Geotechnical Data for Transportation Infrastructure

Tim Spink, Mott MacDonald
The transportation geotechnical asset

- Foundations
- Tunnels
- Road & track bed
- Earthworks
- Also supports:
  - communication lines
  - noise barriers
  - landscaping
Earthworks

- ~1/3rd cutting
- ~1/3rd embankment
- ~1/3rd total asset value
- Aging asset
Rock falls
Soil slips
Geotechnical asset deterioration

Network Development
Initial Deterioration
Deterioration / Maintenance Cycles

Fixed Asset Value

Time

Maximum Serviceability State
Minimum Serviceability State

If failure

Time of optimal maintenance action
Reactive >> proactive maintenance

• Benefits
  – Improved safety
  – Reduced disruption
  – 80% less maintenance cost

• Requirements
  – Improved asset knowledge
  – Systematic surveys
  – Standardised procedures
  – GIS/database asset management systems
  – Standard data formats
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Project Stages

Conceptual/feasibility studies

Investigations

Design

Construction

Maintenance Management

Decommissioning

Strategic: (Preventative/ improvement) or Tactical: (Remediation)
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**Project Stages**
- Conceptual/feasibility studies
- Investigations
- Design
- Construction
- Maintenance Management
- Decommissioning

**Data types**
- Preliminary sources study data
- Aerial photographs
- Topographic surveys
- Digital terrain models/LIDAR etc
- Intrusive geotechnical
- Geophysical
- Geochemical
- Monitoring etc
- Ground models
- Design parameters
- Design details based on the above

**Strategic:** (Preventative/ improvement) or **Tactical:** (Remediation)

- Main works contractor: Compliance testing data
  - Construction record/drawings
  - Feedback reports
- Specialist sub-contractor: Tunnelling, piling, dewatering, strengthening, ground improvement records etc
- Managing Agents & specialist survey contractors
  - Geotechnical asset condition/inventory data
  - Related assets: drainage, structure, pavement etc
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Data types

- Preliminary sources study data
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Available Data Transfer Formats

- Documents: Word, PDF etc
- Proprietary images formats
- Drawings: DWG, DGN, DXF etc
- Proprietary DTM formats: LAS, MX etc
- AGS data
- Various geophysical transfer formats: LAS, SEG-Y etc
- Geochemical transfer formats: EQUIS etc
- Drawings: DWG, DGN, DXF etc
- Spreadsheets: Excel etc
- Documents: Word, PDF etc
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- Documents: Word, PDF etc
- Drawings: DWG, DGN, DXF etc
- Spreadsheets: Excel etc
- Documents: Word, PDF etc
- Databases: MDB, DBF etc

Main works contractor:
- Compliance testing data
- Construction record/drawings
- Feedback reports

Specialist sub-contractor:
- Tunnelling, piling, dewatering, strengthening, ground improvement records etc

Managing Agents & specialist survey contractors
- Geotechnical asset condition/inventory data
- Related assets: drainage, structure, pavement etc
Supported data formats

- 1600 geotechnical / geological etc software programs
- 120 data formats

[Bar chart showing the count of data formats supported for different categories such as Petroleum Geoscience, Mapping and GIS, Images, Geotechnical, Geophysics, Geological, Geoenvironmental, Documents, Database and Spreadsheet, and Asset.]
Most popular supported formats

- DXF
- Excel
- Windows bitmap
- Windows metafile
- Access
- Word
- JPEG
- MIF / MID
- Tagged Image File
- AGS
- ZSoft Paint
- Comma Separated Values
- dBase
- HPGL
- Graphics Interchange Format
- LAS
- DEM
- Rich Text Format
- Paradox
- LIS/LIS-79

Count
Geotechnical / geological / geophysical formats

Scope

- Ground investigation
- Monitoring
- Design
- Construction
- Asset management
- Hazard

Count
Geotechnical data transfer needs

• Lack of standard approach for transfer of:-
  – Documents, mapping/GIS, drawings

• Lack of standard specialist formats for:-
  – Transfer of conceptual/feasibility/desk study info
  – Transfer of interpretative data
    • interpretative ground models
    • design/analysis models
    • design data
  – Transfer of construction information
    • as built records
    • piling
    • feedback information
  – Transfer of geotechnical asset data
Example geotechnical asset data format

• UK Highways Agency
  – 9400km of motorway & trunk roads
  – 6000km of earthworks
  – Valued at £20 billion
  – Maintained by contractors

• Standard procedures
  – HD41 2003 standard
  – 5 year inspection cycle
  – Risk based assessment

• Standard tools
  – Internet GIS asset management system (HAGDMS)
  – Handheld field data capture device (PocketGAD)

• GADML data format
Earthworks and observations
GADML for Geotechnical Asset Data

• GML compatible XML format

• Inspections
  – Who
  – When
  – Where
  – Survey equipment & accuracy

• Earthworks
  – Type (embankment, cutting, bund, at-grade)
  – Earthwork extents
  – Geology
  – Attached sketches or photographs

• Observations
  – Start and end of observation
  – Geometry (height & angle)
  – Defects, vegetation, water, drainage, reinforcement
  – Attached sketches or photographs
Field surveys

- Data round-trips
  - Server
  - GADML
  - Field survey
  - GADML
  - Server
- Inventory & condition
- Maps, aerial photos & forms
- GPS
- Photos & sketches
- Data validation
DIGGS

DIGGS International Governing Body

DIGGS Technical Steering Committee
  (formed out of existing Data Coalition)
    - Ground investigation (current WP)
    - Foundations (current WP)
    - 2D & 3D (offshoot from current WP)
    - Geophysics (offshoot from current WP)
    - Geo-environmental
    - Geotechnical Asset Data (including GADML)

Technical Special Interest Groups

Country Special Interest Groups
  - North America (current GMS)
  - UK (AGS)
  - Hong Kong (HK AGS)
  - Netherlands
  - Sweden
  - Denmark
  - Japan
  - Australia
  - etc