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Use of Digital Survey Vehicle For Airport Pavement Condition Surveys

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Presentation Outline

Use of Digital Survey Vehicle for Airport Pavement Condition Surveys:

- Describe foot-on-ground & semi- automated approaches to airport condition surveys
- Advantages & disadvantages of each approach
- Real vs. perceived problems with semi-automated
- Techniques to handle challenges
- Recommendations on appropriate uses of each approach

Overview - Airport Pavement Management Systems (APMS)

- Inventory & current condition assessment of all pavements
- Forecast future conditions
- Program maintenance & rehab (M&R) treatments
- Prioritize M&R to optimize performance and/or meet established goals
- Prepare CIP
- **Condition Assessment - a Key Component of APMS**

Contrast Between Airport & Highway Condition Assessment Approaches

- Airports Approach:
  - Foot-on-Ground (FOG)

- Highways Approach:
  - Semi- automated/ automated
  - Digital Survey Vehicle (DSV)

DSV Use on Airports - Proven But Not Widely Accepted

- DSV used successfully on limited number of airports
- Some perceived limitation have been overcome
- Some challenges need to be overcome

FAA Often Funds APMS - What Does FAA Require?

- AC 150/5380-6B “recommends” ASTM D 5340 but doesn’t mandate

- ASTM D 5340 requirements:
  - walk over area to be inspected
  - measure quantities with a hand odometer (wheel)

- Not all airports use FOG per ASTM D 5340

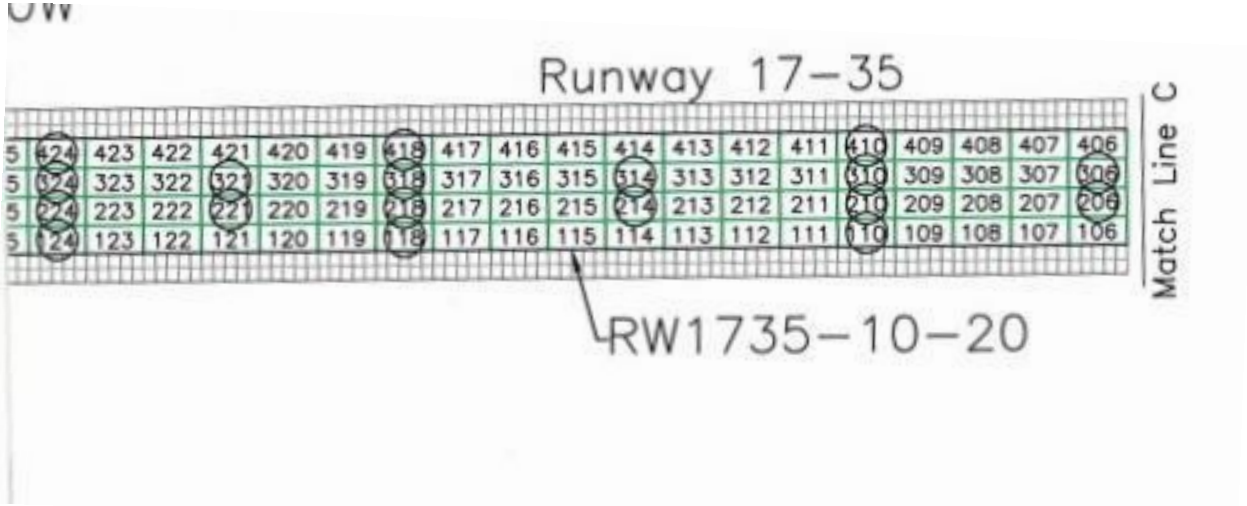
Description of Foot-on-Ground (FOG) Approach

- Walk pavement & document type, quantity & severity of distresses (ASTM D5340)
- Measure quantities of distress
- Additional measurements as needed to determine severity

Examples of Physical Measurements

Physical Layout of "Sample Units" Required for FOG

- Typical network level PMS uses < 100% survey
- Sample units inspected for each section
- Sample unit= 5,000 sf (asphalt); 20 slabs (concrete) (+/-)



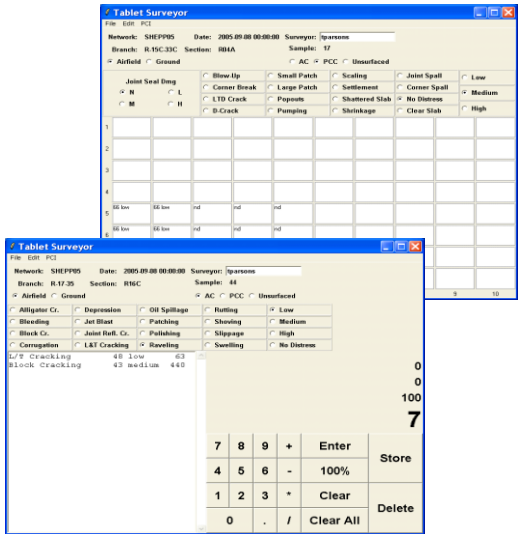
Physical Layout of "Sample Units" Required for FOG

Moving Around the Airfield

- Pick up truck, golf cart, bike, walk
- Typically require several days to survey large airfield

Recording of Field Data- FOG

- Clipboard or tablets



Semi-Automated Condition Survey Approach

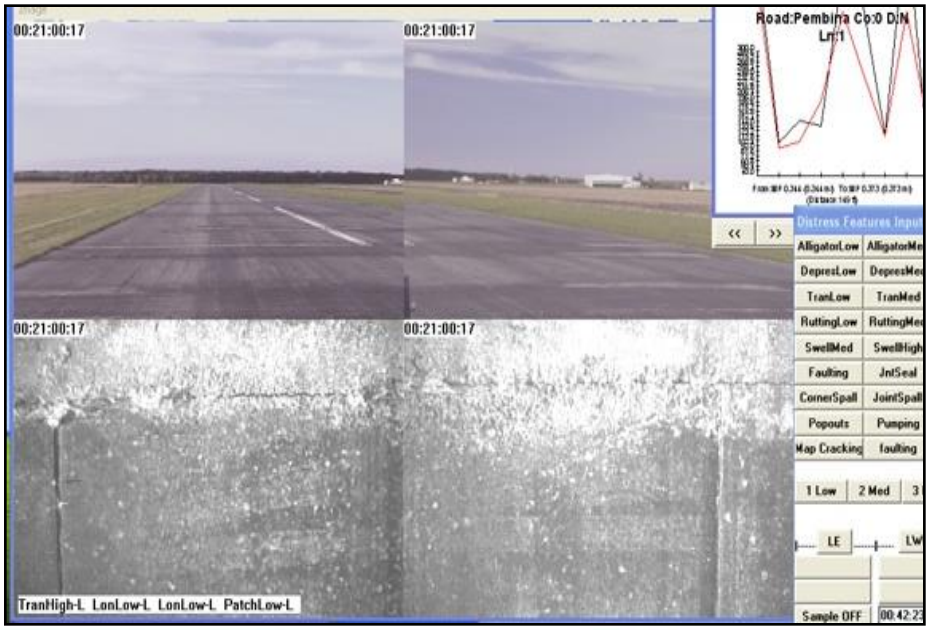
- Digital Survey Vehicle (DSV)
  - Surface conditions from high resolution pavement images
  - Laser based data (rut, texture, smoothness)
- Laser Crack Measuring Systems (LCMS)
  - Similar to DSV but computer algorithms to estimate pavement distress
- LiDAR

