SUMMARIZED RELIABILITY-BASED GEOTECHNICAL INVESTIGATION AND DESIGN OF TRANSMISSION LINES

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Summary

- Case Study
- Using geology to select boring information
- Statistical evaluation of profiles
- Standard of practice implications
BPC 500/230kV Transmission Line

- Located Southeast of Phoenix, AZ
- 40 mile segment of the larger loop
- 301 drilled shaft foundations
- 37 boring locations
- 9 seismic surveys
- 8 pressuremeter tests

Using Geology to Select Boring Locations

- Geologic variability is indicative of geotechnical variability
- Investigation sites within a geologic region should be proportional to structures within the region
- Number of investigation sites influenced by multiple factors
Statistical Evaluation of Subsurface Resistance

- Multi-step process
  - Initial Data Grouping
  - Initial Design Profile
  - Statistical Evaluation of Profiles
  - Acceptable Variance?
  - Statistical Derivation of Idealized Soil Parameters
  - Foundation Design

Statistical Evaluation of Profiles

- Statistical evaluation of profiles

Zone 2A Corrected SPT

Corrected SPT vs. Depth (m)

0 10 20 30 40 50 60 70 80

0 -2 -4 -6 -8 -10

Depth (m)
Statistical Evaluation of Profiles

- Statistical evaluation of profiles

<table>
<thead>
<tr>
<th>Zone 2A Corrected SPT</th>
<th>Corrected SPT</th>
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<tbody>
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<td>Depth (m)</td>
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<td>70</td>
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<td>80</td>
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- COV 50%
  - Mean: 35
  - Std. Dev.: 17
  - 1- Std. Dev.: 17
  - 5% LEL: 30

- COV 35%
  - Mean: 45
  - Std. Dev.: 16
  - 1- Std. Dev.: 30
  - 5% LEL: 39

- Depth (m): 0 - 3.5m
  - n=8?

- Depth (m): > 3.5m
  - n=39?
Statistical Evaluation of Profiles

- Statistical evaluation of profiles

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<tr>
<th>Depth (m)</th>
<th>Zone 2A Corrected SPT</th>
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<tr>
<td></td>
<td>Corrected SPT</td>
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<td></td>
<td>n=12</td>
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<tr>
<td>0 - 1.5 m</td>
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- No unifying design standard exists
  - Soil zones defined based on material similarity in adjacent borings (no geologic information)
  - Blow counts used as a check for validity of groupings
    - Iterative approach to strata groupings
    - 9 design soil zones selected under standard of practice
    - 12 zones selected using geologic information
BPC Standard of Practice Implications

Field and Lab Data Analysis

- Engineering judgment utilized to select low bound values
BPC Standard of Practice Implications

Cost impact study results of Simplified Statistical Approach vs. Standard of Practice

<table>
<thead>
<tr>
<th>Total Foundations</th>
<th>Avg. Additional Concrete /Fdn</th>
<th>Total Additional Concrete</th>
<th>Avg. Additional Cost/Fdn</th>
<th>Total Cost Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>274</td>
<td>4.5</td>
<td>949</td>
<td>$1,405</td>
<td>$299,912 (13%)</td>
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- Simplified RBD methods are intended to augment sound engineering judgment
- Standard of practices results in a 0.02% probability of failure
- Techniques utilized on the BPC provide a 2% probability of failure which is comparable to other civil engineering structures