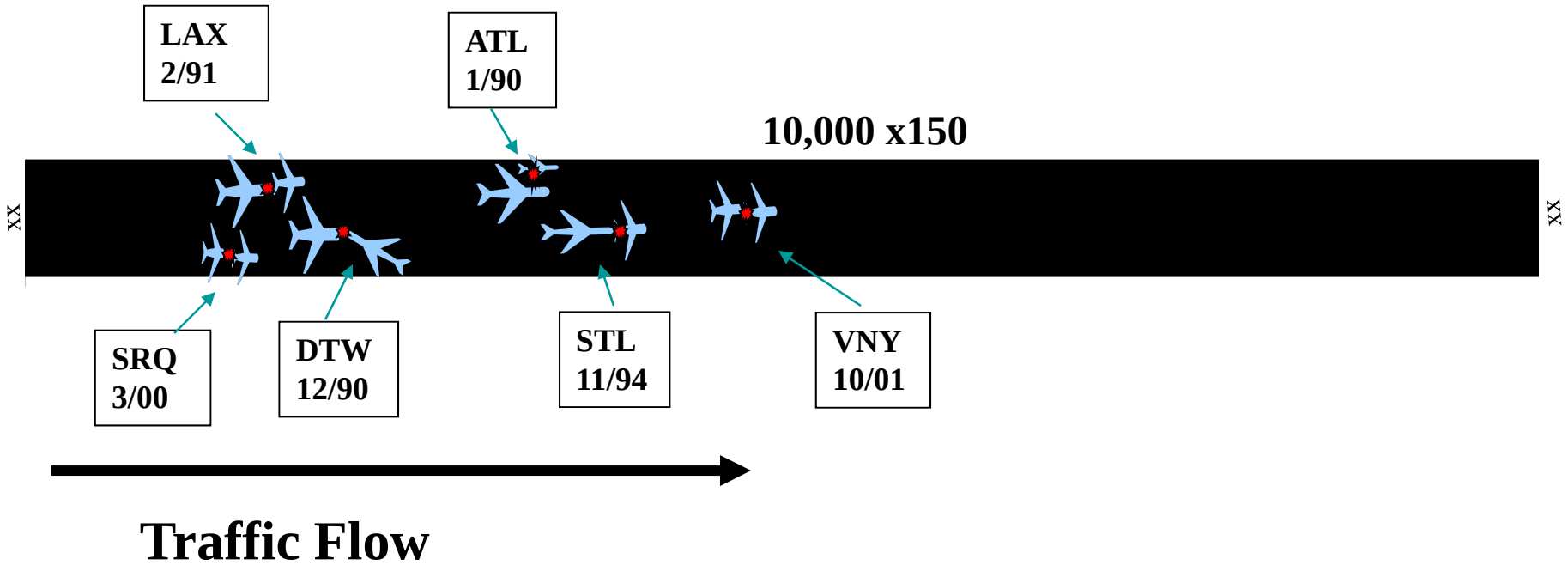
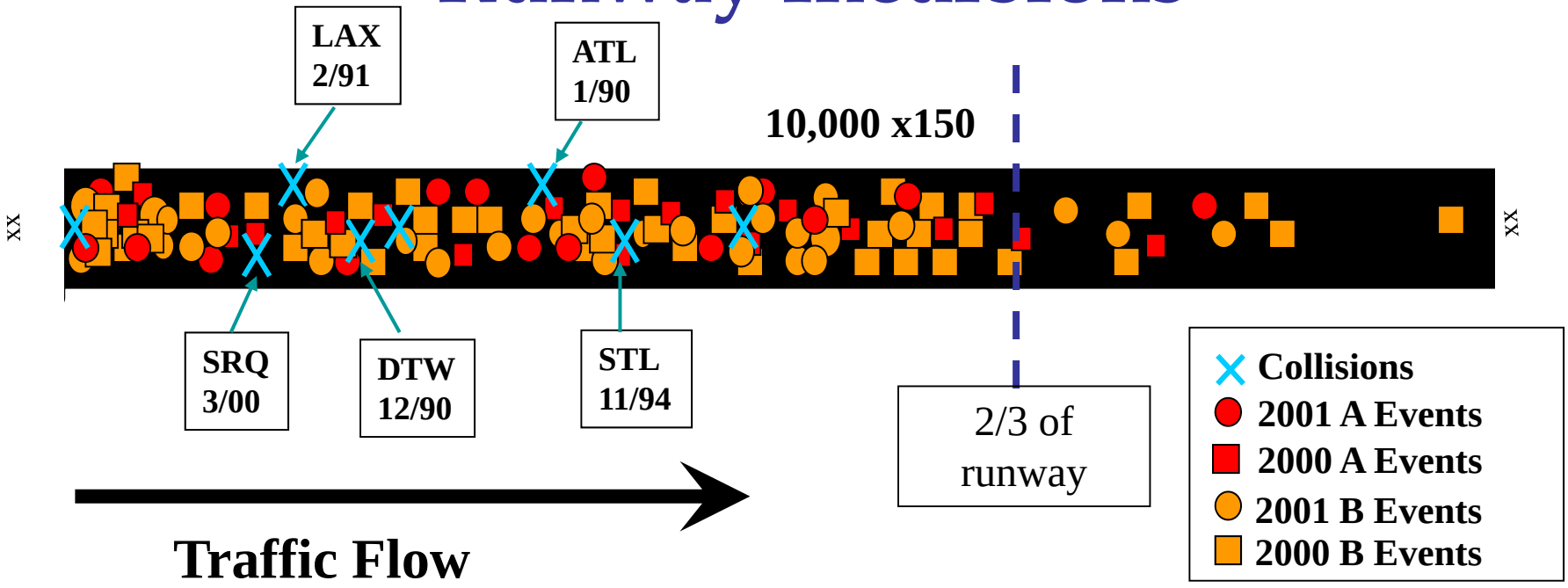
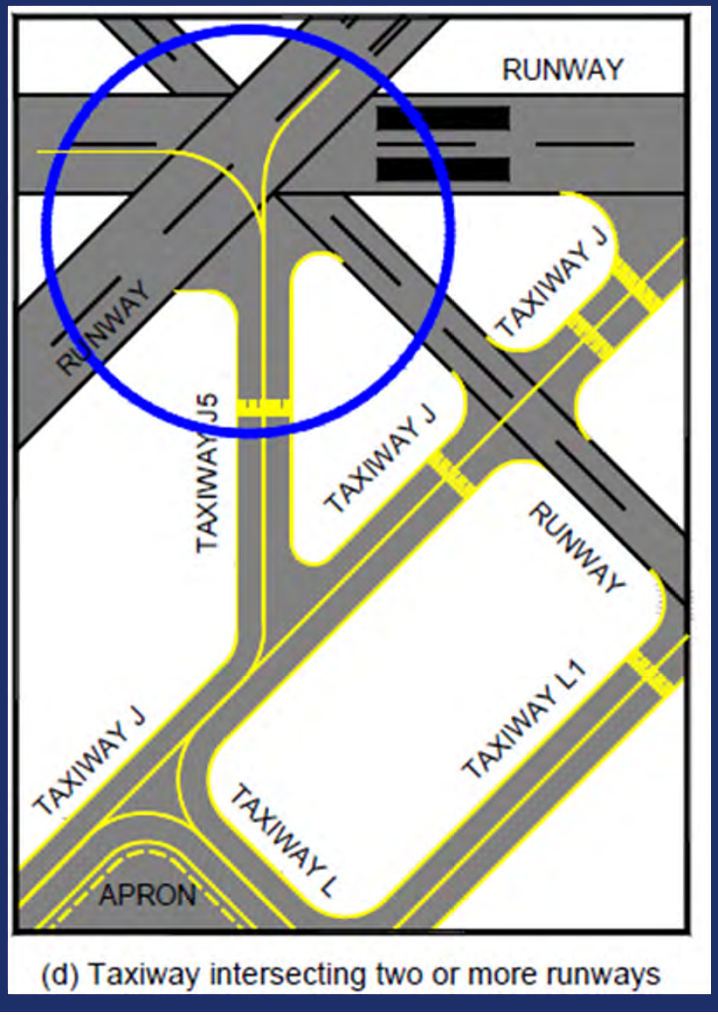
Location of all Runway Collisions at Towered Airports Since 1990 in USA



