# Visual Guidance Research & Development

## Update

**Given by: Lauren Vitagliano**

**IESALC Spring meeting May 8, 2014**
**Washington, DC**

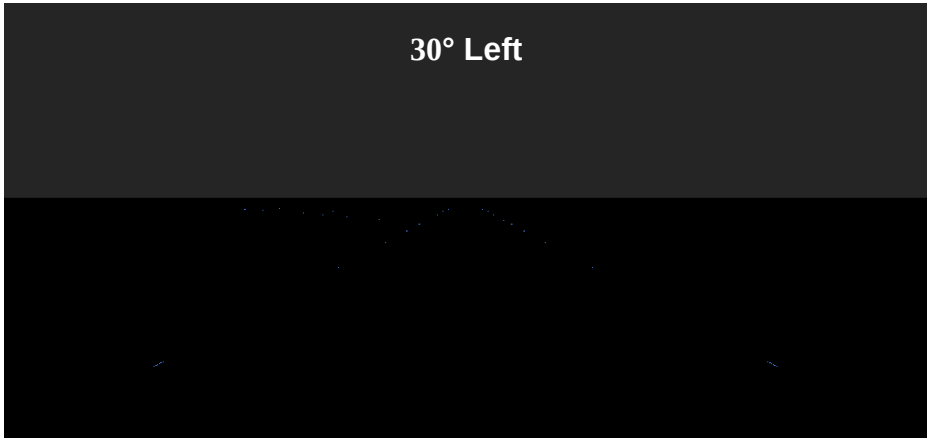
# TOPICS

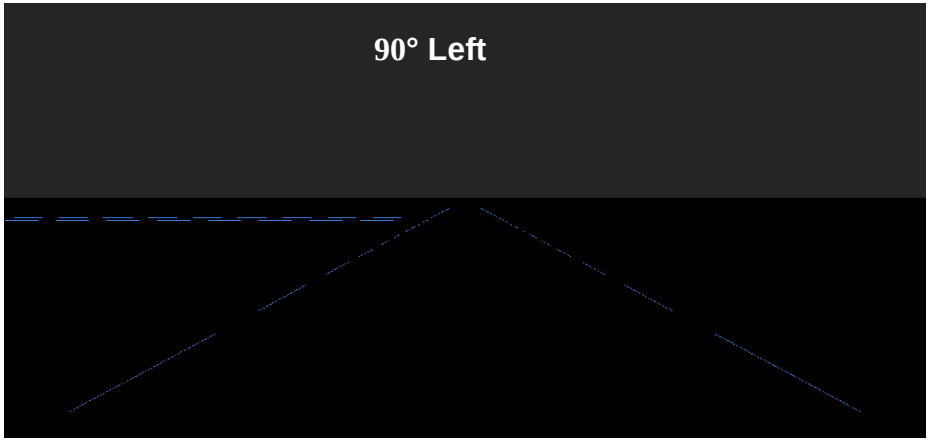
1. Airport Linear Source Visual Aid
2. Frangible Connections and Structures
3. Electrical Infrastructure Research
4. Constant Current Regulator Loading
5. Safety Orange Visual Aids for Airport Construction
6. Enhanced Visual Aids for EMAS
7. RSA/Approach Hold Signs and Markings

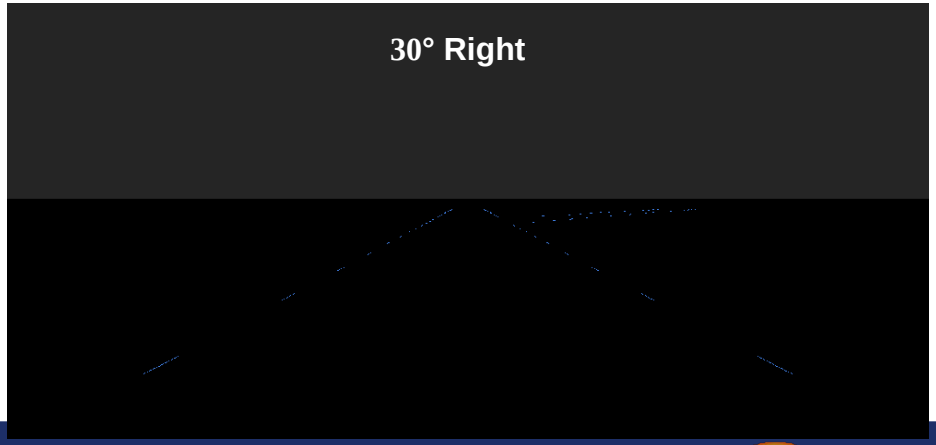
# Airport Linear Source Visual Aid

# Experiment 1 Stimuli – “No Noise”

- Linear element spacing: 50, 100, 200 ft
- Linear element length: 2, 8, 32 ft
- Configurations: 90º (low-speed taxiway exit) and 30º (high-speed taxiway exit), left and right