DSV Survey Systems

Sample Unit Layout, Moving Around Airfield & Recording Data

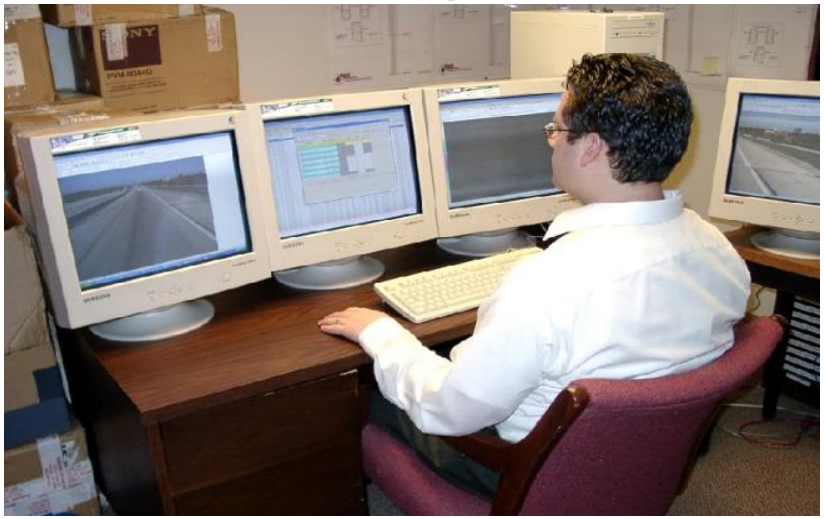
- DSV quickly surveys 100% of paved area
- Sample units determined (for rating) in office
- Images & laser data recorded on DSV computer
- DSV can survey 150’ X 5280’ runway in 2-3 hours
- Large commercial airport runway 200’ X 10,000’ in 3-4 hours

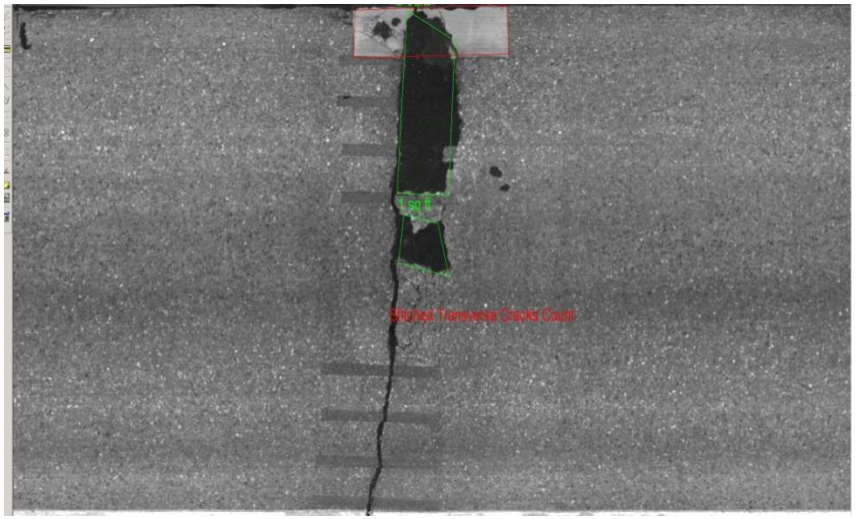
From the Field to the Office



Condition Assessment in Office

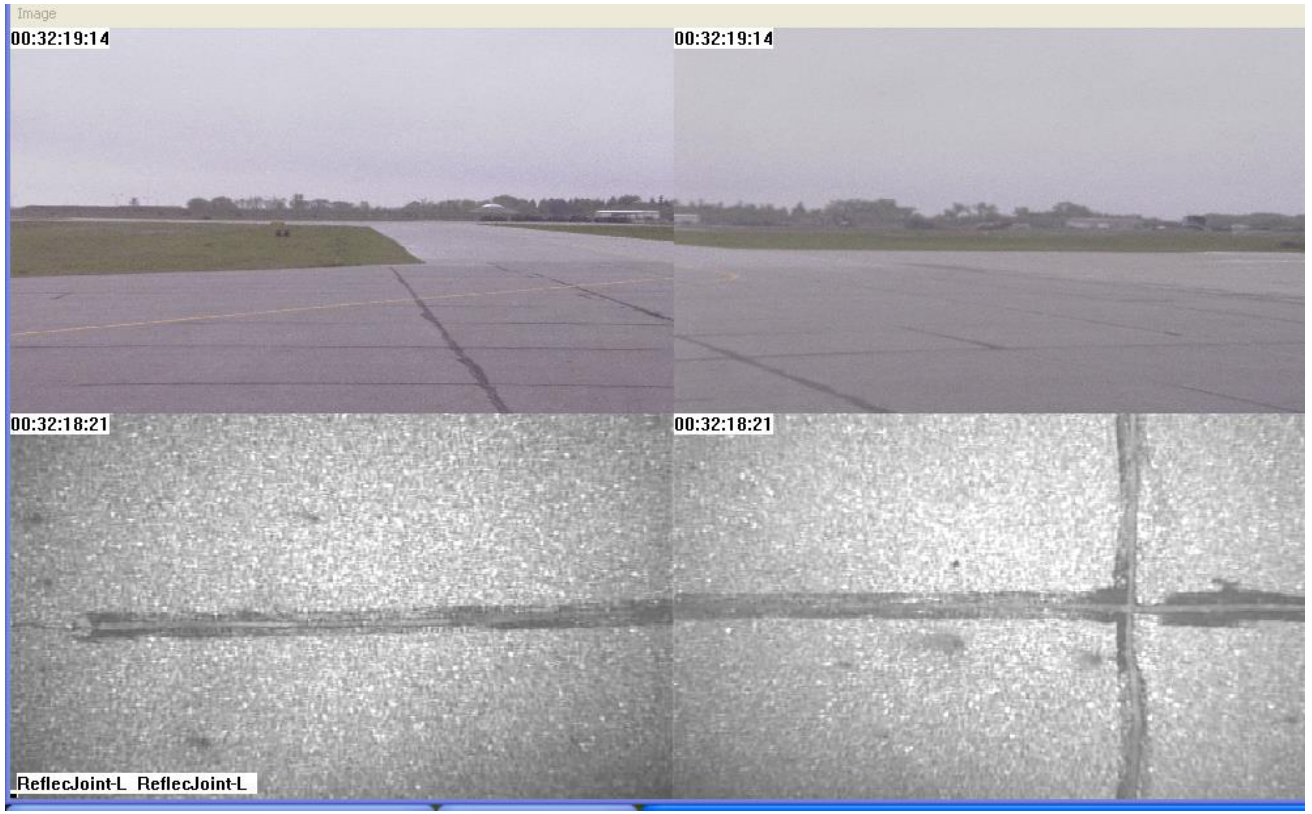
- High resolution downward pavement images viewed with customized software
- Same rating procedure as FOG
- Can digitize for accurate quantities- optional distress map