Location of Runway Fatalities at Towered Airports since 1990 in USA, with CY 2000 and 2001 Category A and B Runway Incursions



Problematic Taxiway Geometry - Not recommended for construction



(d) Taxiway intersecting two or more runways

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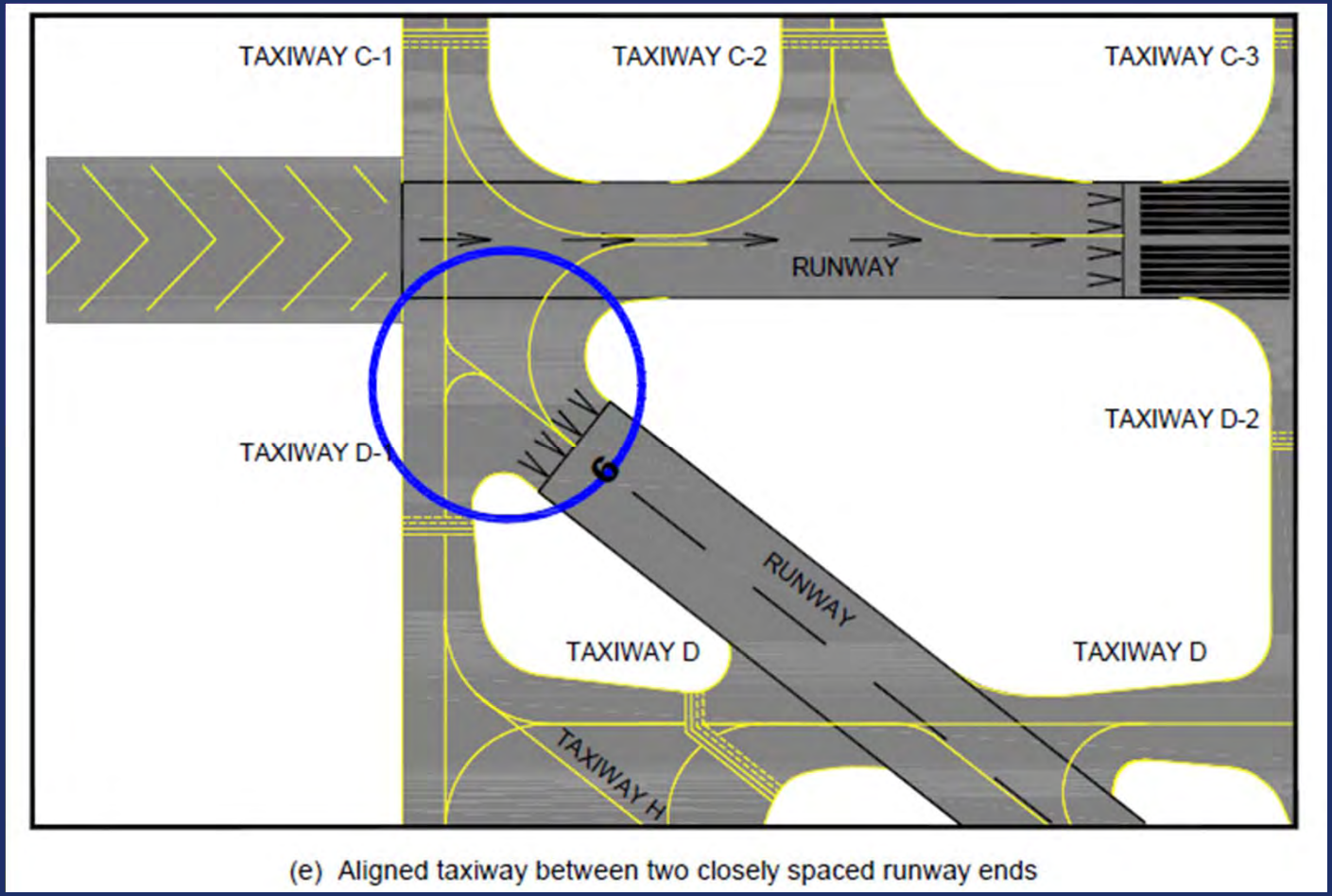
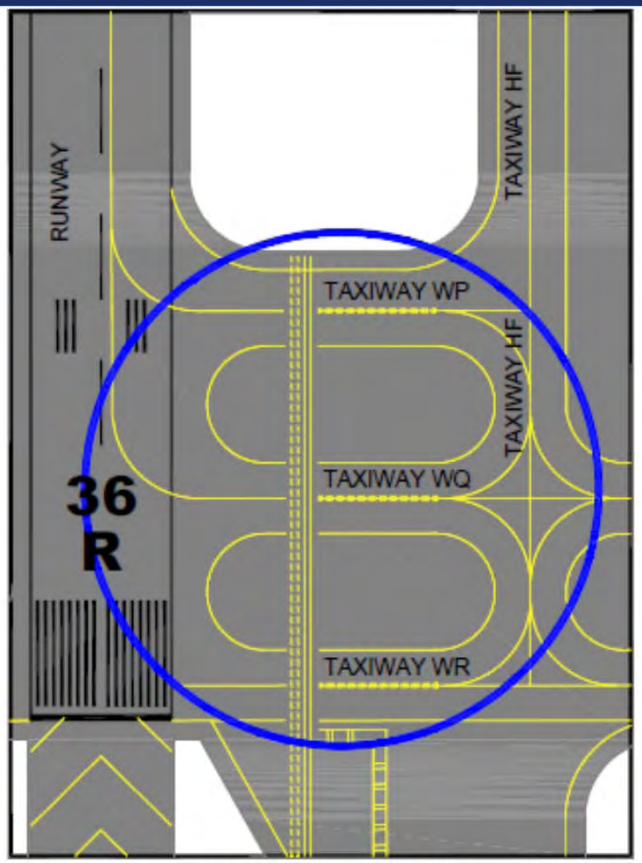
Problematic Taxiway Geometry - Not recommended for construction