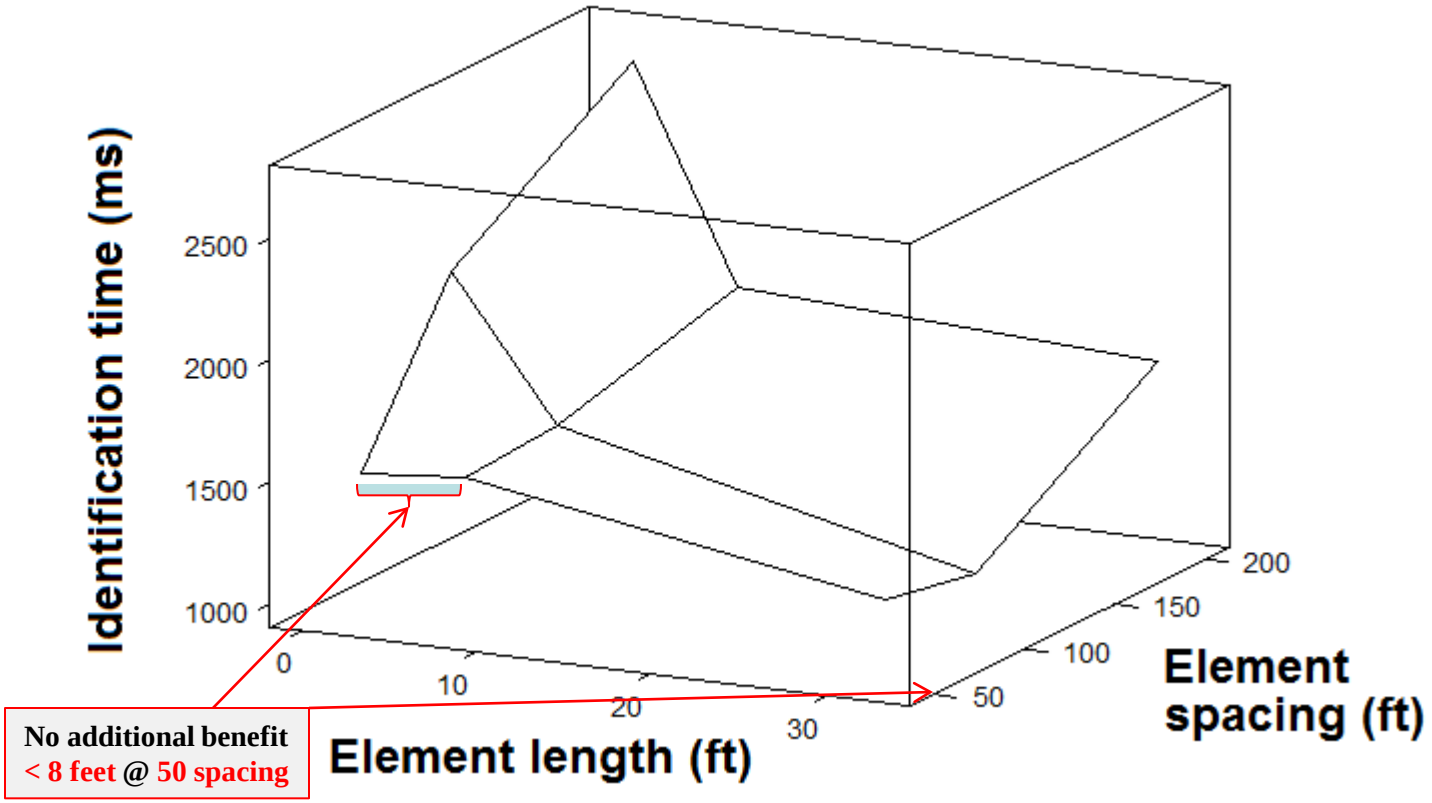


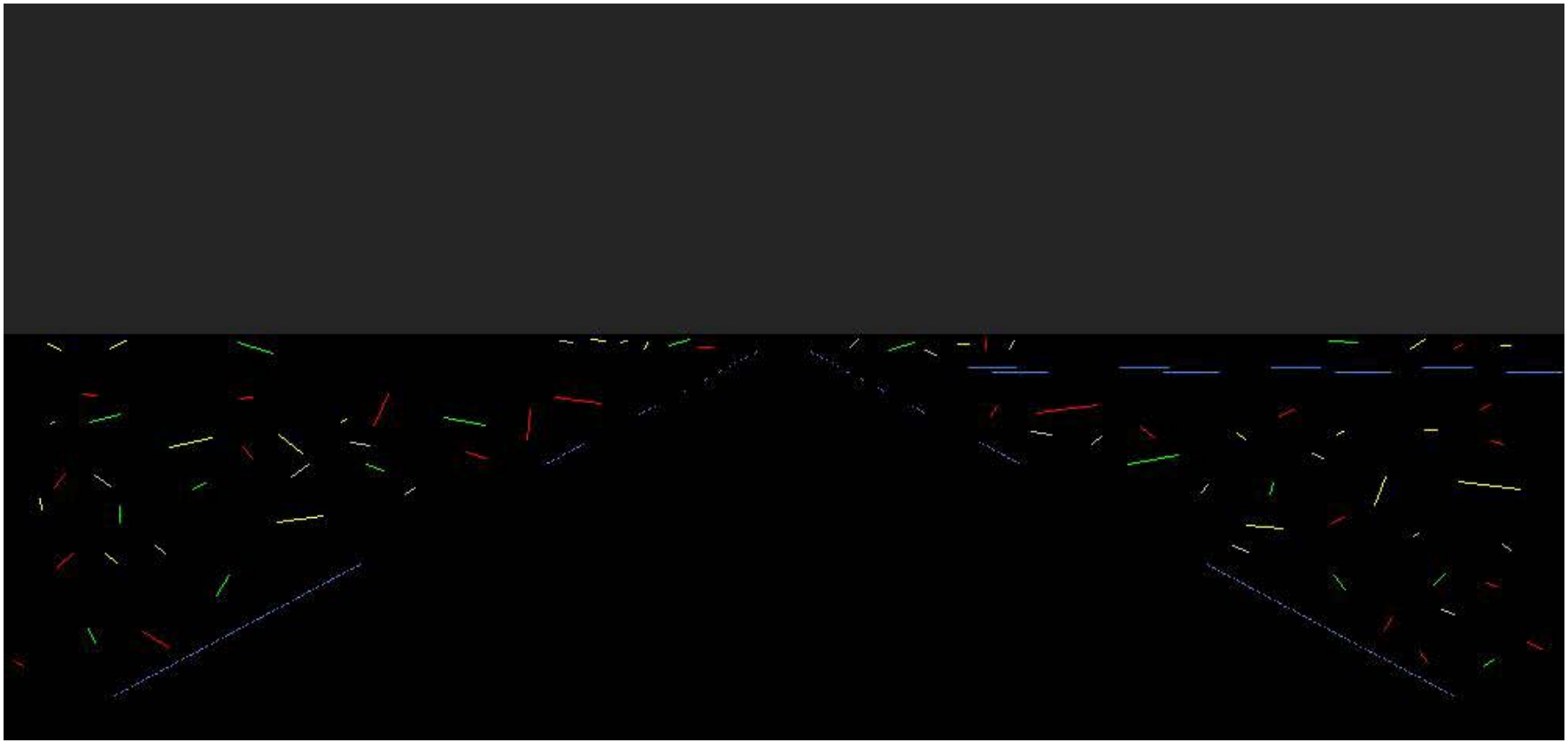



# Experiment 1 Results – No Noise

**Accuracy was always > 90%**

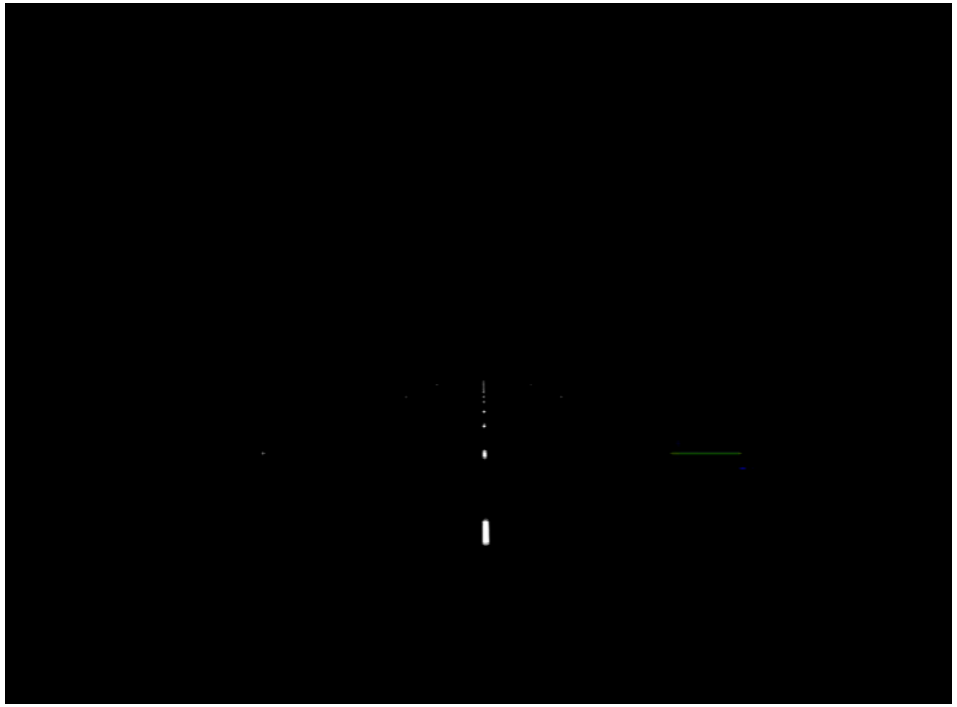


# Experiment 2 Stimuli – Visual Noise



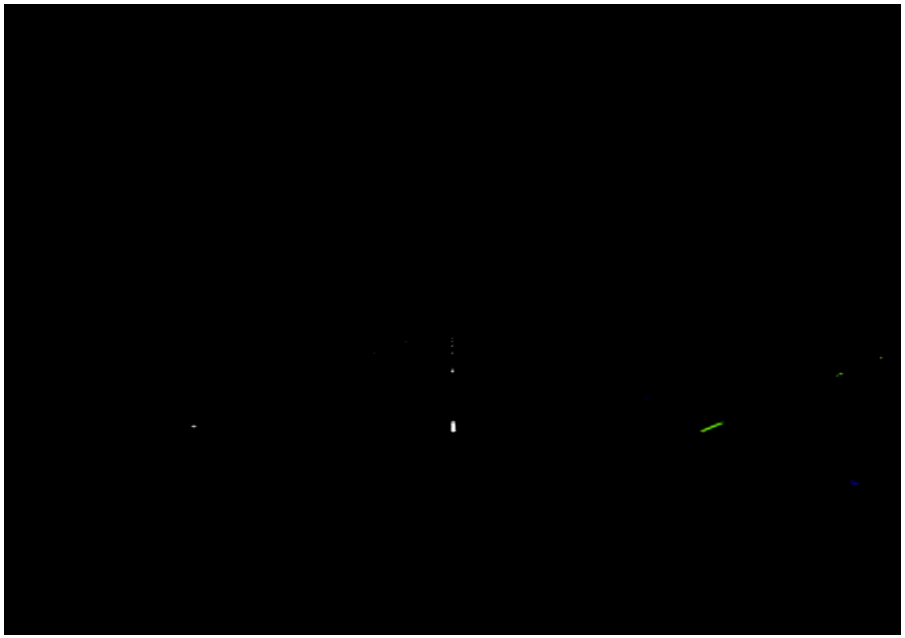
# Experiment 3 - Dynamic

- Dynamic animation starting from 2000 ft away, 50 mph
- 30º/90º left/right taxiway from runway