Sample Images of Typical Distresses- Flexible Pavement

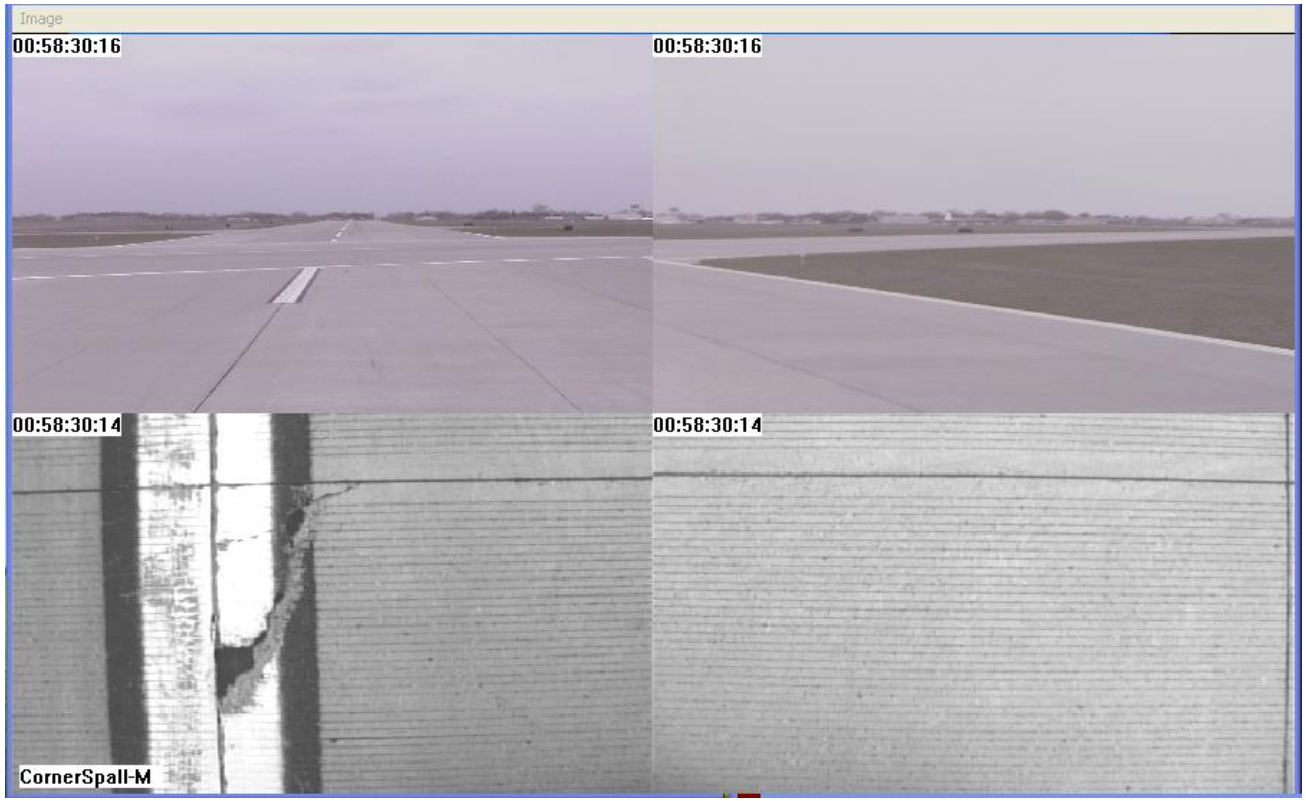
- Joint Reflection Cracking



Med-High Alligator