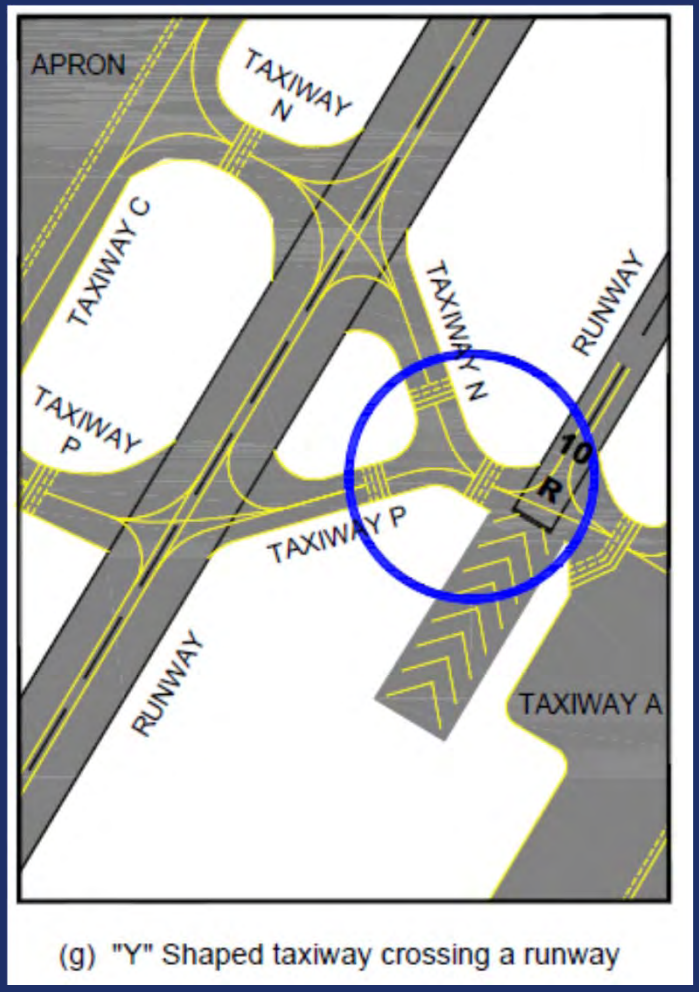
(e) Aligned taxiway between two closely spaced runway ends

Problematic Taxiway Geometry - Not recommended for construction



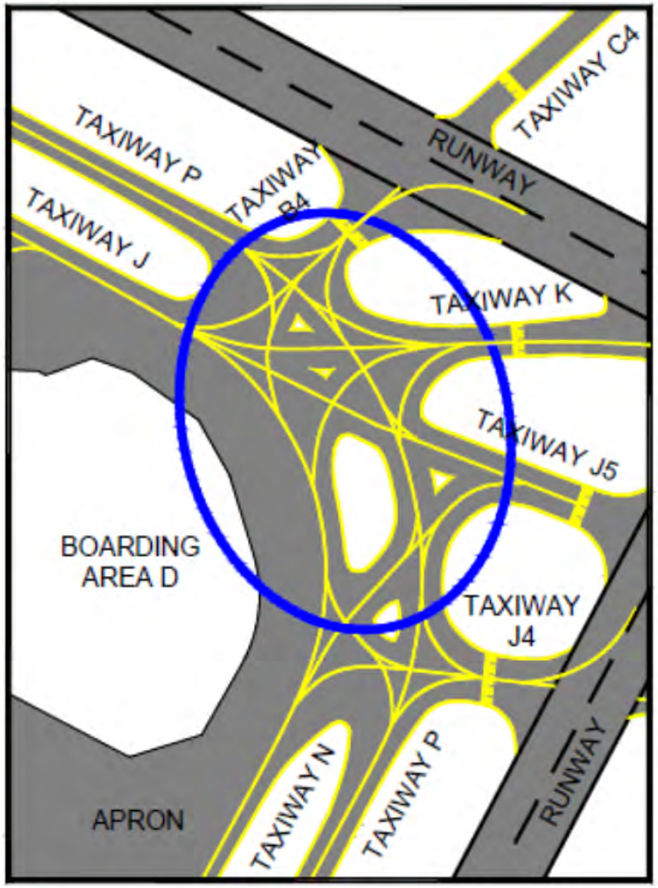
(f) Two or more taxiway entrances lacking "No Taxi" islands

Problematic Taxiway Geometry - Not recommended for construction



(g) "Y" Shaped taxiway crossing a runway

Problematic Taxiway Geometry - Not recommended for construction



(c) Taxiway intersection exceeds "3-node" concept

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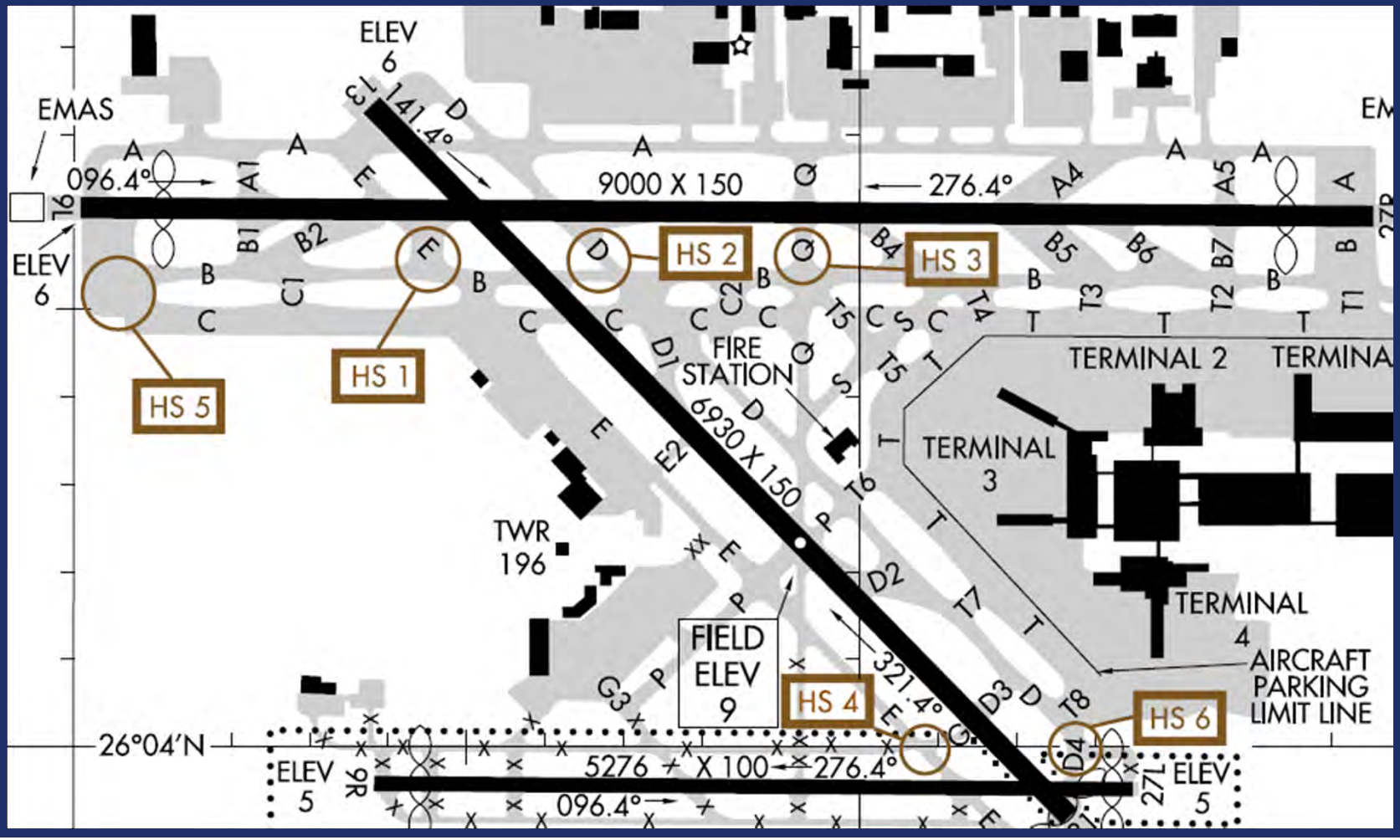
Practical Exercise