- Centerline delineation (white/runway, green/taxiway)
- 2, 8 or 32 ft element length; 50, 100, 200 ft spacing



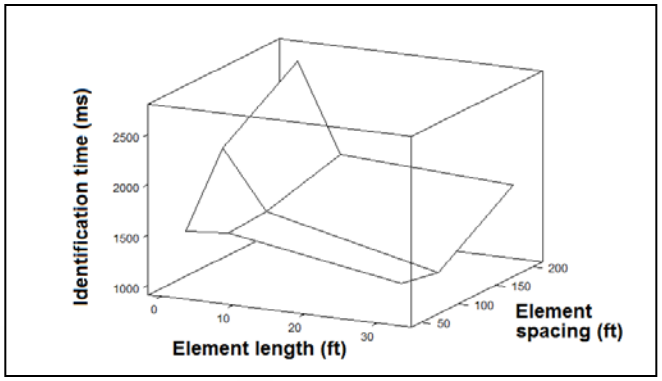
# Experiment 4 – Lower Intensity

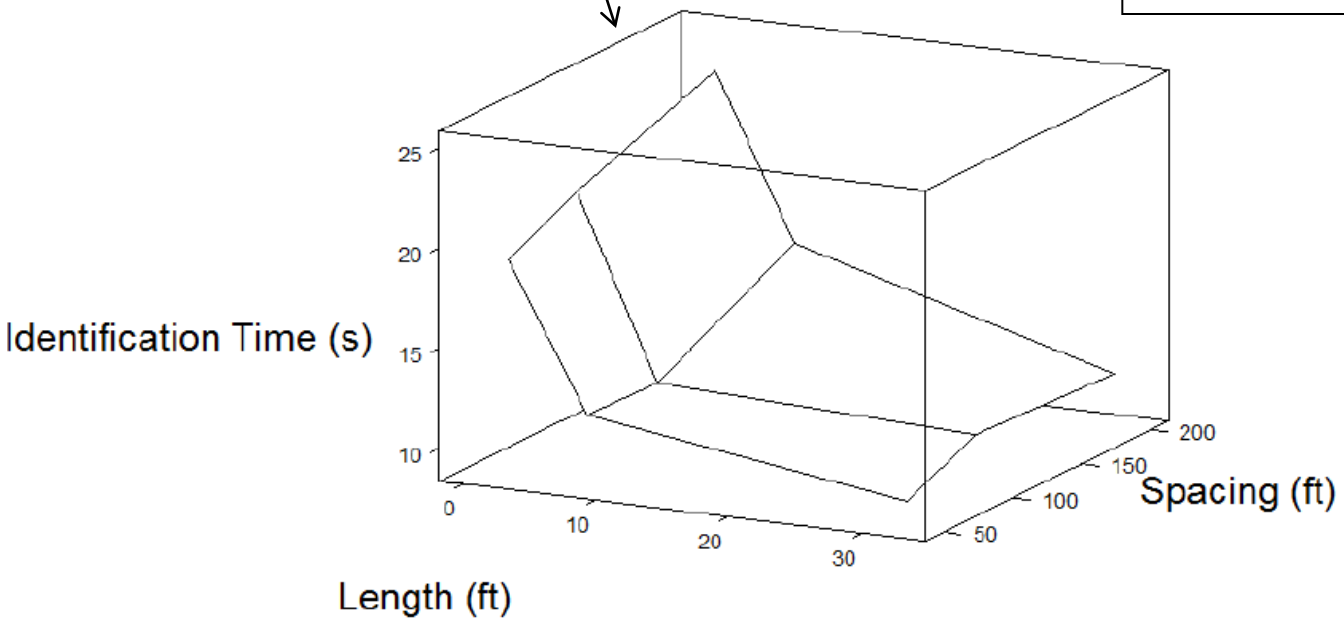
- Same as experiment 3 except luminance was decreased to:
  - White 30 cd/m²
  - Green 18 cd/m²
  - Blue 1.8 cd/m²
  - Background 0.25 cd/m²