Sample Images of Typical Distresses- Rigid Pavement

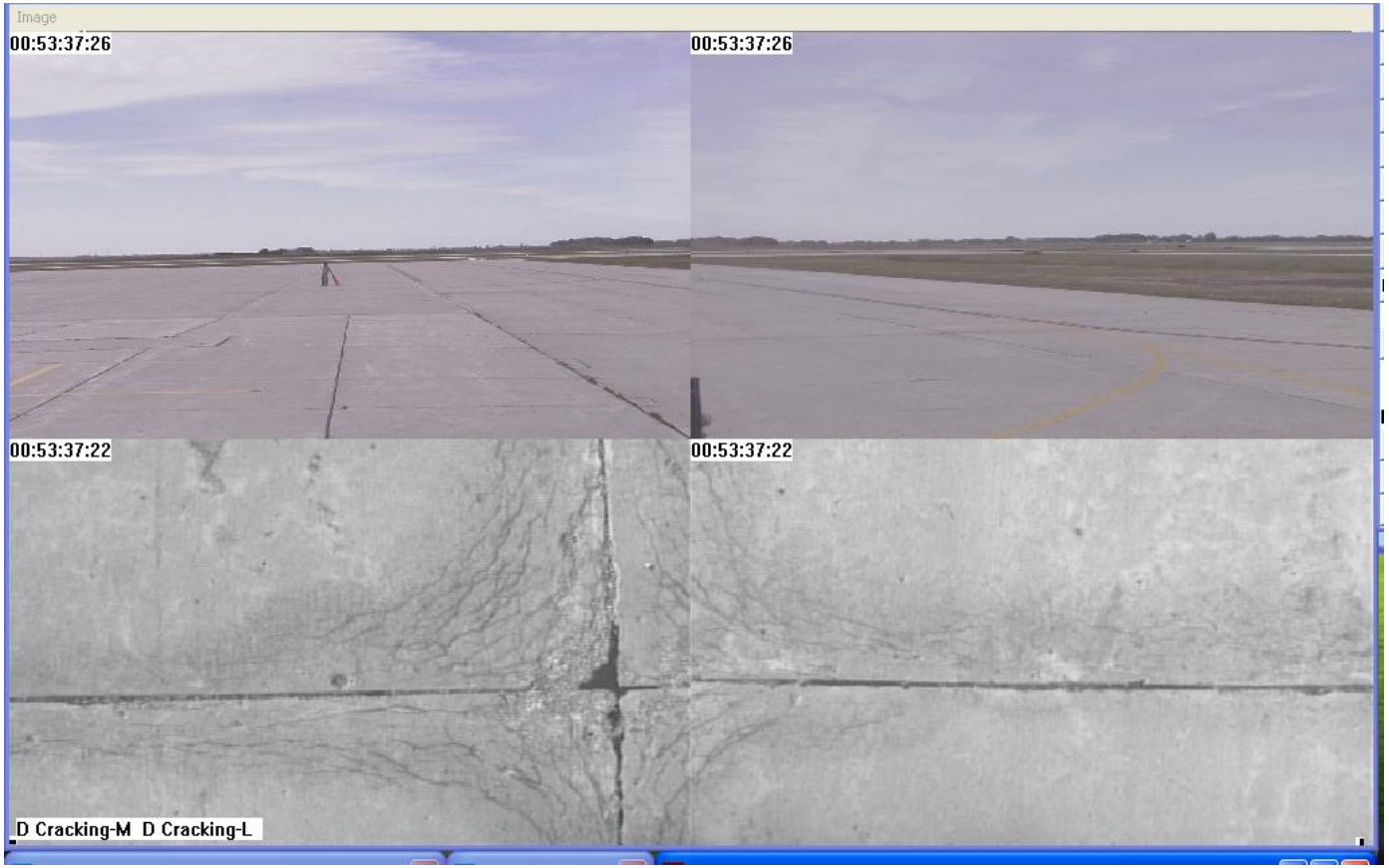
- Corner Spall



Shattered Slab

Corner Break & Faulting

D Cracking