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Geometry issues – not captured in Engineering Brief 75

Apron taxiways with no parallel taxiway

- Often short taxi distance to runway
- Signage difficult
- Often protected only by painted markings

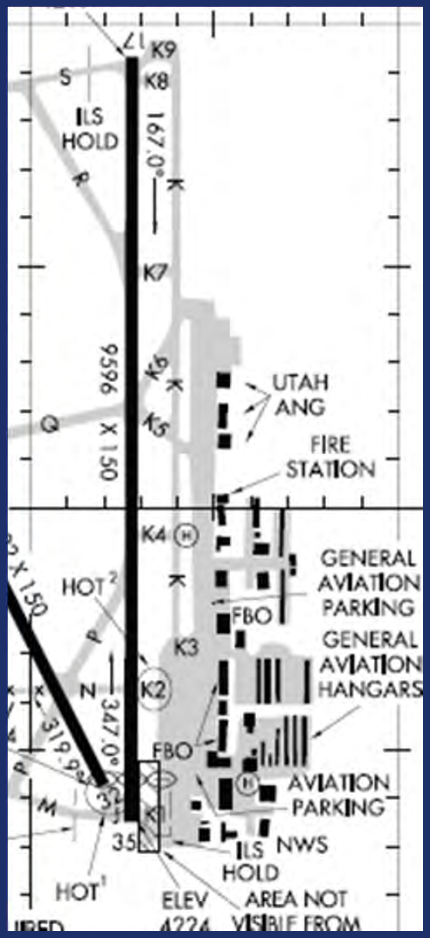
- **Human Factors issues**
  - Unexpected hold line locations
  - Look of a runway entrance
  - Approach hold lines

Apron Taxiways

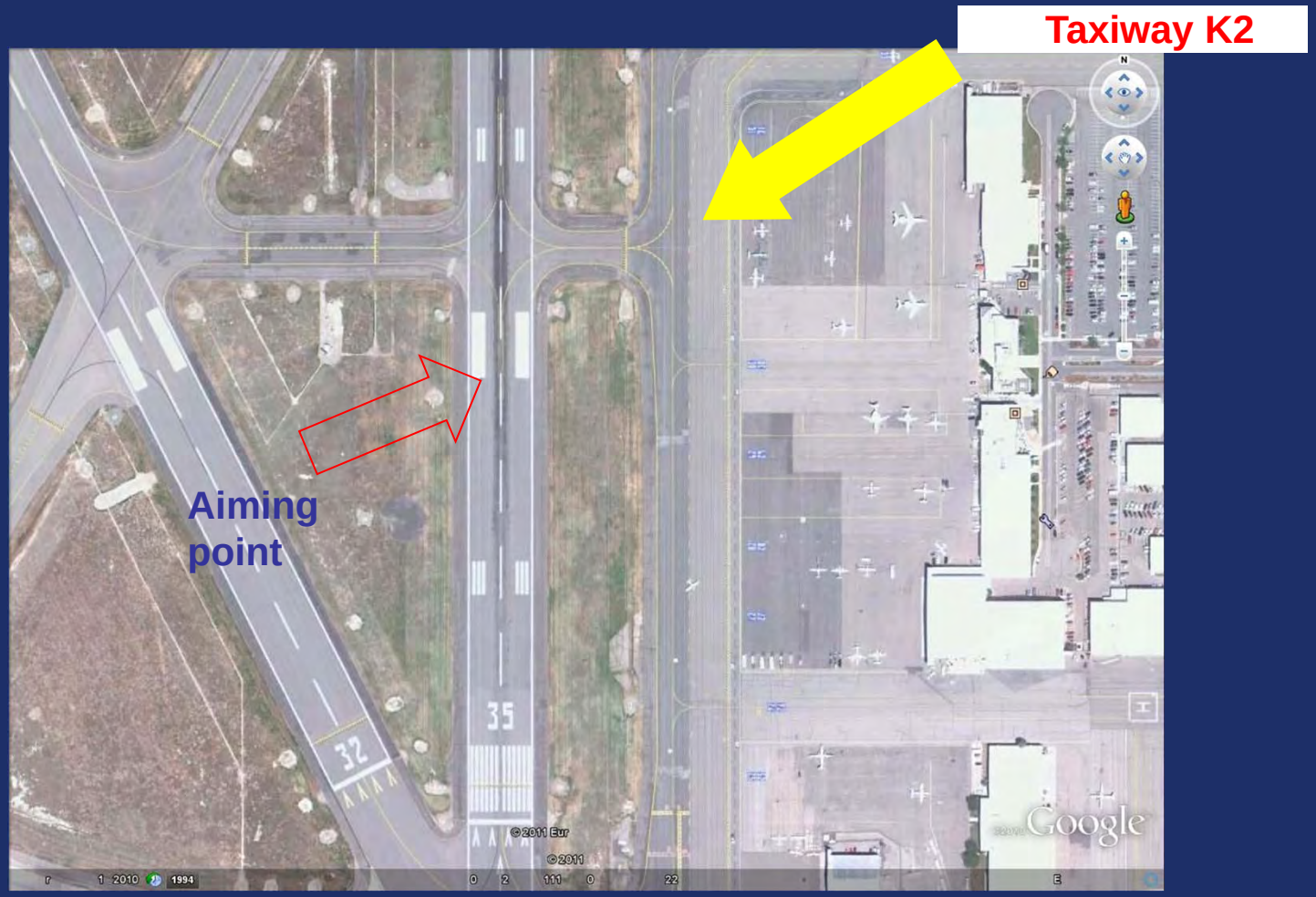
- **Pilots may expect …**
- **Ramp**
  - Grass
    - **Taxiway**
      - Grass
        - » **RUNWAY**
- **Provides for easy signage locations**
- **Pilots expectation is ramp is free for passage**
- **Apron taxiways usually marked/protected only with painted markings**