# Experiment 2 to 4 Results

**Same correlation between Length and Spacing to Reaction Time in all experiments**

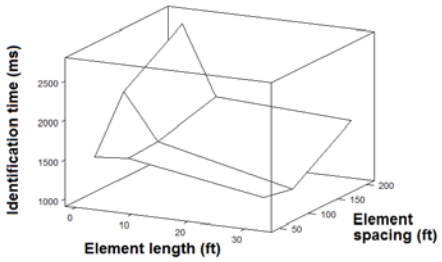



Correlated ($r^2$=0.69) to Experiment 1 & 2 results

Factor: 8.8x

# Developed Predictive Response Time Equation




$$RT\ (ms) = 286 - 607 \log L + 989 \log S$$

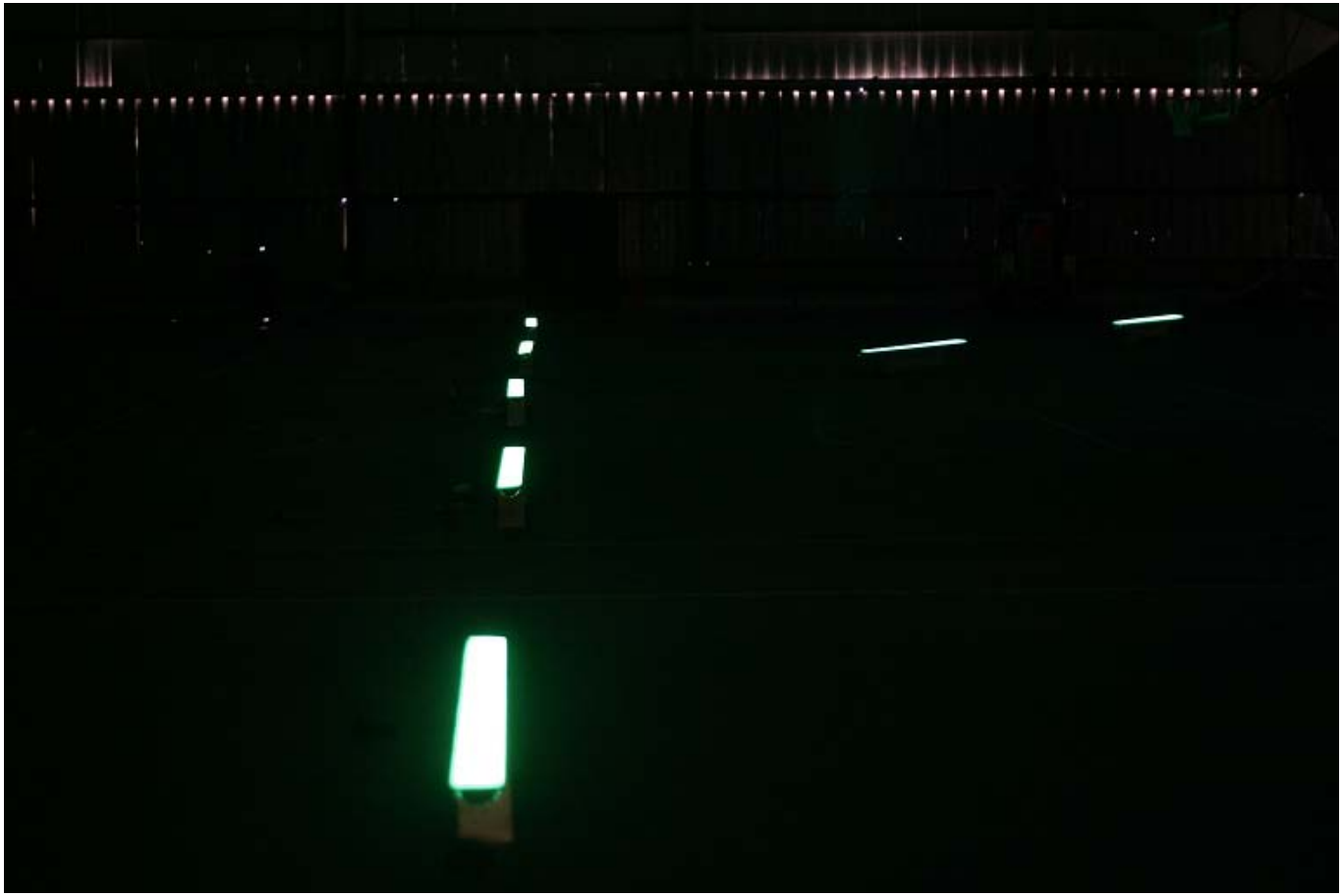
**Combinations of delineation element length and spacing to achieve the same relative response times expected from 2-ft-long delineation elements spaced at 50 ft and 100 ft.**

| | | | | | |
|---|---|---|---|---|---|
| Base Case 1 | Element length | 2 ft | **6.2 ft** | **12.0 ft** | **19.2 ft** |
| | Element spacing | 50 ft | 100 ft | 150 ft | 200 ft |
| | Relative response time | 1784 ms | 1784 ms | 1784 ms | 1784 ms |
| Base Case 2 | Element length | | 2 ft | **3.9 ft** | **6.2 ft** |
| | Element spacing | | 100 ft | 150 ft | 200 ft |
| | Relative response time | | 2081 ms | 2081 ms | 2081 ms |

# Validation Study

- Validation study was conducted using the 9 linear segments created with blue and green LED sources.
- For the experiment, prototype linear light source segments in 2-ft, 4-ft, and 8-ft lengths were used at a 25-ft and 100-ft spacing.
- The experiment was conducted in a large and enclosed space where the ambient illumination could be turned off.
- The results were consistent with the laboratory experiments using computer displayed images.

# Validation Study



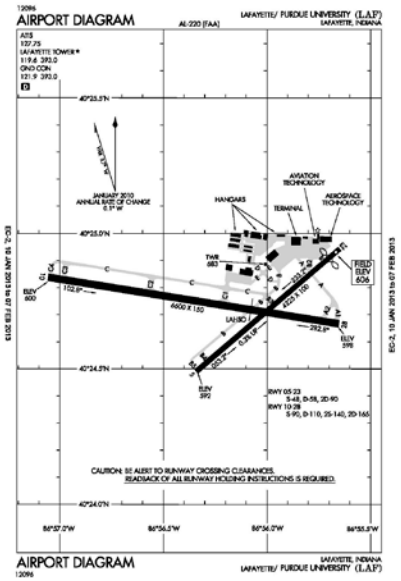
View of one of the test conditions as presented to observers that participated in the validation field experiment.