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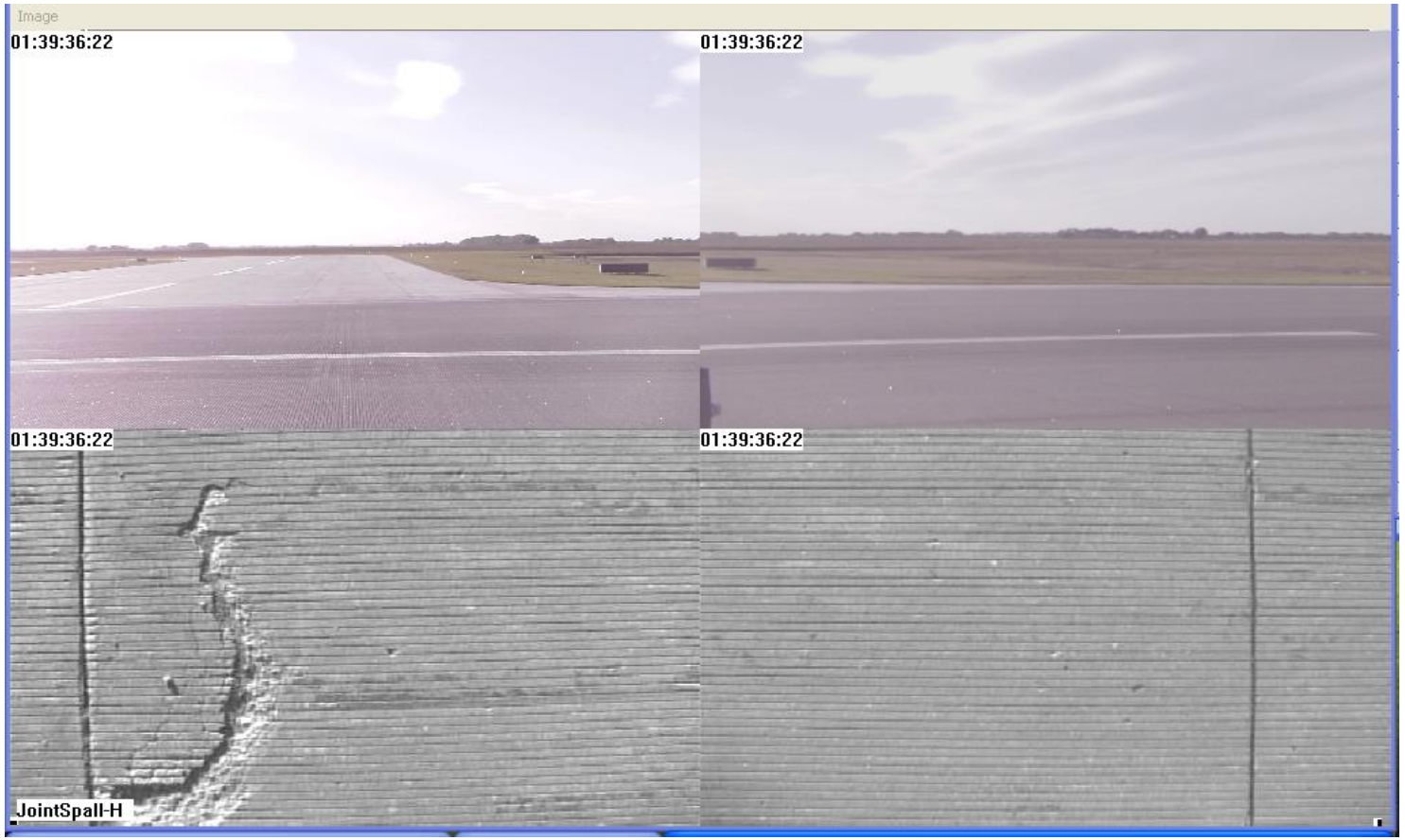
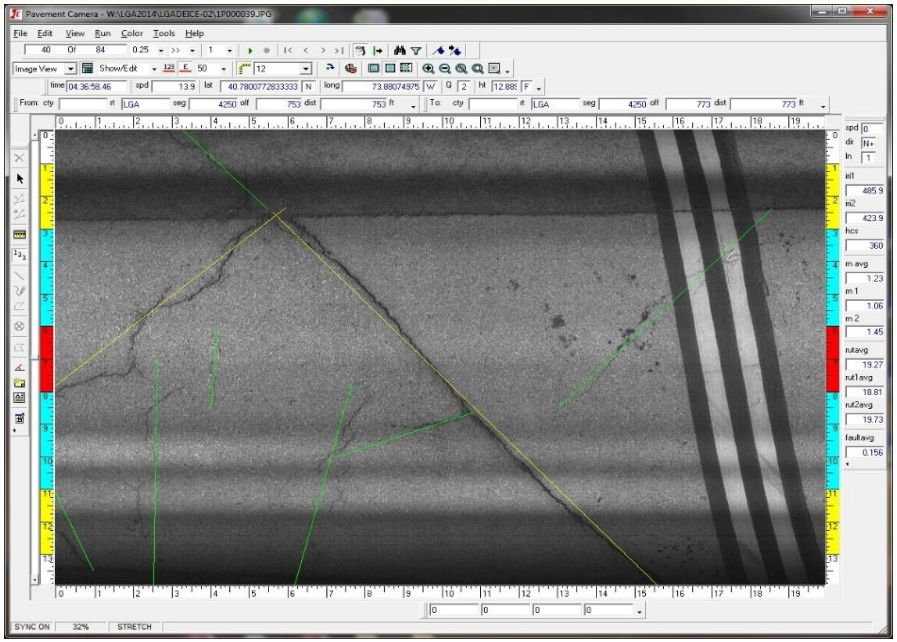
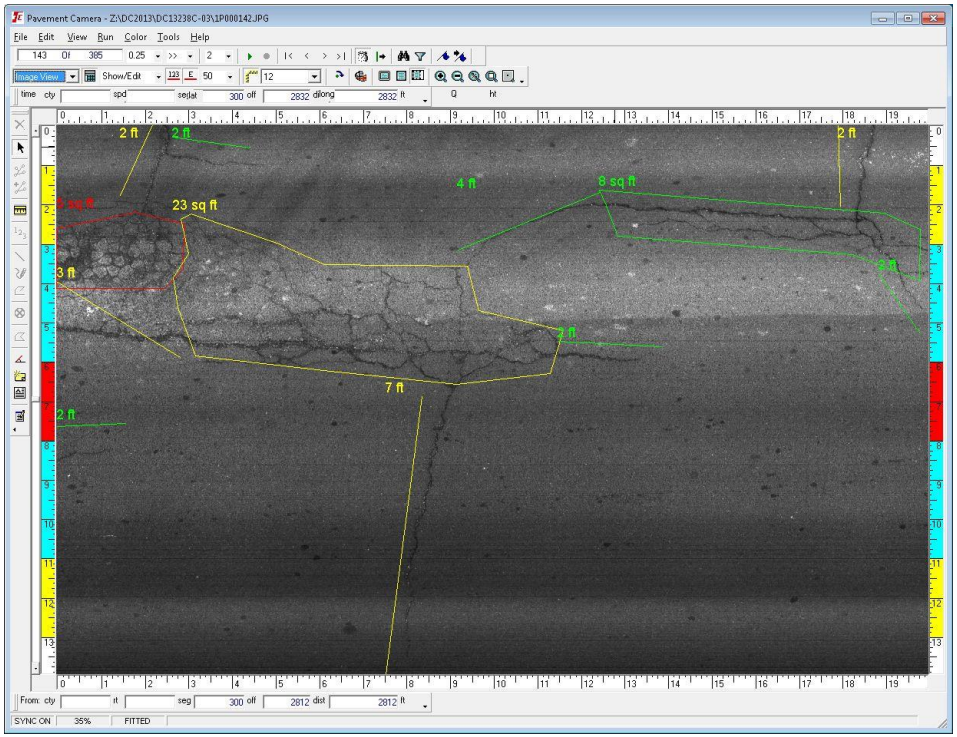
Joint Spall