Salt Lake City, Utah

- **Taxiway Kilo is apron taxiway**
  - Protected only with painted markings
  - No signs for Kilo when leaving FBO ramp
- **On Airport Diagram, Kilo only labeled as parallel taxiway – north of GA area**
  - Continues across the ramp to the south
  - Common technique for airport diagrams



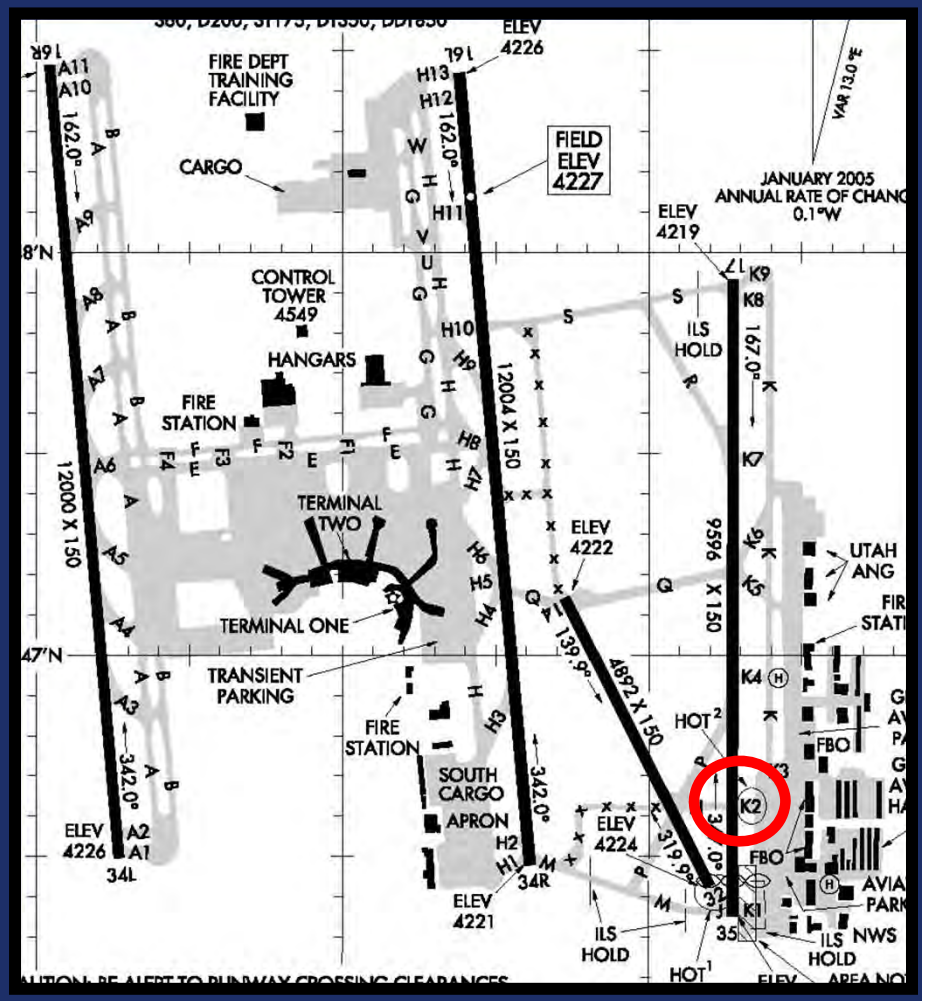
Apron Taxiway



SLC Runway Incursion

February 15, 2010. Pilot Deviation. Category C.

A Beech BE30 was issued taxi instructions via Taxiway Kilo to hold short of Runway 17 at Taxiway Kilo-5. The BE30 pilot read back the hold short correctly. Ground (GC) then instructed the BE30 to monitor tower on 118.3, which pilot read back. The BE30 then crossed Kilo and entered Runway 17 at Kilo-2 without clearance, taxied northbound and conflicted with a Cessna C560 on departure Runway 17 full length. Local (LC) canceled the C560s takeoff clearance. The pilot aborted, stopped by Kilo-7 and exited the runway at Kilo-7. The BE30 was instructed to exit the runway at Kilo-2 after making a u-turn between Papa and K-2. Distance from Kilo-2 to Kilo-7 is approximately 5,000 feet. This event met the parameters established within ASDE-X to cause an alarm and an alert was received.

