Use of Digital Survey Vehicle For Airport Pavement Condition Surveys

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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
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

Downward Facing Camera

Pavement Illumination System

Forward & Side (ROW) Cameras

Pavement Profiling System

DGPS

DMI
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
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?

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