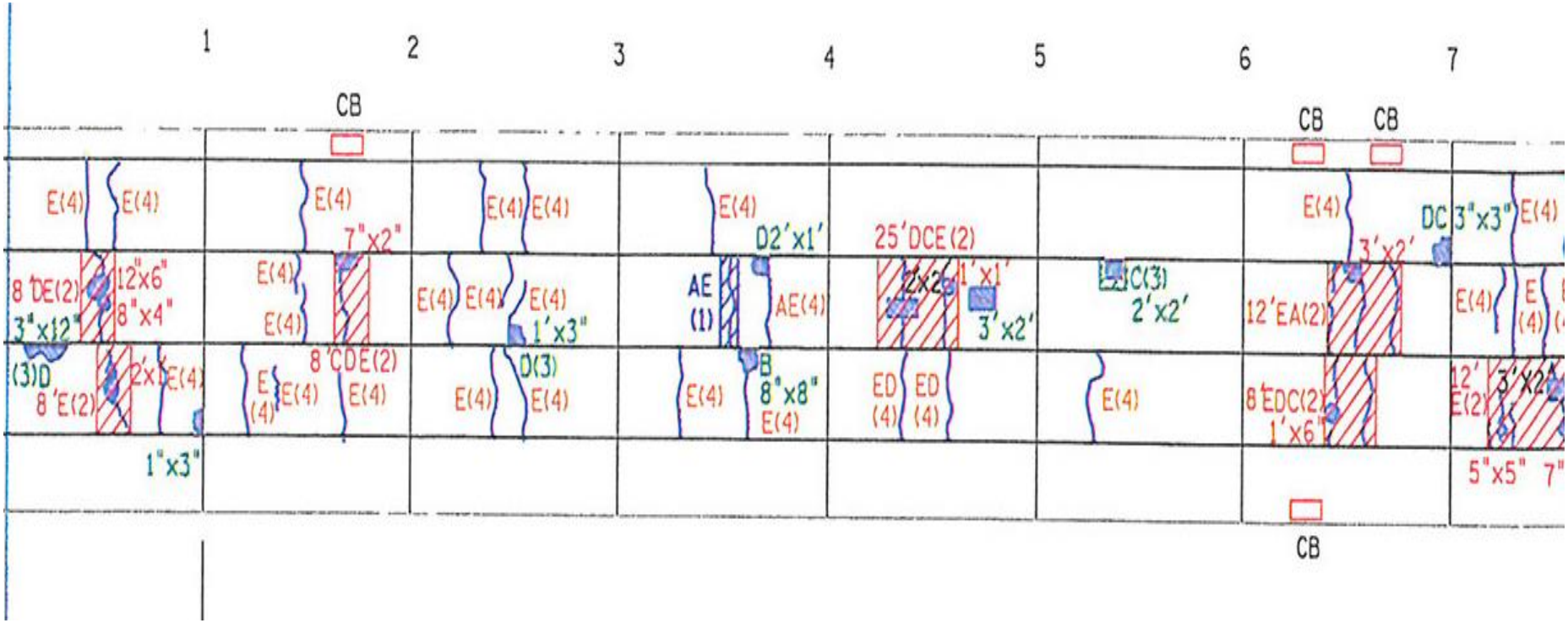
Digitized Distresses





Distress Maps

- Useful for forensic evaluations or concrete repair plans



Advantages & Disadvantages of FOG & DSV Approaches

Advantages & Disadvantages of FOG Approach

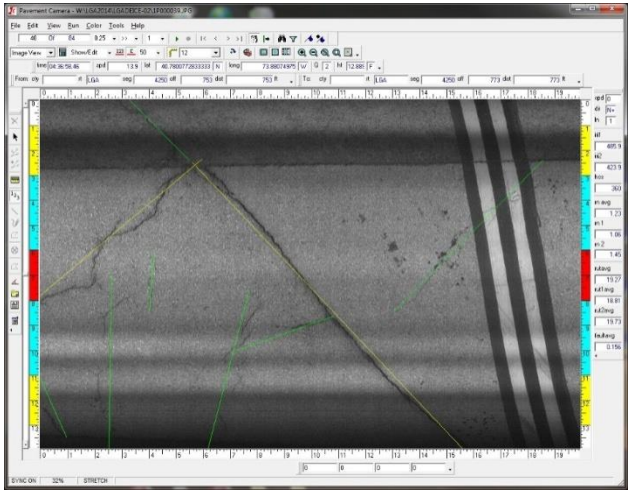
- Advantages
  - Inspector's real-life view of pavement
  - Measurements if needed for severity
- Disadvantages
  - Much slower than DSV- affects airfield operations
  - QC after field trip not possible

Advantages of DSV Approach

- Survey Speed
  - Up to 50 mph
  - Much less impact of airfield operations
  - Runway surveyed in 2-3 hours
  - Can survey at night

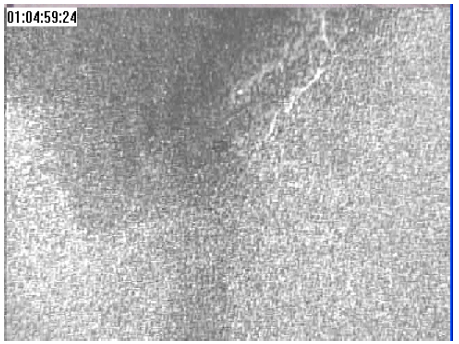
DSV Advantages (cont'd)

- Images on 100% of pavement area
- Ability to review images after field work
  - QC or other reasons
- Ability for virtual "drive through" of airfield
- Accurate quantities (if digitized)
- Ability to produce distress map



DSV Disadvantages & Challenges

- Raveling & Distortions difficult to detect
- Multiple DSV passes to cover wide airport pavement- referencing challenges
- Inability to “see” beneath parked aircraft



Raveling Challenge

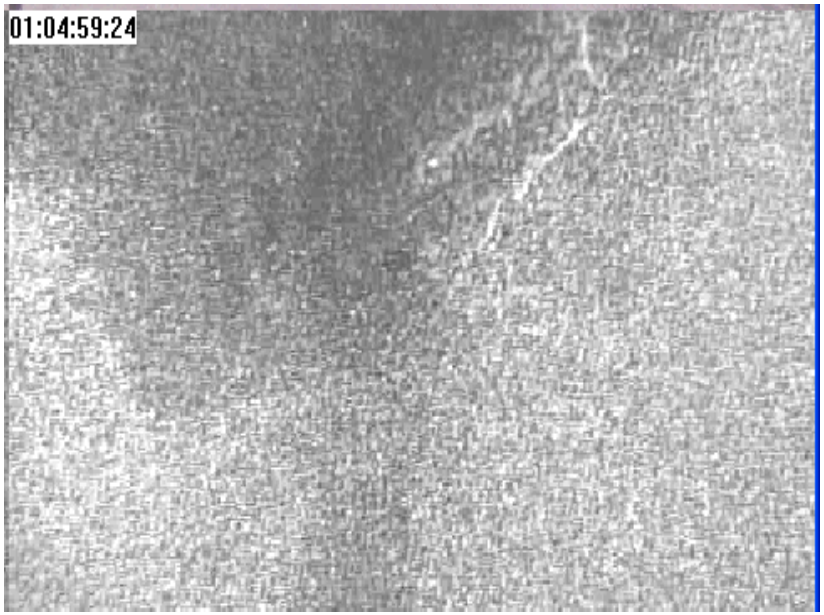
- Asphalt Raveling Rating:
  - Number of pieces of coarse aggregate missing & subjective assessment of FOD potential
  - Not reliably detected from images

Addressing the Challenge with Raveling

- Use of DSV laser data can improve objectivity of raveling assessment
- Mean texture depth (MTD) calculated from laser data
  - Average distance between high & low points of pavement surface
  - Can equate MTD to L,M,H severity raveling