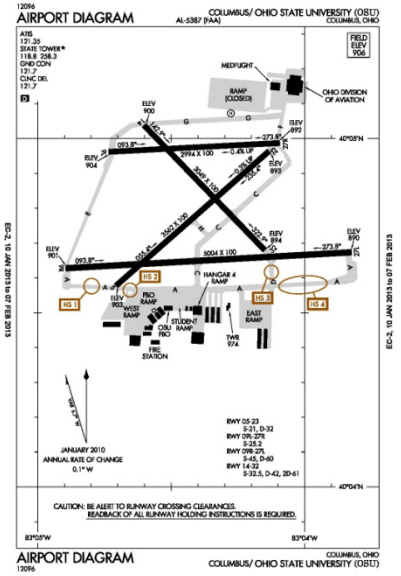
# PHASE THREE

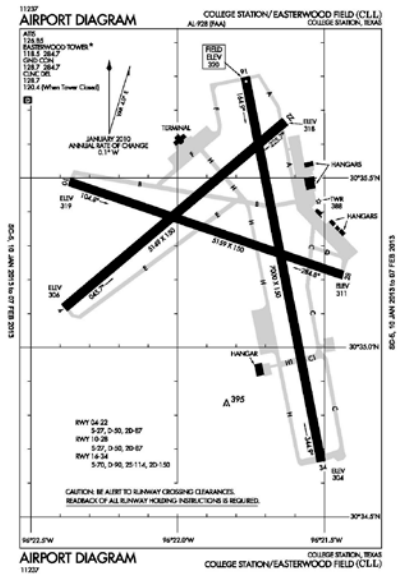
- **Task 1: Conduct  a simulation evaluation. (4 months)**
  - **Utilizing the FAA Technical Center's Simulation facility.**

# PHASE THREE

- **Task 2: Conduct a field evaluation. (6 months)**
  - **Utilizing the Partnership to Enhance General Aviation Safety, Accessibility and Sustainability (PEGASAS) Center of Excellence.**
  - **Three of the six core members also own and operate their own airports (Purdue, Ohio State, Texas A&M).**



# Schedule

| Activity | Completion |
|---|---|
| Test Plan | 02/28/12 |
| Phase 1 | 09/30/12 |
| Analysis/Decision Point | 10/31/12 |
| Phase 2 | 02/15/13 |
| Analysis/Decision Point | 02/27/13 |
| **Extended Phase 2** | **07/31/13** |
| **Phase 3** | **06/30/15** |
| **Final Report to Sponsor** | **09/30/15** |

# Frangible Connections and Structures

# Research on Frangible Connections and Structures

## Project Objective:

**Develop a better methodology for measuring and evaluating the frangibility characteristics of connections/structures intended for use on airport RSAs and TSAs.**

## Goal:

- **Simplified and standardized testing procedures**
- **Identify potential areas that require clarification**

# Frangible Structures

**Prioritized Listing of Airfield Structures for Simulation, Testing, and Analysis:**

- FAA Approved Approach Lighting Systems
- Frangible Configuration of the End Fire Glide Slopes (EFGS)
- Composite Jet Blast Deflectors
- ILS localizer Array
- Small Monopole Structures (Wind Cone, Anemometer)
- PAPIs and REILs
- Airfield Signs

# Types of Frangible Connections

Application of Fuse Bolts

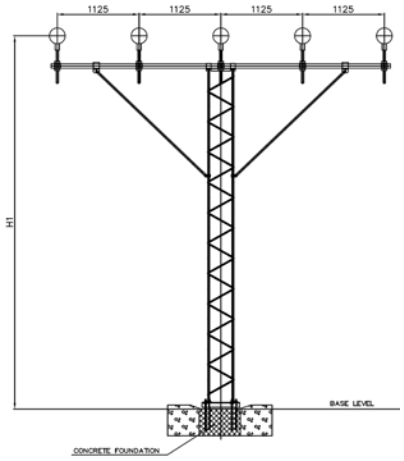
Examples of Frangible Couplings

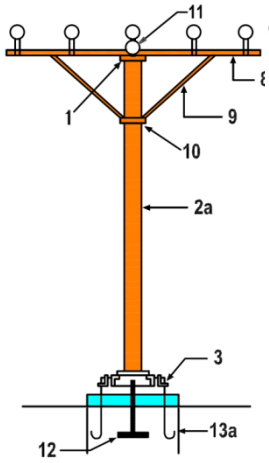
# Research on Frangible Connections and Structures

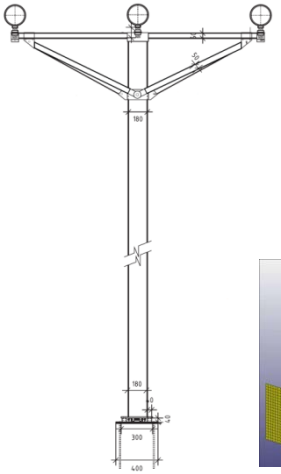
## Phase I:

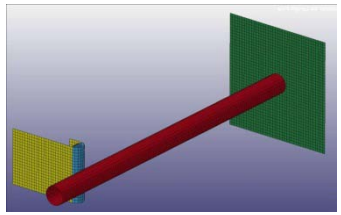
- Task 1 Requirements Analysis ← **Completed**
- **Task 2 Finite Element Development**
- **Task 3 Test Setup Development** ← **On-going**

## For Simulation:





# Research on Frangible Connections and Structures

**Phase II:**

- **Task 4 Test Plans / Procedures Development**
- **Task 5 Test Setup Fabrication**
- **Task 6 Dynamic Testing and Evaluation**
- **Task 7 Guidebook Development**

# Electrical Infrastructure Research

# Issues resulting from LED implementation in the Current 6.6A Series Airfield Lighting System

- **Added complexity and cost to the LED fixture due to the addition of electronics to mimic the non-linear dimming curve of incandescent lighting.**

- **LEDs must convert the supplied AC current to a DC current of lower amplitude at the array.**

# Electrical Test Goals

- **Characterize each system's electrical performance**
- **Characteristics will be analyzed for the development of report**
- **Electrical measurements include power consumption analysis, efficiency of the system, harmonics and electrical emissions**
- **Fixture level testing includes power analysis at each fixture**

# EIRT Testing Team Recommended Two Paths

- **Path # 1:**
  - **Fixture Centric**
    - **An airfield lighting architecture where the fixture controls its intensity**

- **Path # 2:**
  - **Vault Centric**
    - **An airfield lighting architecture that directly controls the fixture intensity from the power source in the vault (same as the traditional 6.6 amp)**

# Architectures Tested

VAULT CENTRIC ARCHITECTURE


VAULT CENTRIC ARCHITECTURE

FIXTURE CENTRIC ARCHITECTURE

FIXTURE CENTRIC ARCHITECTURE

# Roadmap Testing Phase

- ***Alpha testing at FAATC, May 2014***
  - Integration including mixing of product
  - Fixtures will be instrumented and monitored by FAA equipment to determine performance
  - Identify any deficiencies, or adjustments to be made