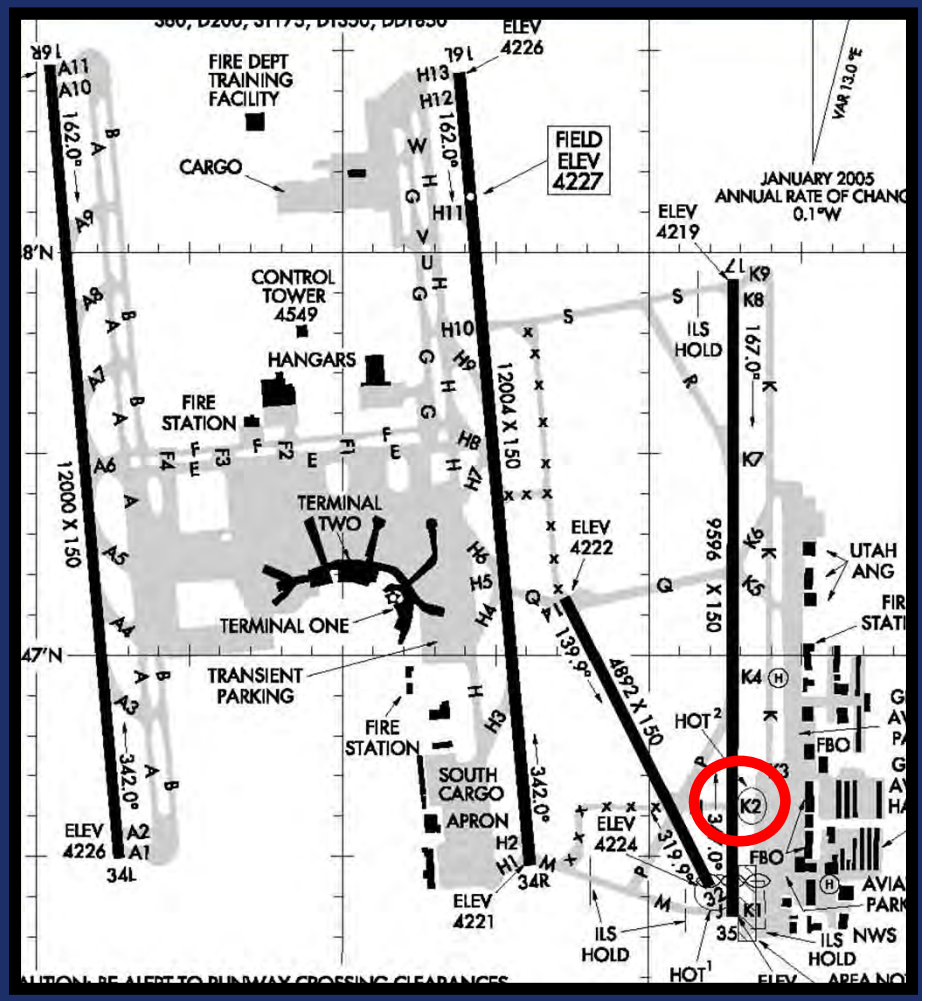


Aircraft entered runway without clearance at K2 while taxiing to 17

SLC Runway Incursion

November 1, 2009. Pilot Deviation. Category D.

A Cessna C425 was taxied to Runway 35 via Taxiway Kilo for departure. Subsequently the C424 entered Runway 35 at Taxiway K2 without clearance thus conflicting with a Piper PA28A on final same runway. The PA28A was issued a go around at 1.25 mile final to avoid loss of separation. The C425 was instructed to exit the runway.



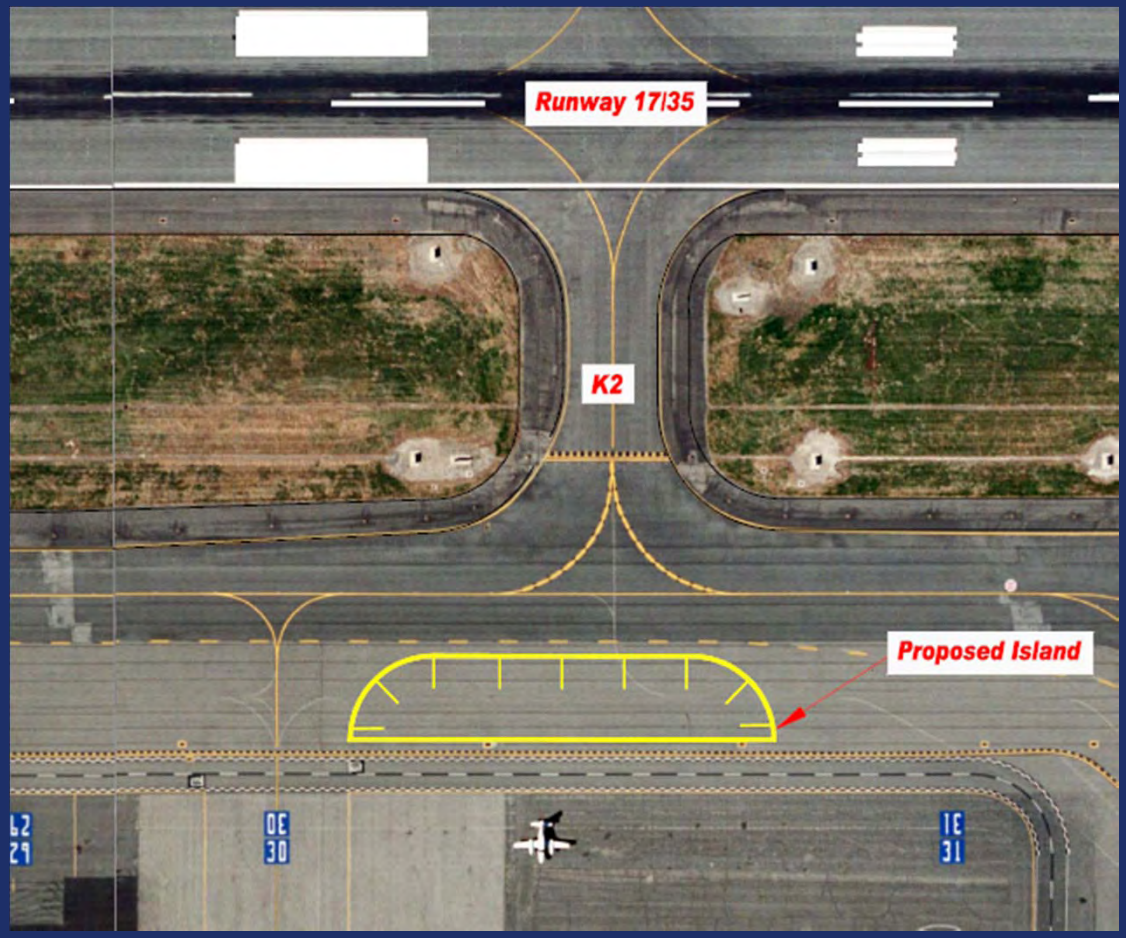
Aircraft entered runway without clearance at K2 taxiing to 35

Conclusion of PD investigations

- **Both of these pilots were instructed to taxi via Kilo and pulled out onto Runway 35 looking for Kilo**
  - Airport diagram didn't show Kilo where they were taxiing from
  - Missed painted markings on expansive ramp – snow present in second event
  - Their expectation that Kilo wasn't on ramp led them to taxi past hold signs, in pavement guard lights, hold lines,etc..
- **Both pilots had commercial rating**
- **Danger is high at K2 – touchdown point for Rwy 35**
- **RSAT team proposed closing K2 – airport implemented an alternative**