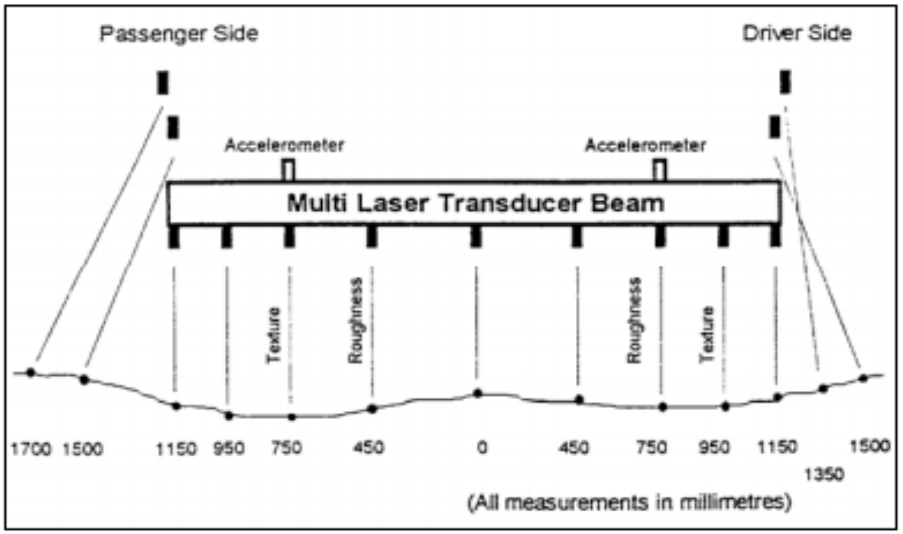
Distortion Challenge

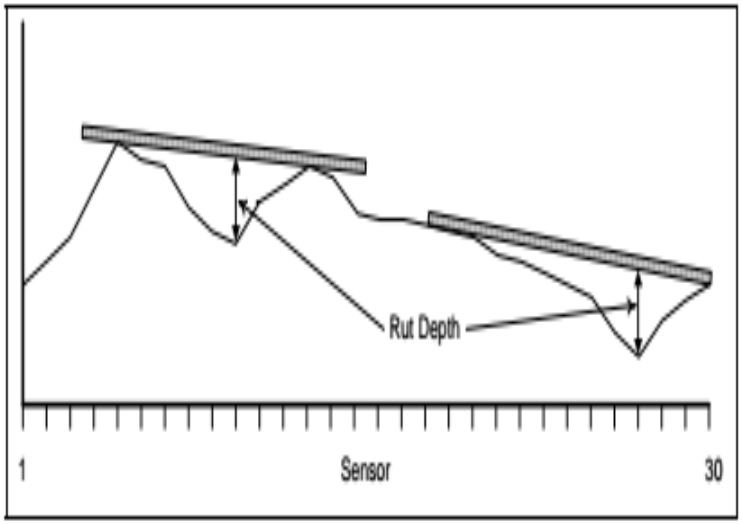
- Depressions & ruts not reliably detected from images alone



Use of DSV to Detect Rutting

- Use of DSV with laser profilometer can detect rutting
- Need adequate number of lasers

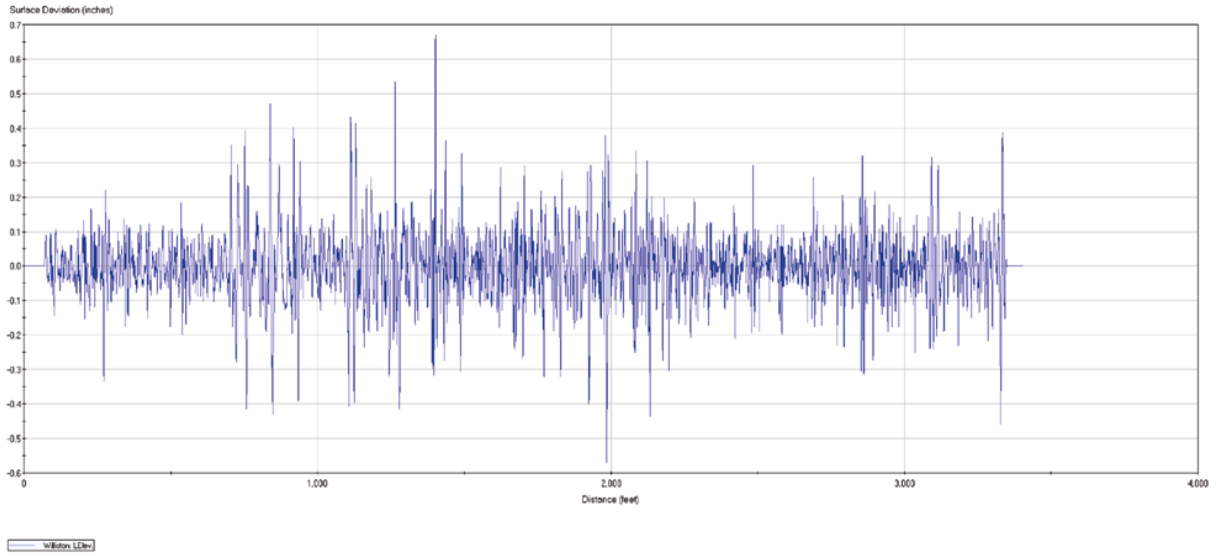




Figures 4.32 & 4.33 C. Bennett, et al 2007

Use of DSV to Detect Depressions

- Longitudinal profile from lasers analyzed with rolling straight edge (10 ft)



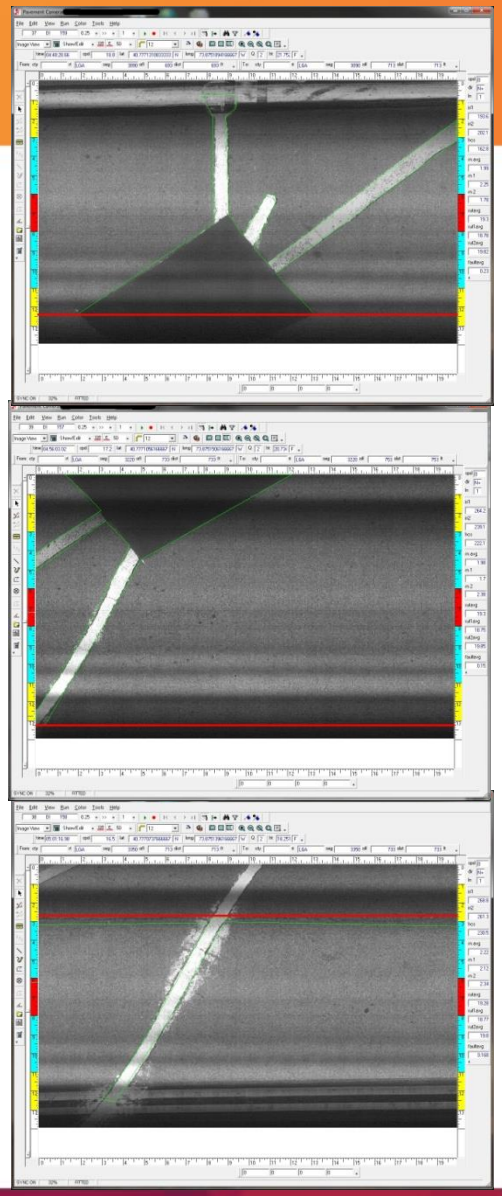
Williston Rolling Straightedge – 10 foot simulations – runway 20 – Run 3 just to the right of centerline