- ***Beta testing at PEGASAS Airport July, 2014***
  - Similar set up as alpha testing
  - Large circuit
  - Legacy mode will be available in case there is an issue with the circuit

# Investigation of Maximum Constant Current Regulator Loading

# Project Objectives

- **Investigate reports of overloaded CCRs relating to a predominance of constant Volt-Amperes (VA) sign**
- **Investigate if restrictive maximum loading at lower steps for CCRs is specific for a particular CCR technology**
- **Determine any relationship between lower step loading and the use of Light Emitting Diode (LED) fixtures**
- **Determine if the lighting system power factor has an adverse effect upon the CCR**
- **Investigate the impact on power factor and input power when CCRs are under loaded.**

# Test Locations

- Louis Armstrong New Orleans International Airport (MSY), New Orleans, LA
- George Bush Intercontinental/Houston Airport (IAH), Houston, TX
- Ryan Field Airport (RYN), Tucson, AZ

# Schedule

| Event/Deliverable | Tentative Completion Dates |
|---|---|
| Airport Circuit Investigation/Testing | April 4, 2014 |
| FAATC Post Investigation/Testing | July 31, 2014 |
| Analysis/Draft Report | August 29, 2014 |
| Final Report/Recommendations | November 15, 2014 |

# Safety Orange Visual Aids during Airport Construction

# Safety Orange Visual Aids during Airport Construction

**Project Objective:**

To produce measures to reduce the number of runway incursions and accidents that might be caused due to construction.

- FAA is working with Air Traffic Organization Airport Construction Advisory Council (ACAC) on this project

# Visual Aids and Markings used during Construction

## Current Visual Aids

# Scope of Work

- **Collect data from existing construction sites**
- **Develop alternative sign and portable/reflective visual aids**
- **Simulation**
- **Field Installation and Evaluation – PVD, ISP, SFB, PDX, & ORD**

# Field Installations at PDX


# Findings

- **“CONSTRUCTION AHEAD” sign - 109 respondents**
  - **87% sign was conspicuous.**
  - **88% sign was comprehensible at an adequate distance.**
  - **90% sign adequately notified them of the existing construction.**
- **“CONSTRUCTION ON RAMP” sign - 51 respondents**
  - **92% sign was conspicuous.**
  - **88% sign was comprehensible at an adequate distance.**
  - **94% sign adequately notified them of the existing construction.**
- **Currently conducting additional research on TORA sign**

# Enhanced Visual Aids for EMAS

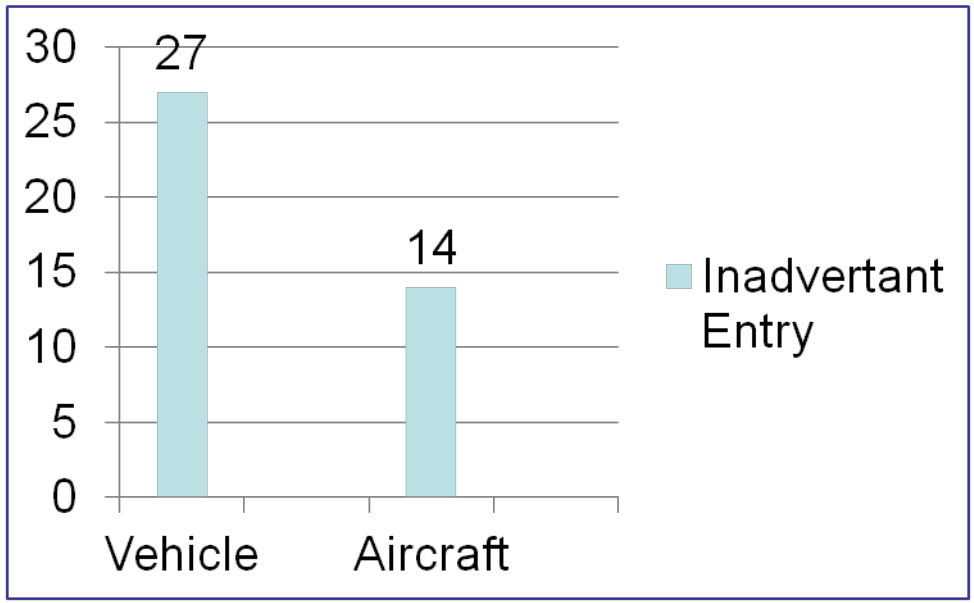
# Enhanced Visual Aids for EMAS

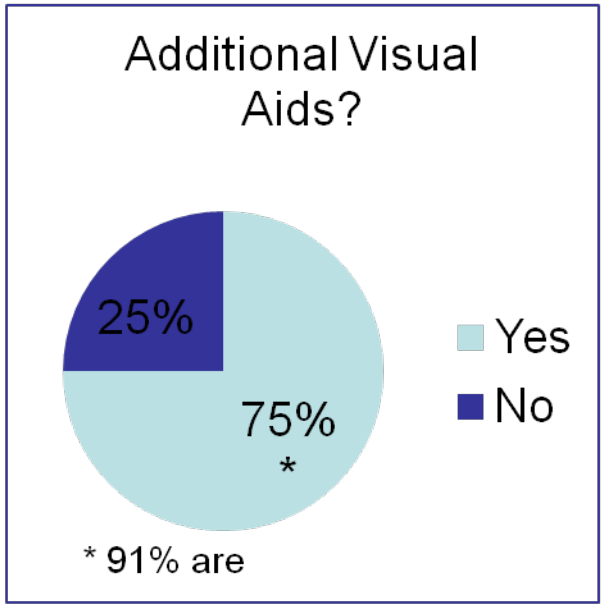
**Project Objective:** Determine if additional EMAS visual aids are required for pilot awareness

•Determine if additional EMAS visual aids are required for preventing inadvertent vehicle and aircraft entry

# Enhanced Visual Aids for EMAS

- Surveyed 42 airports with 63 EMAS beds
  - Incidents
  - Existing markers in place
- Surveyed 399 pilots
- Input from SMEs (EMAS Manufacturer, Airport Certification Inspectors)



# Current EMAS Markings/Signage



# Scope of Work

- **Simulations**
- **Field Evaluations**
- **Field Installations**

# Enhanced Visual Aids for EMAS

- **Recommendations**
  - Red, retroreflective markers, 18” or 24” in height, spaced 7.5’ apart around the sides and rear of EMAS.
    - Yellow, retroreflective markers, 18” or 24” in height, spaced 7.5’ apart along the front of EMAS.
    - Engineering brief with specifications under development
    - Additional research for signage – currently ongoing

# APCH Hold/RSA Signage & Marking

# APCH Hold/RSA Signage & Marking:

There are inconsistencies in implementing approach hold signs, marking and procedures among the nation's airports, causing confusion among ATC, pilots, airport operators and cert inspectors.