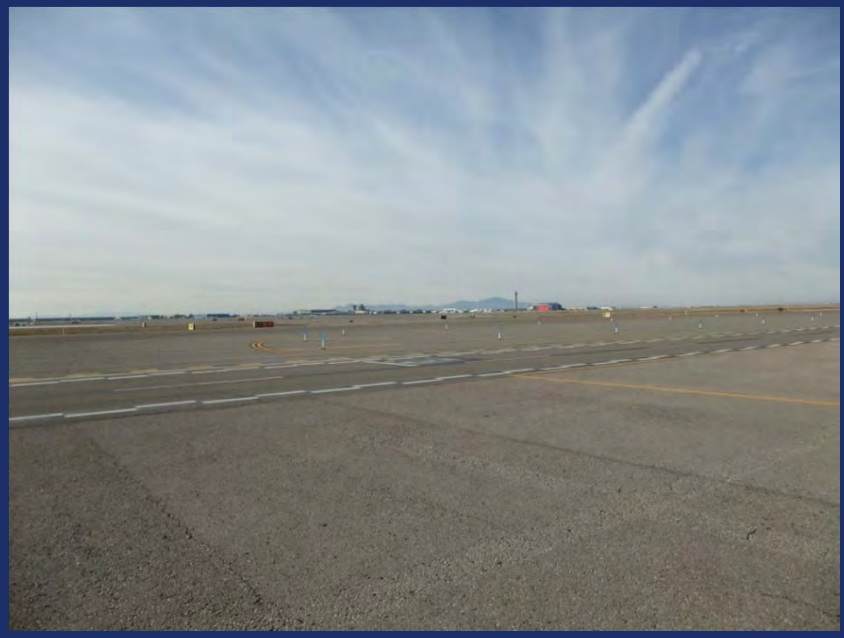
Taxiway K2 - Then

Mitigation – Island



Island protecting K2

Painted Island



DATA ARE PRELIMINARY AND
SUBJECT TO CHANGE

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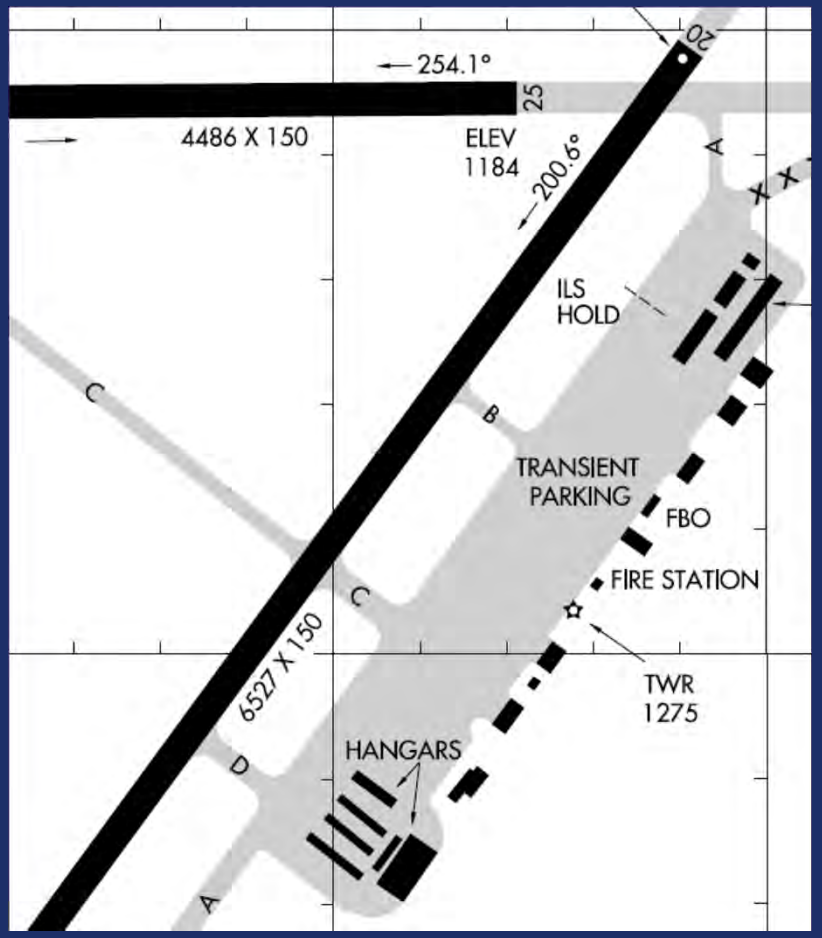
Signing an apron taxiway

- **AC 5340-18F, Standards for Airport Sign Systems**
  - Chapter 1 par 3 – Components of a sign system
  - D. Install a taxiway direction sign array **prior** to taxiway/taxiway intersection … where an aircraft would turn or hold short

Sign Challenges – Apron Taxiway ramp

- Runway 20, taxi via Alpha



Which taxiway is front of you?

Can you see the painted taxiway lines?

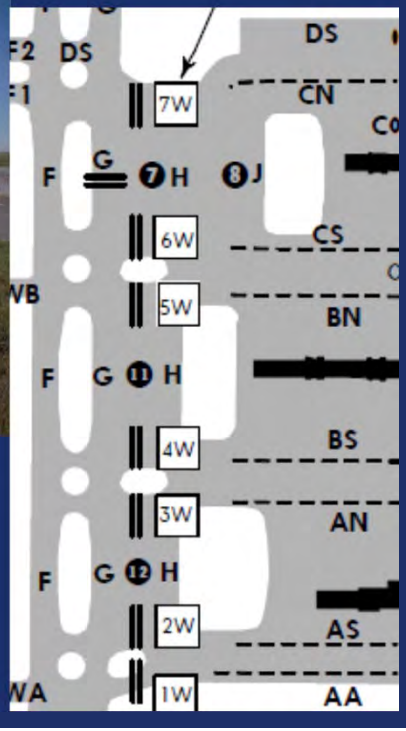
Where does ramp end and taxiway begin?

Sign placement

- **Taxi instructions will include all taxiways**
  - Includes taxiways on edge of ramp
- **Is signage visible to pilot?**
  - Many times signs are edge on for pilots
  - Need to consider visibility from typical approach angles
- **Sign standard only allows for signs AFTER taxiway**
  - Need exception for areas where sign in advance not possible

Approach Signs

- **Used extensively to protect surfaces**
- **Pilots don't stop unless directed**
- **Use runway hold lines**
- **At airports like DEN – used at 17 locations**
  - Serve as movement area boundary on west side