Challenge Referencing Multiple DSV passes

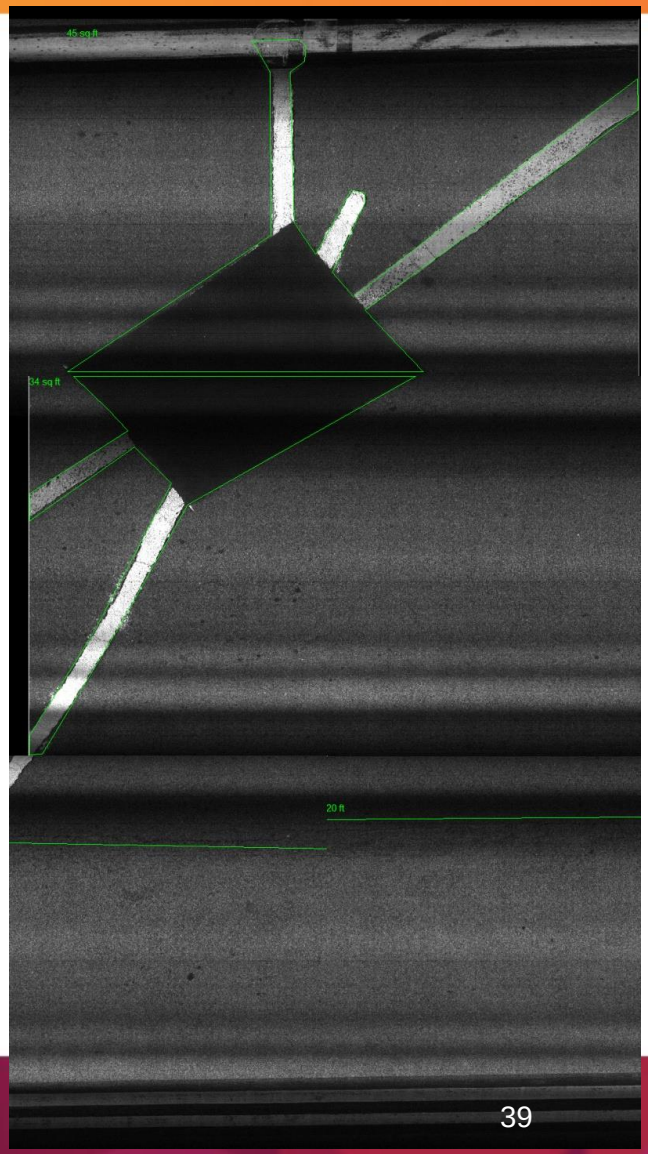
- Single runway or taxiway “section” wider than DSV path
- Multiple passes of DSV necessary
- Office technician to rate multiple images
- Proper referencing critical

Rating Multiple Asphalt Images

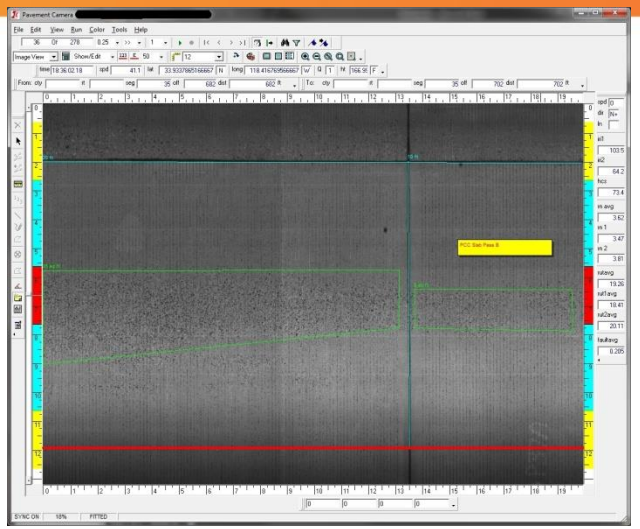
- Referencing to ensure proper images combined within section
- System to avoid overlapping distress

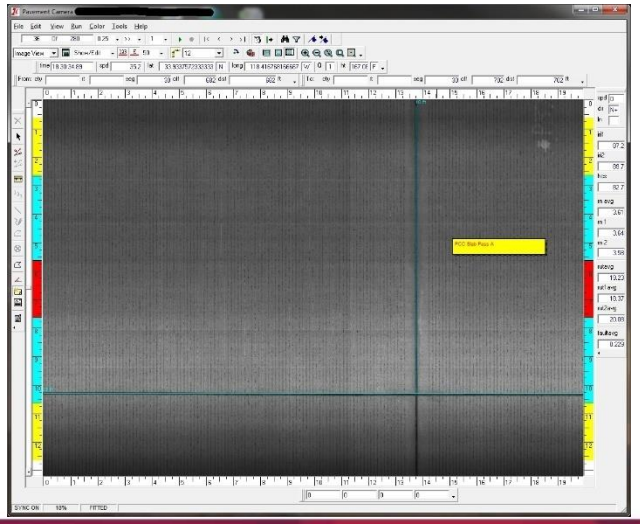


Combined Images Indicate Viability of Referencing Adjacent DSV passes



Rating Multiple Concrete Images





Challenge: Rating Pavement Under Parked Aircraft

- DSV maneuver around aircraft
- Area beyond aircraft often sufficient for “network level” APMS
- Supplement with FOG survey if necessary

Safety An Important Consideration

- Mis-communication could lead to disaster with FOG survey of runway
- FOG worse- time on pavement & less visible

Summary & Conclusions

- FOG & DSV approaches both viable
- Real & perceived disadvantages of DSV can be mitigated
- Busy airfields vulnerable to runway & taxiway closure encouraged to use DSV approach

Busy Airfield- Who you gonna call?

Questions?

- Contact Info:

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