**Project Objective:** Install and test new signs and markings as recommended in the Safety Risk Management Document (SRMD) from the Approach Hold Workgroup to protect other critical surfaces like RSA, approach, departure, etc.

# Current Configuration

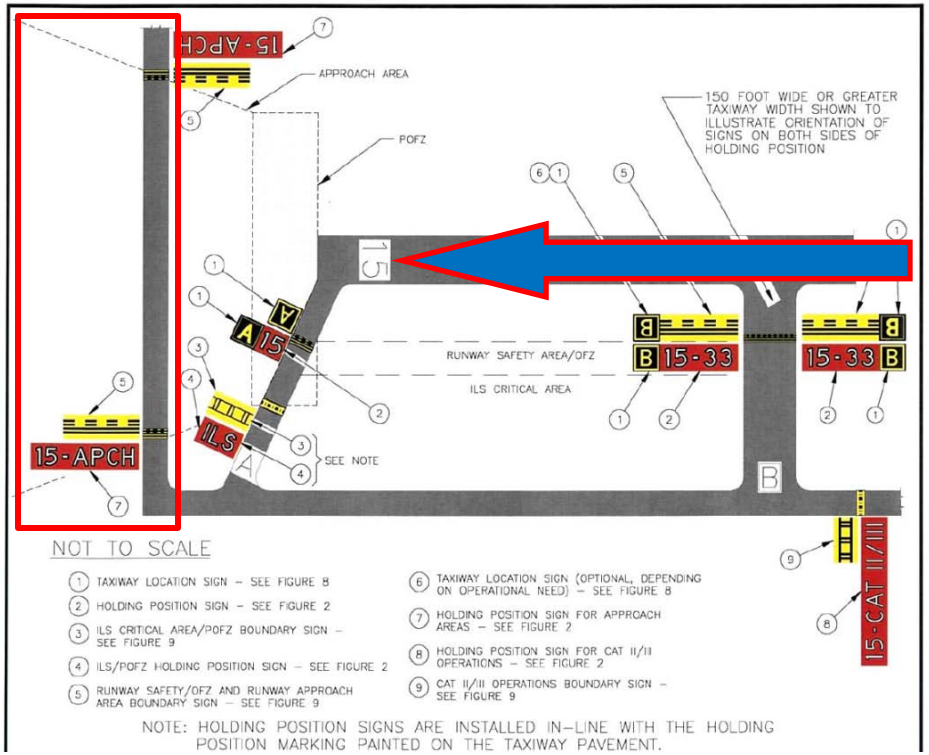



Figure 3. Application Examples for Holding Position Signs.

08/16/2010

AC/150/5340-18F

## The Problems:

Using  with 15-APCH can result in pilot confusion.

*"Do I have to hold short?"*

Pilots expect  to be near the runway entrance. Results in confusion when it's a long distance from the runway.

*"Why am I holding short so far from the runway?"*

Having only one runway designation on the sign, 15-APCH causes confusion when the APCH hold is being used for protecting DEP traffic.

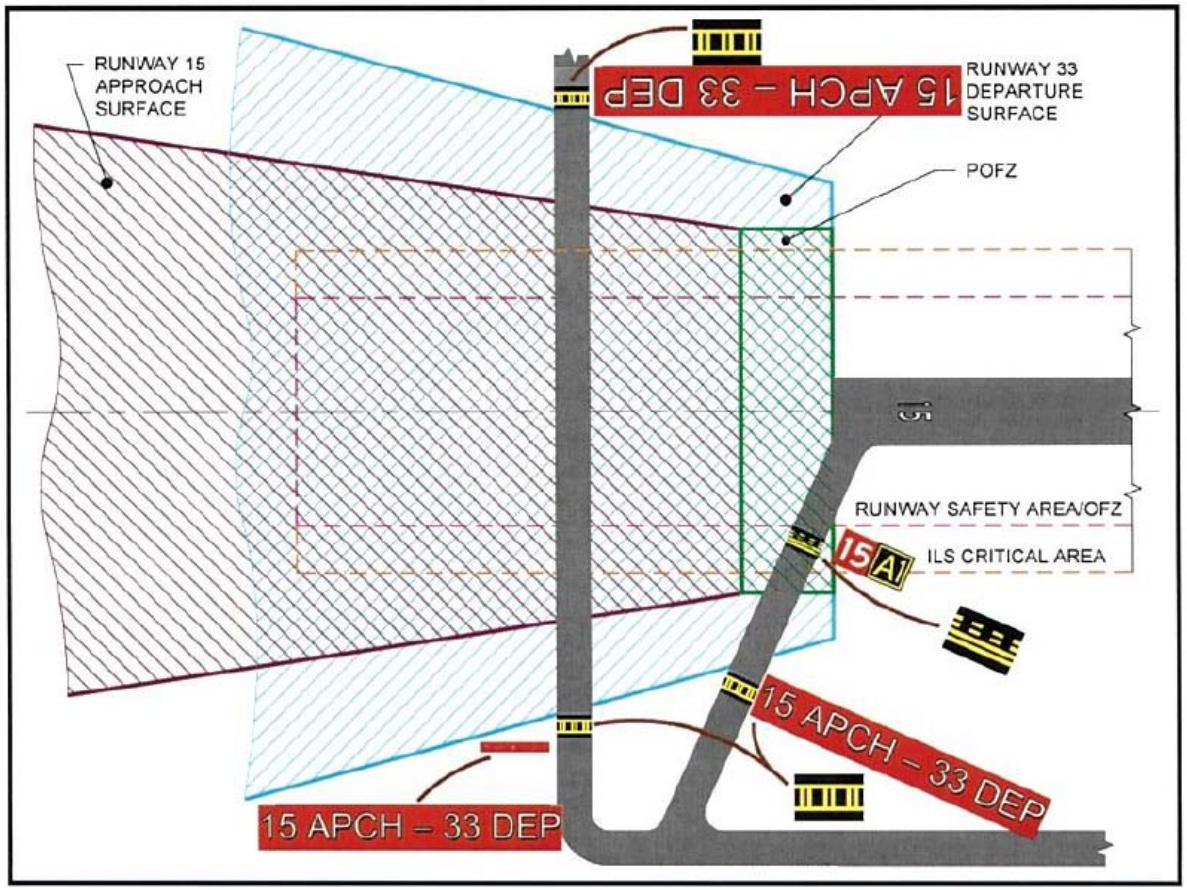
*"I don't need to hold short since RWY 15 isn't being used?"*

Requiring ATC Clearances to pass a holding marking when runway not active will increase ATC workload.