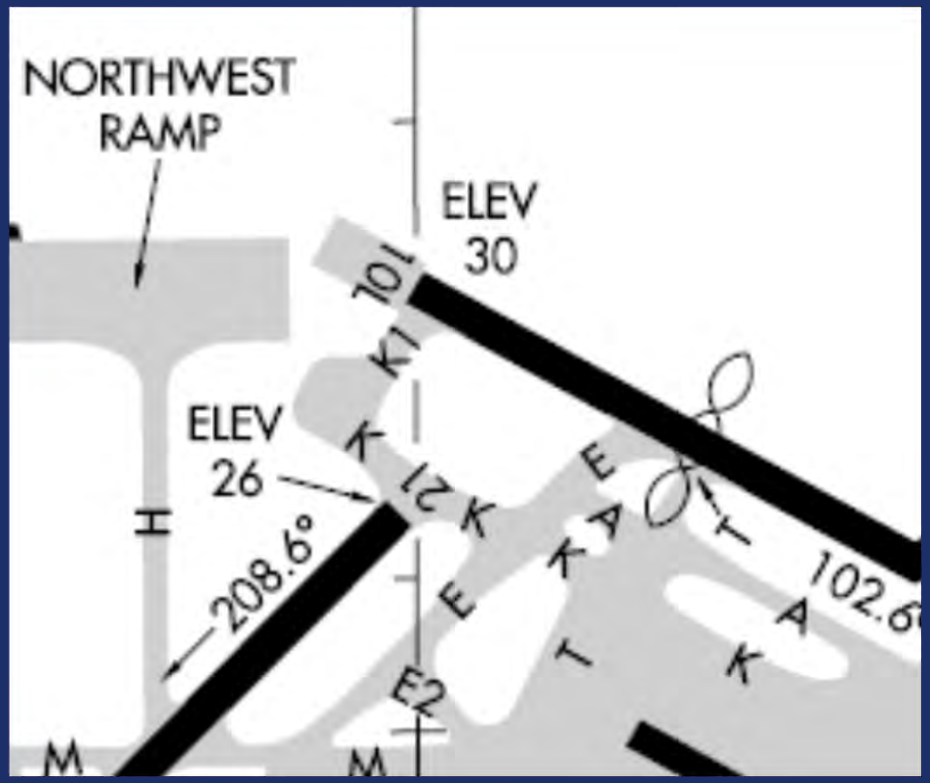


Approach Signs

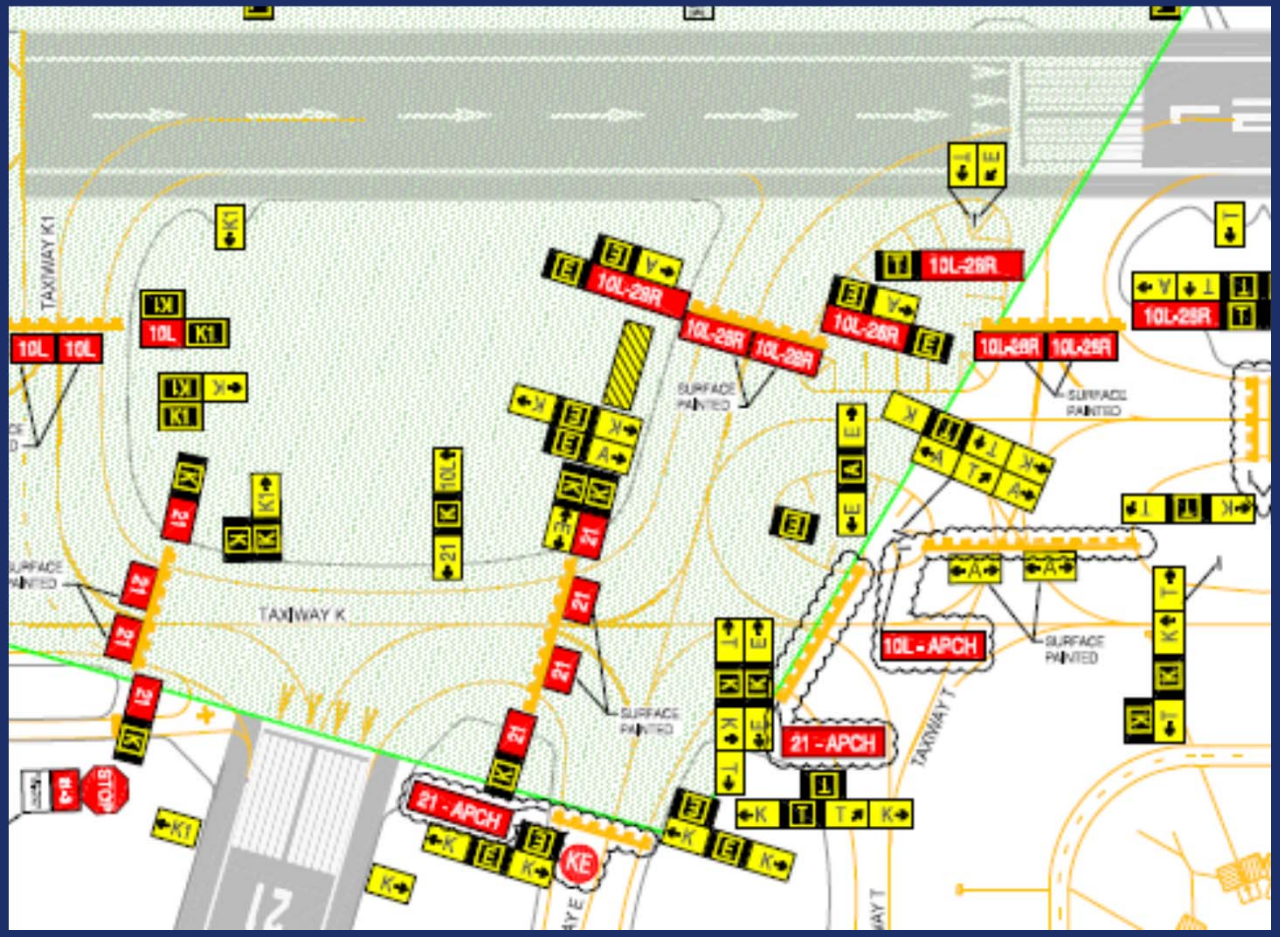
- **Human Factors concern**
  - Are we forming a habit with drivers and pilots crossing approach hold lines, without crossing instructions?
  - DOT Human Factors experts agreed this was a problem
- **Runway Safety recommended use of alternate marking**
  - ILS critical area marking (ladder marking)
  - Pilots already trained – stop when directed
- **Recommend encouraging use of alternative methods**
  - Hold short at taxiway intersections – can use taxiway hold marking
- **Use of approach hold can result in confusing situations**

Portland, Oregon

- Runway 10L and Taxiway Kilo extended
- Runway 21 shortened – threshold moved south
- Now multiple obstacle clearance surfaces need protection
- Proposal to use taxiway intersections to hold aircraft clear
- Concern about use of approach holds



Portland with Approach Holds



Preventing Construction Events

- **Brief operational constraints daily**
  - Don’t let expectations that a surface is closed lead to an incursion
- **Clear and unambiguous protection for closed surfaces**
- **Escort procedures for deliveries and untrained drivers**
- **Train on dangers of runway incursions, critical signs and markings**

Use of barricades

- **Barricades are sometimes**
  - Used to indicate no entry
    - Protecting a runway – or protecting a taxiway where no entry is allowed
  - Used to protect areas where vehicles must give way to aircraft
    - Barricades placed so that vehicles know the boundary – but can look and go
- **Make sure intent is clear**
  - Signage is what may make the difference

Relocating a Threshold for Construction

- **Cover up at least the runway numbers**
  - Suggest covering with landscape fabric and sandbags
  - Blasting the markings off can leave residual marks that look like painted marking
- **Consider using alternate material to fencing for chevrons**
- **Temporary PAPI or VASI is a great idea**

Runway Safety Construction Risks

- **Change in taxi patterns**
  - Pilots may be asked to take an unfamiliar route
  - Is signage adjusted for new routes
  - Are extra runway crossings required?
    - Locations of runway crossings can affect risk
  - Do taxiway closures require back taxi on runway?
- **Closure of runways**
  - Visual Glide Slope, runway lights,etc off
  - Leave signs for closed runways
    - ATC must clear aircraft across even closed runways