No standard marking/signage for RSAs that intersect runways

# Proposed Configuration

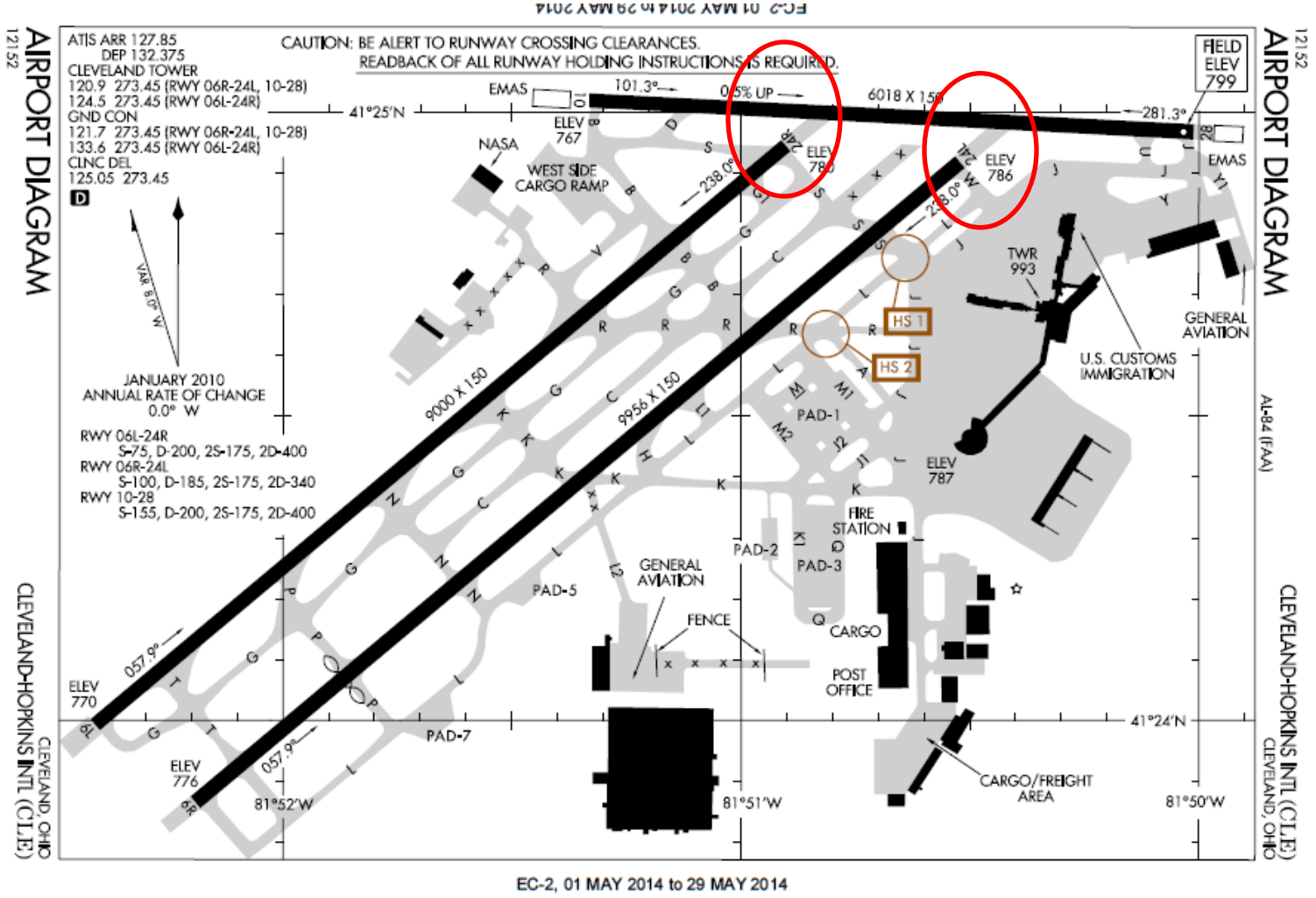
FIGURE 2-2. UPDATES TO AC 150/5340-18F, FIGURE 3




Size 3, 2 Mod, 10" Legend

# Example: ORD 9R APCH

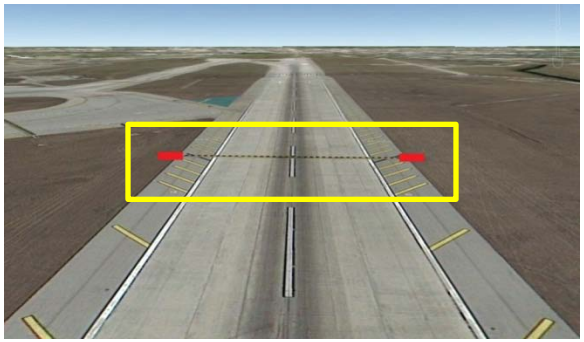
# Example: CLE


AIRPORT DIAGRAM
121.52
ATIS ARR 127.85
DEP 132.375
CLEVELAND TOWER
120.9 273.45 (RWY 06R-24L, 10-28)
124.5 273.45 (RWY 06L-24R)
GND CON
121.7 273.45 (RWY 06R-24L, 10-28)
133.6 273.45 (RWY 06L-24R)
CLNC DEL
125.05 273.45
CAUTION: BE ALERT TO RUNWAY CROSSING CLEARANCES.
READBACK OF ALL RUNWAY HOLDING INSTRUCTIONS IS REQUIRED.
FIELD ELEV 799
EMAS
101.3°
0.5% UP
6018 X 150
281.3°
41°25'N
ELEV 767
NASA
WEST SIDE CARGO RAMP
ELEV 780
ELEV 786
238.0°
TWR 993
HS 1
HS 2
GENERAL AVIATION
U.S. CUSTOMS IMMIGRATION
JANUARY 2010
ANNUAL RATE OF CHANGE
0.0° W
VAR 6.0° W
RWY 06L-24R
S-75, D-200, 2S-175, 2D-400
RWY 06R-24L
S-100, D-185, 2S-175, 2D-340
RWY 10-28
S-155, D-200, 2S-175, 2D-400
9000 X 150
9956 X 150
PAD-1
PAD-2
PAD-3
PAD-5
PAD-7
ELEV 787
FIRE STATION
GENERAL AVIATION
FENCE
CARGO
POST OFFICE
CARGO/FREIGHT AREA
ELEV 770
ELEV 776
057.9°
41°24'N
81°52'W
81°51'W
81°50'W
CLEVELAND-HOPKINS INTL (CLE)
CLEVELAND, OHIO
AL-84 (FAA)
EC-2, 01 MAY 2014 to 29 MAY 2014

# Scope of Work

- **Prototype Testing**


- **Simulations**




- **Field Testing / Evaluations**
  - ORD, CLE, BNA, DEN

# Questions/Comments?

**Airport Linear Source Visual Aid - Donald Gallagher**

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**Frangible Connections and Structures – Joseph Breen**

Joseph.breen@faa.gov, 609-485-8825

# Questions/Comments?

**Electrical Infrastructure Research**
**Constant Current Regulator Loading**
**Safety Orange Visual Aids for Airport Construction**

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**Enhanced Visual Aids for EMAS**
**RSA/Approach Hold Signs and Markings**

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